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INTERACTION OF HEALTH EXPENDITURE AND THE THAI ECONOMY



Ms. Nalyn Siripong

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for the Degree of Master of Science Program in Health Economics**

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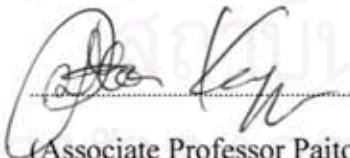
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ปัญหาสำคัญในลำดับแรก ๆ ที่รัฐบาลในประเทศกำลังพัฒนาต้องเผชิญ คือปัญหาในการจัดสรรงบประมาณเพื่อการพัฒนาทางสังคมและการพัฒนาทางเศรษฐกิจ นอกจากนี้เป็นที่ยอมรับกันมานานแล้วว่า ปัจจัยด้านสังคมกับปัจจัยการพัฒนาเศรษฐกิจต่างมีความสัมพันธ์ซึ่งกันและกัน โดยขณะที่สถานะเศรษฐกิจกำลังเฟื่องฟู รายได้จากการจัดเก็บภาษีจะมีมากขึ้นและส่งผลให้รัฐบาลมีเสถียรภาพทางการเงินเพียงพอ ที่จะจัดสรรงบประมาณให้กับกิจกรรมโครงการต่างๆ เพื่อสังคมได้ องค์กรปกครองส่วนท้องถิ่นได้แก่องค์กรปกครองส่วนท้องถิ่นและการศึกษาและองค์กรปกครองส่วนท้องถิ่น หากมีการพัฒนาแล้วย่อมส่งผลต่อการพัฒนาผลิตภาพแรงงาน ซึ่งในท้ายที่สุดก็จะเป็นปัจจัยที่สำคัญต่อการพัฒนาเศรษฐกิจให้ยั่งยืนต่อไป

การศึกษานี้เป็นการศึกษาแบบจำลองทางสถิติของระบบเศรษฐกิจไทยในระดับมหภาค ประกอบด้วยภาคสาธารณสุข และภาคอุตสาหกรรมอื่น ๆ ในระบบเศรษฐกิจ เพื่อที่จะทดสอบและเปรียบเทียบนโยบายต่าง ๆ ที่เกี่ยวข้องกับนโยบายด้านสาธารณสุขและนโยบายอื่นๆ โดยเฉพาะอย่างยิ่งนโยบายการประกันสุขภาพถ้วนหน้า ที่ได้เริ่มดำเนินการในปี พ.ศ. 2544 แบบจำลองนี้ได้ใช้วิธีการแบบกำลังสองน้อยที่สุดแบบสองขั้น (two-staged least squares) ในการประมาณสมการในแบบจำลองจำนวน 20 สมการ ข้อมูลที่ใช้เป็นข้อมูลรายไตรมาส โดยแหล่งข้อมูลจาก กระทรวงสาธารณสุข สำนักงานคณะกรรมการพัฒนาเศรษฐกิจและสังคมแห่งชาติ สำนักงานสถิติแห่งชาติ และธนาคารแห่งประเทศไทย

ผลจากการทดสอบแบบจำลองแสดงให้เห็นว่า ระบบประกันสุขภาพถ้วนหน้า มีอิทธิพลน้อยต่อสถานะทางสุขภาพ แต่ในทางกลับกันแสดงให้เห็นถึงผลกระทบที่มีนัยสำคัญต่อรูปแบบค่าใช้จ่ายทางการแพทย์ การปรับปรุงรูปแบบโดยมุ่งตรงไปที่รูปแบบการบริการด้านสุขภาพ เช่น การลงทุนด้านเทคโนโลยีทางการแพทย์หรือบุคลากรทางการแพทย์นั้น จะทำให้เกิดการพัฒนาทางด้านสุขภาพอย่างชัดเจนแต่ส่งผลกระทบต่อระบบเศรษฐกิจเพียงเล็กน้อยเท่านั้น อย่างไรก็ตามงบประมาณค่าใช้จ่ายของรัฐบาลในด้านการสาธารณสุขนั้น แสดงให้เห็นชัดว่าเป็นนโยบายที่มีประสิทธิผลมากต่อการพัฒนาสุขภาพและการพัฒนาระบบเศรษฐกิจ

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ปีการศึกษา 2548

ลายมือชื่อนิติศ 

ลายมือชื่ออาจารย์ที่ปรึกษา 

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KEYWORDS : HEALTH / HEALTH CARE / GOVERNMENT EXPENDITURE /
HEALTH POLICY / THAILAND / MACROECONOMETRIC MODEL /
SIMULTANEOUS EQUATIONS

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In determining appropriate policy, leaders in developing countries constantly face with the dilemma of how to allocate money between social and economic development. It has been long accepted that the two factors are closely linked. A prosperous economy will reap higher tax revenues, providing governments with the financial means to provide social programs to the public. Improved social factors, such as education and health, will make the labor force more productive, which, in turn, promotes improved economic development.

This research formulates a macroeconometric model of the Thai economy, with particular emphasis on the health care sector, to test and compare various policy programs in medical care or other industries. In particular, the model is used to test the effect of the recent universal coverage scheme, implemented in late 2001. The methodology utilizes a two-staged least squares (TSLS) approach to estimate the 20-equation model. Quarterly data are acquired from several sources, including the Ministry of Public Health, the National Economic and Social Development Board, the National Statistics Office, and the Bank of Thailand.

The results from these tests show that the universal coverage scheme has little influence on health status, but instead shows significant effects on spending patterns medical care. Improvements directed at the provision of health care services, such as investments in medical technology or the accessibility of medical personnel, shows decided improvements in health but very slight affect on the economy. Government expenditures in health, however, prove the most effective policy for improving Thailand's health and economy.

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Student's signature

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สถาบันวิทยบริการ
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CHAPTER I

BACKGROUND

1 Introduction

Health is a basic human right that must be guaranteed to all individuals. Health is a measure of quality of life and standard of living. It is an essential part a person's well-being. Health is a vital resource necessary to the fulfillment of a happy and satisfying life. It is not simply one's physical state, but also includes the gratification of mental and social interactions and endeavors as well.

Health can also improve an individual's life span and quality of life. By lowering the chance of death and increasing the state of well-being, individuals will ultimately contribute more economic output, thus accelerating the rate of growth. It is this contribution to economic production that serves as an incentive for governments to invest in health promotion programs. Improving the health status of the general public is not only a strategy to increase economic growth and development, but will also improve the population's quality of life in general.

The recent formation of the World Health Organization's Commission on Macroeconomics and Health and its report *Investing in Health* (CMH 2001), have reinforced the significance of improving health outcomes, particularly those in poor and developing countries. This publication calls attention to the importance of health, and the function of public policy in improving health, particularly for those people who are incapable of providing or ensuring good health for themselves. The United Nations also emphasizes the role of government in improving the health of poor and marginalized groups:

Çwe have a collective responsibility to uphold the principles of human dignity, equality and equity at the global levelÇ
(UN Millennium Development Goals, 2000)

The responsibility of the public sector has grown rapidly as experts have increasingly acknowledged the important issues that prevent people from seeking adequate medical care for themselves and their families. Almost 95% of child deaths, for example, could be prevented through early diagnosis and treatment or through the administration of vaccines (Mosley and Cowley, 1991).

Experts have varying views on how to improve health in a society. In highly developed countries, the government often guarantees provision of health care services to all its tax-paying citizens. The budgets of governments in most developing countries, however, do not have the financial means or adequate infrastructure to implement such ambitious coverage programs. Instead, there are several policy options available for a country with limited budgets. Some experts suggest the use of cost-effectiveness analysis to determine the highest priorities in health policy formation. Others propose that governments focus on identifying and assisting people living in poverty and are unable to realize their own health needs. Many of the problems that arise in the proper provision and utilization of health care services are derived from a lack or imbalance of information available to the public. In an effort to reduce the knowledge gap, then, some policy makers advocate the dissemination and distribution of information regarding the utilization of medical care and family planning services.

In 2001, Thailand's central government initiated its first plans for universal coverage scheme, commonly termed the 30-Baht Cures All Diseases scheme. This plan guarantees health care for every Thai citizen with a co-payment of a mere 30-Baht for less than US\$1 per visit. Although the government displays a noble effort, it still faces many obstacles to achieving success in this program. Some groups will under-utilize the services, while others will take advantage of the low cost by ordering unnecessary medical goods and services. The low levels of payment also put the issue of quality of care into question. Varying levels of quality of care may also change consumption patterns and strategies as well as health outcomes in the population.

One common method of analyzing policy effects is to model the economy and test how changes in different variables may affect the outcomes in the society. The model may be mathematical or statistical, depending on the technique preferred by the investigator. This paper identifies and examines links between health and economic output using a simultaneous equations econometric model. This econometric model provides a statistical estimation of how exogenous changes in health outcomes of health policies can help or hurt the Thai economy.

1.1 Objectives

The primary objectives of this investigation are three-fold:

- 1.1.1 To identify the strongest links and mechanisms through which health and economic output interact and determine the magnitude of the association
- 1.1.2 To provide a robust and predictable model that can be used to forecast the economic effects of health care policy
- 1.1.3 To use the specified model to test the effect of the recent implementation of the Universal Coverage (๓30-Baht Cures All Disease) Scheme



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CHAPTER II

LITERATURE REVIEW

2 Introduction

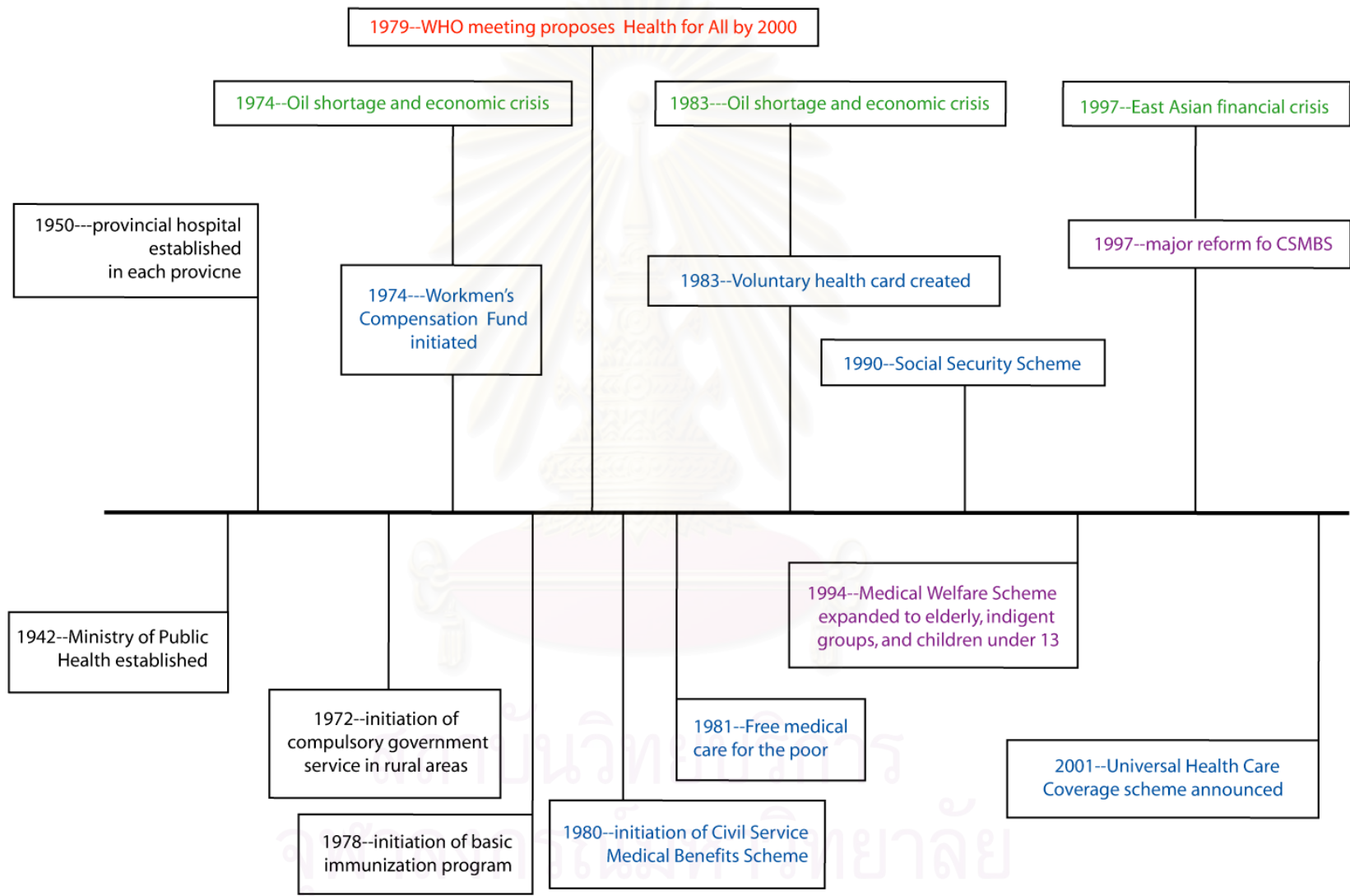
To gain a more complete understanding of Thailand's current health system, it is important to be aware of the past reforms and public responses in the health care industry. A complete review of the health care reforms in Thailand and the physical, social, and political environment that brought about these changes will elucidate the motivation and justification behind the implementation of these reforms. The chronology of health care reforms in Thailand is outlined in Figure 2.1.

2.1 History of Health Care and Health Policy in Thailand

Analysis of health and health care reform in Thailand and other developing countries has led to the identification of several important factors that are important to the movement toward change and reform and the subsequent improvement of health in a country. Zwi and Mills draw an important but rarely noted distinction between the health care system and the health system in a country (Zwi and Mills, 1995). The *health care system* refers to health care providers, such as hospitals, clinics and other inter-connected facility networks in a society. The *health system*, however, considers the interactions between five groups, each playing a vital role in producing health outcomes. The contributors include: (1) health care provider; (2) the population; (3) government and political environment; (4) sources of funds and financing; and (5) other sectors providing services that impact health. The distinction between the health and health care systems is important because improvement in overall health will not result simply from a better, more extensive health care system. Health reforms must consider the reactions and responses of all players in the health system.

Within Thailand's health system, Green identifies four influential non-governmental factors that have had an impact on changes in the health care system (Green, 2000). Though not directly related to government, each has the power to sway popular view or behaviors, and thus directly relating to the health system. The four factors are: (1) the Thai Royal Family, (2) the predominantly Buddhist culture, (3) a widely-accepted perception of the State as the main provider of health care, and (4) the political state in neighboring countries in the region. These specific factors and the responses of the five factors in the health system have shaped the direction and trends in health care reform and health outcomes throughout Thailand's history.

Figure 2.1. Chronology of Health Care Reforms in Thailand



2.1.1 Early Medicine (prior to MOPH, est. 1942)

Western medicine was introduced in Thailand much later than in other countries in the Southeast Asian region. Many experts attribute the delayed introduction of Western medical practices to the country's aloof attitude towards foreign affairs, which maintained Siam's position as the only country in the region that was free of European invasion. Prior to Western medicine, people in ill health were treated by traditional healers. Most healers during this time were trained in the Indian Ayurvedic tradition. Temporary health clinics or stations were established to treat and admit patients in the case of disease outbreaks, but no permanent hospitals were built prior to 1888.

In 1828, Dr. Dan Bradley of the American Presbyterian Mission was the first to initiate the practice of Western medicine in Thailand. Most of the administered treatments were in the form of public health interventions, combating illnesses such as cholera, small pox, yaw, malaria, and other infectious diseases. The delay in using Western medicine in Thailand was quite apparent. The smallpox vaccine is one illustrative example. Discovered by Dr. Edward Jenner in 1798, over 40 years had passed before the vaccine was purchased and administered in Thailand in 1841. As Thailand was under the Rule of the Royal Family during this time, the monarchy decided to expand on the widely accepted view of Western medicine. In 1888, King Rama V opened the country's first hospital, named Siriraj Hospital in honor of its founder. In 1914, King Rama VI opened Chulalongkorn Hospital, and the construction and expansion of public sector hospitals continued to grow.

In 1932, the King Rama VII abdicated his political powers to the People's Party, who constructed a Constitutional Monarchy power that resembled those government ideologies present in much of the Western world, with Monphorn Nitithada as Siam's first Prime Minister. Pridi Banomyong, a leader of the original People's Party and an author of the Constitution, proposed the country's first National Economic Plan, which outlined several proposals for infrastructural and social change, including the first proposals of a Social Security system or program for workers in the formal sector. This plan was viewed by some politicians as reminiscent of Communist views and, consequently, was never developed into actual government policy. Instead, most changes in the health care system involved expansion of the network of health care providers throughout the country. By 1950, a government hospital was established in each province.

In 1938, a coup overthrew the government and placed Phibul Songkram in the position of Prime Minister; but shortly after coming into power, his reign transformed from

one of democracy to a military dictatorship and repression. Under his leadership, health needs of specific interest groups, such the poor and rural farmers, was not a serious concern, although health and health care in the aggregate remained important as an International measure of the standard of living in then Siam. The Thai government did not wish the country to fair poorly in comparison with other countries, and particularly European colonies, in the area. Their response was to establish an extensive and comprehensive health care provider network was one focus of the social development during this period. By 1950, each province had established at least one major hospital, demonstrating the government's continued commitment to the expansion of the medical care system.

2.1.2 Early Reforms (1942-1978)

In 1942, reorganization of the Cabinet structure converted the Public Health department under the purview of the Ministry of Interior, to the Ministry of Public Health. Despite the administrative change, the primary duties of the Ministry of Public Health remained quite similar as collecting health data and evaluating the performance of the health care system. The importance of health on a worldwide scale was the driving force in improving the accessibility and quality of health care services. In 1946, Thailand was active in the founding of the World Health Organization (WHO). Established in 1948, the WHO served as an International body responsible for disseminating information and offering professional assistance or advice in any health related issues and research. Since its initiation, Thailand has served as one of the prominent regional offices of the WHO.

Politics and foreign policies passed during World War I gave military dictator Phibul Songkram a rather unpopular reputation. The leader was quickly thrown out of power and the National Assembly appointed Khuang Aphaiwong the new Prime Minister. The period that followed was marked by significant unrest and political instability. In the course of 20 years, the seat of Prime Minister changed hands eleven times, serving terms as temporary as a few weeks and as long as 3 years. Social policies during this time were dictated by 5-year National Economic and Social Development Plans, which set targets in social and economic development. The first of these plans was published in 1961, and placed strong emphasis on economic performance.

The assassination of King Rama VIII and the suspicion surrounding various politicians only served to further weaken government powers. The government is increasingly ineffective and the public is less and less satisfied with its leaders. Political unrest and the constant turnover of power meant that very few social policies or programs

could be successfully implemented. Demonstrators protested the government's repressive nature and lack of understanding people's needs. The protests climaxed on October 14, 1973, dubbed *Wan Maha Wippasoké* (translated as 'the most tragic day'), when conflict erupted between protestors and police, causing over 400 deaths (Kreutz 2000). The violence that ensued forced Field Marshall Thanom Kittikachorn out of office and King Bhumibol Adulyadej appointed Sanya Dhammasakti to the position of Prime Minister. In 1974, during Sanya's term in office that the Worker's Compensation Fund, the first form of health coverage was finally implemented in Thailand. The program required employers to finance the fund in terms of a given annual contribution. The funds were used to cover medical costs for any injury or health condition inflicted to a person in the workplace. In 1975, a plan to offer medical benefits to the poor was also passed into law.

While social and political domestic reforms were implemented, an oil shortage had a significant economic impact throughout the world, including Thailand. In 1974, the world price of oil rose by 284% from the previous year, and in Thailand, GDP growth dropped from 9.9% in 1973 to a mere 4.3% in 1974 (Nitayarumphong *et. al.* 2000). However, this economic episode coincided with political reform and a transition to a more democratic political state in Thailand. Thus, despite poor economic performance, the new government and political determination to improve social development maintained the continuation of proposed health reforms and programs. In 1974-75, government expenditures grew from 7% to 11%. Despite the effort to stimulate economic growth, in response to the oil crisis, social programs were not cut during this time period, which helped the continued improvement of health outcomes in Thailand.

In 1975, the Communist Party came into power in Cambodia, Vietnam, and Laos, inducing an increasingly anxious public sentiment regarding domestic left-wing political parties. Without leftist politicians in power, most social reforms or developments were halted. The primarily right-wing political views were unchallenged for several months, until the end of the Vietnam War, when the Communist Party's victory sparked liberal, left-wing students to protest. Violent conflict ensued, as officers attempted to disperse the crowd. The civil and political unrest during this period slowed or completely impeded further social reforms. Virtually no new significant health care reforms were introduced after 1975.

2.1.3 Health for All (1978-1989)

In 1978, the World Health Organization held one of its most memorable meetings, in which the organizations and its members drafted a proposal to provide Health for All by the Year 2000. The document emphasized health as a complete state of well-being that required committed efforts from not only the health care sector but also other related sectors. Supporters of the idea focused on improving the health of the poor, who were often marginalized and particularly vulnerable to falling into traps of poverty cycles. Primary health care was implemented through the initiation of local health facilities, called primary health care units, operated by one or more general practitioners. Their role was to support and promote healthy habits and lifestyles in society. These primary health care units, along with programs in clean water, sanitation and education would foster good health through individual and community behavior and practices.

The concept of primary health care was criticized by many as being an idealistic plan for poor developing countries at the time, and brought about the alternative concept of selective primary health care. According to its proponents, this methodology maintained the same overall goals of health betterment in developing countries, while using a more attainable and realistic approach. The technique utilizes cost-effectiveness analysis, which compares the cost of a health program to its health gains, offering policy-makers an objective assessment of each program to facilitate prioritization of programs. Using this analysis, policy makers can identify those interventions that will save the most lives, using the least amount of money.

The Thai government responded to these proposals with many plans for financial protection for the poor and increasing accessibility to health care for rural residents. Training of village health volunteers (VHVs) and village health communicators (VHCs) was initiated in 1977. In 1978, the first national formal immunization program was implemented. The government also implemented its first program to offer health care coverage for the poor. In this phase of the coverage program, physicians were responsible for determining which patients could not pay for the services provided. The physician then filed a report, requesting government reimbursement for the service.

In 1979, the Thai economy was again devastated by a second oil crisis. Inflation of prices was not as severe, but the effects had a most enduring effect on consumer and investor behavior. Real GDP growth was a mere 5% and inflation at peaked at 19.7%. The central bank was forced to raise the ceiling on interest rates in order to discourage high

levels of borrowing in the economy, as credits grew by 18.9% in 1980 (Nitayarumphong *et al.* 2000). Even social developments during this period were sacrificed, as most policies and reforms were postponed to make more funds available to programs that ensure economic stability and continued growth of the Thai economy. Most health policies and programs realized prior to this period were maintained, but virtually no new health policies were proposed nor implemented during this period.

In the late 1970s, the Vietnamese Communists invade Cambodia, and many flee to Thailand, entering the country as refugees. The influx of Cambodian refugees resulted in more political unrest in Thailand, as the elected Prime Minister resigns to the former Defense Minister and Army Chief, Prem Tinsulanonda. This general was well known for his close relationship with the Royal Family and his paternal approach to political conflict within his party. Although without political powers, the Royal Family continues to be held in high regard in Thailand, so their support helped keep Prem in power, despite the invasion of Vietnamese troops and domestic attempts at military coups.

In 1980, King Rama IX issued a national decree for the establishment of a new health coverage program. The program offered benefits specifically to permanent public officials. The Civil Service Medical Benefits Scheme used general tax revenues to pay for a generous health care coverage program for all long-term government officials. This program gave beneficiaries their choice of health care provider and paid physicians on a fee-for-service basis. The motivation for this program was in part due to the low salaries of many government officials. The extensive coverage not only offered pervasive protection from catastrophic disease, but also gave beneficiaries their choice of providers, giving each recipient the potential to receive the highest quality of health care. Clearly, the program was thoroughly utilized by government officials, which was effectively described by the escalating costs in the company.

Despite continuing conflict between Vietnam, Cambodia, and Thailand, the WHO goal of Health for All was never forgotten, which pushed several new health care reforms into policy. In 1981, protection for the poor was extended to an actual program in which community leaders identified and distributed cards to the poor. These cards gave the beneficiaries the right to seek health care at any public facility, free of charge. In 1983, the first form of voluntary health insurance was offered in the form of Maternal and Child Health fund, which offers financial protection to women who seeking care regarding their pregnancy. By 1984, the program was expanded and transformed into the sale of a health card, which entitles the beneficiary to free provision of basic services provided at public

providers. The Voluntary Health Card Scheme (VHCS) was aimed at anyone who chose to purchase cheap and reliable health insurance. The program was yet another extension from the WHO's Health for All goal.

During this period, the Thai government also initiated the Basic Minimum Needs approach, an inter-sectoral effort towards health and social reform. The program was dictated by four government ministries: Agriculture, Interior, Education and Public Health. These goals include: (1) adequate intake of safe and nutritious food; (2) appropriate housing conditions; (3) full employment for the labor force; (4) provision of basic services in health and education; (5) safety in daily life; (6) maintenance of good culture and habits; (7) the opportunity to earn a sufficient income; (8) family planning; and (9) community participation and obedience of the law. Support for this inter-sectoral reform coincides with both the earlier Health for All and later Millennium Development Goals Declarations, which promote the provision of a minimum standard of health care for all.

2.1.4 Recent reforms (1990-present)

In the late 1980s and throughout the 1990s, the focus of health care reform moved away from primary health care and towards improving efficiency in the health care sector. Structural changes in the organization and financing of health care services became central to most reforms during this period. In its 1993 World Development Report, entitled *Investing in Health*, the World Bank continued support for the use of cost-effectiveness analysis and prioritization to determine the most effective and least costly package of essential health services (World Bank, 1993).

In an effort to expand its coverage and provision of health services, Thailand introduced the Social Security Scheme in 1990, almost 60 years after Pridi Banomyong's original proposal. The Social Security Scheme is a compulsory program that offers health care coverage to workers in the formal sector. The scheme is funded by mandatory equal contributions by the employee, employer and the government. Beneficiaries must specify their provider who subsequently received a capitation payment from the Social Security Office, which served to cover most basic treatment costs. To promote competition in cost and quality of care, the Social Security Scheme did not set any restrictions on the provider they chose; the only condition was that all health care must be initially sought with their registered provider. The organization of the Social Security Scheme proved to be beneficial to the efficiency of hospitals and quality of service provided at various hospitals. Many

private hospitals established networks of clinics and health centers to appeal and attract more registrants.

In 1991, a peace pact ends war in Cambodia and the political peace has allowed the Thai government to shift its focus away from military strategy and fortification, to ensuring sustained social and economic development in the country. The economy did not require significant stimulation; growth during this period was almost 10% per year during the period 1985-1995 (Warr, 2000). The high economic performance brought increased government revenues in the form of taxes. Despite the constant change of political powers, a significant and rising amount of government budgets was dedicated to social development. In 1992, funds were dedicated to extend free provision of health care services to the elderly as well as the poor. Emergency care is provided under the Traffic accident victim insurance protection program, initiated in 1993. Both the Social Security Scheme and Medical Welfare scheme expanded the coverage populations to offer financial security to as much of the population as possible.

In the new millennium, the focus of health care provision has shifted towards the poor and ensuring equity in access to and quality of health care (Sitthi-amorn *et. al.* 2001). The focus on the poor is exemplified, on a global scale, by the declaration of the Millennium Development Goals (MDGs) by the United Nations in September 2000. The MDGs outline 18 targets for all countries to reach, in an effort to reduce global poverty and improve the global standard of living.

Thailand expanded its health focus with this introduction of universal health care coverage (UC), which Thais commonly know as the 30-Baht scheme or 30-Baht: the cure for all disease. This program was part of a package of proposals that lead to the election of Thaksin Shinawatra to the seat of Prime Minister in 2001 (Towse *et. al.*, 2004). This program guarantees health care at any public facility to all Thai citizens, with a co-payment of 30-Baht for a value less than US\$1 per visit. The scheme is financed by general government budget, and funds are allocated to various hospitals using a registration system similar to that utilized in the Social Security Scheme. Thus far, the program has been a political success, but actual changes in health outcomes are less clear. Any depiction of the current health care system in Thailand must also account for this change in health care coverage and should evaluate the consequences of the program.

2.2 Overview of Thailand's Health and Health Care System

The World Health Organization defines health as a complete state of mental, physical, and social well-being and not merely the absence of disease or infirmity (Constitution of WHO). According to this description, it is difficult to make any comprehensive measurements of health. The Thai Ministry of Public Health uses as a guideline to understanding the determinants of health and, subsequently, implementing specific and effective reforms that will best serve the public. Figure 2.2 offers a comprehensive view of the determinants of an individual's health, primarily derived from individual and environmental surroundings, as well as the efficiency and effectiveness of the health care system. These three areas must be addressed in a complete description of the current health situation in Thailand.

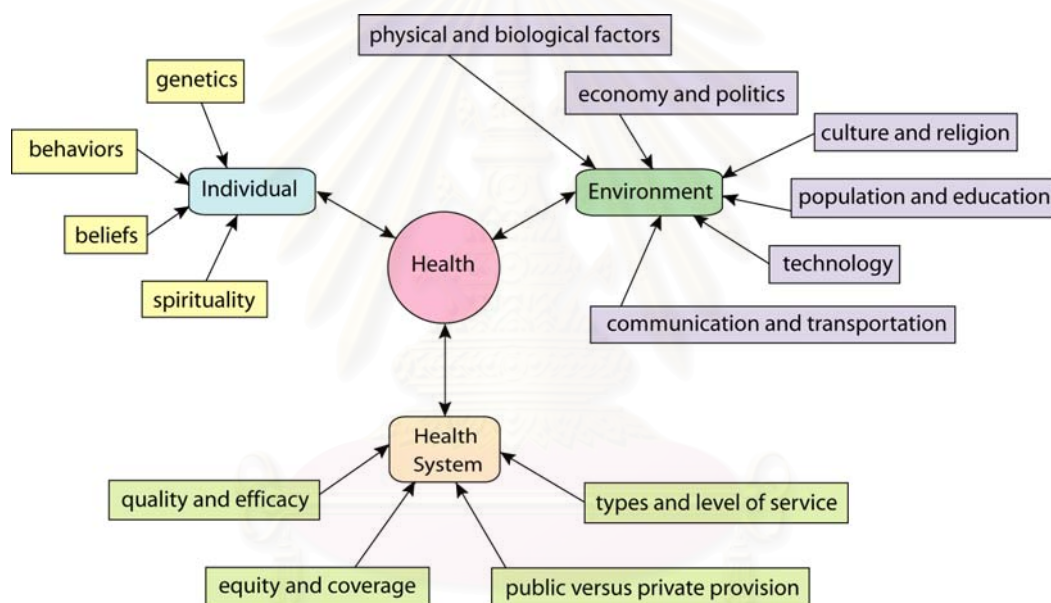


Figure 2.2. Determinants of Health, defined by the Thai Ministry of Public Health.

2.2.1 General Health Status

As shown in Figure 2.2, health status is influenced at three different levels: (1) the individual; (2) the environment; and (3) the health care system. Each level involves more specific factors that can change health outcomes, as detailed in the diagram. Some of these factors can be changed or dictated by government policies; while others are the sole responsibility of the individual or the collective responsibility of all of society. To choose the most effective policies, governments should understand the specific relationship between each of these factors and their effects on individual health.

Individual behavior and choice are significant factors in the determination of health status. Some hereditary health conditions, such as cystic fibrosis, Down syndrome, or epilepsy, are an inescapable part of one's genetic composition. Much more of an individual's health is derived from habits and choices in behavior. Decisions as simple as daily diet have a significant effect on acquiring a disease or suffering from poor health conditions. Surrounding cultural, religious, political and social norms are important factors in that they can influence the general acceptability of a person's decision. If tobacco or alcohol use was considered a filthy habit and socially unacceptable, their popularity will probably fall considerably.

Physical environment refers to the accessibility of clean water, as well as the prevalence of disease. Some disease, like malaria, thrive in more tropical climate, making these areas destined to a higher prevalence and are inherently higher risk to such diseases. Awareness of these biological and physical differences can help governments properly target interventions to the most affected areas. This knowledge, however, is insignificant without the political commitment.

2.2.1.1 Patterns in and Burden of Disease

The Thai people have demonstrated an exceptional understanding and appreciation of the importance of good health. As of 2000, households spent over 191 billion Baht on health, accounting for some 65% of total health expenditures that year (Ministry of Public Health, 2002).

The effective utilization of medical services has a significant impact on health outcomes. Two common measures of health outcomes, which are also included in the Millennium Development Goals, are maternal mortality and infant mortality rates. These measures are revealing indicators regarding the success of the health care system because maternal and child health care is a relatively inexpensive yet vitally important form of primary health care. Measures of maternal mortality and infant mortality reflect the quality of service at the most basic level of provision of health care services in a country. Over time, several changes in Thailand's economic and social development have improved the health status of the general public, causing significant improvement, which is depicted in Figure 2.3. This graph shows the rapid decline in maternal and infant mortality rates, particularly after 1977 when many health care and coverage programs were instituted in Thailand.

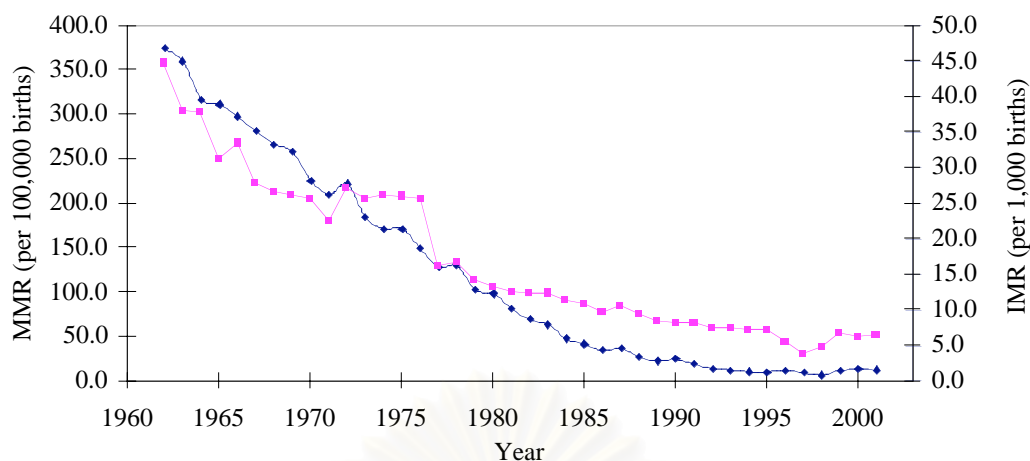


Figure 2.3. Infant and Mortality Rates in Thailand between 1960 and 2003.

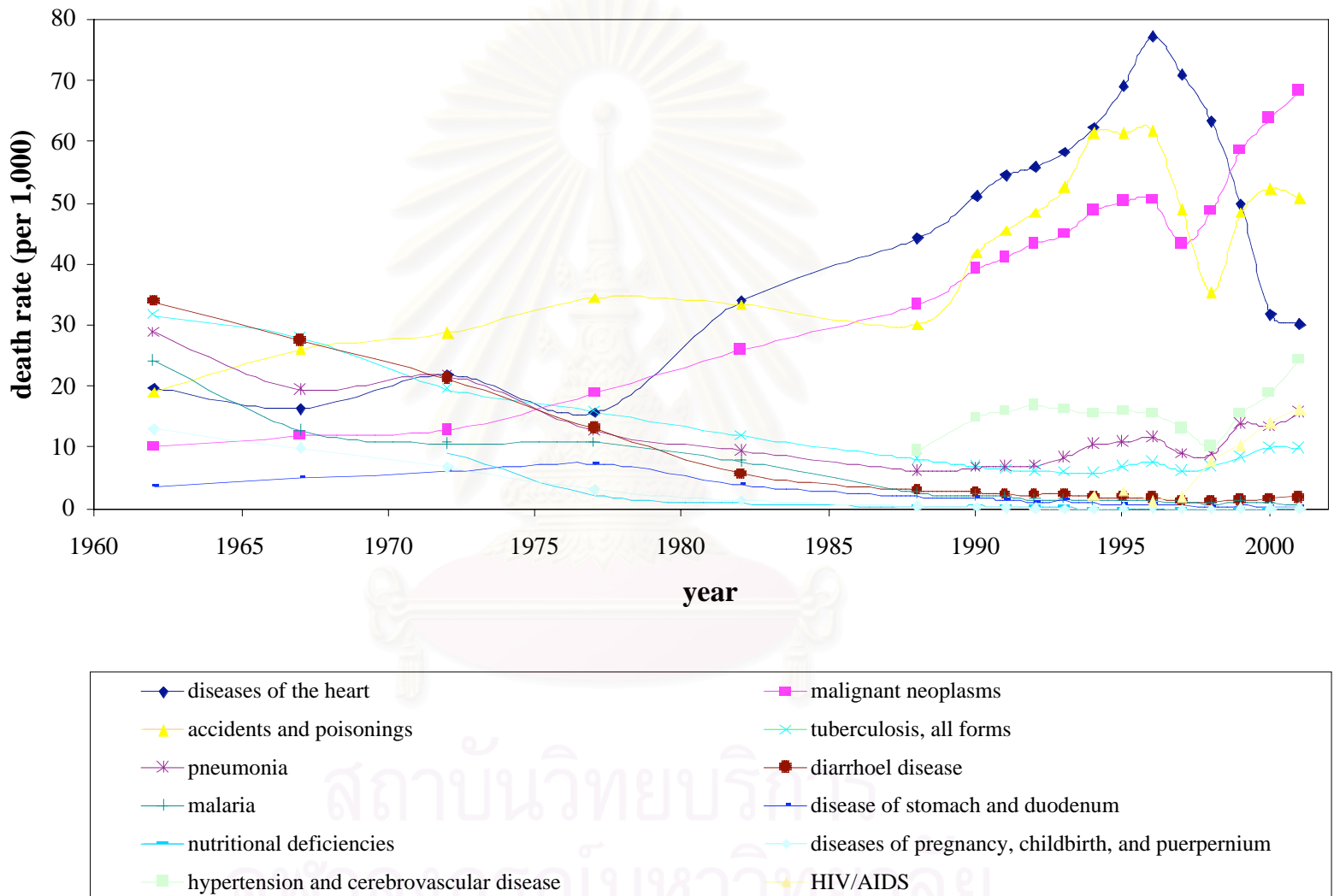
The reduction in maternal and infant mortality rates can be attributed to a number of specific events and programs in health care reform. Two important events that promoted the use of maternal and child care and family planning services were the introduction of the Low Income Card Scheme and of the Voluntary Health Card Scheme. Both of these programs allowed women to seek maternal and child health care free of charge. Without the additional financial burden to consider, pregnant women do not view health care and check-ups as a burden on household income. This should result in a higher utilization rate and, consequently, lower maternal and infant mortalities throughout the country. Gender equality and, more specifically, the education of women were also significant factors in higher utilization of maternal and child health care.

Another important reflection of the general state of health in a country is the pattern of disease observed. As a country develops economically and socially, health outcomes tend to improve in several ways: death rates and fertility rates fall and life expectancy rises. In addition, the patterns of disease will also change significantly. In a less developed country, outbreaks of infectious or easily preventable diseases are not effectively contained, resulting in a large number of deaths. As a country becomes increasingly developed, several factors will alter the number of deaths and incidence of disease. Health services become more available and accessible, which means that many previously untreated diseases that were will be cured, saving thousands of lives. Increased social development implies a highly-educated public, which means that the general population will also be more aware of and more willing to actively participate in prevention measures. Development and growth is also likely to lead to the expansion and improvement of the quality of infrastructure. This includes not only roads and public buildings, but also laying pipes to

service clean water to more households and providing effective sanitary services over a wider area. This kind of expansion will further reduce the risk of contracting and spreading many dangerous infectious diseases. As infectious disease becomes a minimal issue, non-communicable diseases will strike an increasing proportion of the population in a developed country. Many diseases may result from lifestyles of people in developed countries, while the causes of other diseases remain unknown. These trends are seen in the historical context of almost any developed country, but also can be observed on a cross-country level. In developing countries, the impact of infectious diseases will be high, while more developed countries, non-communicable disease will be the cause of death for a large majority of the population.

A graphical representation of the specific mortality rates of several of the leading causes of death in Thailand is shown in Figure 2.4. This figure clearly illustrates Thailand's shift through the health development transition described above. In the 1960s, infectious diseases, such as malaria, pneumonia, tuberculosis, and diarrhea, claimed the most lives. It is not unlikely that these deaths occurred in clusters, because once a person contracted the disease, he or she could spread the disease to most of the surrounding community without knowledge of preventive measures. Forty years later, economic and social development has lowered the mortality rates of these diseases significantly. Non-communicable diseases like cancer, heart disease, and cerebrovascular disease are dominating disease patterns in Thailand at present. The reduction in deaths due to preventable and treatable diseases is testimony to the progress made in the provision of health care services over this period.

Figure 2.4. Leading Causes of Death in Thailand, 1962-2002.



More recently, a research team at Thailand's Ministry of Public Health published a report on the Burden of Disease in Thailand. This type of information differs from general mortality rates in that it accounts for the age at which each person is affected by a particular health condition. The report offers two measures of disease burden. The first measure was the Years of Life Lost (YLL) due death from a given disease. This measure is the easier and more direct of the two, based on life expectancy compared to actual age at death. The second measure utilizes disability-adjusted life years (DALYs). Introduced in the late 1980s, this measurement tool estimates the number of *healthy* years lost, thus including those diseases or conditions that are debilitating but not fatal, a key point that is missed using the YLL measurement. Results are given in Table 2.1, which detail the leading causes of burden of disease by gender. The burden of disease is also given by age group in Appendix A. The results from this study show that HIV/AIDS has the most significant impact on the death toll in Thailand, contributing over 15% to the disease burden in Thailand. Stroke, diabetes, liver cancer, heart disease, and traffic accidents also rank in the top 10 causes of disease burden for both genders. This study reflects some of the major health problems in Thai society, serving as a valuable tool in priority-setting and decision-making for those who initiate health care policy.

	Males			Females			
	Disease category	DALYs	%	Disease category	DALYs	%	
1	HIV/AIDS	960,087	17%	HIV/AIDS	372,947	9%	1
2	Traffic accidents	510,907	9%	Stroke	280,673	7%	2
3	Stroke	267,567	5%	Diabetes	267,158	7%	3
4	Liver cancer	248,083	4%	Depression	145,336	4%	4
5	Diabetes	168,372	3%	Liver cancer	118,384	3%	5
6	Ischemic heart disease	164,094	3%	Osteoarthritis	117,994	3%	6
7	COPD (emphysema)	156,861	3%	Traffic accidents	114,963	3%	7
8	Homicide and violence	156,371	3%	Anemia	112,990	3%	8
9	Suicides	147,988	3%	Ischemic heart disease	109,592	3%	9
10	Drug dependence/harmful use	137,703	2%	Cataracts	96,091	2%	10

Table 2.1. Burden of Disease by gender in Thailand, 1999.

2.2.1.2 HEALTH RISK FACTORS

The burden of disease study is extended to account for various factors determining one's state of health. This research utilizes a reliable probability technique, which was presented in the 2002 World Health Report entitled *Reducing Risks, Promoting Healthy Life*. The methodology analyzes patterns of behavior in a society and can link unhealthy practices to patterns in morbidity and mortality. The project offers important reflections on

the important links between individual behavior, the surrounding environment, and the health care system.

Specifically, this study shows how decisions and habits are manifest in diseases, thus increasing the burden of disease. The risks of each habit or practice were given in the 2002 World Health Report, but the specific links between health risks and the leading causes of disease burden in Thailand were determined by this study, and are detailed in Figure 2.5 and Figure 2.6. The heavier lines indicate a stronger link between the risk factor and resulting disease. Those factors with the highest impact on burden of disease are given in Figure 2.7. The risk factor with the largest impact on disease burden is unsafe sex, accounting for approximately 12% of all DALYs lost in 1999. Tobacco and alcohol abuse, both of which are very popular in current Thai society, are the second and third leading causes, contributing a combined % of disease burden. The top five risk factors alone account for over one-third of total disease burden in 1999. Reduction of such unhealthy practices and early detection of the resulting disease can help reduce the disease burden on Thai society, thus improving health outcomes.

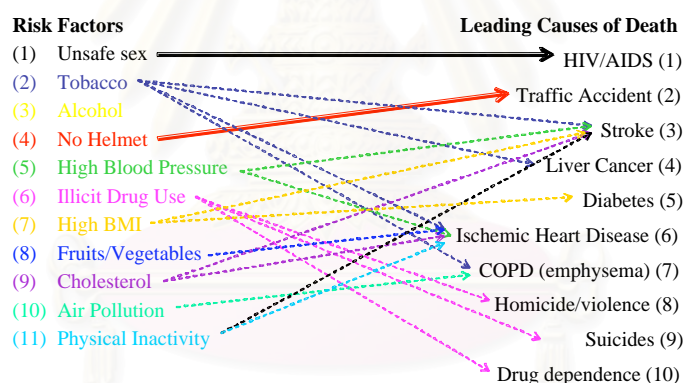


Figure 2.5. Impact of health risk factors on disease for men in Thailand, 1999.

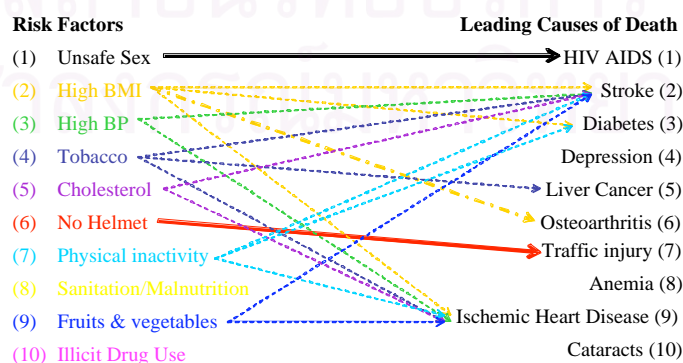


Figure 2.6. Impact of health risk factors on disease for women in Thailand, 1999.

Most of these risk factors are the result of individual choice: the choice to have protected sex, the choice to abstain from smoking and alcohol, the choice to consume a healthy diet and exercise regularly. The *individual* makes the decision, but his choice is based on a number of external factors. Societal acceptance or pressure of a particular practice may promote or condone some poor health decision. In other cases, the individual may be completely unaware of potential poor health outcomes of particular practices. In these cases, it is important that the government and specifically the health care system are prepared to amend its practices so as to improve individual health.

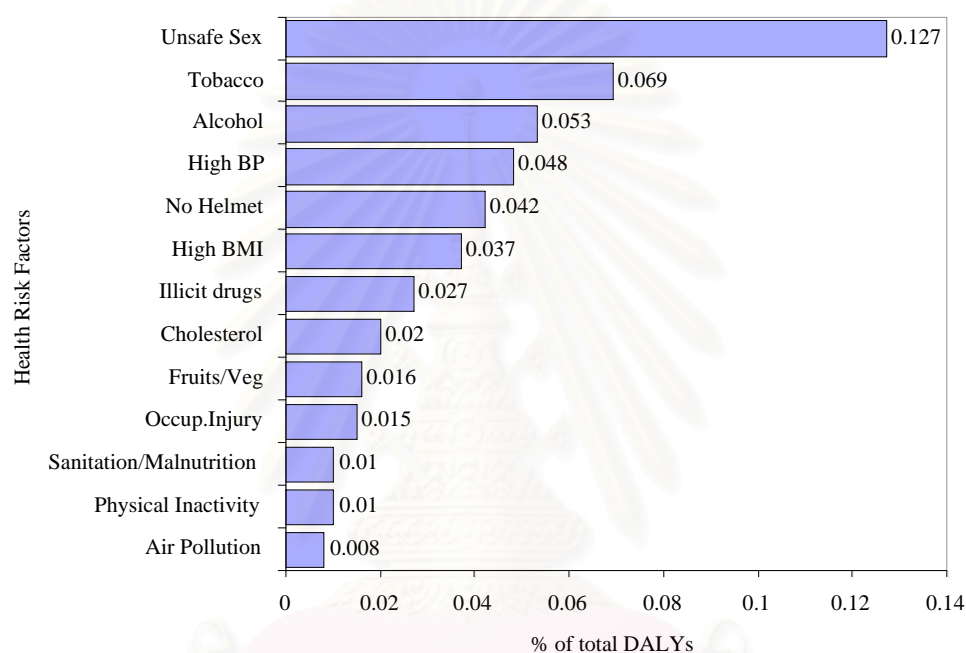


Figure 2.7. Risk factors with the highest impact on Disease Burden.

2.2.1.2.1 Unsafe Sex

Over 50,000 deaths are attributable to unsafe sex. Unsafe sex can lead to HIV/AIDS, other sexually transmitted infections (STIs), and cervical cancer. Of these consequences, HIV is undoubtedly the most prominent and devastating outcome. HIV/AIDS was the leading cause of disease burden in Thailand in 1999, causing the loss of over 1.3 million DALYs.

On a worldwide scale, most HIV incidence is a result of heterosexual sex. Shortly after the discovery of HIV/AIDS, the disease remained primarily among specific surveillance groups such as homosexuals and commercial sex workers (CSWs). At present, the incidence of new HIV cases in these groups has slowed, while the incidence in other groups like married women and adolescents is rising.

The Thai government promoted and established the widely acknowledged 100% Condom Program and met with great success, as fewer and fewer new cases are being reported in these specific groups. Programs included education of the dangers of the disease, how the disease is contracted, and distribution of condoms, focused on these groups and slowed the spread of HIV significantly. Those programs that showed such success in these focus groups should be scaled-up to apply to the general public in an effort to prevent the further expansion and possible mutation of the disease.

2.2.1.2.2 Addiction and Abuse: Tobacco, Alcohol, and Illicit Drugs

Habitual alcohol, tobacco, or drug consumption can have significant and even fatal consequences to the user and even those around him. Regular tobacco use, particularly though smoking cigarettes, can lead to adverse outcomes like lung cancer, emphysema, chronic obstructive pulmonary disease (COPD), and other respiratory and vascular diseases. Alcohol consumption can lead to other potentially fatal conditions, like stroke, heart disease, liver cirrhosis, liver cancer, as well as motor accidents and other injuries. In Thai society and culture, smoking and habitual alcohol consumption are accepted as commonplace. Stringent laws prohibiting under-aged drinking cause many youths to consume in excess once they are of age. Most youths adapt regular alcohol consumption into their daily routine. In a study that estimated the average weekly alcohol consumption of young adults, Thailand ranked within the top 10 worldwide. Once accustomed to such heavy consumption, most people will continue some form of habitual drinking throughout most of their lives. Historically, regular alcohol consumption has been a habit primarily common among men, but in recent years, women are increasing their consumption, as bars, pubs, and dance clubs become increasingly popular in Thai culture and society.

Like alcohol, smoking has become an accepted part of the Thai lifestyle and culture. Before scientific studies provided proof of the dangerous consequences of cigarette smoke, tobacco consumption was quite popular in Thailand, in both urban and rural areas. Many people became addicted to the nicotine, the addictive drug and key ingredient in cigarettes, which makes it physically and mentally difficult to quit smoking cigarettes, even once the potential dangers were made known to the public. Children who observe their parents smoking cigarettes are more likely to condone the activity, accepting it as a part of life. Media and entertainment also promote smoking, in that movie characters and even famous icons will often be seen smoking or drinking. As the activity become more and more

popular and pervasive in culture and society, impressionable children and adolescents accept smoking as indispensable component in a fashionable lifestyle.

The Thai government has made some efforts to change social and cultural views on tobacco and alcohol consumption. Cigarettes that are legally imported into the country are required to attach large and obvious warning labels. Cigarette and alcohol consumption is banned from television media, and commercials for alcoholic beverages can be aired only after a late hour, to reduce or prevent exposure to children. In addition, business curfews and random check points are invoked to limit drunk driving. Clean air laws also prohibit smoking in most indoor facilities, to discourage cigarette consumption and prevent the incidence of lung cancer and other respiratory and vascular diseases.

2.2.1.2.3 High Blood Pressure and Cholesterol

High blood pressure and cholesterol are risk factors indicating the potential for ischemic heart disease as well as a number of other fatal and debilitating diseases. These factors may arise from high-stress working environments and poor eating habits, which are becoming increasingly common, particularly in the Bangkok metropolis area. As the demographic and epidemiological trends in Thailand transition to more closely resemble trends observed in developed countries, there is a growing concern for these non-communicable but preventable diseases.

Several factors affect blood pressure and cholesterol levels, and many different approaches can be taken to reduce them. The best and least expensive way to avoid this problem is through the promotion of healthy eating and lifestyle habits, including diet, regular exercise, and stress reduction techniques. Treatment through medication is possible for people already diagnosed with such problems, but the medication is quite costly. If the condition is not treated early enough, expensive surgery may be required to relieve blockage in the arteries. The longer this type of condition is left unattended, the more expensive and more risky the solution becomes. The best solution, then, is to monitor and treat patients early to prevent further complications of the disease.

2.2.1.2.4 Helmet Use

Motorcycles are ubiquitous in Thailand. In the busy city of Bangkok, they serve as a rapid mode of transportation, since its small size allows its riders to maneuver through traffic quite easily. In rural areas motorcycles serve as the quickest and most inexpensive mode of long distance travel. Despite the wide-spread use of motorcycles and frequent

accidents which are reported, many Thais continue to neglect the habitual use of a helmet for protection. In rural areas, some people may see it as unnecessary if they are traveling a short-to-medium distance. Others find it inconvenient or uncomfortable, and thus choose not to wear this potential life-saving device.

The dangers of neglecting proper helmet use are demonstrated by the high rate of fatalities due to traffic accidents. The burden of disease study shows that almost 600,000 years of life were lost from deaths in traffic accidents alone. The Thai government has already instituted a law requiring all motorcycle riders to wear a helmet for their own protection. In addition, there are laws prohibiting motorcycles on many high-speed dangerous roads. Despite the many safety laws enacted, many people continue to neglect or avoid them. To ensure that these laws are to have the deepest impact on the population, it is important that officials strictly enforce these rules, to build their own credibility as well as to make the adherence to these laws habitual for all motorists.

2.2.1.2.5 Clean Drinking Water and Sanitation

Safe drinking water and sanitation are two of the main causes of diarrhea, which caused the loss of over 70,000 years of life in 1999 alone. Safe drinking water is available throughout most of the country; however, in most rural areas, safe drinking water refers to collected rain water. Although they are taught how to collect, keep and treat rainwater to ensure it is rid of disease or other contamination; there is no guarantee that they follow these steps with every collection. In addition, during drought or periods of little rainfall, there is no alternative source of clean drinking water. The safest and most certain way to prevent the problems from drinking water is to lay down the pipeline infrastructure needed to provide tap water to all households. Laying this pipeline to provide clean drinking water also provides the framework to provide sanitation services to these areas as well.

2.2.1.2.6 Malnutrition

Malnutrition is no longer a major problem among children but remains an important issue in pregnant women in Thailand. Projects initiated by H.M. Bhumiphol Adulyadej provide iodized salt and guarantee proper nutrition to children in schools, which has helped reduce malnutrition in children over the past 30 years. Low birth weight, however, remains one of the most common problems among children under 14 years of age, accounting for some 150,000 DALY lost in 1999. Low birth weight can lead to further health problems or complications in terms of the child's growth and strength in the months following delivery.

The best solution is prevention through proper medical care and attention throughout the pregnancy and after delivery, whether the attending health care professional is a physician, a nurse or a midwife.

2.2.2 Health Care Providers

Changes in human behavior and cultural norms are very difficult to instill and impossible to impose on people. Although these factors must be considered in choosing the most effective policy reforms, the government's prime responsibility lies in the provision of a comprehensive network of providers is made available and accessible to the population. A complete evaluation of the government's progress should assess the accessibility and effectiveness of Thailand's current health care system.

Medical care, like most other productive sectors in an economy, requires several inputs to provide health care services. These inputs can be divided into several categories: human and physical capital, skilled and unskilled labor, and research and innovation. Physical inputs include buildings and surrounding land that house health care facilities, patient bed, and other equipment. Human resources refer not only to the medical staff of a hospital, but also social health workers and even village volunteers trained to provide information and advice to the community. Technology can encompass many things and is very difficult to measure in that some advances are complicated, while others less so; and the discovery of an innovation cannot be scheduled or predicted, like payments for an expensive piece of equipment or machinery. If one of these inputs is absent or insufficient, then production of the service will be inefficient and more costly. To provide an illustrative and encompassing description of the health care sector in Thailand, one should examine the supply of each of these inputs.

2.2.2.1 Health Care Facilities

Health care in Thailand is provided at many levels, from prevention and promotion of healthy lifestyles, to the treatment of cancer or HIV/AIDS patients. Different forms of treatment are available at different facilities; specifically, most care is provided at primary, secondary, and tertiary care facilities. Promotion of rural health beginning in the 1960s and the consequent proposals for primary health care systems led to the expansion of smaller health centers throughout the country. These centers administer preventive care and education, as well as curative care for minor diseases or conditions. In addition to health centers, most districts have local hospitals to provide emergency and higher level curative

care, as well provide patient beds if admission to the hospital is necessary. In addition to the major health care facilities, many people, particularly the poor, will seek rapid and inexpensive curative care from pharmacies. This usually pertains to people who are struck with cold or flu-like symptoms, but some with even more serious illnesses will also seek the advice of a pharmacist instead of a physician because of the disparity in price. Each level of care is important to the maintenance and improvement of Thailand's health status.

Table 2.2 shows the regional distribution of health centers, patient beds, and pharmacies in Thailand. The figures given are in terms of the number of population per center, bed or pharmacy. Lower figures, then, indicate a high concentration of the specified facility. Because a hospital is expected to oversee a large population, figures on the number of population per hospital are not very revealing of the accessibility of health services. The only possible insightful fact that may be demonstrated is the concentration of hospitals in Bangkok in disproportionately higher than in other figures. Health centers are very rare in Bangkok, with only one for every 40,000 people, but the lack of health centers in this metropolis is compensated by the number of private clinics and hospitals available there. A more revealing figure is the distribution of patient beds. In Bangkok, one patient bed was available for every 200 people. The figure is over twice the average 454 people per patient bed across the country, and over 3 1/2 times better than the 766 people per bed in the Northeastern region.

Region	Population per Facility		
	Health Centers	Patient Beds	Pharmacies
<i>Bangkok</i>	39,660	202	1,872
<i>Central</i>	3,631	369	8,365
<i>North</i>	4,132	493	19,136
<i>South</i>	5,194	494	11,309
<i>Northeast</i>	8,311	766	39,356
<i>Nationwide</i>	3,427	454	9,546

Table 2.2. Regional distribution of health facilities, population per facility (2000)

This regional disparity arises from several factors. First is the difference in the economy of each region, in terms of both amount and type of production. The northeast region refers to a large area of land, which encompasses many forms of economic production, from manufacturing to agriculture. Another possible explanation for the inequality across regions is that services in Bangkok are more specialized and people may have to travel to Bangkok to receive tertiary care, such as chemotherapy. Because the need for such care is quite infrequent, this explanation cannot possibly completely account for the dramatic difference observed between Bangkok and the Northeast region. The most likely

explanation for this inequality is the disproportionate distribution of private providers in each area. Table 2.3 shows that the city of Bangkok alone has almost three times the number of private hospitals and five times the number of private patient beds in the Northeast region, but less than one-third of the population.

Region	Hospitals			Patient Beds		
	Public	Private	Total	Public	Private	Total
Whole Kingdom	943	328	1,301	104,296	31,007	135,303
Bangkok	40	78	118	17,278	11,176	28,454
Central	247	128	375	28,785	9,319	38,103
Northeastern	301	38	339	24,178	3,198	27,376
Northern	202	58	260	20,319	5,107	25,426
Southern	165	42	207	13,737	2,207	15,944

Table 2.3. Public and Private Hospitals and Patient beds, by region (2000)

2.2.2.2 Equipment and Medical Technology

Technology itself is difficult to measure but can be assessed through its manifestation in terms of medical equipment and pharmaceutical drugs. There is little documentation on the minimum requirements or current stock of medical equipment in hospitals. Table 2.4 shows the distribution of highly specialized medical equipment, specifically CT scanners, MRIs, and mammography instruments. Because the equipment is rather expensive, the highest concentration of equipment is found in Bangkok, which also has the most private providers. Magnetic resonance imaging equipment is almost ten times more common in Bangkok than in any other region in Thailand. CT and mammography instruments show similar trends in distribution. These figures do not distinguish between the public and private sectors, but it is most likely that a considerable proportion of the surplus is a result of the private hospitals that opened during the economic boom.

Region	Instruments per 1,000,000 population		
	CT scanners	MRI	Mammography
<i>Bangkok</i>	15.9	3.2	10.9
<i>Central</i>	5.2	0.1	1.5
<i>North</i>	3.4	0.2	0.6
<i>South</i>	2.2	0.1	0.7
<i>Northeast</i>	2.8	0.3	1.1
Nationwide	4.5	0.4	1.8

Table 2.4. Concentration of medical equipment across regions (2000)

2.2.2.3 Medical Personnel

The general trend of human resources for health in Thailand is one of insufficient and poorly distributed personnel. The shortage of personnel and the disproportionate distribution has persisted since the 1960s, despite significant government efforts to reverse

both trends. The problem originated from several issues, including the capacity of training institutions, the draw from hospitals in the private sector and abroad, as well as the disparity in the standard of living across regions. The government has demonstrated dedicated efforts throughout its history, but without active recruitment and commitment to change this trend, the gap will continue to widen.

The first wave of physicians to leave the public health care system came in the 1960s, when physicians from Thailand were recruited to fulfill a shortage of physicians in the United States. This phenomenon, termed 'the external brain drain,' resulted in the loss of approximately 1500 doctors, or almost 25% of their physicians (Wibulpolprasert and Pengpaibon, 2003). Although the strain on the domestic medical care sector was not apparent in terms of the mortality rate or life expectancy, it was clear that the loss of a significant proportion of the personnel strained the effectiveness and efficiency of health care provision.

To prevent the emigration more medical personnel, the government created a compulsory rural health service program. In return for government-subsidized tuition fees, students would work at public hospitals in rural areas in their first 3 years after graduation. Medical school graduates who chose not to serve in rural areas faced severe penalty fees. This program proved to be quite successful in its initial phases. Between 1976 and 1985, the number of rural doctors increased four-fold. In addition, the concentration of doctors, measured by the doctor-population ratio, increased rapidly. The program was less successful in retaining students in later years because the rise in penalty fees rose slower than incomes, making the fines more affordable.

The rapid uncontrolled growth of private hospitals during the 1990s led to an 'internal brain drain,' which drew many health professionals away from the public sector. Penalty fees required to leave the compulsory health service program early rose at a rate much slower than the rise in physicians' potential incomes, particularly in the private sector. As a result, many physicians in rural areas found the incentives at private hospitals attractive enough to even break the rural service contract and pay the fines using the substantial salaries offered at private facilities. Table 2.5 shows the entry and exit of physicians in public hospitals under the purview of the Ministry of Public Health (MoPH). While the number of new graduates generally increases each year, the number of doctors who resign from their service also rose every year up to the economic crisis in 1997 (Wibulpolprasert and Pengpanibon, 2003).

year	number of doctors		
	<i>new</i>	<i>reapplied</i>	<i>resigned</i>
1994	526	--	42
1995	576	--	71
1996	568	--	98
1997	579	30	205
1998	618	93	117
1999	830	168	63
2000	893	92	133
2001	883	67	135
2002	913	22	316

Table 2.5. Physicians entering and leaving public hospitals under the Ministry of Public Health.

During the economic crisis in 1997, the over-supply of private providers was curbed, as many private hospitals were forced to scale down, cut back, or close altogether. The number of patient beds in the private sector fell by almost 40% during this period, and personnel in the public sector specifically rural areas began to increase as private hospitals in Bangkok were forced to close (Tangcharoensathien *et. al.*, 2000).

At present, however, the distribution and concentration of medical personnel across regions is still quite biased. Bangkok has the highest concentration of physicians, dentists, nurses, and pharmacists per 1,000 people, for many of the same reasons that many facilities are located there. Some experts suggest, however, that the capitation payment mechanism of the UC scheme may benefit rural health centers, giving rise to the increased competition and similar phenomena observed as a result of the Social Security Scheme's capitation payment design.

Region	Physicians		Dentists		Nurses		Pharmacists	
	<i>number</i>	<i>ratio</i>	<i>number</i>	<i>ratio</i>	<i>number</i>	<i>ratio</i>	<i>number</i>	<i>ratio</i>
<i>Bangkok</i>	7,155	793	1,607	3,529	18,338	309	2,223	2,551
<i>Central</i>	4,029	3,576	857	16,813	17,469	825	1,303	11,058
<i>North</i>	2,691	4,501	711	17,037	13,341	908	1,100	11,012
<i>South</i>	1,576	8,311	363	22,549	9,264	884	774	10,575
<i>Northeast</i>	2,574	8,311	603	35,476	12,566	1,702	984	21,740
<i>Whole Kingdom</i>	18,025	3,427	4,141	14,917	70,978	870	6,384	9,676

Table 2.6. Regional distribution of medical personnel, 2000.

2.2.2.4 Research and Development in Pharmacological Technology

Many people will opt to self-treat their illnesses as a cheap and expedient alternative to hospitals or clinics. This often requires the purchase of medicine, which is often available without prescription at any pharmacy. Pharmaceutical drugs, whether prescribed or not, often present a further financial burden, which some may view as superfluous or unnecessary. The market for pharmaceutical products in Thailand consists of two types of

producers: multinational corporations, which usually discover and patent the drugs that they produce; and generic producers, most of which reproduce biochemical copies of drugs already on the market. The drugs produced by most generic producers have the same efficacy but are sold at a lower price because the companies that produce them do not bear the considerable research and development costs required to discover, create, and test new drugs. Generic producers must sell at a price lower than that of its brand-name competitors.

The issue of brand name is important, particularly in Thailand, which has over 170 local drug producers. Most pharmacies provide both brand name and generic drugs, but some people believe that the lack of a popular brand name compromises the quality or efficacy of the drug. The changes in market share during positive economic times clearly illustrate this point. Between 1992 and 1997 the market share held by multinational corporations rose by 1-6% per year, peaking in 1997 when they owned 67% of the market share in Thailand (Supakankunti *et. al.*, 1999). Likewise, drug expenditure rose steadily from 1980 to 1997, when the economic crisis forced most consumers to cut back on all their spending. When given the option, most people will choose to purchase brand name drugs over the generic alternative if it is within their means. Increasing the number of generic producers or the efficiency of those producers in the market, then, will affect neither the health care system nor health outcomes if public attitudes towards pharmaceuticals are not shifted toward the use of generic drugs.


To stay competitive and profitable, each of the 170 domestic drug producers in Thailand must initiate research and development of new drugs. Unlike their foreign counterparts, most drug companies in Thailand invest less than 20% of their revenues on research and development (R&D) (Supakankunti *et. al.*, 1999). In addition, a significant amount of the R&D reported in these surveys represents research into the development of efficient synthetic schemes to producing drugs already readily available in the market. It is clear that small companies in Thailand do not have the financial means or the experienced personnel to effectively develop innovative and life-changing drugs. R&D presents a particularly large burden on those smaller companies, which may lack the facilities, as well as the long-term financial stability to risk years and years of study to create, test and market a brand new drug. It should be the government's responsibility to promote further local R&D in pharmaceuticals, though the provision of financial, technical, and professional support.

2.2.3 Health Care Coverage and Financing

Efforts to provide effective health care system are futile if those people who need medical attention most are denied access to care. Throughout most of Thailand's early history, health care was paid for out-of-pocket by individual consumers. shows health care expenditures over the past 20 years, organized by the source of spending. Although government expenditures have risen continuously, public expenditures accounted for only one-third of health care expenditures even as late as 2000. International aid in Thailand plays a minimal role, contributing less than one-half of 1% of total expenditures on health. Private insurance has also played a minimal role, making up a mere 2.5% of all expenditures on health (Ministry of Public Health, 2002). The bulk of health care spending lies with the household, which comprises over 50% of all health care expenditures.

Out-of-pocket payment for health care is unfavorable because it contests the goal of equal access to health care. In particular, such payments disproportionately disadvantage the poor by placing a significantly higher burden on their income. Those who are educated enough to recognize the importance of seeking medical care will face a disproportionate strain on their income compared to their wealthier equivalents. In addition, the onset of a potentially fatal illness can instigate a cycle of poverty, in which the cost of medical care incurs such a heavy burden that the younger generation may abandon their education to work a low paying job, thus committing them to further poverty.

To protect the public from the catastrophic impacts of high-cost health care and the constant vulnerability to poverty, it is essential that some form of health care coverage or insurance is made available, in particular to the poor. The problem of adverse selection is inherent in any private insurance markets, and the venue of health care is no exception. Payment systems without protection and without risk-pooling tend to reduce equity in access to medical care and attention. Offering health insurance to the poor will crowd out healthier potential consumers of health insurance in a private market. There are two possible solutions to eliminate the problem of adverse selection. The first option is to price discriminate, offering insurance at a price based on the individual's health status and likelihood of becoming ill. This method is likely to cover the largest number of people under a private insurance market, but it will continue to exclude the poor most vulnerable to the catastrophic financial burden of disease. The government should be responsible for the health care coverage of the poor who are excluded not by their own choice but by their inability to pay the market price insurance premiums.



Year	public sector expenditures								private sector expenditures				international aid		grand total	per capita	% of GDP
	MOPH	other ministries	CSMBS	enterprise benefits	WCF	SSS	total	percent	insurance	households	total	percent	total	percent			
1980	4,495	2,210	660	111	100	-	7,576	29.93%	224	17,150	17,374	68.63%	365	1.44%	25,315	549.40	3.82%
1981	5,572	2,535	995	167	149	-	9,418	29.66%	284	21,229	21,513	67.75%	824	2.59%	31,755	668.70	4.18%
1982	6,652	2,838	1,219	204	153	-	11,066	31.73%	318	23,109	23,427	67.18%	380	1.09%	34,873	719.16	4.14%
1983	7,902	3,134	1,482	248	205	-	12,971	31.50%	350	27,469	27,819	67.55%	391	0.95%	41,181	832.63	4.47%
1984	8,618	3,467	1,791	300	250	-	14,426	27.61%	469	36,951	37,420	71.63%	395	0.76%	52,241	1,036.61	5.29%
1985	9,044	3,716	2,157	362	236	-	15,515	26.18%	547	42,751	43,298	73.06%	452	0.76%	59,265	1,146.75	5.61%
1986	9,275	3,965	2,594	435	221	-	16,490	25.06%	360	48,432	48,792	74.16%	508	0.77%	65,790	1,254.78	5.83%
1987	9,525	4,082	2,828	474	274	-	17,183	22.70%	756	57,258	58,014	76.63%	507	0.67%	75,704	1,439.10	5.82%
1988	10,373	4,338	3,156	529	347	-	18,743	20.83%	951	69,955	70,906	78.81%	319	0.35%	89,968	1,649.70	5.77%
1989	11,733	4,448	3,521	590	397	-	20,689	19.69%	1,162	82,988	84,150	80.07%	252	0.24%	105,091	1,895.31	5.66%
1990	16,225	4,558	4,316	723	443	-	26,265	20.96%	1,403	97,450	98,853	78.89%	184	0.15%	125,302	2,224.04	5.74%
1991	20,569	4,699	5,127	859	624	778	32,656	23.52%	1,544	104,348	105,892	76.28%	270	0.19%	138,818	2,449.93	5.54%
1992	24,604	4,840	5,854	981	753	2,057	39,089	24.75%	1,775	116,745	118,520	75.03%	356	0.23%	157,965	2,753.20	5.58%
1993	32,898	4,928	7,906	1,291	927	2,473	50,423	27.39%	2,061	131,297	133,358	72.45%	281	0.15%	184,062	3,141.85	5.81%
1994	39,190	5,558	9,954	1,668	1,169	3,773	61,312	29.71%	2,307	142,535	144,842	70.19%	206	0.10%	206,360	3,516.76	5.69%
1995	45,833	6,677	11,156	1,869	1,370	3,991	70,896	30.05%	4,987	159,858	164,845	69.88%	151	0.06%	235,892	3,979.38	5.63%
1996	55,861	7,768	13,587	2,418	1,610	6,239	87,483	32.95%	6,296	171,596	177,892	67.01%	111	0.04%	265,486	4,440.44	5.77%
1997	68,934	7,182	15,503	2,756	1,987	10,245	106,607	37.09%	7,518	173,210	180,728	62.87%	122	0.04%	287,457	4,754.01	6.15%
1998	65,065	5,740	16,440	2,817	1,630	7,637	99,329	35.41%	7,803	173,215	181,018	64.53%	183	0.07%	280,530	4,587.13	6.14%
1999	62,787	6,087	15,174	2,539	1,404	7,676	95,667	32.99%	8,171	185,894	194,065	66.92%	275	0.09%	290,007	4,709.60	6.28%
2000	63,001	6,195	17,062	1,622	1,257	9,623	98,760	33.09%	7,291	191,995	199,286	66.77%	413	0.14%	298,459	4,831.76	6.09%

Table 2.7. Breakdown of Health Care Expenditures

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In many developed countries, including the United Kingdom, Canada, and Singapore, governments have successfully established systems of universal health care coverage. In 2001, Thailand's central government followed suit with the implementation of its universal coverage health care scheme, which guarantees medical care services for every Thai citizen with a co-payment of 30 Baht (the equivalent of less than US\$1) per visit. Prior to the initiation of universal coverage, however, the Thai people were covered through four main insurance programs: the Low Income Card Scheme (LICS), which covered the poor and elderly; the Civil Servant Medical Benefits Scheme (CSMBS), which provides a generous health insurance package to permanent government officials; the Social Security Scheme (SSS) and Worker's Compensation Fund (WCF), which is a compulsory, contribution-based program that offers health insurance to workers for any injuries on or away from the workplace; and the Voluntary Health Card Scheme (VHCS), which is aimed primarily at the marginally poor or other groups vulnerable to catastrophic disease. The details of each of these programs are described in Appendix B (Pramualratana and Wibulpolprasert, 2002).

Initially, the Thai population did not understand or recognize the importance of health care coverage or insurance. Despite government efforts to legislate and promote new coverage programs, a significant majority of the population did not utilize these social programs. As late as 1991, as much as 67% of the Thai population was not covered by any of these insurance schemes (Pramualratana and Wibulpolprasert, 2002). It is evident that over the next decade, however, health insurance became increasingly important to both the Thai government and the Thai people. The Thai government expanded the Low Income Card Scheme to include children, the disabled and local leaders. Similarly, both promotion by the Thai government and heightened public interest resulted in a significant increase in the number of Voluntary Health Card subscribers.

Financing of each coverage scheme differs slightly, drawing attention to the advantages and disadvantages of each program. The Civil Servant Medical Benefits Package, for example, compensates health care providers on a fee-for-service basis. This type of payment is likely to yield the highest quality care, but because providers are compensated for each and every consultation, this payment scheme is also vulnerable to rapidly escalating costs due to excess or superfluous procedures. The Low Income Card Scheme and Voluntary Health Card Schemes are reimbursed. The Social Security Scheme pays its providers on a capitation basis. Because capitation payments were very attractive to most hospitals at the outset, the Social Security Scheme, along with the rapid economic

growth in Thailand and most of Southeast Asia, promoted increasing competition between hospitals. This resulted in higher quality service, without the escalating costs observed under the Civil Servant Medical Benefits Scheme. The benefits and obstacles in each of the previously existing plans were taken into consideration in the drafting and implementation of the Universal Coverage Scheme (UCS) in Thailand.

2.2.4 Health and the Millennium Development Goals (MDGs)

Health, as defined by the World Health Organization is not simply the absence of disease but a complete state of well-being. To achieve such a state requires collaboration and cooperation between the health and other sectors. Specifically, such factors include education levels, clean water and sanitation, economic development and gender equality. The recent Millennium Development Goals, which are available in full in Appendix C, encompass these sectors, so a review of these targets offers a comprehensive reflection of Thailand's progress in these sectors.

2.2.4.1 Goal 1: Eradicate extreme poverty and hunger

Poverty is significantly linked to health through a household's ability to purchase inputs related to the production of good health. These inputs range from the food used to fulfill daily nutritional intake, to medical services and related medicines. Without a sufficient amount of each of these inputs, the poor become more vulnerable to fall into ill-health. People with insufficient incomes are also susceptible to the poverty cycle, which is perpetuated by poor health. This cycle was discussed in more detail in the subsequent sections discussing health-economic links.

Income inequality has been a persistent issue in Thailand. GDP growth and economic development observed in the early 1990s is primarily a reflection of the influx of new industries and businesses in Bangkok and other urban areas. Despite the constant and considerable growth in output, the main result was that the rich were becoming richer, while the poor fell into deeper poverty. Most rural residents did not benefit from the economic expansion. An overwhelming 86% of people living in poverty reside in rural areas (NESDB, 2004). Over half of the poor work as farmers, and almost 60% live in the northeastern region of the country. This regional inequality in terms of incomes earned is probably reflected in the provision of medical services and the number of medical personnel in each region.

With his first election in 1999, Prime Minister Thaksin Shinawatra set out to reduce poverty, as he had promised in his campaigns for Prime Minister. The manifestation of these proposals came in the forms of a Farmers' Debt Moratorium policy, the allocation of a 1,000,000 Village fund, and the creation of People's Bank for microfinance, as well as several other programs. These programs served as an important contribution to reducing the proportion of the population living below the poverty line. Thailand has already achieved the MDG target of halving the proportion of people living in extreme poverty between 1990 and 2015, as shown in Figure 2.8. The government has set the more stringent target of reducing poverty incidence below 4% by 2009. Despite the progress made, incomes of the poor make up a mere 4% of total income in Thailand, and the figure has remained unchanged over the past 10 years.

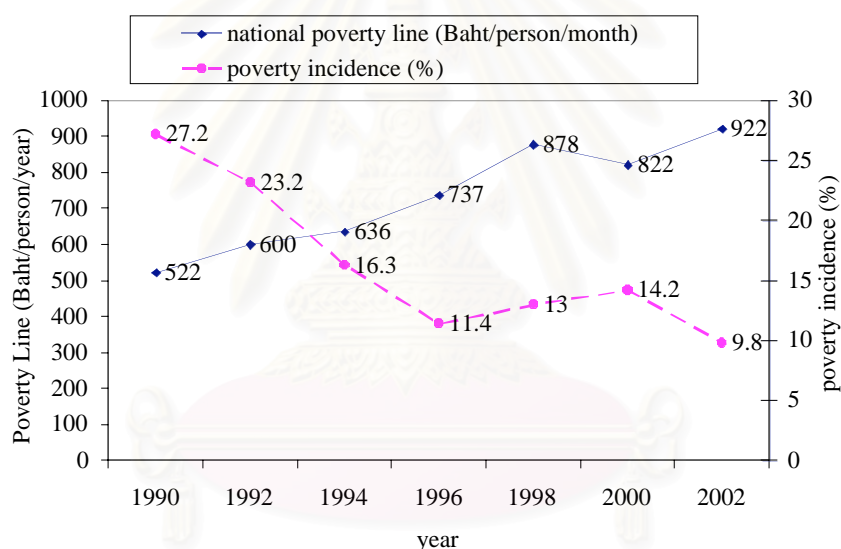


Figure 2.8. The poverty line and Poverty Incidence in Thailand, 1990-2002.

2.2.4.2 Goal 2: Achieve universal education

Education and health have an important interdependent and reciprocal connection that has long been noted by academics and policy-makers alike. Cooperation and collaboration between the education and health ministries is necessary to establish and maintain high quality training programs and institutions for the production of medical personnel, and scientists to perform research into new pharmaceutical products. These links relate to a higher education problem, not primary school. Most health programs for the prevention of infectious disease and promotion of healthy habits require education sessions or programs for the public to understand the dangers and to ensure proper practice of prevention measures. Educated individuals are more likely to assess their health status and

utilize health services in an appropriate amount and under necessary circumstances. In return, good health will not only improve attendance at school but also make students more productive while in school. A sick child who has or will miss a significant proportion of school is less motivated and has less energy to do his schoolwork, which will reduce his productivity in terms of his own education and knowledge. This will affect a person not only throughout his childhood, but even into his working years and beyond.

Thailand is well on its way to achieving the target of 100% primary school education of the whole population by 2015. Enrollment rates at present are over 90% and the literacy rate in Thailand is an impressive 95% (NESDB, 2004). Gross enrollment is often over 100% in primary education because some children's entries into school are delayed, for whatever reason. Because so much of cognitive learning occurs at a younger age, it is important then that students enter school close to those ages set by the government. Education reforms in Thailand were advanced by the Basic Minimum Needs (BMN) policy which emphasized the government's role in providing some standard of living to all Thai citizens. This approach was quickly followed by the proposal and implementation of the National Education Act, which has extended compulsory education from six years to nine years, and has increased scholarship money to college-bound students.

2.2.4.3 Goal 3: Promote gender equality and empower women

Women play a particularly important role in maintaining the good health of a household, especially with children. Beginning from the child's growth in the womb, a mother is responsible for the health of not only herself but also her unborn child. Poor health practices, from habitual alcohol or tobacco consumption, to poor dietary habits, can seriously affect the child's health and habits. Proper check-ups will also ensure the health of the mother and her child. Once the child is born, his mother traditionally cares for his health and hygiene, seeking out a physician only if necessary.

In some countries, gender equality is still an uphill battle. Women in some cultures are banned from work or education. In some societies, women are not allowed to leave their homes unless accompanied by her husband. This treatment of women is often affiliated with countries that have strong religious ties. In Thailand, Buddhist culture had some effects on the asymmetric treatment between genders. With significant expansion of education infrastructure and economic development, women have gained an increasingly important role in Thai society. Some continue to believe a woman's role is to be more submissive, but these people are certainly in the minority in Thailand.

Statistics confirm that the Thai government and society has made significant strides in gender equality. This is in view of the labor force participation among females. In addition, women become a rising proportion of the student population as children continue through the education system. While the ratio of girls to boys in primary school favors boys, by secondary school, girls slightly outnumber boys. At the tertiary level, the difference is even more staggering. The ratio of females to males in post-secondary school has risen over the past decade, to almost 1.15 girls for every boy (NESDB, 2004).

The empowerment of women has shown impressive progress in school and in the workplace, but in other settings, women are still viewed as inferior to men. Two emerging problems in gender equality are emerging in Thailand: domestic violence and rape. Both events have a significant bearing on health outcomes in a household. Rape, for example, can lead to unwanted pregnancy, in addition to significant physical and psychological problems. Domestic violence reinforces the idea that a woman is somehow of less value or worth than the men in the household. Without sufficient self-confidence, women are likely to reject seeking treatment when she becomes ill. Limited information is available in these areas, and many cases are likely to go unreported out of fear or ignorance. It is important that these issues are given close attention, not only for better health, but also for the improvement of the standard of living in Thailand.

2.2.4.4 Goal 7: Ensuring environmental sustainability

Protection of the environment is the final MDG target that has strong links with health. Environmental sustainability pertains not only to the surroundings, but also has a direct influence on individuals and their health. Air pollution is strongly linked to lung cancer and other breathing-related diseases. Clean water and appropriate sanitation practices will prevent the spread of disease. Large amounts of standing water and poor sanitation will accelerate the proliferation of infectious disease.

Thailand is close to achieving all MDG targets for environmental sustainability. The proportion of the population with access to safe drinking water and proper sanitation is almost 96% (NESDB, 2004), far above the MDG targets. The final step is to extend and improve access to piped tap water. More stringent laws on emission standards have helped to reduce pollution and disposal of hazardous or illegal waste. In addition, a heavy tax on the sale of motor vehicles, along with more attractive public transportation alternatives, has also helped to reduce the number of cars on the road and air pollution in Bangkok.

2.3 Links between Health and Economic Development

Academics and policy-makers have long known that an important connection exists between health and economic development. In the past, most attention was centered on the causality originated from progress of economic output and incomes. A productive economy will improve the standard of living and well-being in any country, including their health. In addition, heightened economic production means higher tax revenues, which could translate into more money available to government programs, including health policies. This understanding led most governments believed that social development would follow economic development, as occurred in man now highly developed countries after industrial revolutions. Within the last 50 years, however, academics have begun to recognize the important role that health plays in society, as human rights and establishing a standard of living began to take precedent over economic development. As the idea of human capital and the importance of health playing a central role, many leaders appreciate the significance of the role that health plays in economic development as well. Investments in improving health outcomes and other forms of human capital will promote further economic growth and development. One illustration that captures links between health, demographic, and economic factors is shown in Figure 2.9.

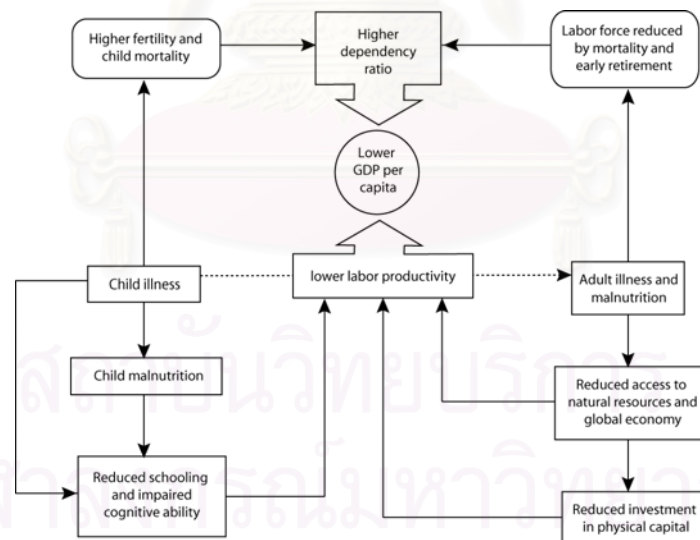


Figure 2.9. Links and interactions between health and economic output.

Health can influence economic growth and development through many channels. One of the most obvious of these channels is via changes in the size and efficiency of the labor force. Poor health patterns tend to indicate certain demographic trends and negative changes in health can initiate demographic transitions. Countries suffering from poor health show disproportionately heightened child mortality rates, while those that maintain low

mortality rates observe a majority of deaths in the elderly and rarely the young. Cross-country studies show that, in countries facing low mortality, less than 2% of the deaths occur in children under 5 years old, while another two-thirds of deaths occur in the elderly, aged over 75 years (Mosley and Cowley, 1991). High child mortality will encourage parents to have more children, to compensate for the possibility that one or more of their children will die from disease or malnutrition. As mortality rates fall, a steady but high fertility rate will increase the proportion of the children in the population. A rise in children, who are not capable of entering the work force, will raise the dependence ratio: while a decreasing proportion of the population is producing output, an increasing proportion is consuming it. In effect, the burden expressed through a rising dependency ratio will manifest itself in economic terms as lower per capita GDP.

Poor child health has significant negative consequences in and of itself, but the converse is also true. The improvement of child health has significant positive consequences, making the reduction of child mortality even more important. Reducing child mortality will eventually cause what is termed the demographic dividend (Bloom and Canning, 2000). Once child health begins to improve in the long-run, parents will accordingly choose to have fewer children. As mortality and fertility fall, so too will the dependency ratio, which subsequently increases GDP per capita. In addition to this effect, however, lower fertility means that population growth will slow and the bulk of the population will no longer be the children being born. Instead, those children born during times of high fertility will enter the labor force, further reducing the dependency ratio. As the bulk of the population ages into adulthood, the actual number of people entering the workforce will also grow considerably. This demographic transition explained a considerable proportion of the dramatic economic growth, dubbed the East Asian miracle, in the 1990s (Bloom *et. al.*, 2000; Collins *et. al.*, 1996).

High child mortality will lower parents' incentive to invest in their children, in terms of nutrition and education. If there is a good chance that the child will not survive to adulthood parents may choose to purchase goods for immediate consumption rather than invest in the possibility of their children's future. The effects of poor nutrition or education are likely to increase the probability of a child dying. For those children who survive into adulthood, studies have shown that their labor productivity is significantly lowered as a result of this low investment. Using height as an approximation for malnutrition, a 1% rise in one's height could explain as much as an 8% rise in wages, holding other factors equal (Strauss and Thomas, 1998).

Increasing child mortality can also affect decisions involving investments in social programs. For example, a government investment in the construction of a school is only worthwhile if there are enough students to utilize the facilities. To look at it in business terms, the returns on the construction of a school are higher when a large number of students attend and matriculate through the school. This can be achieved most effectively by ensuring that the children are healthy and safe. The denial on construction of a school has significant further repercussions on society in that labor productivity of the population will continue to fall. In agricultural societies, families tend to have a large number of children, in the hopes that they might assist on the farm, but the income received on a farmer's salary is insufficient to provide proper nutrition and protection of their children. This will reduce the state of child health and increase mortality. Many Asian countries including Thailand also tend to have several children to ensure that someone will take care of them in their old age. As a family grows in size, the financial burden of adequately fulfilling their needs will also grow. Family size, therefore, plays a significant role in the investments and thus the economy of a country.

Child mortality refers specifically to the health of one age cohort, while good health should reflect all age groups. Life expectancy also has a significant impact on economic progress, through its effects on consumer decisions and behavior. A person with a longer life is more motivated to invest in human capital. Investments in education prove to reap significant returns through higher wages, which exceed the cost of the original investment. If life expectancy is low, and an individual can expect to earn a sufficient wage for a relatively short time, then it may be more beneficial to enter the labor force at 15, and not to spend the time and money on additional education. Extended life expectancy, however, means that the returns on education or other investments in human capital are sustained over a longer period of time and make these investments much more attractive (Mushkin, 1967).

Once a person has entered the labor force, lengthened life expectancy can change the worker's decisions to spend or save money. If a person does not expect to live very long after his 40th or even 50th birthday, then his incentive to save for retirement is considerably low. Conversely, a longer life expectancy means a greater chance that the person will have time to enjoy his retirement and thus will have better incentive to save money for that time.

The effects of these improvements in health that increase the number and proportion of population participating in the workforce can be described as a direct rise in labor inputs. The economic impacts of these demographic affects are actually quite significant. As much as one-third to one-half of the rapid positive economic growth in East Asia was attributed to

demographic change (Bloom *et. al.*, 2000). However, health can also contribute to economic output through labor productivity, or human capital. Although this measure is slightly more difficult to measure than the size of the workforce, its impact cannot be ignored. Human capital usually refers to investments made specifically to improve labor productivity, usually through the expansion of education and health. Both types of health capital represent forms of consumption as well as investment. In the case of health spending, an individual may consider the purchase of a medication or even something as significant as a surgery may relieve pain or discomfort. The patient who purchases this treatment may view his spending as the fulfillment of personal consumption at the present. The lack of pain may also cause the person to be more productive in the workplace, and the early treatment of a health condition could extend the individual's life, therefore offering a more productive and longer-lasting contribution to the economy.

2.3.1 Human Capital

The benefits of investment in human capital have been well-established throughout literature and are becoming more widely accepted in society. In developed countries, the minimum education requirements demonstrate employers' views on the importance of schooling. A rapidly increasing number of studies attempt to strengthen the link between health and economic growth. A controlled experiment in Tanzania, for example, demonstrated that people in good health earned the highest wages, which serves as a direct reflection of their high productivity (Strauss and Thomas, 1998). Even businesses in the United States and other developed countries are placing more emphasis on ensuring the good health of their employees.

Many early studies of human capital and its impact on economic performance focus on the education of the population. Despite sharing the common heading of human capital, education and health are not synonymous. In fact, many studies have found the two to be complements: investment in one sector is made less effective if the other sector is denied a budget. Even health and education needs are served by separate government agencies, so there is no reason why their effects should be considered one and the same.

It is precisely this complementary nature of health and education that makes separate investments in each sector necessary. For example, the quality of physicians, nurses, and other health care professionals is dependent on the quality of education and training. In addition, many preventive and promotive health interventions include education of the public, so a strong education system is necessary to achieve success in these programs. For

instance, studies show that effective education of the population will decrease mortality levels by almost three times (Regidor *et. al.*, 2002). Education will also help people better analyze their own health circumstances and decide with confidence the level of urgency (Ensor and Cooper, 2004). A controlled study indicates that an educated mother is significantly more likely to seek immunization services for her child, clearly putting that child at a significant health advantage (Bishai *et. al.*, 2002).

Conversely, the benefits of proper schooling are utilized to their fullest when the students are in good health. Healthy students not only have better attendance but also demonstrate improved cognitive aptitude in the classroom. The mechanism through which life expectancy lowers the depreciation of investments in human capital, such as education, was also demonstrated. This complementary connection between health and education emphasizes the importance of cooperation and collaboration between the respective agencies in policy formation.

Improvements in health are not likely to affect *only* labor productivity or *only* the size of the workforce, but will probably have some effect on both factors. If the quantity of labor rises simultaneously with the rise in labor productivity, the heightened competition between workers will keep wages low. Low wages will likely attract foreign investment, which provides local business entrepreneurs an opportunity to open or expand their business. In either case, the injection of additional funds resulting from good health will have a significant positive effect on the economy. Conversely, poor health can detract foreign spending. Disease endemicity will isolate a country by making the country less appealing to tourism and trade. Two recent applicable and illustrative examples are the recent emergence of SARs and the avian flu in East and Southeast Asia. The onset of SARs, an unknown, airborne, contagious virus, deterred many tourists from traveling to this region. Prior to the discovery and understanding of this danger, this region was becoming increasingly popular with tourists; foreign tourists, in particular, contribute a significant proportion of the money in the tourism industry because of the difference in incomes and standards of living. With the appearance of this disease, many economies suffered from declines in tourists.

The causality between health and economics does not move in only one direction. A macroeconomic view of the interdependence between health and economic progress is shown in Figure 2.10 (CMH, 2001). This figure shows not only the mechanisms by which health influences economic development, but also outlines those channels through which

economic factors affect health. Health causes economic development primarily through two mechanisms: through the build-up of human and enterprise, or physical, capital. These forms of capital are complementary: workers with high levels of human capital will best utilize the physical capital available; while technologically advanced physical capital will make labor more productive (Sachs and Warner, 1997).

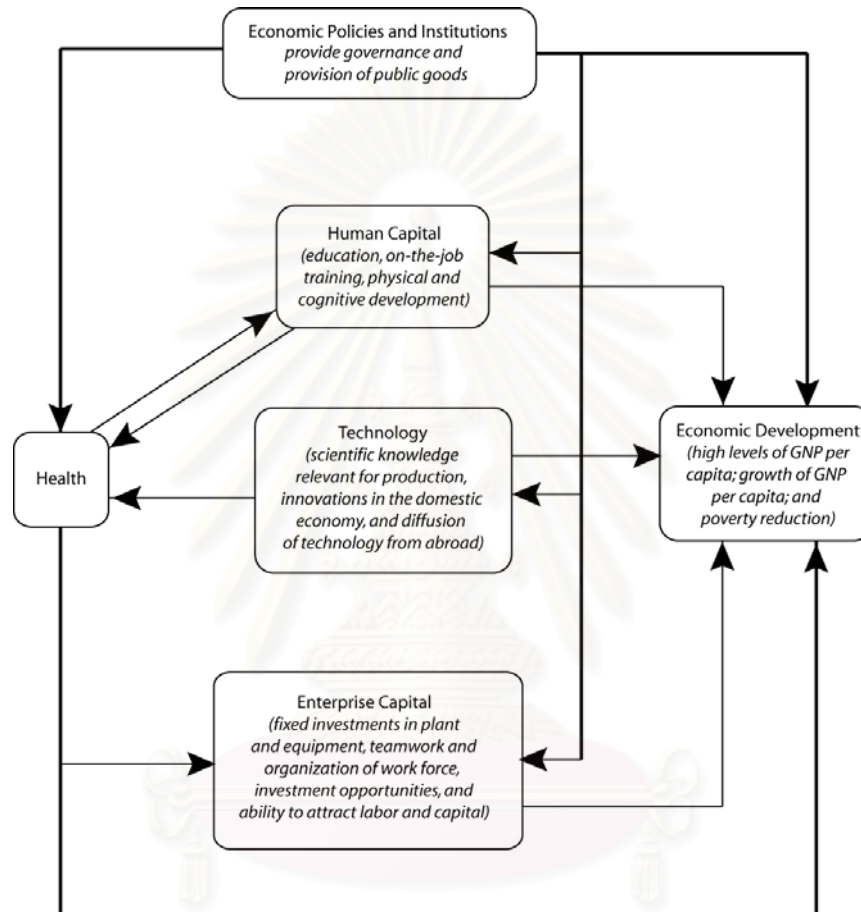


Figure 2.10. Macroeconomic view of health-economic links.

Human and enterprise capital, including health outcomes, are also related to technological innovation and advancement. Increasing investment in equipment can facilitate the more rapid development of new inventions and other technological discoveries. Human capital, specifically investments in education, will expand the knowledge base and continue the progress of technology. The emergence of technological advancements and innovations are directly related to both economic development and better health outcomes. Advancements in vaccines and medicines are important to the eradication and treatment of many diseases that were previously fatal. One widely accepted belief attributes most of the global improvements in health incomes as a result of new technological advancements in pharmaceuticals (Rifkin and Walt, 1986; Intarakumnerd *et.*

al., 2002; Jha and Lavery, 2004). Developments in technology will promote more economic development through the improvement of both labor and capital productivity and reducing the average costs of inputs.

Despite the fact that health and economic development are closely linked has been widely accepted, arguments refuting this evidence still exist. If the workforce is employed below capacity, for example, a sick individual may easily be replaced by someone who is unemployed, with little or no loss in productivity (Normand, 1998). However, health is not only important to the economic capacity of a person, but also as a measure of standard of living. As a human right and measure of well-being, governments should not *require* economic justification for such health investments. This divide has brought out two schools of thought. The social rights approach declares that everyone in society is entitled to equal access and opportunity to attain good health; and furthermore, it is the responsibility of society to take care of the poor and underprivileged, who do not recognize their own need for health care services. On the other hand, the economic approach requires some economic benefit or justification to invest in health, or any social program. Most low-income countries are not financially capable of implementing funds that both improve health and stimulate a poor-performing economy, so that government officials will carefully choose based on the most profitable benefits. It is important, then, to determine the optimal conditions under which improved health will stimulate economic performance.

With this understanding of the specific links and mechanisms that connect health and economic development, it is important to analyze how the effects of health are represented in theoretic and empirical models. Examining measures of health, and their links to economic productivity and development proven in other models, will build a better understanding of the rationale in deriving the empirical model utilized in this paper.

2.3.2 Health-Poverty Cycle

Any household struck by disease or poor health conditions incurs significant costs. The cost of diagnosis and treatment is the most obvious and can be quite serious. For some conditions, such as cancer, the cost of treatment is devastating. In addition to the direct financial burden, the household also loses any income that the sick individual may have earned working. In the case of a sick child, illness may cause him or her to fall behind in school or to leave school altogether. If the sick individual also earns the primary income for the household, then someone else in the household must find a job to cover not only the cost of treatment but also the lost income. It is not uncommon for children to be removed from

school or sacrifice their nutrition to pay for the medical costs (Sen, 1998). Because the poor suffer a higher probability of incurring costs through illness and missing work, employers also tend to avoid hiring people in low-income families (Strauss 1998), further exacerbating the situation for the poor. Whatever the reason, a child with low levels of education has significant effects on the health, productivity, and subsequently, income of the individual. Poor health and insufficient education will reduce the earning power of the worker.

The dramatic cost of treatment alone can initiate a vicious poverty cycle, illustrated in Figure 2.11 (Wagstaff, 2002). This cycle is exacerbated when the sick individual provides part or all of the household's income, by influencing the actions and consequences future generations. Poor health causes incomes to fall, due to the cost of treatment as well as the loss of income. Households who are near poor could fall into poverty, and those who are already poor are likely to fall into even deeper poverty. People living in poverty do not have the financial means to provide even the bare necessities. Proper nutrition, clothing, and medicine, which are generally considered necessities, are not affordable for the poor. Without these basic needs, however, poor individuals are even more likely to fall ill. The poor are also less likely to receive quality medical care, if they receive any medical attention at all. They are often excluded from insurance and their incapability to pay for their own treatment often discourages most poor households from seeking medical care. The under-utilization of health care services, combined with low buying power and poor hygienic practices will subsequently result in poor health and heightened probability of disease, thus perpetuating this vicious cycle, in which the poor will fall into deeper and deeper poverty.



Figure 2.11. Vicious Poverty Cycle.

Without external assistance, the poverty cycle will continue to reduce the health and standard of living of the poor, pulling them into deeper debt and poverty. Government or other intervention at any point in the cycle can instigate a virtuous cycle, which follows the reverse steps as described previously. If economic development can improve incomes of the poor, then food, clothing, medicine and clean water are more affordable. This will improve the health of the poor, which subsequently improves total labor productivity by decreasing the number of days they are sick and their productivity at work. Greater output per worker will yield a rise in wages, which will further improve health status, as the virtuous cycle persists. If economic outcomes cannot be changed, studies suggest that governments may find more success in implementing policies that improve health (Mayer, 2001). Better health will result in higher labor productivity, which will yield higher wages, perpetuating the same virtuous cycle. It is irrelevant whether the initiation of this cycle begins with economic development or improvement in health. With evidence that the poor tend to receive less of public health spending (Wagstaff, 2002), it is vital that whatever programs or interventions are instilled, they must be even more targeted to improve the status of the poor.

2.4 Application of Economic Theory to Health Care Development and Reform

Since the introduction of human capital as an input in economic production (Grossman, 1972), health has inherently been a vital, though sometimes neglected factor of economic growth and development. The importance of good medical services to relieve pain or discomfort is purchased for private consumption as well as an investment in labor productivity. More significantly, there is no substitute for medical care. If a person is sick or injured, a rise in food consumption alone is likely to substitute for the health care services required. If medical care services were completely unavailable in a country, then natural evolution would dictate the progress of health. Without treatments available to treat people who become ill, people who are sick will die, while those immune will survive and have offspring who have the same immunity.

2.4.1 Economic Theory and Insights on Health Policy Debates

Ever since the 1978 Alma Ata Declaration of Health for All, there have been conflicting views of how health care should be provided. At this WHO meeting, member countries drafted several proposals and ideologies to structure the path towards achieving these goals. The declaration states the need for urgent action by all governments, all health

and development workers, and the world community to protect and promote the health of all the people of the world (WHO, 1978). Closely following this announcement, several other academics voiced opposing opinions. Specifically, these experts claim that achieving the primary health care structure proposed in the Alma-Ata Declaration was too ideological and unrealistic, particularly for poor and undeveloped countries. To propose more realistic and effective goals, this group suggested the use of cost-effectiveness analysis, which may be used to identify those programs that will provide the greatest improvement in health at the lowest cost. Since then, many experts have debated the issue, appointing to each perspective different forms and titles; but essentially, every school of thought falls into one of these two camps.

The concept of comprehensive primary health care was born in 1978, at an International Conference of the World Health Organization in Alma-Ata, USSR. This document (available in Appendix D) charges all governments with a responsibility for the health of their people which can be fulfilled only by the provision of adequate health and social measures. A main social target of governments, international organizations and the whole world community in the coming decades should be the attainment by all peoples of the world by the year 2000 of a level of health that will permit them to lead a socially and economically productive life. Primary health care is the key to attaining this target as part of development in the spirit of justice (Article V, WHO 1978). The definition of primary health care is broad, including all aspects and levels of health and well-being.

The following year, Walsh and Warren pointed out that the Health for All goal, though admirable, is neither realistic nor attainable with the resources available. Instead, the authors suggest that policy-makers prioritize, specifically by utilizing cost-effectiveness analysis. In other words, define those diseases or health issues that have the highest levels of incidence; and find the lowest cost treatment that will cure the disease. Those treatments that result in the most deaths averted or the lowest morbidity define the interventions that governments should utilize. The publication of this article led to a significant amount of controversy. Defenders of the WHO proposal cited the fact that selective primary health care neglects several aspects of health and well-being. Often those developing countries which Walsh and Warren argue should utilize cost-effectiveness analysis do not have the resources or the expertise to accurately and effectively evaluate all available interventions, their cost, and their effects in addition to the cost of implementation itself.

Some experts use the terms economic versus social rights approaches to health policy (Gauri, 2004). The social rights approach mirrors views and goals set forth in the

Alma-Ata Declaration, while the economic approach is an extension of the prioritization argument. In addition to choosing the most cost-effective programs, the economics approach also entails proving the economic benefits of such health policies, either through improvements in labor productivity or a larger labor force. An important difference between the two approaches is that the social rights approach accounts for those people who do not recognize their need for medical attention, and hold society responsible for ensuring these individuals receive the care that they need. Regardless of the evolution of titles, the underlying philosophy of each view on policy-making remains constant. To determine the more effective approach to policy decision-making, it may be helpful and interesting to take note of the insights that economic theory will provide.

Throughout the 1980s and 1990s, however, the concept of cost-effectiveness analysis grew in popularity. Many physicians and policy-makers realized that comprehensive care was not within the scope of government budgets of most developing countries. Prioritization was a way to ensure that the most effective and extensive programs were financed (Bissell, 1995; Wikler, 2003). Even the World Bank recommended the use of cost-effectiveness analysis as an essential strategy in determining the essential package of services each government should provide for its citizens (World Bank, 1993). Prioritization and cost-effectiveness analysis are useful tools used to identify policy areas and groups that governments should target, but many countries lack adequate and appropriate data to conduct such evaluations. In developing countries, the disparity between the poor and wealthy is usually quite wide, so that health goals that specifically target the poor should be more useful than sector-wide reforms offered to the whole population. As this fact was more widely recognized, the focus of health policy shifted away from cost-effective treatments, to those programs and treatments that would specifically target the poor.

In September 2000, the United Nations Assembly put forth the Millennium Development Goals, a collective agreement by all members to eradicate poverty, reduce inequity, and improve the standard of living for under-developed countries throughout the world. The ideals of these goals in many ways mimic the Alma Ata Declaration, which differs only in its specificity to health. Goals of improving equity and equality within and across countries worldwide mean that these governments should shift focus away from economic benefits of social programs and seek out programs that will specifically target people living in poverty. Previous studies have noted that goals support programs that are in direct conflict with prior programs implemented by international organizations offering

financial assistance, such as the World Bank and the International Monetary Fund (Sen and Koivusalo, 1998).

2.4.1.1 Demand for Health Services

In 1972, Michael Grossman presented one of the first and most prominent models of the demand for medical care (Grossman, 1972). According to his model, every individual has a stock of health capital, which is used to produce the output of healthy outcomes. Like any other form of capital, health capital will depreciate at some given rate. Individuals must maintain their health capital stock, to remain a productive participant in the workforce or in the household. Maintenance usually refers to the purchase of medicine, doctors' visits, as well as healthy living and eating habits. According to this structure, then, the demand for medical services is not based on one's *need* but rather based on a number of other factors that affect the demand for other goods and the rate of depreciation of one's health stock. Grossman uses this model to make several predictions regarding consumer behavior with respect to medical care services.

The first prediction relates health to life cycle spending and saving behaviors. Specifically, the model predicts that, after a certain age, medical expenditures will increase with age. In addition, an individual's demand for health care services will rise with income. In this case, health care services are similar to and must compete with other normal consumption goods. Conversely, then, people with lower incomes will purchase fewer medical services, *regardless of their need* for such services. This result seems to suggest that an individual's demand is not necessarily related to his need, but more so to his income, age and other factors. This prediction may seem to suggest that the government should invest in reducing the price of medical services or increasing private incomes. On the other hand, if incomes are too high, people may purchase health care services superfluously.

The Grossman model also offers some insights on the effects of education. Assuming that a better education will result in more efficient production of health, people who are highly educated will demand a higher health stock. This seems to reinforce previous claims of the complementary nature between health and education (Mushkin, 1962; Sachs and Warner, 1997). Well-educated consumers are more aware of their health, the importance of health, and are able to assess their health situations more accurately. Educated individuals are also more likely to be aware of dangers and potential disease outbreaks that may occur in the community.

Wagstaff offers an extension of the Grossman Model and several additional insights on the potential effects of health policy (Wagstaff, 1986). Using Grossman's idea of health as a stock of capital used to produce health outcomes, Wagstaff presents a graphical model (explained in detail in Appendix E) that is less technical and thus more accessible to policy-makers. According to his four-quadrant model, consumers choose between investment in health and consumption of other goods and services. Like the more mathematical Grossman Model, this model also predicts that increasing income will improve health status. More specifically, this design suggests that there is a point at which consumers will observe the effects of diminishing marginal returns on the production of health outcomes. This fact promotes narrowing the focus to the poor, who are unable to afford the medical care that they need.

In addition, the model shows that improvements in treatments and technology will yield more efficient production of health outcomes. In other words, fewer resources are needed to achieve a better level of health. This conclusion is consistent with arguments that progress in worldwide health has come from technological advancements rather than from improvements in economic or social development policy (Rifkin and Walt, 1986; Jha *et al.*, 2004). The conclusion that policy should promote further research and development of new medical technology seems to contradict most prioritization arguments. Although this investment is invaluable to the country, it is certainly not the most cost-effective way to spend government funds on health.

Another expansion on this model offers a general equilibrium analysis of the consumer's decision, assuming that consumers do not directly receive utility from any goods but instead gain utility by producing other goods and services with their purchases. This model, addressed in full in Appendix F, presents the consumer with four allocation decisions, which will be determined simultaneously: (1) the labor-leisure decision; (2) production of health and other goods; (3) purchases of inputs to produce health and other goods; and (4) health investment in the long-term (Goodman *et al.*, 1999). Working will produce income, used to purchase inputs that are used to produce either health or home goods. It is the production of health and home goods, and not their inputs, that consumers receive utility. This model further extends on Grossman's model with its income effects. According to this design, an increase in income will yield a more than proportional rise in the production of health. This fact reinforces the idea that health policy should focus on the poor.

The Grossman model and its extensions suggest that raising income and lowering the price of medical care are the most effective forms of health policy. These theories do not offer direct evidence or conclusion regarding the comprehensive versus selective primary health care debate, but one inference that can be drawn is that increasing the incomes of the poor will improve their health and welfare.

In these demand for health models, purchase of medical care is considered an investment, which people purchase to increase their health stock. Sometimes consumers will purchase treatments for disease or discomfort to fulfill their own personal interest, which means medical services are considered consumptions and not investments. Paglin addresses the issue of health care spending as a consumption good, which people purchase to better their quality of life (Paglin, 1977). This model is described in full in Appendix G. There is the careful identification of the interactions between health services and other consumption goods: they not only compete with health care services, but some goods like food can contribute to improving health outcomes. In this model, a given level of life expectancy will determine the production possibilities frontier at which society will produce. This frontier serves as the constraint on total consumption. The society will maximize its collective utility, with respect to this production possibilities frontier.

Several conclusions and predictions can be drawn from this representation of the demand for medical care services. The first prediction is quite obvious: an increase in life expectancy, will expand the production capacity of the economy, even if physical capital stock is left unchanged. Promotion of health care coverage or provision, then, should improve economic production, although the model does not delineate the difference between providing comprehensive or selective primary care. The model also shows that the level of services actually purchased is likely to fall below the level required to achieve optimal health if medical services are offered at cost. This problem is rooted in the presence of externalities and public goods, which cause consumers to neglect these effects into their purchase decision. The model also predicts if general consumption falls too far, the productivity of labor will suffer, thus *retracting* the production possibilities frontier.

The demand for health itself is immeasurable but may be revealed through the demand for medical care services. Grossman, Wagstaff, and Goodman, *et. al.*, predict consume behaviors with regards to their investment in improving their health stock. Paglin, on the other hand, addresses health as a consumption good that people purchase to relieve pain and discomfort. Some predictions are consistent, in terms of the effects of the price of medical services. In other respects, each model offers a slightly different insight on

consumer behavior with regards to health care. No model described here offers a conclusion regarding the comprehensive and selective care debate. Because health care is both a consumption and investment purchase, any conclusion is not guaranteed to be in accord with the actual consumer reactions and behaviors.

2.4.1.2 Elasticity of Demand

Factors determining the demand for health care services are important but not sufficient in the implementation of effective health policy. The importance of demand and income elasticity can affect the success or failure of certain health care policies. An illustrative example is provided in Figure 2.12 (Hammer and Berman, 1995). The government faces a choice between two interventions, *I* (green) and *2* (blue). In the free market, both programs are provided in the same amounts of x and at a price of p . Clearly, intervention *I* displays a more elastic demand curve. This means that lowering the price will yield a much higher quantity demanded, while raising the price will cause a large number of purchasers to drop out of the market. If the efficacy and results of the interventions are similar, then a government subsidy on program *I* will attract a significantly larger number of people to benefit from the intervention. Therefore, if the cost-effectiveness ratios of each of the two programs are similar, it seems clear that subsidizing policy *I* will affect a larger population and is more effective. If, however, intervention *I* results in a slight improvement quality of life, while policy *2* is a life-saving procedure, then the decision is much more difficult. Although the same amount of money will affect fewer people, intervention *2* has a more profound effect, so that some policy-makers will deem this intervention a better investment of funds.

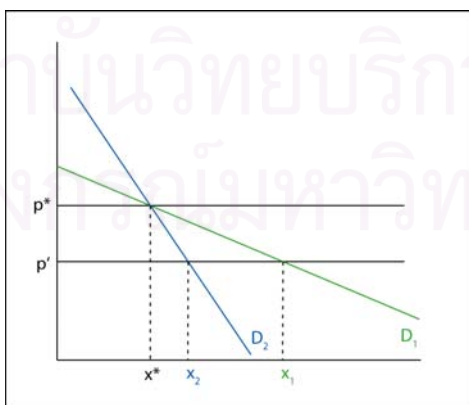


Figure 2.12. Effects of elasticity on Subsidization practices.

The previous example shows that elasticity can determine the extent of utilization and success of subsidization practices by the government. One possible alternative to

subsidies is to offer complete government provision of medical services. Even if the government opts to offer full provision of certain services, knowledge of demand elasticity is still vital to understanding and predicting success or failure of a program. Figure 2.13 illustrates why demand elasticity is important to the implementation of successful health programs. Free market allocations will produce q^* amount of services provided at a price of p^* . If the government provides n services, the supply curve will shift by this amount, but the total service produced is not simply the sum q^*+n . With the entry of government provision, many private providers will no longer find this market profitable, and exit the market. This behavior will continue until the market has equilibrated at q' , considerable lower than the original target of q^*+n . Even if the government chooses to eliminate private hospitals and offer free government provision in an effort to equate supply with need for health services, consumers will not utilize services beyond q_{max} . Spending funds to extend provision beyond this point would be a poor allocation of scarce resources.

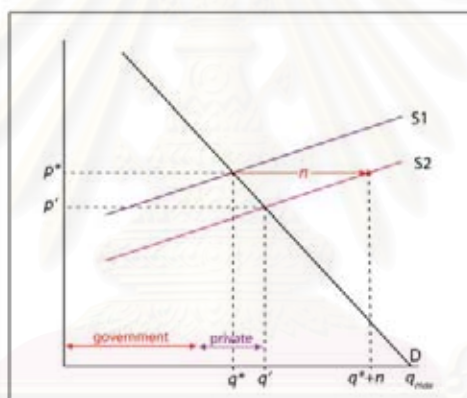


Figure 2.13. Effects of Elasticity of Demand on Public Provision

2.4.1.3 Demand versus Supply versus Need for Health Care

Economic theory states that the free market provision of goods will equilibrate at some level where both supply and demand are met at the same price and quantity. Free market allocation of medical care, however, does not account for asymmetric information issues unique to this sector. Figure 2.14 depicts the problem manifest from asymmetric information: supply may equal demand, but neither reflects the *need* for health care services. Illnesses like malaria, for example, may show cold-like symptoms and could easily be mistaken for the flu or common cold if not diagnosed by a medical care professional. In addition, the model presented here accounts for other forms of asymmetric information; more specifically, the effects of externalities and public goods, as well as adverse selection and moral hazard, are addressed in this model (Musgrove, 1995).

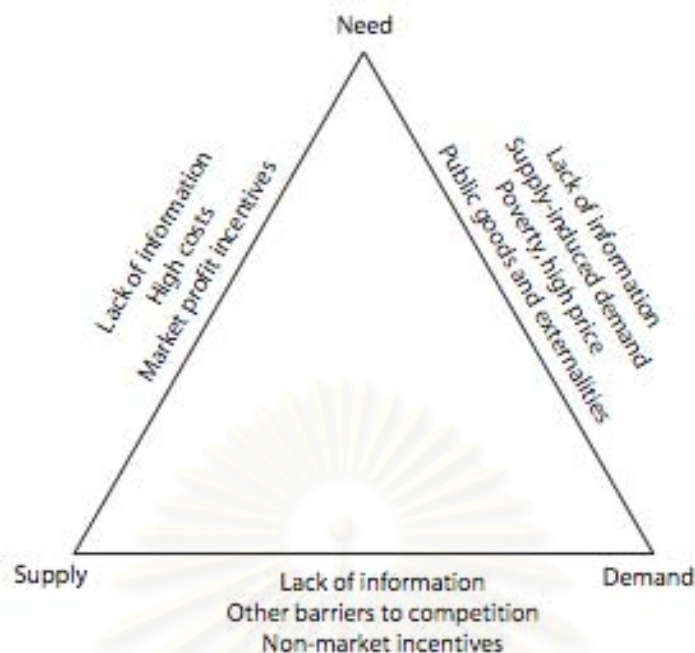


Figure 2.14. Imbalance between Supply, Demand, and Need for Health Services.

Most economy theory suggests that the best way to reduce the problems that arise from asymmetric information is to impose government intervention or regulation. This model cautions the conversion to complete government provision, as doing so may induce non-market incentives. For instance, health care workers in China had little or not motivation to provide preventive or education services, because they received compensation only for the provision of curative services (Sheng-lan and Sing-yuan, 1996). Providing preventive care for free was not an attractive option when, if the person actually became sick, the health care worker would receive payment for his work.

This model does not offer a clear-cut answer to the question of how health care should be provided and who is responsible for the provision and costs of medical care. In the complete absence of government intervention, supply of services falls far short of the health needs of the population. Under complete government provision, however, the quality and efficiency of service are likely compromised. People may not suffer in their pocketbooks, but may suffer in other ways, such as long waiting times, instead. Policy makers must establish an appropriate balance, ensuring the quality and efficiency of competitive markets and the guarantee to fulfill health needs under government provision.

2.4.2 Econometric Studies and Empirical Evidence

Econometric studies on health view several aspects of health and its economic consequences. Different studies address these effects using different methodologies, each

presenting different insights as well as obstacles. To design an appropriate and descriptive econometric model, it is necessary to examine various econometric studies of health and the extent of their success in identifying links between health and economic performance. It is useful and insightful to discuss the design and findings of previous studies and how these studies may offer influence methodological and design considerations for the model structure presented in this paper.

Most econometric studies are identified as microeconomic or macroeconomic studies. Several features distinguish the two, the most obvious of which is the unit of observation used in each investigation. Microeconomic studies focus on individual decisions and behaviors. In macroeconomic studies, the unit of observation is usually a state, province, region or country. Some macroeconomic studies will use one particular country as a case study, using time-series data. Others are single-period studies that compare differences across countries, and still others use panel data, taking cross-country samples over several periods of time. Each study reflects a different aspect of health and its association with economic output and productivity. It is therefore important to address both microeconomic and macroeconomic studies of health. Although the model presented in this paper is a macroeconomic simulation of the Thai economy, conclusions and insights from both macroeconomic and microeconomic studies are useful to the structure and prediction of the effects of variables included in this model.

2.4.2.1 Microeconomic Studies

Most microeconomic studies predict individual behavior and reaction to certain exogenous events, based on their preferences and tastes. Most microeconomic studies involving health fall into one of two categories. Many studies estimate derived demand for medical care, using the Grossman's Model (Muurinen, 1982; Wagstaff, 1986). By addressing the demand for medical services, these analyses are able to assist policy-makers in identifying the areas and groups that would benefit most from government subsidization or provision. This model, described in Appendix H, describes the individual's desire to invest in his health stock. This health stock depreciates at some rate; leaving individual's responsible for the continual maintenance of his stock. The model specifies the demand of health care services as a result of the health stock allotted to each person and the natural rate of depreciation of their health, in addition to one's desire to maintain a certain level in their stock of health.

Micro econometric studies that do not address the Grossman Model address the theorized link between health status and labor productivity. Labor productivity can be measured in many ways: older studies measured agricultural productivity in terms of output per hour or per worker (Sahn and Alderman, 1988; Strauss, 1986). Estimates of agricultural output and wage in Southern India, for example, are shown to be quite responsive to changes in health, measured as weight-for height (Deolalikar, 1988). Later studies extended this theory to include workers in other economic sectors, hypothesizing that hourly wage rates should also reflect changes in worker productivity. Specifically, if two identical workers differ only in their level of productivity, the more productive laborer should earn a higher wage (Lee, 1982). One study of Brazilian workers used height as a proxy for child health and nutrition and found that a 1-centimeter rise in one's height will yield an increase in income by as much as 8-10% (Schultz, 1994). Regardless of the methodology and measures of health and output, all studies demonstrated negative effects of poor health on worker output.

2.4.2.2 Macroeconomic Studies

At the country-level changes in health are less defined. When average health outcomes improve, it is unclear whether these changes occur equally across the whole population or if one particular group is affected more than another. In addition, if the health of one individual improves, while another person's health deteriorates, the combination or average of their health may be viewed as two individuals of normal health, which is *not* an accurate depiction of the economy. The ambiguity of these measures tends to exclude estimates of health against wage that are measured at the microeconomic level.

Microeconomic studies are useful to study the effects of an individual's health on personal and household well-being. Although these studies can be scaled to estimate or predict effects at the country level, they may fail to capture certain effects that can be revealed only in a macroeconomic study. Specifically, the purchase of public goods and externalities cannot be addressed in microeconomic studies. This is particularly important in addressing preventive services, such as the distribution of treated bed nets to prevent malaria, screenings for tuberculosis, or immunizations against various diseases. These types of study are more useful to policy-making officials in that they reflect the response of the whole population, as opposed to one individual.

These investigations of aggregate health outcomes and economic performance are most easily divided into two groups. The first group tends to measure economic output

based on the Solow Growth Model. In its original form, the Solow Model did not separate human capital as an independent factor of growth. In practice, then, econometric studies tended to include the effects of human capital with those of total factor productivity (TFP). By modifying the production function to include human capital, Mankiw, *et. al.* described a new version of the model (explained in Appendix I), which demonstrated that the addition of human capital will explain an additional 30% of cross-country variation in income per capita (Mankiw *et.al.*, 1992). Another test of this model finds a robust correlation between life expectancy and income per capita (Knowles and Owen, 1995). One study conducted by the Asian Development Bank determined that the main factors that influence the rate of change of the steady state output level in a country include schooling, natural resource abundance, government savings, trade policy, quality of institutions, and geography (Bloom and Malaney, 1998). Econometric studies have shown that health influences differences in income, as well as changes in socioeconomic indicators such as fertility, education, female labor participation rates, and wages. Various studies using different measures of health and different methodologies estimate the effect of health on output growth. Some studies claim smaller impacts; for example, a five year difference in life expectancy can lead to an additional 0.5% growth per annum (Bloom *et. al.*, 2000). Other studies do not follow the format of the Solow Model, but estimate health effects using some other modified production function (Sachs and Warner, 1997; Bloom, *et. al.*, 2004). Adjusting for country-specific levels of total factor productivity shows that one additional year of life expectancy will raise output growth by 4% (Sachs and Warner, 1997). It is unclear the magnitude of health impacts on economic growth, but the many studies have strengthened growing confidence in the connection.

Production function estimations reveal important relations between health outcomes and economic growth, but these studies do not address the possibility that income levels can channel back to improve health outcomes. Another division of macroeconomic study uses simultaneous equations to address this interdependence between health and economic growth. One study utilizes the natural phenomenon of the mortality crisis in Russia that resulted from the fall of Communism to study the interactive effects of health and economic growth. The study revealed that per capita growth slowed by approximately 0.3% per year because of the sudden death of some 1.3-3.1 million Russians from 1990-1995 (Bloom and Malaney 1998). Using panel data, Bhargava *et. al.*, demonstrate the significant positive effect of good health on economic growth (Bhargava *et. al.*, 2001). This interdependence

seems to promote the further improvement of health outcomes, instigating a virtuous cycle to pull people out of poverty status.

2.4.3 Barriers to Effective Policy Implementation

Even the most effective and accurate tests cannot completely predict the response to any particular chosen intervention. Many potential barriers can hinder or lessen the effects of government programs in prevention, promotion, and provision of health. Barriers exist at all levels of provision, from consumer and household behavior, to political and economic environment. All factors play a vital role in the implementation of effective health policy and must be considered to successfully target and reach those areas and groups that are most in need of health care services.

Financial constraints are the most obvious and central concern for most policy-makers. With extremely limited budgets, many governments are left with very little flexibility in the implementation of programs. In low-income countries, public health expenditures contribute approximately 1% of GDP (Lafond, 1995). With such limited resources, poverty reduction programs are likely to reach very few people, in view of the poor financial circumstances of the economy and the government. Many health ministries seek financial assistance from international organizations and donors. Donors are able to provide significant grants or loans, but most grants are accompanied by further conditions. Most organizations or countries that donate money to a health ministry require rapid and clear results within a relatively short period of two or three years (Lafond, 1995). These types of conditions discourage long-term investments and reforms, and instead tend towards the implementation of vertical programs, which focus on disease prevention or eradication programs. In addition, money is provided for only a few years; long-term or permanent projects, however, require constant and consistent budgets to continue operation. This means that funds after the conclusion of the grant will have to be found within government budget. It is difficult to implement programs that will have a lasting effect on health outcomes, if the sustainability of the program is in question. Donors lift the burden of financial restriction from health ministries, but replace it with other constraints as to how the money can be spent.

Poor economic performance and other financial restraints has several negative effects on the provision of health services, in particular a lack of technological capability. Pharmaceutical innovation and technology have been widely noted as one of the leading factors influencing the advancement in health outcomes and health status worldwide. Many

experts believe that health improvements observed in developing countries can be attributed to technology, primarily through the progress in vaccines (Rifkin and Walt, 1986; Intarakumnerd *et. al.* 2002; Jha *et. al.*, 2004). Because of their deep financial resources, wealthy nations tend to develop most advances in medical technology, and these innovations tend to focus on the needs of people in these more developed countries. Studies of current investments into research and development of medicines and health-related products show that only 10% of the world's health research resources go toward the research of 90% of the diseases the burden the poorest countries (Jha *et. al.*, 2004).

Malaria is a noted example of neglected disease burdening underdeveloped countries. In the past, malaria presented a significant disease burden across the world, which led to considerable research and development in methods of prevention and treatment. These treatments, along with the preferable climate conditions, eliminated malaria in most wealthy and developed region. Tropical weather will promote the growth and spread of malaria. Warm weather allows the malaria vector to grow more rapidly (Sachs and Malaney, 2002). In addition, without a cold winter, mosquitoes that serve as the vector host, live longer live, which only promotes the disease to extend to even further reaches. Malaria prevention entails the use of mosquito-nets and the spraying of pesticides. In addition, treatments for the disease are still readily available. Repeated infection can promote mutation to a form that is less responsive to the treatments available. Most highly developed countries show little interest in the control and eventual eradication of this disease, which is revealed by the increasing impacts of the disease. Studies show that in 2004, several years after the initiation of a 'Roll Back Malaria' campaign to draw more attention to the prevalence and effects of the disease, the number of deaths due to malaria are even higher than in 1998 (Yanney, 2004).

HIV/AIDS is another widely recognized disease, but neglected disease in the realm of research and development. When the HIV virus was initially isolated and understood in the more developed countries like the United States, many scientists worked to find a cure or some form of treatment for the devastating disease. The research uncovered most of the anti-retrovirals currently on the market. During this time, many laboratories established quite an elaborate base of research on the development of a vaccine for HIV/AIDS. As education and prevention programs spread throughout the world and the general public acquired a better understanding of the disease and how it is contracted, the spread of HIV/AIDS began to fall in most high-income countries. This reduced research into an HIV vaccine from the top priority, to an unprofitable investment. The people who will benefit

from the discovery of an HIV vaccine predominantly reside in low and middle-income countries, which have neither the resources nor the knowledge base to conduct the research themselves. Most of these people do not have the financial means to purchase the vaccine at a market price that covers the industry's costs. The potential loss of profit in this investment, then, deters most pharmaceutical companies from research in this area. Experts believe that a vaccine for HIV can be achieved within the next 7-10 years (Makgoba *et. al.*, 2002), but this goal cannot be realized with cooperation between wealthy pharmaceutical companies and the rich and poor countries that will benefit from the treatment. If the health of people in low-income countries is truly to improve, the commitment must include not only local governments, but also the pharmaceutical companies and researchers who will help investigate technologies that can be applied to low-income countries' situation.

Execution of health policy and health care reforms is not only hindered by supply-side barriers. The behavior and response of consumers to various policy decisions can have a significant effect on the success or failure of health policy. Travel time and inconvenience is an important barrier for many consumers, particularly in the provision of preventive and promotive services. If people do not recognize an improvement in their well-being from receiving such services, even the smallest inconvenience will cause people to choose to allocate their time to some other activity, instead. This will reduce the effects of positive externalities on society. Demand for health services may also be influenced by community or social factors. Societal norms and cultures may foster accepted or assumed roles for people within a household. For example, many societies viewed a woman's role as purely domestic at some point in their history, and in some places, this attitude persists even at present. With close ties between education and the utilization of health services, a society in which women are not educated is likely to suffer poor health consequences due to underutilization. Even under full comprehensive provision of health care services, health is likely to suffer because some people are unaware of the need for medical services.

The political environment and commitment can play a significant role in the success or failure of health care reform. Most health policy proposals originate from health ministry or related officials. Cooperation and collaboration among different sectors and areas is necessary for the successful implementation of a comprehensive health care reform program. In China, political commitment was the driving force behind initiatives in rural health in the 1950s-1970s, which caused improvements in health status, despite the country's slow growth and low incomes (Sheng-lan and Sing-yuan, 1996). In Brazil, the fall of military rule in the 1980s resulted in a new emphasis and focus on universal access to

health care services (Collins *et. al.*, 2000). Determined efforts on the part of the government will promote the better health, but political environment can also hinder the realization of health and health care reform. Vietnamese children were shown to suffer from poor nutrition and health status during the period of war and political unrest in the 1970s (Strauss, 1998). After the fall of communism in the Soviet Union, health services were considerably less accessible. Investments in human capital, which includes the provision of health care services, shifted to physical capital instead. For instance, emergency response times in Russia had slowed from a few minutes, to several hours, because many ambulances were used as taxi-cabs (Bloom and Malaney, 1998). The poor provision and accessibility of health care services may help explain the mortality crisis that Russia suffered in the 1990s.

2.4.4 Goals of Health Care Reform and Strategies for Health Policy

Successful implementation of health policy and reforms requires clear and definite goals. The government can set several different goals depending on how changes in population health are measured. Hammer and Berman identify three goals of health care reform: (1) to improve the aggregate health status of health outcomes; (2) to reduce or prevent poverty incidence and poverty traps; and (3) to maximize consumer welfare, measured in the economics sense (Hammer and Berman, 1995). Achieving the Alma-Ata Declaration and Millennium Development Goals (MDGs) sets health equity as the focus, which falls under the second goal of reducing and preventing poverty. During the era of cost-effectiveness, however, most governments measured health in terms of aggregate health, as described in the first goal. Finally, economists might suggest that health insurance should be offered at actuarially fair rates, to cover the largest number of people, thus maximizing consumer welfare as defined in the third goal.

To consider these factors in another way, Rifkin offers several important issues to consider in setting goals for health policy. These factors are: (1) the definition of health; (2) the importance of equity and reduction of poverty; (3) the importance and interaction with other sectors; and (4) the role of community participation. Cost-effectiveness evaluation tends to view health as the absence of disease, thus focusing solely on the health care sector. This method of prioritization does not focus on improving the poor, unlike the Alma-Ata Declaration or the Millennium Development Goals. Most recently, governments tend to focus on equality in health, both within and across countries and regions, which requires the implementation of programs that specifically target the poor. In fact, a study of national

health accounts in developing countries showed that the most spending on coverage or health insurance provides services to the wealthy, not the poor (Musgrove *et. al.*, 2002). Sen points out that, because of the unpredictable nature of health and disease, equity in health is very difficult to define (Sen, 2001). In general, though, health equity is achieved if the poor and disadvantaged have equal access to and financing of health care services. It is important to focus and maintain these clear goals to produce and implement effective and beneficial health policy.

As the general focus of health reforms shifts to helping the poor, many experts have varying strategies to successful policy implementation. Some suggest that the government's primary role is to reduce inequalities in knowledge and information available to the public (Bloom, 2001). In other cases, experts claim that it is important to focus on the disease prevention and health promotion, which will foster healthier lives and reduce the need for medical care in the long-term. According to this group, successful policy implementation requires that governments pursue a human-centered approach (Pappas and Moss, 2001). Other country studies suggest focusing on the local infrastructure by building village health stations to provide some basic package of health services (Sheng-lan and Sing-yuan, 1996). Some experts propose that reducing debt will help make additional funds available to the improvement of health care policies and programs (Gwatkin, 2001).

Regardless of the kind of reform, it is important to observe current consumer behavior and predict their reactions to the implementation of various policies to determine the most appropriate approach to health care reform. This model works to provide the basis from which policy-makers can make such predictions and prepare for any potential obstacles toward the successful completion of a health care program.

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CHAPTER III METHODOLOGY

3 Introduction

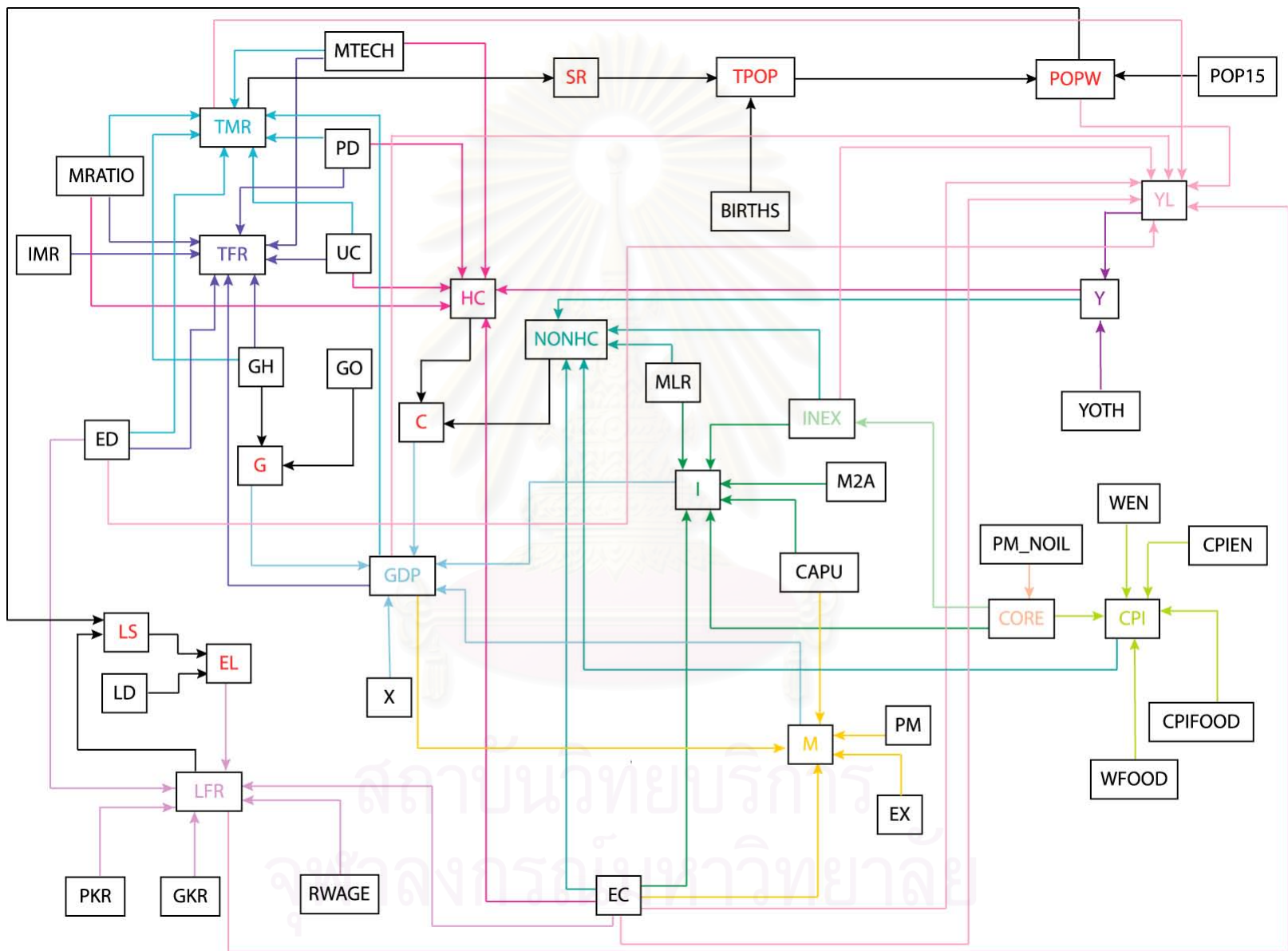
This paper presents a statistical model of Thailand's economy, including those important links between health and economic growth. The structure of the model is such that policy-makers can predict the outcomes of various development policies. More specifically, this model will test the effects of the universal coverage scheme (UCS), implemented by the Thai government in 2001. The design and structure of the model is based on previous theoretical and empirical findings in Thailand and other developing countries. Many of the equations estimated are extensions or adaptations of prior publications, most notably the UNDP's *Demographic-Economic Model for Thailand* (UNESCAP, 1988) as well as economic models published by the Bank of Thailand.

The model consists of ten estimated equations and another ten identity equations. Twenty endogenous variables, twenty-five exogenous variables, and several lagged endogenous variables will be described in the following discussion. A complete overview of the equations is listed in Appendix K. The links between variables are given in Figure 3.1. Endogenously determined variables are highlighted in color, while exogenous variables are in black.

To run the model, one must first examine the relationships and the number of exogenous and endogenous variables, relative to the number of equations to be estimated. A brief examination of the rank and order show that the system is over-identified, which makes the use of two-staged least squares the most beneficial method of estimation. Once the model is established, policy makers can predict health and economic outcomes under different circumstances based on the estimates in the model.

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Figure 3.1. Conceptual Diagram of Links between Variables



3.1 Demographic Sub-Model

The first part of this model describes the aggregate health of the Thai population. By identifying the main factors that determine the health and structure of the population, this sub-model will relate these health factors to the population and size of the workforce. A large labor force should increase competition and reduce wages, which should also raise economic production. In fact, several income accounting studies show that a rise in the size of the workforce explain one-third to one-half of the dramatic economic growth observed in East and Southeast Asia throughout the late 1980s and early 1990s (Collins *et. al.*, 1996). There are two ways to increase the population: either to raise fertility or lower mortality in the society.

A rise in fertility will temporarily cause the dependent younger generation, but as these youngsters survive into adulthood, most will enter the workforce and thus indirectly contribute to the economic production. On the other hand, a fall in mortality will only affect the workforce if the people dying are still of working age. If a predominant amount of deaths are among the elderly and low among the younger age groups, then a reduction in mortality will not offer additional workers to the labor force or additional production to the economy. Thailand's life expectancy is still sufficiently low such that then a reduction in mortality will likely improve the size of the workforce. Determining and defining these two factors, then, serve as the framework of the demographic sub-model.

3.1.1 Total Fertility Rate (TFR)

The total fertility rate (TFR) refers to the average number of children each woman in the population will bear throughout her child-bearing years. In this model, fertility is defined as:

$$\ln(TFR_t) = \beta_0 + \beta_1 GDP_t + \beta_2 ED_t + \beta_3 IMR_t + \beta_4 GH_t + \beta_5 MRATIO_t + \beta_6 PD_t + \beta_7 MTECH_t + \beta_8 UC_t \quad (1)$$

A discussion of the expected relationship between the dependent variables and their factors will better explain the determination of each equation. Various studies in the determinants of fertility suggest an interesting trend. Cross-country studies tend to show that in poor countries, families tend to have more children than in wealthier, more developed countries. There are several explanations for this negative relationship between income (GDP) and fertility (TFR). Economic theory dictates that at low incomes, and especially in rural areas, households have a higher incentive to have more children, who can help produce income for the family. Conversely, at higher incomes, parents will choose to

have fewer children, but emphasize on producing high quality children (Becker, 1991). The standard of living is much higher and the money invested per child is much higher than in less developed countries. Most parents in developed countries, then, will choose to have fewer children in an effort to provide the highest quality of nutrition, education, and other forms of investment in human capital.

Education (ED), like income, is expected to be negatively correlated to fertility (TFR). Several causal relationships support this hypothesis. First, well-educated women are likely to be more aware of contraceptive and family planning options available to them. A highly educated population is also a direct reflection of the standard of living in a country. If the general expectation is for children to attend university, parents must consider the financial burden presented by high levels of schooling before deciding to have children. The education variable, in this case, represents that number of people over 15 who *are currently enrolled* in school at the secondary level or higher.

Infant and child mortality rates (IMR) are two of the most important factors influencing parents' decision to have children. In a society where the likelihood of a child dying is very high, a couple will account for this probability in deciding how many children to have. For example, if there is a 50% that any given child will die, parents are likely to have close to twice as many children as they actually want, to ensure that the desired number of children survive to adulthood. In fact, a high level of child mortality is often the motivating factor driving high fertility (Mosley and Cowley, 1991). As infant or child mortality (IMR) falls, then, fertility (TFR) should also fall.

The following four variables in this equation relate fertility to the capability and accessibility of health care and health-related services. Specifically, increases in public expenditures on health (GH) or medical technology (MTECH) and in the accessibility of medical personnel, or a fall in the price of drugs (PD), will make health services more accessible. The changes in the number and ratios of physicians, dentists and nurses tend to occur in the same direction, the three variables were combined in these estimations, which yields a cumulative ratio (MRATIO).

The model hypothesizes that as health care services become more physically and financially manageable, even marginalized groups will learn about family planning and contraceptive options, which should reduce the fertility rate. As the quality and capability of medical care services improves, women who might have miscarried during pregnancy or delivery are more likely to have their child in a safe environment, which will help child survival. This effect also suggests that better accessibility to health services will lower the

fertility rate. The levels of public expenditure (GH), ratios of medical personnel (MRATIO) and expenditures on medical technology (MTECH) should demonstrate a negative correlation with fertility, while the price of drugs (PD) should be positively correlated.

The final variable included in the estimation of fertility is a dummy variable for the universal coverage scheme (UC). This scheme, introduced by the Thai government in 2001, is a health policy that provides medical care for all Thai citizens at the cost of a 30-Baht co-payment per visit. The coverage scheme makes health care more financially available to everyone who previously had no health insurance coverage, and thus should show the same effects as those other factors that improve accessibility of health care services. The coefficient on the universal coverage dummy variable should be negative in relation to the fertility rate.

3.1.2 Total Mortality Rate (TMR)

The second determinant of demographic change is the crude mortality rate. A fall in the mortality rate (TMR) should raise the size of the workforce (POPW), given that the people who survive are of working age. Most econometric studies that attempt to link health and economic productivity tend to shy away from the use of total mortality because of its negative nature, which limits the health of the society at a mortality rate of zero. In addition, positive changes in health are shown through decreases in mortality. If an investigator were to use a fixed approach, he could not analyze the rates of change as health improved because this would be a negative change in the mortality rate, making it impossible to take the natural logs of the change in mortality. This model does not use a fixed effects specification, thus avoiding the problem of taking the log of a negative number. The mortality rate is estimated as:

$$\ln(TMR_t) = \beta_9 + \beta_{10}GDP_t + \beta_{11}ED_t + \beta_{12}GH_t + \beta_{13}GH_{t-1} + \beta_{14}MRATIO_t + \beta_{15}PD_t + \beta_{16}MTECH_t + \beta_{17}UC_t \quad (2)$$

The expected negative correlation between income (GDP) and mortality (TMR) has been widely and historically recognized and requires little explanation. A wealthy country is more financially capable of researching and providing the latest technological advances and life-saving techniques to its citizens. Less developed countries have neither the financial means nor the vital infrastructure to purchase and administer innovations in pharmaceuticals. In addition, citizens of developed countries usually have the financial means to purchase those necessities that people in poorer countries cannot buy. For

example, the incidence of starvation and malnutrition is very high in Third World countries, but virtually obsolete in their First World counterparts.

Education (ED) should prove negatively correlated with mortality. A well-educated population is more aware of their physical and mental condition, and will be able to evaluate when a physician's expertise is needed. This is particularly important in the case of epidemics or outbreaks. Many epidemic diseases, such as malaria or SARs, show symptoms quite similar to the common cold or flu. In less developed countries or among poorer households, people may ignore their symptoms or may choose not to seek a physician, assuming that the disease will disappear on its own. This kind of practice can put the neighboring households, cities, or even countries by making them more vulnerable to contract the disease as well. Educated individuals may be more aware of the potential dangers and seek a physician's opinion in response to suspicious symptoms. This practice can save lives, which will manifest through a lowered mortality rate.

The accessibility and technological capability of the health services industry is even more important in determining the mortality rate than the fertility rate. Advances in medical technology (MTECH), in particular, can help save or extend many lives. As investments in this field of study rise, the mortality rate can be expected to fall. In addition, reducing the cost of medical care through government subsidy (GH) and better personnel-to-population ratios (MRATIO) will make health services more accessible, particularly to the poor who are most vulnerable to disease and other poor health conditions. These factors should work together to further reduce the mortality rate.

3.1.3 Labor Force Participation Rate (LFR)

The primary channel through which health and changes in the health care system affect the economy is through changes in the labor force. One significant aspect of the labor market is the labor force participation rate (LFR). The major determinants of the labor force participation rate are outlined as:

$$\begin{aligned} \ln(LFR_t) = & \beta_{18} + \beta_{19} \ln(RWAGE_t) + \beta_{20} ED_t + \beta_{21} PKR_t + \beta_{22} GKR_t \\ & + \beta_{23} EL_{t-1} + \beta_{24} UC_t + \beta_{25} EC_t + \beta_{26} EC_t * PKR_t + \beta_{27} EC_t * GKR_t \end{aligned} \quad (3)$$

The decision to work can also be described as the allocation of one's time between work time and leisure time, which has been modeled in economic theory. Working earns income, which an individual can subsequently use to purchase goods and services that will provide utility. On the other hand, leisure will directly give a person some utility. The opportunity cost of not working is the real wage (RWAGE) that he may have earned for his

time. As wages rise, then, the cost of leisure time will also rise. Higher wages will attract more people into the workforce, thus explaining the predicted positive correlation between wage and the participation rate. This point is particularly important because of the significant link drawn between productivity and wage rate (Strauss, 1998).

The education variable (ED), in this equation, refers to the number of people over fifteen who are still in school. The minimum age at which an individual can enter the workforce is 15, so there is no need to consider the education of children under this age. The model hypothesizes that education should be negatively correlated with labor force participation (LFR). People who are in school usually are not simultaneously working in the labor force. Thus, as the number of people in school rises, the participation rate should also fall.

Labor force participation will also be influenced by the rate of employment (EL). If, for example, the economic outlook tends toward high unemployment, young graduates may seek an alternative to enter the workforce. Some students may continue their education in seeking a graduate degree. Other students may choose to further their language studies so that they may study abroad. These students are not included in the education variable, but are very likely to be affected by the employment and wage rates. Employment is indicated by the *EL* variable, which is a ratio of the number of people employed compared to the size of the labor force:

$$EL_t = \frac{LD_t}{LS_t} \quad (4)$$

Fixed capital formation will also likely have an important affect on labor force participation. Capital and labor are complements in production. In other words, a rise in capital is best utilized if the employment of labor rises as well. The prediction is that the coefficient on capital formation, in both the public (GKR) and private sectors (PKR), should prove a positive correlation with participation in the workforce.

Also included in the estimation of the labor force participation rate is the dummy variable that allows the model to differentiate between the periods preceding and following the economic crisis (EC), which occurred in the third quarter of 1997. At this time, Central Bank of Thailand was unable to contain the falling free-market value of the Thai Baht and was forced to convert from an exchange rate essentially fixed to the US dollar, to a floating exchange rate that allows the free-market to determine the value of the currency. The value of the Thai Baht dropped by almost half and the Thai economy quickly spiraled downward. It is not surprising that the floating exchange rate dummy variable is predicted to have a

negative correlation with labor force participation. In addition to the direct dummy variables, interaction terms with capital formation are also included in the equation, and are expected to have similar effects on the labor force participation rate.

3.1.4 Population Size

The labor participation rate is not the only determinant of the workforce. The size of the workforce will also depend on the population that is of working age (POPW). Population (TPOP) is determined by the number of births added to the population (BIRTHS), less the number of deaths incurred on the population from the previous period. In other words, the population is defined by the following equation:

$$TPOP_t = SR_t * TPOP_{t-1} + BIRTHS_t \quad (5)$$

$$\text{where } SR_t = 1 - \left(\frac{TMR_t}{1000} \right) \quad (6)$$

This equation details the components of the total population. The population eligible to work, then, will subtract the population under 15, which is the minimum legal working age in Thailand:

$$WPOP_t = TPOP_t - POP15_t \quad (7)$$

This working population (WPOP) variable, however, refers to the people *eligible* to work, but not people seek work. To determine the labor supply, or the population currently searching for work, the work-eligible population must be multiplied by the labor force participation rate (LFR):

$$LS_t = LFR_t * WPOP_t \quad (8)$$

This measure of the labor supply is used to measure the effective employment rate.

This system of equations provides an important connection between the mortality rate (TMR), which is a reflection of the health status and the effectiveness of the health care system, and the potential workforce, which will later provide an important link into the economic sub-model described below.

3.2 Economic Sub-Model

On the economics side of this model, health is expressed primarily in terms of its effects in the size of the labor force. Limitations and restrictions in terms of available data exclude the direct analysis of productivity. Changes in worker productivity are incorporated into changes in disposable income, which will change consumption patterns. Both expenditure and financial sectors are included in this model. The exchange rate and

more specifically the financial crisis of 1997 are shown to have significant effects on health outcomes and spending patterns in both the public and private sectors. In addition, the inclusion of the financial sector allows money values to stay in monetary terms. It is important that both factors are included to present the most accurate picture of the economy.

3.2.1 Gross Domestic Product (GDP)

The economic sub-model begins with a general national income identity, which defines the gross domestic product (GDP) as the sum of private consumption (CONS), private investment (I), government expenditures (G), and net exports (X-M).

$$GDP_t = CONS_t + I_t + G_t + X_t - M_t \quad (9)$$

In the Thai economy, exports have virtually no demonstrated interaction with health status or the provision of health care services; it has thus been treated as exogenous. Each of the four remaining components is described in this part of the model.

3.2.2 Private Consumption (CONS)

Consumption is one of the primary components that makes up the gross domestic product (GDP) of Thailand. In this model, private consumers' spending (CONS) on goods and services is divided into 2 parts: (1) purchase of health-related goods and services (HC), and (2) all other goods and services (NONHC). The consumption term is given as:

$$CONS_t = HC_t + NONHC_t \quad (10)$$

Each of these components are then estimated, in turn.

3.2.2.1 Health-Related Consumption (HC)

The equation describing consumption of health care is described as:

$$HC_t = \beta_{28} + \beta_{29}Y_t + \beta_{30}PD_t + \beta_{31}MTECH_t + \beta_{32}MRATIO_t + \beta_{33}EC_t + \beta_{34}UC_t \quad (11)$$

The definition of health care consumption is generally based on those same factors that determine the demand for any good or service. The primary determinants are price and income. Like most normal goods, income (Y) should be positively related to the purchase of health care goods and services. As income (Y) rises, private consumers will purchase more of all goods and services, including health. Price, on the other hand, tends to be negatively related to the amount of health care goods and services. As price (PD) rises, consumers are financially able to buy less of that commodity, which should reduce the total money spent on health care services (HC).

Several additional factors play key roles in the determination of the consumption of health care goods and services. The level of investment in medical technology (MTECH) will improve the quality and accuracy of service in diagnosis and treatment. Therefore, the improved technology should raise the general demand for health care services (HC). Likewise, the ratio of health care workers to the population (MRATIO) will improve accessibility to health care, which should also increase consumer's incentive to purchase more health care services than in the past, so that the ratio of medical care personnel (MRATIO) should be positively related to the consumption of health care goods and services (HC).

The universal coverage scheme (UC), which was implemented in 2001, allows Thai citizens to seek medical care with the minimal 30-Baht co-payment per visit. This policy, then, should virtually reduce the price of health care, and should therefore raise the *quantity* of health care demanded, but actually *reduce* the private consumption of health-related goods and services. The universal coverage (UC) variable, then, should be negatively related consumption (HC). Another single shock to the economy is noted at the outset of the economic crisis. The East Asian financial crisis (EC) caused a significant fall in economic status, which will clearly affect spending on health care (HC). The universal coverage (UC) variable also has a negative relationship with the purchase of health care (HC).

3.2.2.2 Non-health Consumption (NONHC)

A more complete model of the Thai economy will include many equations that depict consumption or spending, based on the bulk of industries in the economy. To simplify this model and fit it within the parameters necessary for an accurate and reliable estimation, consumption of all non-health (NONHC) are combined into one equation, represented as:

$$\begin{aligned} NONHC_t = & \beta_{35} + \beta_{36}Y_t + \beta_{37}CPI_t + \beta_{38}EC_t + \beta_{39}(MLR_t - INEX_t) \\ & + \beta_{40}EC_t * Y_t + \beta_{41}EC_t * (MLR_t - INEX_t) \end{aligned} \quad (12)$$

Consumption here does not differ significantly from the consumption of health care goods and services. Private spending is based primarily on income and price, just like health-related goods and services. The levels of consumption are positively related to incomes, and negatively related to prices. In addition, consumption is also based on the opportunity cost of spending their money today. If a consumer spends *less* than their total income in one period, then he will probably save his remaining income in a bank account, where it can earn interest. On the other hand, if an individual chooses to spend *more* than

his income, he is forced to borrow from a bank and pay back the original principle plus interest. A consumer's incentive to spend more or less than his income, then, is based on the cost of spending or earnings from saving, which are represented by the real interest rate (MLR-INEX). When interest rates are low, people are encouraged to spend and less encouraged to save. If, on the other hand, interest rates are high, the cost of borrowing money is much higher, which will encourage people to save instead of spend money. On the other hand, if the interest rate is low, people are urged spend their money and save as little as possible, often to further boost the economy.

The economic crisis (EC) variable is also included in this estimation, as it will have a significant effect on the incomes and spending patterns of consumers in Thailand (NONHC). The crisis variable alone will demonstrate a negative effect on the levels of consumption. In addition, interaction terms between the crisis variable and incomes (EC*Y) and price (EC*CPI) should also have an influence on spending. Changes and adjustments in the interest rates will change after the crisis, because inflation patterns will probably change as a result of the extreme changes in the exchange rate. In addition, the crisis will also have an important effect on the role of incomes in the estimation of consumption patterns. After the financial devastation of the economic crisis, people were much more cautious about their spending, and were more likely to save their money for the future. For this reason the inclusion of these interaction terms is important to represent the patterns in non-health consumption.

3.2.3 Private Investment (I)

Investment refers to corporate spending on capital, land and technology. It is primarily determined by the costs of making an investment and the income available to investors. The equation for private investment (I) is given as:

$$I_t = \beta_{42} + \beta_{43} \left(\frac{M2A_{t-1}}{CORE_{t-1}} \right) + \beta_{44} CAPU_{t-1} + \beta_{45} EC_t + \beta_{46} (MLR_{t-1} - INEX_{t-1}) + \beta_{47} I_{t-1} \quad (13)$$

This specification assumes that investments purchased in the current period are based on funds secured through loans granted in the preceding period. Most money to fund investments is borrowed from some independent source, such as a bank, and as investors pay back their debt, they all must pay interest. Investors choose to invest based on their available finances, or income, and the opportunity cost of making such investments, which includes forgone spending as well as accounting for the risk involved in making such investments. Interest rates (MLR-INEX), then, can be defined as the price of loans.

Accordingly, a higher interest rate will lower the demand for loans and subsequently the level of private investment.

Banks and investors view the supply of loans in terms of real money supply (M2A/CORE). An increase in the supply of money means that loans should be more readily available, so that investment should rise, indicating a positive correlation. The East Asian crisis probably affected private investment significantly, because as loans were recalled, the money supply detracted until very little money was available for investment. The dummy variable (EC) indicating this period should show a negative relation. The lagged investment variable is also included, to account for fixed effects.

3.2.4 Government Spending (G)

Expenditures by the government are not estimated in the model but are represented by the following identity equation:

$$G_t = GH_t + GOTH_t \quad (14)$$

Expenditures are not always linked to tax revenues collected, because governments experiencing deficits may borrow money from abroad to help fund programs and policies as necessary. It is for this reason that government spending is not estimated within the model, but is simply defined as the sum of spending in health and other areas. Spending on health is separated from other spending because of its connection in equations in the demographic sub-model.

3.2.5 Imports (M)

Imports are affected by the same factors as most other normal goods. The specification for imports (M) is given as:

$$M_t = \beta_{48} + \beta_{49}GDP_t + \beta_{50}\left(\frac{PM_t * EX_t}{GDP_t}\right) * 100 + \beta_{51}CAPU_{t-1} + \beta_{52}EC_t + \beta_{53}M_{t-1} + \beta_{54}EC_t * M_{t-1} \quad (15)$$

Since the purchasers of imports are the local public, their income is derived directly from domestic gross domestic product (GDP). At higher levels of national income, people have more money to spend on all goods, including imports. The correlation between income and imports, then, is expected to be positive. This is, in fact, the opposite of the effect in exports. A rise in GDP causes a rise in demand for local currency, which will cause an appreciation of the currency against foreign markets. It is interesting but not unusual to notice that this change will have opposing effects on exports and imports.

In addition to income, the real price of imports will also influence how much the population will want to purchase them. According to general consumer theory, high-priced

items will have a lower demand because people are either financially unable to purchase such goods, or their utility from the purchase does not exceed the price of the good. Price (PM*EX/GDP), then, should be negatively correlated to imports. The floating exchange rate (EC) variable will have an effect opposite the effect predicted for exports. As local currency loses its value, goods imported from other countries with more stable incomes are expensive when converted to the devalued currency. The coefficient on the floating exchange rate dummy variable, then, should be significantly negative.

3.2.6 Consumer Price Indices and Inflation

Prices and incomes valued in monetary terms should be adjusted to account for changes in the general cost of living. The price level, which is represented by the consumer price index (CPI), is one of the most commonly used measures of the general standard of living in an economy. The consumer price index is defined as the sum of the weighted values of the food CPI, energy CPI, and CPI of all other goods. The CPI of goods other than food and energy is further estimated here:

$$CPI_t = CORE_t(1 - WEN_t - WFOOD_t) + (WEN_t * CPIEN_t) + (WFOOD_t * CPIFOOD_t) \quad (16)$$

$$\ln(CORE_t) = \beta_{55} + \beta_{56} \ln(PM_NOIL_{t-1}) + \beta_{57} \ln(CORE_{t-1}) \quad (17)$$

According to the equation, the price level of goods is based primarily on the previous level and on the change in the price of imports, excluding oil (PM_NOIL). Imports are used because their pricing will also incorporate effects of the exchange rate in changes in the price levels (CORE), since imports that are too expensive will not be purchased.

The consumer price index (CPI) plays an important role in the expected rate of inflation (INEX) in the economy. Inflation is defined as a rise in the general price level of goods and services. Assuming that consumers already have some sense of the change in the general price level and consumer price index from year to year, the expected rate of inflation should reflect both past rates of inflation as well as the current price level, as depicted in the equation below.

$$INEX_t = \beta_{58} + \beta_{59} CORE_t + \beta_{60} INEX_{t-1} \quad (18)$$

3.2.7 Earned Labor Income (YL)

In this model, the connection between health and economic production is through the labor force. Specifically, the labor force will grow in size and productivity as the state of health improves. A system of identity equations will connect the labor force to individual incomes, which relates directly to the level of consumption. The system of

equations used here are based on the Philippine's demographic-economic model, presented in the UNDP's *Demographic-Economic Models* (UNESCAP, 1988). The system of equations is presented first, and the discussion to follow will identify the specific links from and to the demographic and economic sub-models, respectively:

$$YL_t = \beta_{61} + \beta_{62}POPW_t + \beta_{63}ED_t + \beta_{64}TMR_t + \beta_{65}LFR_t + \beta_{66}EC_t + \beta_{67}INEX_t \quad (19)$$

$$Y_t = YL_t + YOTH_t \quad (20)$$

Labor income refers to the compensation received by all employed workers in the economy. This representation assumes that the economy is either working at or near full-employment; or if not, it is responsive to changes in the labor supply. Equation 19, which estimates the main factors in determining cumulative labor income, is based on other empirical studies estimate wages and their main attributes (Deolalikar, 1988; Lee, 1982; Schultz, 1994). Cumulative labor income will include most of these factors, their interpretation may differ significantly from other empirical studies of wage.

Most empirical examinations of the interdependence between wages and health are conducted at the microeconomic level, where the individual is the unit of observation and the wage rate is the dependent variable. These studies show that wage tends to be influenced by factors that reflect age, education, and health, as well as a number of individual characteristics that are not included in this formulation. In this model, the average wage rate (RWAGE) is less predictive because differences in individual characteristics, such as race or regional location are aggregated and will not directly relate to overall average wage. In discussing the effects of each factor included here, it is interesting to note the additional differences in the interpretation of each variable and how it is related to wage at the microeconomic and macroeconomic levels of observation.

Important factors influencing one's wage are measures of human capital. When applied at the macroeconomic level, however, education presents two opposing effects on the level of cumulative labor income. Because highly educated workers tend to be more valuable and productive, they tend to earn a higher wage rate. This factor alone should raise earned labor income (YL). At the same time, however, people who are extending their education (ED) are intrinsically excluded from the labor market. By lowering the pure number of people working, labor income should also fall. The size of the labor force (POPW), however, should also be reflected through the labor supply variable. A rise in labor supply may have two effects on total received income. If the rise in labor supply raises the number of people working, then income should rise. On the other hand, economic theory of labor markets imply that a rise or outward shift in aggregate labor supply should

cause wages to fall, as supply and demand for labor equilibrate. It is not clear which effect will dominate the relationship, so the correlation between labor supply and income is not well-defined at this stage.

Mortality rate (TMR) serves as a proxy for health human capital. Although this measure is not the most descriptive factor for either productivity or well-being, data availability limit the possible variables to be used in this equation. The mortality rate (TMR) should, however, reflect changes in the general accessibility to and quality of health care providers for the general public. This factor, however, may have conflicting effects on total labor income. Health, like education, should raise general wage rates, which alone would have a positive effect on cumulative income. On the other hand, a rise in one's hourly wage also increases the opportunity cost of leisure time, so that some workers may shift their labor-leisure allocation to work less. In this case, *total* labor income for that individual may rise, fall, or remain unchanged; and the aggregate effect of the whole labor force is even less predictable.

Finally, the floating exchange rate dummy variable (EC) is included because during and immediately following the economic crisis, the whole economy including labor and incomes suffered an external shock. The negative effects were an anomaly that precipitated from the financial crisis. This variable, then, is expected to demonstrate a negative correlation with labor income. A brief examination of the data shows that the financial crisis also had a severe effect on health outcomes, so an interaction term between total mortality and the crisis dummy variable is also included in the estimation.

Labor income does not include transfers from the government or abroad, which are added to determine total disposable income. In the original form of this model, household income was used and although household income is likely to be more useful, the estimation of consumption requires that figures be in the total aggregate form, not at the individual level. Even major changes in household income cannot compare to any level of change in total consumption; therefore, total income is used in the estimation of private consumption.

Variable	Description
<i>BIRTHS_t</i>	total number of births in quarter <i>t</i>
<i>CAPU_t</i>	industrial capacity utilization in quarter <i>t</i>
<i>CONS_t</i>	private consumption in quarter <i>t</i>
<i>CORE_t</i>	consumer price index of all goods, excluding food and energy in quarter <i>t</i>
<i>CPI_t</i>	consumer price index of all goods in quarter <i>t</i>
<i>CPI_EN_t</i>	consumer price index of energy in quarter <i>t</i>

Variable	Description
<i>CPI_FOOD_t</i>	consumer price index of food in quarter <i>t</i>
<i>ED_t</i>	population who has or is being educated at the secondary level or higher
<i>EC_t</i>	1 during and after the financial crisis of 1997 and 0 otherwise
<i>EL_t</i>	employment rate or ratio of labor demand to labor supply
<i>EX_t</i>	exchange rate of Thai Baht to US\$1 in quarter <i>t</i>
<i>G_t</i>	government expenditure in quarter <i>t</i>
<i>GH_t</i>	government expenditures in health in quarter <i>t</i>
<i>GOTH_t</i>	government expenditures on other goods in quarter <i>t</i>
<i>GDP_t</i>	gross domestic product in Thailand in quarter <i>t</i>
<i>GKR_t</i>	gross capital originating from the public sector in quarter <i>t</i>
<i>HC_t</i>	private health consumption in quarter <i>t</i>
<i>I_t</i>	private investment in quarter <i>t</i>
<i>IMR_t</i>	infant mortality rate in quarter <i>t</i>
<i>INEX_t</i>	expected inflation rate in quarter <i>t</i>
<i>LD_t</i>	total labor demand in quarter <i>t</i>
<i>LFR_t</i>	labor force participation rate in quarter <i>t</i>
<i>LS_t</i>	total labor supply in quarter <i>t</i>
<i>M_t</i>	value of imports in quarter <i>t</i>
<i>MLR_t</i>	minimum lending rate in quarter <i>t</i>
<i>MRATIO_t</i>	ratio of medical professionals per 1,000 population in quarter <i>t</i>
<i>MTECH_t</i>	medical technology purchased in quarter <i>t</i>
<i>NONHC_t</i>	non-health private consumption in quarter <i>t</i>
<i>PD_t</i>	consumer price index for medical drugs in quarter <i>t</i>
<i>PKR_t</i>	gross capital formation originating from the private sector in quarter <i>t</i>
<i>PM_t</i>	price index of imports in terms of Thai Baht in quarter <i>t</i>
<i>PM_NOIL_t</i>	price index of imports excluding oil, in terms of Thai Baht in quarter <i>t</i>
<i>POP15_t</i>	population under 15 years of age in quarter <i>t</i>
<i>POPW_t</i>	population of working age in quarter <i>t</i>
<i>RWAGE_t</i>	real wage rate in quarter <i>t</i>
<i>SR_t</i>	survival rate in quarter <i>t</i>
<i>TFR_t</i>	total fertility rate in quarter <i>t</i>
<i>TMR_t</i>	total mortality rate in quarter <i>t</i>
<i>TPOP_t</i>	total population in quarter <i>t</i>
<i>UC_t</i>	1 for period during and after universal coverage was introduced, 0 otherwise
<i>WEN_t</i>	weight for energy price index in CPI basket
<i>WFOOD_t</i>	weight for food price index in CPI basket
<i>X_t</i>	exports in quarter <i>t</i>
<i>Y_t</i>	total income in quarter <i>t</i>
<i>YL_t</i>	earned labor income in quarter <i>t</i>
<i>YOTH_t</i>	other income in quarter <i>t</i>

Table 3.1. List of variables and definitions as found in the model.

CHAPTER IV

DATA

4 Introduction

As described in the methodology, this model consists of a total of 20 equations and 46 variables, which are listed in Table 4.1. Data compiled in this model were collected from several government and academic sources. All data were obtained in quarterly format unless otherwise noted.

4.1 Sources of Data

National Income data are published by the National Economic and Social Development Board of Thailand (nesdb.co.th). This government agency maintains national income accounts as early as 1976, but began publishing quarterly data only after 1993. Prior to this year, quarterly data were estimated based on annual totals and trends in available quarterly data. National income data refers to the level of gross domestic product (GDP) and the value of each expenditure component of GDP. In addition, data on income and earned labor income are also made available through the national income account. Since the financial sector is included as a separate part of this model, all the economic data are given in current monetary terms. Inflation and exchange rate fluctuations are accounted for in other equations of the model. The national income account also details the levels of fixed capital formation. Early data, however, did not distinguish between private and public spending so the data was disaggregated based on later observed trends.

The Bank of Thailand (BoT) serves as a central agency for most economic and financial data. Most financial data were obtained from the Bank of Thailand's *Quarterly Bulletin of Statistics*, in print until 2000. After 2000, financial data released by the Bank of Thailand was compiled in the *Economic and Financial Statistics* periodical, also available on a quarterly basis. In many cases, data in these publications are also available at the Bank of Thailand's website (www.bot.go.th). These publications provide important financial data, including interest rates, lending rates and money supply, as well as other important data.

Another area of data under the purview of the Bank of Thailand is foreign trade. This includes import and export indices, exchange rates, and international reserve holdings. Exchange rates are based on those rates provided by commercial banks within Bangkok, assuming that rates outside the capital will likely be higher due to domestic factors.

Import and export indices are computed by the Bank of Thailand, based on data from the Customs department, which classifies and records the volume on exports out of and imports into the country. Data on the price index of all imports excluding only oil are not available, so the price index for consumer goods is used instead. Because this index excludes many intermediate goods imported into Thailand, it is not the most accurate measure but it likely the best available index to exclude the effects of oil imports. Net International Reserve holdings combine several components. Specifically, the measure of reserve assets includes gold holdings, special drawing rights (SDRs), the holdings in the Fund and the Bank of Thailand's foreign exchange assets. Quarterly data, in this case, refers to the reserves available at the end of each quarter.

Government revenues and expenditure variables are compiled and published by the Bank of Thailand, which retrieves the data from the Comptroller's Office at the Ministry of Finance. These figures reflect only the federal budget; revenues earned in local district governing bodies are not counted. Data on government expenditures are disseminated by the Bank of Thailand, which acquires its data from the Bureau of the Budget, a division of the Office of the Prime Minister. This model calls for data on public spending on health and health-related goods and services and all other spending. These data are available on a quarterly basis from the Bank of Thailand after 1995, but prior to this year, annual data was disaggregated to determine adjust quarterly data. The final piece of data obtained from the Bank of Thailand is on capacity utilization in specific industries as well as in all industries as a whole. The data are available on a quarterly basis after 1995. Before this year, the Bank of Thailand publishes capacity utilization data biannually, based on surveys sent to representative companies in most large industries. Quarterly data were interpolated from the available data.

Consumer price indices are acquired from the Bureau of Statistics and Indices, a division of Thailand's Ministry of Commerce. The Bureau offers monthly data on the total consumer price index in Thailand, as well as data for individual sectors or types of goods, such as energy, food, and medical services. The data are increasingly detailed over time, becoming as specific as providing data on the price level of pharmaceutical drugs after 2000. Prior to this year, however, the price index for all health services is aggregated into one figure. A brief examination of the available data shows that the trends in changes in the price level of medicine and that of health services as a whole are quite similar, so that the price index for medical care is used as a proxy for the price index of drugs. The calculation of the total consumer price index requires weights for the food index, the energy index, and

the *core* index (all goods excluding food and energy). These weights are obtained from the 2000 socio-economic survey, which was conducted by the National Statistics Office.

Labor statistics were acquired from the *Labor Force Survey Reports*, published by the National Statistics Office. The office conducts surveys the employment status and other demographic information of people in representative provinces across the country and estimates the population data based on these surveys. Prior to 1997, the surveys were conducted three times a year in March, June, and October. A fourth survey was added in December 1997, providing quarterly data. Labor data includes the size, age structure, and education level of the labor force, the labor force participation rate, and the wage rate.

Statistics regarding the size and age structure of the total population were obtained from the Department of Provincial Administration (DOPA), which falls under the purview of the Ministry of the Interior. On its website (www.dopa.go.th), the Department provides annual data of the population of Thai citizens, based on its house registration system.

Health and demographic statistics are primarily obtained from the *Public Health Statistics*, released annually by the Bureau of Policy and Strategy, a division of the Ministry of Public Health. The mortality rates are available on a monthly basis in these publications; the quarterly values are given as the average of every three months. The total fertility rate is not given, but must be calculated based on the levels of age-specific fertility and the number of women in each age group, which is acquired from the *Labor Force Survey Reports*.

4.2 Description of Data

All data collected are summarized in Table 4.1. Most of the statistics collected do not show strange unexplained shocks or anomalies, although many financial and economic statistics demonstrate significant negative effects as a result of the Asian Financial Crisis in 1997. This data is not unusual, but should be considered carefully in the determination and analysis of the results.

Variable	Mean	Median	Minimum	Maximum	Standard Deviation
<i>BIRTHS_t</i>	885.850	937.337	1008.98	719.644	92.8874
<i>CAPU_t</i>	74.8068	73.3250	92.4800	56.2400	11.4937
<i>CONS_t</i>	577.574	627.173	866.406	291.977	159.195
<i>CORE_t</i>	90.7536	91.1500	105.100	68.4000	12.4166
<i>CPI_t</i>	88.4482	89.5500	106.500	63.9000	14.1937
<i>CPI_EN_t</i>	93.9786	83.7500	131.900	71.6000	20.3162
<i>CPI_FOOD_t</i>	84.4518	87.8500	103.900	57.6000	15.4999
<i>ED_t</i>	587.611	634.927	698.628	311.383	120.555
<i>EL_t</i>	0.95884	0.96150	1.00720	0.89230	0.02896
<i>EX_t</i>	32.5904	25.8730	47.1148	24.6046	8.14535
<i>G_t</i>	180.910	192.275	298.265	79.3455	56.2368
<i>GH_t</i>	13.5281	12.6790	34.0040	4.02351	6.44181
<i>GOTH_t</i>	167.382	177.108	271.185	75.3220	50.8086
<i>GDP_t</i>	1017.03	1107.21	1557.87	508.238	269.813
<i>GKR_t</i>	88.2379	89.6658	192.486	29.4663	33.5824
<i>HC_t</i>	17.7725	18.3384	24.5847	9.92722	4.00125
<i>I_t</i>	231.283	220.435	395.451	125.348	65.5656
<i>IMR_t</i>	6.62321	6.90000	9.00000	2.40000	1.29334
<i>INEX_t</i>	0.93672	0.83200	2.86344	-0.79523	0.83101
<i>LD_t</i>	31065.8	31011.7	34676.4	27301.3	1770.97
<i>LFR_t</i>	0.74743	0.73506	0.82206	0.70602	0.03427
<i>LS_t</i>	40901.5	42251.8	49996.5	30198.9	6025.77
<i>M_t</i>	518.613	509.478	936.229	209.601	202.932
<i>MLR_t</i>	11.2262	11.6875	16.0830	5.62500	3.10466
<i>MRATIO_t</i>	22.9476	22.3575	30.6356	18.6126	3.71188
<i>MTECH_t</i>	5.04019	3.99028	10.2216	2.24287	2.28795
<i>NONHC_t</i>	559.802	603.967	843.304	282.050	155.854
<i>PD_t</i>	92.0250	92.6000	115.800	64.2000	14.5331
<i>PKR_t</i>	231.283	220.435	395.451	125.348	65.5656
<i>PM_t</i>	89.6238	94.0500	118.310	56.9500	13.3754
<i>PM_NOIL_t</i>	111.791	103.930	187.400	57.3800	35.7434
<i>POP15_t</i>	16851.6	16372.0	18819.8	15664.5	1089.23
<i>POPW_t</i>	43475.6	43710.0	48573.5	37141.9	3399.06
<i>RWAGE_t</i>	5341.88	5755.15	6911.60	2448.00	1401.24
<i>SR_t</i>	0.99464	0.99470	0.99630	0.99360	0.00070
<i>TFR_t</i>	1630.25	1689.25	1855.00	1342.00	194.805
<i>TMR_t</i>	5.35536	5.30000	6.40000	3.70000	0.70348
<i>TPOP_t</i>	60327.2	60274.3	64238.0	55961.7	2361.45
<i>UC_t</i>	0.17857	0.00000	1.00000	0.00000	0.38646
<i>WEN_t</i>	0.08400	0.08400	0.08400	0.08400	0.00000
<i>WFOOD_t</i>	0.38500	0.38500	0.38500	0.38500	0.00000
<i>X_t</i>	545.875	468.955	1047.035	174.926	264.590
<i>Y_t</i>	1017.03	1107.21	1557.87	508.238	269.813
<i>YH_t</i>	692621	763945.9	997038.5	362178.4	175773.1
<i>YL_t</i>	308.558	350.848	451.155	127.452	98.2660
<i>YOTH_t</i>	708.472	751.446	1106.72	380.786	173.455

Table 4.1 Summary Statistics of Variables included in the model.

CHAPTER V

RESULTS AND DISCUSSION

5 Introduction

The behaviors of exogenous variables and structural equations make conditions conducive to the utilization of the two-staged least squares (TOLS) estimation technique. The regression estimation of each structural equation identifies all exogenous and lagged endogenous variables as instrumental variables (IV). Each equation is individually estimated, as indicative of the TOLS technique.

This section is divided into several sections. The first part offers a discussion of the results of the estimation and their implications on the relationship between health and economic output. After this, several policy changes are tested to show the possible results on economic output and health status. Finally, obstacles and possible problems are discussed in the context of avenues for further research.

5.1 Initial Estimation Results

A summary of the results of the two-staged least squares estimation is given in the following section, but the complete results of each estimation can be found in Appendix J. Most results follow the predictions made in the methodology section, but several discrepancies are noted. An complete explanation of each of these discrepancies and the mechanisms through which they arise are offered throughout these discussions. A careful and reasonable description of the mechanism that links health and economic development will offer a better understanding of what, where, and how health care reforms should be implemented in Thai society.

5.1.1 Total Fertility Rate

Because positive changes in health are not exclusively associated with either rising or falling fertility rates, it is difficult to unambiguously identify how health reforms should be used to influence fertility rates. Despite this fact, it is important to describe how different variables will affect the fertility rate in Thailand.

Table 5.1 shows the estimation of the fertility rate.[?] Infant mortality demonstrates a negative correlation with fertility, which can rationally be explained. As the infant

[?] Statistical significance is noted according to the following key:
*** = statistic at the ? ? 1%-level
** = statistic at the ? ? 5%-level
* = statistic at the ? ? 10%-level

mortality rate falls, more children will survive beyond their first several months of life, which can help account for the predicted rise in fertility. This correlation is rather expected, and helps explain some part of the variance in the fertility rate in Thailand.

$$\ln(TFR_t) = \beta_0 + \beta_1 GDP_t + \beta_2 ED_t + \beta_3 IMR_t + \beta_4 GH_t + \beta_5 MRATIO_t + \beta_6 PD_t + \beta_7 MTECH_t + \beta_8 UC_t + \varepsilon_t$$

Variable	Coefficient (Std. Error)
C	6.1610 (0.3952)***
GDP	-0.0001 (0.0001)
ED	0.0003 (0.0002)*
IMR	0.0094 (0.0073)
GH	-0.0003 (0.0012)
MRATIO	0.0373 (0.0008)***
PD	0.0011 (0.0033)
MTECH	0.0245 (0.0044)***
UC	0.0061 (0.0228)

Table 5.1. Results of Estimation of Total Fertility Rate (TFR).

Of particular interest are the effects of social factors, such as the education and health care infrastructures established in society. The bizarre positive correlation between education and fertility is slightly troubling. Previous discussions suggest that better education will raise the cost of having children, which in turn should lower fertility, as described by Becker, among others. The most likely and plausible explanation for this result, though, is in the measurement of the education variable. Due to lack of available data, education was measured by counting the number of people in the population *currently enrolled* in school, which inherently includes a particular age group. Specifically, this variable is likely representative of the population aged 15-30 years in the prime of their childbearing years. Thus, it is not unusual that this variable will be positively correlated with fertility.

Factors that describe the endowments of the health care system prove to be positively related to fertility. A rise in expenditures on medical technology or a rise in the ratio of medical personnel per 1,000 people will increase the fertility rate. These effects are combined because both adjustments represent an effort to make health or medical care more accessible to the public. Better medical technology should shorten waiting times as well as improve the efficiency and accuracy of diagnostic and treatment services provided. A rise in the proportion of medical personnel per 1,000 population will also indicate that health care services can be provided more effectively and efficiently, particularly if the personnel is well-distributed throughout the country. With the increasing availability of

health care services, more pregnant women should be able to carry their babies to term and deliver healthy babies, which will cause the fertility rate to rise. At the same time, if health care services are less available, then women may feel that they lack adequate support and education about proper prenatal care, which has a detrimental effect on the fertility rate.

5.1.2 Total Mortality Rate

In this model, the mortality rate serves as the primary measure of aggregate health in Thai society. Use of this variable as a proxy for health has several shortcomings, which are addressed in many other studies. Most notable, the mortality rate is a negative measure of health; *negative* changes in the mortality rate are *more* desirable, but the mortality rate can never fall below 0, which limits the magnitude of effects that various factors have on health. In addition, mortality does not portray *cause* of death. In developed societies, for example, the mortality rate may rise over time because society is aging, and the high proportion of elderly means a higher death rate. It is difficult to find a single health measure that can effectively portray aggregate health status, but in this case the mortality rate is used because of its direct link to the population and its subsequent effect on the labor force. The results for this estimation are shown below in Table 5.2.

$$\ln(TMR_t) = \beta_9 + \beta_{10}GDP_t + \beta_{11}ED_t + \beta_{12}GH + \beta_{13}GH_{t-1} + \beta_{14}MRATIO_t + \beta_{15}PD_t + \beta_{16}MTECH_t + \beta_{17}UC_t + \varepsilon_t$$

Variable	Coefficient (Std. Error)
C	1.6903 (0.7283)**
GDP	0.00001 (0.0002)
ED	0.0012 (0.0003)***
GH	-0.0022 (0.0025)
GH(-1)	-0.0024 (0.0025)
MRATIO	-0.0126 (0.0152)
PD	-0.0031 (0.0061)
MTECH	-0.0142 (0.0065)**
UC	0.0323 (0.0429)

Table 5.2. Results of Estimation of Total Mortality Rate (TMR)

One particularly disturbing result is that income, measured as GDP, is positively correlated with the mortality rate. In other words, as Thailand's income rose, so too did the mortality rate. This unsettling result can be explained in several ways. As described above, a wealthy society may show a rising mortality rate with an aging population. Another possibility is the rise in income inequality. No measure of income equality is included in the estimation, so its effects may be expressed through the income variable

instead. During the observed time period, 1990-2003, economic performance was generally on the rise until the financial crisis in 1997. The rapid economic growth has also proven to raise income inequality and create wider disparity between class and economic status. Several international studies show a significant relationship between income inequality and health status. This correlation is the driving force behind health policies that improve equity. This unexpected result offers further insight on health trends in Thailand and suggests that future policies focus not on higher incomes but on improving the outcomes of the poor.

Education shows a similarly unusual and unexpected positive correlation with the mortality rate. Both theoretic and empirical studies predict that higher education will make the population more aware of health prevention and medical care techniques, which should lower the probability of people contracting disease or incurring fatal injuries. Despite the quite rational predictions, this result may still have a reasonable, although somewhat disconcerting, explanation. It is possible that the increasing level of education has adverse behavioral effects on the population. For example, students attending university may be more likely to engage in risky behaviors such as driving under the influence of alcohol or other substances. If the alternative to entering the education system is working at home or in a factory, then it is not unlikely that people in the 16-30 year-old age group may face higher risk of accident, injury, or death in the education system.

Resources and investments in health demonstrate the expected effects on mortality. Results show that as expenditures that improve the accessibility of medical care services rise, health shows an explicit improvement, through a lower mortality rate. Government expenditures on health, investments in medical technology, and the availability of medical personnel all show negative correlations with the mortality rate. Government health expenditures should improve both the accessibility and quality of health care service available to the public. Such improvements should clearly improve the general health of the public, which is expressed in this model through the mortality rate. Similarly, further investments in technological advancements in medicine will also improve the health, as expressed through the mortality rate. These results confirm the general hypotheses predicted in the formulation of this model.

Another effective measurement of the accessibility of health care is the number and availability of health care professionals. When there are more medical professionals practicing, health care services should be more accessible to the public, in terms of

financial price as well as opportunity cost through waiting times and other factors. The estimation of total mortality with respect to the ratio of medical professionals per 1,000 population shows a distinct negative relationship. Specifically, the results show that if the ratio of health care personnel rises by 1 professional per 1,000 population, mortality will fall a small amount.

The only factor that seems to show a counterintuitive result is the effect of prices level, which is also negatively related to the death rate. Higher drug prices make medicine less accessible, which should have a negative effect on health status, revealed through a higher mortality rate. In this case, however, higher drug prices seem to *lower* mortality. One possible explanation for this is that the price of drugs may also reflect their quality, which is not explicitly measured in this estimation. If only low quality drugs are offered at lower prices, then this may explain the negative effects observed. It should be noted, however, that the results that compare the price of health commodities and mortality are not statistically significant, and therefore do not show reliable evidence of a negative association.

5.1.3 Labor Force Participation Rate

Variation in the labor force participation rate will have subsequent effects on the labor force. The labor force participation rate is influenced by several important factors. Most factors show results that follow expectations and predictions. Labor force participation is closely linked to factors that influence the productivity of labor. The results of the estimation of labor force participation rate are shown in Table 5.3.

$$\ln(LFR_t) = \beta_{18} + \beta_{19} \ln(RWAGE_t) + \beta_{20} ED_t + \beta_{21} PKR_t + \beta_{22} GKR_t + \beta_{23} EL_{t-1} + \beta_{24} UC_t + \beta_{25} EC_t + \beta_{26} EC_t * PKR_t + \beta_{27} EC_t * GKR_t + \varepsilon_3$$

Variable	Coefficient (Std. Error)
C	-0.7504 (0.2255)***
LN(RWAGE)	0.0863 (0.0301)***
ED	-0.0002 (0.0001)**
PKR	-0.0002 (0.0001)
GKR	-0.0008 (0.0003)***
EL(-1)	-0.0268 (0.0840)
UC	0.0073 (0.0090)
EC	-0.2500 (0.0448)***
EC*PKR	0.0002 (0.0002)
EC*GKR	0.0013 (0.0003)***

Table 5.3. Estimation Results for the Labor Force Participation Rate (LFR).

Enrollment in higher education proves to be negatively related to the participation rate. The primary reason for this outcome is due to the way the education variable is measured. This variable measures the number of people *currently enrolled* in at least at the secondary level of higher. The results show that when the number of people enrolled rises by 1,000, the labor force participation rate will fall by 0.02%. The most likely explanation for this unusual result is that many people who choose to attend school full-time inherently remove themselves from the labor market, thus reducing the labor force participation rate.

The onset of the East Asian financial crisis in 1997 shows a decided negative effect on the labor force participation rate. According to results shown in Table 5.3, the onset of the crisis caused labor force participation to fall by almost 25%. During the economic crisis, the Thai economy crashed as output did not grow but diminished by as much as 5%, and unemployment soared. Most people were forced out of work, and virtually no companies had the capacity to hire new labor. People were quickly discouraged from looking for work, which is observed in the negative correlation between the financial crisis and the labor force participation rate.

The effects of capital formation are quite complicated, but they can be clearly explained through observation of important links with labor productivity and participation. Capital formation is divided into capital originating from the public and private sectors. In addition, the effects of capital formation are hypothesized to differ before and after the East Asian financial crisis. For this reason, interaction terms with the crisis variable are also included in the estimation. The results appear to oppose each other, but the explanation of this strange result helps to better understand the patterns and economic trends in Thailand.

Increased investment in capital formation from the public sector prior to the financial crisis reduces the labor force participation rate. After the financial crisis, however, capital formation in both public and private sectors raise the participation rate. These opposing effects may be explained by observing the *type* of capital that is purchased. Physical capital can be divided into labor-intensive and non-labor intensive capital. Non-labor intensive capital refers to capital that reduces or eliminates the need for labor by automating tasks. Machines in packaging or production factories are good examples of non-labor intensive capital and technology. On the other hand, computer-operated machinery or technologically advance instruments may require educated or skilled workers, defined as labor-intensive physical capital.

5.1.4 Health Consumption

The consumption of medical care reveals consumer preferences regarding the importance of good health and their opinions of the price of health care. It is thus important to study the patterns and trends in the purchase of medical care, particularly with respect to various changes in factors related to the financial, physical, and cultural accessibility of health care. The results of this estimation are provided in Table 5.4.

$$HC_t = \beta_{28} + \beta_{29}Y_t + \beta_{30}PD_t + \beta_{31}MTECH_t + \beta_{32}MRATIO_t + \beta_{33}EC_t + \beta_{34}UC_t + \varepsilon_4$$

Variable	Coefficient (Std. Error)
C	-9.9823 (14.230)
Y	0.0140 (0.0040)***
PD	0.0861 (0.0846)
MTECH	0.5390 (0.1145)***
MRATIO	0.1899 (0.3364)
EC	-3.2200 (0.8108)***
UC	0.1080 (0.8137)

Table 5.4 Estimation Results for Consumption of Health-Related Goods (HC)

Consumption of health related goods and services follows most of its predicted patterns. Income is positively correlated with consumption, which follows results theorized in general consumer theory. Price shows no statistically significant results, which also tends to follow the generally accepted economic predictions that demand for health care is relatively inelastic, or unresponsive, to price. In general, people who are sick will require some form of health care, whether it is through a doctor's visit, self-medication, or alternative medicine. This makes health care somewhat of a necessity, resulting in its inelasticity of demand in response to price.

Improvements in quality of service, including medical technology and personnel availability will also raise health care consumption. Such improvements in quality of care are likely to make consumers value this service more. Therefore, people who did not seek medical care in the past may have more confidence in the health care system and be more likely to see a doctor. In addition, improvements in diagnostic medical technology will probably raise supply-driven demand, which will increase health consumption.

The financial crisis variable also shows a significant negative effect on consumption. When Thailand's economy collapsed in 1997, all consumers were forced to reduce their spending patterns, even in the purchase of apparent necessities like proper medical care. According to the estimates provided, consumption of health care goods and

services dropped off by over 1.5 million Baht in the years following the financial crisis. This demonstrates the severe negative effects of the economic crash in 1997.

5.1.5 Private Consumption of Non-Health Goods

Observing patterns in the consumption of medical goods and services is useful and insightful in developing and identifying areas of focus for future health care policy. It is equally necessary, however, to describe and observe how consumer preferences in other areas are defined as well. In particular, it is important to identify how spending patterns in each area change in response to various policies. The results for the estimation of non-medical care purchases are given in Table 5.5.

$$NONHC_t = \beta_{35} + \beta_{36}Y_t + \beta_{37}CPI_t + \beta_{38}EC_t + \beta_{39}(MLR_t - INEX_t) + \beta_{40}EC_t * DY_t + \beta_{41}EC_t * (MLR_t - INEX_t) + \varepsilon_5$$

Variable	Coefficient (Std. Error)
C	-518.94 (137.01)***
Y	0.0709 (0.1286)
CPI	12.003 (3.2626)***
EC	930.76 (232.63)***
MLR-INEX	-1.2012 (1.9112)
EC*Y	0.2975 (0.1378)**
EC*(MLR-INEX)	-12.230 (2.6509)***
EC*CPI	-12.609 (3.9055)***

Table 5.5 Estimation Results for Non-Health related Consumption (NONHC)

This table shows that the primary factors affecting private consumption demonstrate outcomes that are in line with the hypothesized results. Income is positively related to consumption expenditures, which follows general economic consumer theory. As income rises, then, people will raise their general spending accordingly. Spending is somewhat limited, however, by the opportunity cost of borrowing money. The rate of borrowing, also measured by the interest rate, tends to encourage or discourage people from spending money beyond their income. People are more willing to go into debt to consume more today and pay off their debt at a later date when the interest rate and cost of borrowing are low. Prior to the economic crisis, results are not conclusive, but after the economic crash, the real interest rate is *significantly* negatively related to patterns in consumption.

Price also proves to have a statistically significant effect on spending. Prior to the crisis, the price index (CPI) has a positive effect on spending, which would during this period, consumers tend to chose to purchase those goods that are included in the CPI bundle, and as their prices rise, consumers cannot reduce their purchases significantly,

because most goods in the CPI bundle are necessities. Therefore, as price rises, so too must total spending on consumption of non-health goods.

After the crisis, the predicted results are prominently shown in the results. Income is strongly positively associated with non-health care spending, while interest rates and price show significantly negative correlations with spending, which follows general expected results described in general consumer theory.

The financial crisis of 1997 displays a positive effect on the level of private consumption, which means that in the period during and after the crisis, total spending on non-health commodities rose. As the value of the Thai Baht falls, a particular bundle of goods will be more expensive after the crisis than before. If consumers adjust their consumption very little, then, it is not unlikely to observe a rise in total purchases as a result of the economic crisis.

5.1.6 Private Investment

The measure of private investment is an important part of the economic sub-model discussed, but inconsequential to health variables because it does not include nor is included as part of the estimation of health variables. The results in the estimation of private investment are given in Table 5.6.

$$I_t = \beta_{42} + \beta_{43} \left(\frac{M2A_{t-1}}{CORE_{t-1}} \right) + \beta_{44} CAPU_{t-1} + \beta_{45} EC_t + \beta_{46} (MLR_{t-1} - INEX_{t-1}) + \beta_{47} I_{t-1} + \varepsilon_6$$

Variable	Coefficient (Std. Error)
C	60.431 (144.35)
M2A(-1)/CAPU(-1)	0.0013 (0.0013)
CAPU(-1)	0.3284 (1.2542)
EC	-51.771 (20.778)**
MLR(-1)-INEX(-1)	-4.4662 (1.5750)***
I _{t-1}	0.7008 (0.1020)***

Table 5.6. Estimation Results for Private Investment (I)

The main variables influencing investment also follow most prior predictions and expectations. Real interest rates are negatively correlated with investment levels. A one percent-point rise in the real interest rate causes investment to fall by 4 million Baht. This is easily explained through general economic theory. As borrowing is less expensive, it is not surprising that businesses will plan to make large investments, as their costs are relatively lower.

In addition, the lagged investment variable also proves to be positively correlated to investment, as expected. The correlation with the lagged investment variable

demonstrates that investments made are generally rational. Investments will continually rise unless some adverse shock induces a change in investment patterns. The final significant variable is that representative of the financial crisis. This estimation clearly shows that the economic crash had a significant negative effect, causing private investment to drop by almost 52 million Baht upon the onset of the crisis in 1997.

5.1.7 Imports

Trade factors can be important to both economic and health factors in Thailand. Many important pharmaceutical products are imported from abroad, particularly new medicines and instruments used in the medical field. Because Thailand is more advanced in drug production than many countries in the region, many domestically produced medicines are exported to surrounding areas as well. Data in these areas, however, are very limited, thus restricting the definition of exports and imports within the model. Because there is little evidence of a direct relationship between exports and health, the export of goods and services (X) remains an exogenously-determined variable. The equation estimated for imports, however, includes only financial variables and are unable to distinguish the health care effects from these general variables. The results from the estimation are shown in Table 5.7.

$$M_t = \beta_{48} + \beta_{49}GDP_t + \beta_{50}\left(\frac{PM_t * EX_t}{GDP_t}\right) * 100 + \beta_{51}CAPU_{t-1} + \beta_{52}EC_t + \beta_{53}M_{t-1} + \beta_{54}EC_t * M_t + \varepsilon_7$$

Variable	Coefficient (Std. Error)
C	-836.43 (202.49)***
GDP	0.3470 (0.1036)***
((PM*EX)/GDP)*100	0.8699 (0.2180)***
CAPU(-1)	3.1535 (1.5718)
EC	329.23 (91.950)***
M(-1)	1.0601 (0.1427)***
EC*M(-1)	-0.5737 (0.1614)***

Table 5.7 Estimation Results for Imports (M)

The results show contradicting reflections of real price, which are quite significant and thus cannot be ignored. One unusual result is the positive correlation between exports and their price. There is a general expectation in economics that as the price index of exports falls, exports purchased should also rise, but in fact the opposite occurs in this case. One possibility to consider for any results within the model is that these estimations make conclusions only about the correlation but do not specify the direction of *causality* in any of the relationships. It is quite possible that it is a rising demand of exports, as

expressed through their rising purchase, which leads to the rise in price, and not the other way around. This would easily explain the strange conclusions made within the model.

The effects of the financial crisis will have a positive effect on imports. To better explain or describe this results, it is useful to examine the composition of imports. The bulk of Thailand's imports (M) tend to be concentrated in goods that serve as inputs in further production. In addition, it is important to note that the crisis variable applies to the period following the crisis as well. Thus, the economic recovery that occurs after the crisis will probably cause imports to continue to rise, which is also expressed through the coefficient on this variable. It is also important to note the important effects of the interaction term between the lagged imports variable and the economic crisis, which tends to show that despite the single positive shock that results from the crisis, imports gradually fall from year to year after the onset of the financial crisis.

Imports are also positively related to income. As local GDP rises, people will purchase more imports, as they purchase more of all goods and services. The price index of imports, again, shows effects that contradict expectations, and the simplest explanation follows the one given in the description of exports. As prices rise, so do the purchase of imports. It is possible that the *causality* actually occurs in the opposite direction, and it is the rise in the demand for imports that causes the price to rise. Another explanation attributes the strange result to the inclusion of other variable in the measure of the price index. Because estimates of the import price index within the imports equation also include exchange rate changes and GDP changes, it is possible that these effects are more significant, and it is the effects of these factors that are observed in the coefficient estimations shown.

5.1.8 Financial Sector

To accurately describe all the components of the Thai economy, it is important to include equations that depict the financial sector as well as the scope of expenditure. Toward this end, inflation rate and price index estimations are estimated. The results are shown in Tables 5.8-5.9 below.

Most of the variables included in the exchange rate follow expectations predicted before estimating the equation. The difference in interest rates and ratios of price indices in Thailand and the US are negatively related to the exchange rate. This means that if price levels in Thailand fall relative to the US, the exchange rate depreciates due to lower demand for Thai currency. Similarly, if interest rates or International Reserve holdings in

Thailand fall relative to the US, the exchange rate will also depreciate. The exchange rates of neighboring countries are closely related to Thailand's exchange rate, showing a significant positive correlation. Finally, the financial crisis has also has a positive correlation, depicting the significant depreciation that resulted from the financial crisis.

$$\ln(CORE_t) = \beta_{55} + \beta_{56} \ln(PM_NOIL_{t-1}) + \beta_{57} \ln(CORE_{t-1}) + \varepsilon_8$$

Variable	Coefficient (Std. Error)
C	0.1185 (0.0407)***
ln(pm_noil(-1))	-0.0008 (0.0070)
ln(core(-1))	0.9762 (0.0155)***

Table 5.8 Results for the CORE price index (CORE)

$$INEX_t = \beta_{58} + \beta_{59} CORE_t + \beta_{60} INEX_{t-1} + \varepsilon_9$$

Variable	Coefficient (Std. Error)
c	2.3299 (0.8514)***
core	-0.0191 (0.0087)***
inex(-1)	0.3711 (0.1268)***

Table 5.9 Estimation Results for the Expected Inflation Rate (INEX).

The price index, denoted as *core*, is related to its previous value and to the price index of imports. If the price of imports rises, the price index of goods, excluding oil and food, will also rise. The level of expected inflation, however, shows an effect opposite that expected. In general a rise in price level *should* result in higher inflation. If consumers are rational, high inflation in the present should also raise expected inflation; however, the results of this estimation show that the price index is in fact negatively related to the level of expected inflation. Because there are so few variables included in this estimation, it is quite possible that this result reflects omitted variable bias. Or, correlation between the lagged inflation variable and the price index may result in the collinearity problem, which is another explanation for this strange result.

5.1.9 Earned Labor Income (YL)

The regression of earned labor income demonstrates relationships that are consistent with expectations. If the economy is doing well, earned incomes should also be high, as shown by the consistently positive nature of the association between gross domestic product and income. When the economy is doing poorly, earned incomes will also be low. This point is reinforced by the negative coefficient on the financial crisis

dummy variable. The economy suffered a severe setback with the onset of the crisis, and these effects are apparent in the negative correlation between the financial crisis and earned income. The results of this estimation are shown below in Table 5.10.

$$YL_t = \beta_{61} + \beta_{62}POPW_t + \beta_{63}ED_t + \beta_{64}TMR_t + \beta_{65}LFR_t + \beta_{66}EC_t + \beta_{67}INEX_t + \varepsilon_{10}$$

Variable	Coefficient (Std. Error)
C	-777.91 (129.89)***
POPW	0.0351 (0.0023)***
ED	-0.0100 (0.0455)
TMR	-24.777 (5.8993)***
LFR	-386.20 (118.59)***
EC	-38.695 (7.7552)***
INEX	5.8641 (2.4956)**

Table 5.10 Estimation Results of Earned Labor Income (YL)

The effects of health, in this equation work through the total mortality, which does not show a conclusive connection with the earned income for the population. A different yet important depiction of the health in the economy is through the size of the working population. When health improves, more children survive into adulthood and enter the labor force. In addition, adults who are currently working will likely live longer with better health conditions and provisions, which will also raise the work-aged population. A rise in the size of the workforce has shown to have a positive effect on the incomes earned, as shown.

Health, as expressed through the mortality rate, also shows that health has a positive effect on earned labor income. As mortality (TMR) falls, earned labor income will rise by a significant amount. For every 1 point fall in the mortality rate (i.e., as the number of deaths falls by 1 per 1,000 people), earned labor income will rise by almost 25 million Baht. Clearly, this variable is likely also representative of other health-related variables. It is important to note that health and factors that affect health show significant effects on income and effects of the Thai economy.

The labor force participation rate (LFR) is also significantly negatively related to earned labor income. As the labor force participation rate falls, people will leave the work force and the supply of labor may become scarce. As labor is harder to find, employers are willing to pay higher wages, which will also raise the level of earned labor income. It is also important to note that it is unclear the direction of this correlation. The effect could possibly be reversed: as earned labor income rises, people may feel that their earnings are high enough and may choose to work fewer hours. A family with two working parents

may choose to change to a single-working parent structure to accommodate their family needs.

The economic crisis also demonstrates a significant negative association with the level of earned income. The adverse effects of the economic crisis are certain to influence the levels of economic performance on both employer and employees. In economic hardship, businesses have no demand for workers, and employees are likely to find it difficult to find work and may find alternatives to work, such as continuing their education or moving abroad to find work. Finally, expected inflation is positively related to income, which is reasonable since the measures of income are not in real terms.

5.2 Initial Two-Stage Least Squares Estimation: System Calibration

The comparison of actual data and model estimates of each of the 19 endogenous variables are given in Appendix M. It clearly shows that this model offers a rather accurate estimate of the interactive effects of health and economic factors. This precision suggests that implications of policy changes should be reliable using the model presented here. The accuracy in these predictions may be more clearly demonstrated graphically, as also shown in Appendix L.

5.3 Policy Tests

To better understand the effects of individual variables, changes are tested one at a time, as well as in combination. It is not unusual to encounter several simultaneous changes. For example, when the economy improves, government spending in the health care sectors, as well as other sectors. Because this model seeks to identify the influence of specific health-related variables, it is important to determine and define the magnitude and direction of the linkages between the potential policy instruments with health and economic indicators in the model.

Each scenario or case study is tested, and results are compared to the results of the calibration series. The first tests display the changes that result from the single adjustment of individual variables. The results of such a test will show the connections and linkages between particular policy variables and the economic and health factors that are depicted in the model. These types of changes, however, are not useful in many realistic situations. The second half of this section therefore presents circumstances when more than one variable is adjusted, to represent changes that could occur in actual policy implementation.

5.3.1 Universal Coverage Scheme Policy (UC)

The first policy test was to test the effects of the universal coverage, or *๑30-baht* scheme. To examine these changes closely, it is useful to compare the model results when the Universal Coverage Scheme is *๑on* (i.e., UC variable = 1) *versus* when it is *๑off* (i.e. UC variable = 0). A specific case is compared in Table 5.10. This table compares the difference between the scenario with and without the universal coverage scheme in two different periods. In 1997, the UC scheme was not yet implemented, so that the first scenario compares the original calibration with a test in which the UC was implemented prematurely, in 1995. Similarly, the 2003 scenario compares the calibration series, where UC was implemented in 2001 with a situation in which the UC scheme was delayed to the second quarter of 2003. This table shows the absolute and percentage difference between the values estimated in the calibrated and test scenarios.

Variable	1998				2002			
	UC "off"	UC "on"	change	%-change	UC "off"	UC "on"	change	%-change
CONS	645.15	641.55	-3.597	-0.558%	768.94	766.74	-2.201	-0.286%
G	190.31	190.31	0.000	0.000%	259.82	259.82	0.000	0.000%
GDP	1,203.5	1,200.5	-3.038	-0.252%	1,317.6	1,315.7	-1.883	-0.143%
HC	21.730	21.244	-0.486	-2.235%	20.135	20.317	0.181	0.901%
LFR	0.7113	0.7164	0.005	0.728%	0.7112	0.7163	0.005	0.728%
NONHC	623.42	620.31	-3.111	-0.499%	748.81	746.43	-2.383	-0.318%
TFR	1,594.4	1,570.3	-24.123	-1.513%	1,354.2	1,372.9	18.675	1.379%
TMR	5.2239	5.4634	0.239	4.584%	5.8432	6.0088	0.166	2.833%
TPOP	61,401	61,387	-14.560	-0.024%	63,552	63,542	-10.450	-0.016%
Y	1,241.3	1,232.9	-8.444	-0.680%	1,341.7	1,335.2	-6.467	-0.482%
YL	370.13	361.68	-8.444	-2.281%	433.48	427.01	-6.467	-1.492%

Table 5.12 Comparison of Predictions with and without Universal Coverage (UC).

This table illustrates several important points. The first point is the difference in the mortality rate when the universal coverage scheme is *๑on* the mortality rate is *higher* than when the universal coverage scheme is *๑off*. This suggests that the universal coverage scheme will have, at best, no significant effect on the health status in Thailand. In addition, the level of earned income falls, which implies that the productivity of labor has deteriorated. This further proves that the universal health care (UC) scheme has little, if any, prominent effect on actual *health* of the country.

It is also interesting to note the changes in spending patterns with respect to the implementation of universal coverage (UC). If the government's intention in proposing the universal care scheme is to reduce the burden of health care on private consumers, then

private health care consumption (HC) should fall in the case where universal health care is implemented, holding all other factors constant. The table above shows that health care spending falls when the coverage scheme has been implemented in 1993, but in the later case, the opposite is true and health care consumption actually *rises* in response to the universal coverage scheme. In 1998, spending in health consumption falls, because health care is provided by the government instead of by the consumer. In 2002, however, effects of the type and quality of care, or the progression of the learning curve on the part of the public likely caused adverse changes in spending patterns. Private consumers shifted spending *towards* health care and *away* from consumption of other commodities.

Another point of interest and conflict are the changes in fertility. Fertility in 1998 is predicted to be lower if the universal coverage scheme is in place, but in 2002 the opposite relationship is observed. This is another phenomenon that may result from the differences in the economic and social structure of Thai society, as a result of the economic crisis in 1998. In early 1998, the economy is doing well and women may utilize the extra family planning units to obtain birth control or counseling, which have caused fertility to fall. In 2003, on the other hand, women may be more careful not to have children if they are aware of the poor economic conditions. If health care is provided to women, however, they may be more likely to have children and seek maternal and child care or family planning services made available to them.

Comparisons of these two time periods offer several interesting observations. The conflicting results seen in the juxtaposition of the effects of the universal coverage scheme these two periods offers an important insight on the importance of the appropriate environment and circumstances needed for the effective implementation of the universal coverage scheme. Implementation during economic prosperity, as was the case in 1998, shows positive changes by alleviating private consumer spending on health and lowering fertility. In 2003, however, the opposite seems to be true. Not only do mortality and fertility rise as a result of the universal coverage scheme, but consumers often spend *more* on health care than prior to implementation of the universal coverage scheme, often due to a shift in the utilization from public to private services. This case study demonstrates the importance of studying the existing situation and circumstances before policy test and implementation.

5.3.2 Policy on Price of Pharmaceuticals and Health Care (PD)

General economic theory dictates that as the price of a good or service falls, demand for that item will increase in response. In the case of medical drugs and care, consumer response is not expected to be very different. When the price of health care falls, people tend to seek out a physician's care in situations where they may have self-treated otherwise. Similarly, when the price of health care, however, most people will seek out substitutes, such as self-treating through their own medication or seeking alternative medicine or other outlets for receiving medical attention. It is unclear how well these alternatives will treat or cure disease. Poor alternatives will lower health status and are likely to have detrimental consequences on the economic output of society. The results are shown in Table 5.11.

† Variable	-10% (A)		-25% (B)		+10% (C)		+25% (D)	
	† amount	%	† amount	%	† amount	%	† amount	%
CONS	-3.730	-0.424%	-8.799	-1.000%	2.737	0.311%	7.381	0.839%
GDP	-3.176	-0.207%	-7.495	-0.487%	2.329	0.151%	6.279	0.408%
HC	-1.264	-5.172%	-2.891	-11.82%	0.894	3.655%	2.504	10.244%
NONHC	-2.465	-0.288%	-5.908	-0.691%	1.843	0.215%	4.876	0.570%
TFR	-27.48	-1.970%	-51.95	-3.725%	5.876	0.421%	31.44	2.255%
TMR	0.248	4.161%	0.593	9.969%	-0.185	-3.110%	-0.490	-8.228%
TPOP	-15.86	-0.025%	-38.01	-0.059%	11.86	0.018%	31.37	0.049%
Y	-6.691	-0.426%	-16.03	-1.021%	5.003	0.319%	13.23	0.843%
YL	-6.692	-1.443%	-16.03	-3.458%	5.003	1.079%	13.23	2.854%

Table 5.11. Results of tests in changes on price of health care (PD).

Of particular interest is the observed influence of price on health status, which shows a relationship opposite the predicted outcomes. As medical goods and services get more expensive, total mortality (TMR) actually *falls*. Less expensive health care, on the other hand, results in poorer health, as observed in scenario C: in the study, a 3% rise in the mortality rate results from a mere 10% rise in the price level. One potential explanation for such a phenomenon is that the price serves as an indicator for the quality of goods and services provided. New pharmaceuticals and treatments are constantly entering the market, making the potential for improvement in health correlated with the price of new effective drugs used as treatment. In addition, rises in the price of medical services (PD) is likely to improve diagnostic accuracy and treatment, which should also improve health outcomes.

Another point of interest is the separate effect of the health care price on income and the economic performance. Changes in the price of health-related goods and services are directly related to the future economic progress. If the general price level of health care

goods and services fall, then most economic indicators will also fall. Both gross domestic product (GDP) and earned income (YL) will decrease, as shown in scenarios A and B. If the changes are observed in slightly more detail, the drive or motivation behind this linkage is clearer. The lower price of health care goods and services will discourage consumers from purchasing medical products, as opposed to other goods. Specifically, the medical care spending will disproportionately fall by 5%, while other spending rises by less than three-tenths of one percent. This lowered expenditure is also reflected in the 0.2% fall in GDP, as shown in scenario A. It is an unusual and insightful connection between the price of health care and its potential economic repercussions.

5.3.3 Ratio of Population-to-Medical Personnel (MRATIO)

The availability and accessibility of medical care personnel is a clear determinant of the quality of not only health status but also of the quality of health care services provided to the community. Often, it is the human aspect of medicine that is most important to the quality of service provided. A talented and well-trained doctor can often treat a patient well, even under less than ideal circumstances. In this way, the ratio of population to medical professionals is even more important than issues of price or medical technology. The number of medical professionals includes physicians, dentists, and nurses, as a ratio: the total number of professionals per 1,000 population. A rise in this figure is indicative of the increasing availability of health care services. Such a rise, therefore should improve the health of the general population as well.

Three different scenarios test the effects of various levels of changes on the ratio of medical personnel per 1,000 population, as outlined in Table 5.12. The rise in the concentration of medical personnel has several relevant effects on health and consumption patterns, which should be noted. First are the effects on the general health status. In particular, rises in the concentration of medical personnel improve the health status, as observed through the clearly defined drop in the mortality rate. Fertility, on the other hand, shows a counterintuitive effect: the rise in fertility that results from the rise in the availability of trained medical personnel is likely representative of the effect that increased quality of service will have on the health of pregnant women. As described earlier, improved accessibility and quality of services will improve the likelihood that women will carry their babies to term and deliver healthy babies.

† Variable	-10% (A)		+10% (C)		+25% (D)	
	† amount	%	† amount	%	† amount	%
CONS	-1.894	-0.215%	1.858	0.211%	4.577	0.520%
GDP	-1.613	-0.105%	1.581	0.103%	3.894	0.253%
HC	-0.424	-1.736%	0.423	1.730%	1.055	4.315%
NONHC	-1.470	-0.172%	1.435	0.168%	3.522	0.412%
TFR	-107.3	-7.696%	104.5	7.491%	262.9	18.86%
TMR	0.148	2.481%	-0.144	-2.421%	-0.354	-5.943%
TPOP	-9.460	-0.015%	9.230	0.014%	22.66	0.035%
Y	† -3.990	-0.254%	3.894	0.248%	9.559	0.609%
YL	-3.935	-0.871%	3.842	0.851%	9.436	2.089%

Table 5.12. Results of tests in changes on number of medical personnel (MRATIO).

Another interesting note is the pattern in spending. Notice that as the ratio of medical personnel per population falls, consumer spending also falls, as people choose to save their money. More interesting than the changes in total private consumption is the comparison of medical care spending versus non-medical care spending. Consumption of medical care and related goods falls disproportionately more compared to non-medical spending. One likely reason for this is the change in the *prices* of health-related goods and services. As the supply or availability of physicians and other medical personnel rises, competition amongst the medical care facilities and clinics will also rise. As the number of clinic rise and the competition among these health care providers increases, clinics and providers will have to enter a pricing war in their fight for patients, which will cause the general price level of goods and services in the medical field to fall. The fall in price is directly reflected in the fall in medical care spending.

5.3.4 Education of the Population (ED)

Education and health are long noted be complementary services. Good health improves student attendance and concentration levels in school, while education allows students to better understand and look out for their own health. It is important, then, to observe the effects that changes in the size of the educated population may have on both the health and economic status. Discussion of the effects of education on health and other economic factors are detailed in the initial estimation of each of the eleven econometric equations. Although the possible economic effects are unclear, health indicators, due to the finishing touches are certain to be improved with a more highly educated population.

The results, shown in Table 5.13, illustrate a significant and important relationship between the educated population and the other equations that depict important health and economic factors.

† Variable	-10% (A)		-25% (B)		+10% (C)		+25% (D)	
	amount	%	amount	%	amount	%	amount	%
CONS	3.184	0.362%	7.930	0.901%	-4.512	-0.513%	-11.45	-1.301%
GDP	2.709	0.176%	6.746	0.439%	-3.842	-0.250%	-9.754	-0.634%
HC	-0.051	-0.208%	0.123	0.503%	-0.332	-1.359%	-0.586	-2.397%
LFR	0.009	1.306%	0.024	3.298%	-0.009	-1.289%	-0.023	-3.192%
NONHC	3.234	0.378%	7.807	0.913%	-4.179	-0.489%	-10.86	-1.270%
TFR	-39.30	-2.818%	-80.74	-5.790%	18.13	1.300%	62.91	4.511%
TMR	-0.434	-7.286%	-1.059	-17.80%	0.527	8.851%	1.355	22.77%
TPOP	27.78	0.043%	67.86	0.105%	-33.74	-0.052%	-86.81	-0.135%
Y	† 8.779	0.559%	21.19	1.349%	-11.34	-0.722%	-29.48	-1.877%
YL	8.779	1.893%	21.19	4.569%	-11.34	-2.446%	-29.48	-6.357%

Table 5.13. Results of the tests in changes in education (ED).

The two scenarios differ only by the magnitude of the change in the population enrolled in an educational institution, but show significantly different results, which is further testimony to the complicated interactive relationship between education and health. It is important to recall, in analyzing and examining this evidence, that the education variable captures only those people currently enrolled in school, and because data on the education levels of the general population are unavailable. As a result, the education variable is inclusive of a particular age group, specifically the 16-30 age group, which may be the actual factor that is causing such results. This fact makes the somewhat unusual outcomes in fertility and mortality more plausible. People in this age group are more likely to participate in risky behaviors, which will likely cause mortality to rise. In addition, people in this age group are in the prime of their child-bearing years, which means that as the number of people in this group rises, fertility should rise as well.

It is also interesting to note the economic results of changes in education. As the number of people enrolled in education rises, income falls. The reason for such an unusual result may be because people who enroll in school tend to drop out of the work force, which means that they are unable to produce economic output or improve the economy. It would be useful, then, to re-run this model with a better measure of education, and a measure of the general age or age populations, to better separate and identify the effects of each group.

5.3.5 Amount of Spending on Medical Technology (MTECH)

Spending on advances in medical technology are certain to help the health and, subsequently, the economic standing in Thailand. Technology, like the concentration and quality of medical personnel, helps improve diagnostic accuracy and effectiveness of treatment. In this regard, then, a rise in spending on medical technology should also

improve health outcomes. This includes a lower fertility rate, and the possible reflection of improved health through an increase in the labor productivity. This is difficult to measure, which makes it difficult to observe and delineate between the effects that result from medical technology versus other spurious or related variables. These variables and the various changes observed are further described below.

† Variable	-10% (A)		-25% (B)		+25% (C)	
	† amount	%	† amount	%	† amount	%
CONS	-0.914	-0.104%	-1.602	-0.182%	0.682	0.077%
GDP	-0.778	-0.051%	-1.364	-0.089%	0.580	0.038%
HC	-0.368	-1.505%	-0.644	-2.634%	0.276	1.128%
NONHC	-0.546	-0.064%	-0.958	-0.112%	0.406	0.047%
TFR	-21.72	-1.558%	-37.79	-2.710%	16.52	1.185%
TMR	0.055	0.921%	0.096	1.617%	-0.041	-0.685%
TPOP	-3.510	-0.005%	-6.160	-0.010%	2.610	0.004%
Y	† -1.481	-0.094%	-2.600	-0.166%	1.102	0.070%
YL	-1.481	-0.319%	-2.601	-0.561%	1.102	0.238%

Table 5.14. Results of the tests in changes in Medical Technology (MTECH).

In Table 5.14, three different scenarios are depicted: a 25% rise and a 10% and 25% fall in spending on medical technology. Several changes and results are important to note as a result of this rise in purchases of and investment in medical technology. One striking result is that a 10% rise in investment in medical technology produces no change in any variable, and thus was not included in the table results. This results suggests that medical technology in Thailand has reached a plateau, and that significant investments must be made to purchase any additional technology that will prove to make a marked difference in Thai society.

Another interesting result is the increase of the statistic result of medical care spending, which rises by over 1% with a 25% rise in investments in medical care technology. This may be a partial result of changes in the price and perceived quality of care, in addition to increased demand for health care services. Usually, heavy investments in medical technology means the development and marketing of new technologically advanced instruments that prove more accurate and efficient use in diagnostic analysis. New instruments of such sort are likely to be used frequently, particularly in the few months following acquisition of such an instrument. This, in turn, passes part of the costs of this investment onto the patient or private consumer in terms of medical care and stay fees. This will drive consumers out of the market, but medical care is necessary enough that the fall in the number of purchasers is not enough to offset the change in price, which explains why medical care rises under such strange circumstances.

Increasing spending or investment in medical technology has a proven effect on health as well as consumption patterns. Clearly, the total mortality rate falls significantly with a rise in spending and investment in new medical technology. This decline is also likely to be related to improved diagnosis and treatment abilities of doctors utilizing this new technology. Physicians and hospitals are more capable of identifying and treating disease at an early stage, which will prolong and improve the health status and lifetime of many patients. The improved health that results from better technology will, in turn, raise the general income level, which is observed in the increase in the gross domestic product. It is interesting to note, however, that the rise in GDP is not nearly as high as the 25% rise in the investments made in medical care technology. This type of policy, then, appears only slightly effective as a direct policy to improve the economy, but because it will improve the economy through its improvement of the quality of life, this type of policy shows a certain appeal to policy makers truly looking to improve the general standard of living and quality of life in Thailand.

5.3.6 Government Expenditures (G)

Changes in fiscal policy are one of the simplest and most direct approaches to improving social status in any country, particularly developing countries. Governments of low-to-middle income countries, however, face a similar dilemma: how can a country balance between the importance of each social or economic program? To answer this question, tests are run to closely examine the effects of different types of fiscal policy that can be tested in Thailand's economy. The first test studies the effects of increased investments in the structure and quality of the health care system. The second part studies the economy response to improvements in other forms of infrastructure, which include investments in the education or industrial sectors.

5.3.6.1 Government Health Expenditures (GH)

History has shown that government spending and priorities have a significant impact on the direction of health policy as well as health care infrastructure in Thai society. It was the Thai government that established and expanded the infrastructure and hospital network in Thailand during the 1960s. It was the drive of the government that designed and implemented the various insurance schemes throughout the past 30 years, including the 30-Baht Universal Coverage scheme. During the economic boom of the early 1990s, the Thai government was committed to improving the infrastructure and

network of health care facilities available to the public, and even after the economic crisis, it was the government's commitment to the further social development of the Thai population that prevented further decline or deterioration of aggregate health statistics.

Government spending on health can take place in many forms. In the beginnings of the health care system, most government health expenditure consisted of establishment and expansion of a health care network throughout the country. Later, the government's focus moved to insuring people who were not prepared for medical problems or catastrophe, through social welfare and even voluntary insurance schemes. Then, government policy moved towards investment in new technology during the early boom years. Finally, the focus of the government moved towards universal coverage, launched in 2001. Increased public health expenditures, then, should tend to improve the health status, without proving a significant economic burden on either private consumers or general economic output. Specifically, then, it is important to observe the gross domestic product, as well as total mortality rate and other indicators of health and economic conditions.

† Variable	-10% (A)		-25% (B)		+10% (C)		+25% (D)	
	† amount	%	† amount	%	† amount	%	† amount	%
CONS	-1.039	-0.118%	-1.922	-0.218%	0.574	0.065%	1.426	0.162%
G	-2.708	-0.908%	-6.770	-2.270%	2.708	0.908%	6.770	2.270%
GDP	-3.190	-0.207%	-7.405	-0.482%	2.793	0.182%	6.972	0.453%
HC	-0.205	-0.840%	-0.238	-0.972%	0.021	0.086%	0.052	0.213%
NONHC	-0.833	-0.097%	-1.685	-0.197%	0.553	0.065%	1.374	0.161%
TFR	-9.687	-0.695%	-7.856	-0.563%	-1.225	-0.088%	-13.94	-1.000%
TMR	0.084	1.406%	0.169	2.843%	-0.056	-0.934%	-0.138	-2.318%
TPOP	-5.360	-0.008%	-10.84	-0.017%	3.560	0.006%	8.840	0.014%
Y	-2.261	-0.144%	-4.572	-0.291%	1.502	0.096%	3.729	0.237%
YL	-2.262	-0.488%	-4.573	-0.986%	1.502	0.324%	3.728	0.804%

Table 5.15 Results of the test of changes in the levels of public health expenditure (GH).

The results for several different changes in the levels of government spending are given in Table 5.15. The clearest effects are demonstrated by the significant changes aggregate health and economic indicators. Health indicators improve significantly. Both total mortality and total fertility fall significantly. Total mortality falls by almost 1%, while fertility falls by a much lower amount. These indicators show that government expenditure does, in fact, have an important effect on health status. Government expenditure on health should also affect the economy through two channels. First, any type of government spending directly feeds into and contributes to economic output. Second, by improving health status, the government's expenditure on health care will

improve the productivity and size of the labor force, which will consequently raise the economic output.

This exercise shows that government expenditures lead to the desired results in terms of both health and economic outcomes. The mortality and fertility rates fall, implying significantly improved levels of health. In addition, earned income and output (GDP) rise, which produces better economic standing in both scenarios C and D. According to this model, then, changing patterns in government spending appears to be the most effective way to improve both health and economic status in Thailand's economy.

5.3.6.2 Other Government Expenditures (GOTH)

The government has a limited budget, which must be carefully allocated to bring about the most desirable result in terms of both social and economic factors. To better understand the trade-offs and opportunity costs of investing in each sector, it is valuable to examine the effects of investing in other government expenditures. Although it is not directly associated with any health variables, clearly higher investment in this sector will occur only at the cost of *not* investing in the health care sector. The results for this test are given in Table 5.16.

† Variable	-10% (A)		-25% (B)		+10% (C)		+25% (D)	
	† amount	%	† amount	%	† amount	%	† amount	%
CONS	-0.447	-0.051%	-0.433	-0.049%	-0.466	-0.053%	-0.479	-0.054%
G	-27.12	-9.092%	-67.80	-22.73%	27.12	9.092%	67.80	22.73%
GDP	-23.52	-1.529%	-58.42	-3.799%	22.64	1.472%	57.00	3.707%
HC	-0.184	-0.751%	-0.183	-0.749%	-0.184	-0.754%	-0.185	-0.756%
NONHC	-0.263	-0.031%	-0.249	-0.029%	-0.281	-0.033%	-0.295	-0.034%
TFR	-8.322	-0.597%	-4.416	-0.317%	-13.47	-0.966%	-17.29	-1.240%
TMR	0.026	0.444%	0.025	0.421%	0.028	0.475%	0.030	0.497%
TPOP	-1.690	-0.003%	-1.600	-0.002%	-1.810	-0.003%	-1.900	-0.003%
Y	-0.714	-0.045%	-0.677	-0.043%	-0.763	-0.049%	-0.799	-0.051%
YL	-0.714	-0.154%	-0.677	-0.146%	-0.763	-0.165%	-0.800	-0.173%

Table 5.16 Test of changes in the levels of public non-health expenditure (GOTH).

It is interesting to note that, although these changes prove to show some influence on health factors, health indicators change very little with respect to changes in the direction and magnitude of government expenditures. In fact, the only significant changes are those made in government spending and gross domestic product (GDP). The changes that occur in other variables are quite close in magnitude, regardless whether there is a rise or fall in government expenditures in non-health sectors. This evidence further shows that public investment in non-health sectors has virtually no bearing on health status, despite the positive effect on economic status.

5.3.7 Unearned Income (YOTH)

The previous test suggests that economic status appears to show little bearing on health outcomes. To further investigate this relationship, unearned income (YOTH) is increased, and its effects are shown in Table 5.17.

† Variable	† -10% (A)		† -25% (B)		† +10% (C)		† +25% (D)	
	amount	%	amount	%	amount	%	amount	%
CONS	-42.767	-4.860%	-106.23	-12.07%	41.855	4.757%	105.32	11.97%
G	-36.534	-2.376%	-91.272	-5.935%	35.510	2.309%	88.938	5.783%
GDP	-1.7321	-7.085%	-4.0543	-16.58%	1.3642	5.580%	3.6864	15.08%
HC	-41.035	-4.797%	-102.18	-11.94%	40.490	4.733%	101.63	11.88%
NONHC	-6.8670	-0.492%	-0.7290	-0.052%	-14.903	-1.069%	-20.833	-1.494%
TFR	0.0259	0.435%	0.0238	0.399%	0.0288	0.483%	0.0309	0.519%
TMR	-1.6600	-0.003%	-1.5200	-0.002%	-1.8400	-0.003%	-1.9800	-0.003%
TPOP	-111.37	-7.092%	-277.32	-17.66%	109.90	6.998%	275.85	17.57%
Y	-0.7004	-0.151%	-0.6422	-0.138%	-0.7771	-0.168%	-0.8340	-0.180%
YL	-42.767	-4.860%	-106.23	-12.07%	41.855	4.757%	105.32	11.97%

Table 5.17 Results of the test of changes in the levels of unearned income (YOTH).

Again, regardless of whether total income rises or falls, health factors remain almost constant, changing by only a small fraction of a percent. Spending patterns, on the other hand, change dramatically. Most notably, spending in health appears to be most responsive to income. As income rises, spending in health rises quite dramatically, whereas changes in other consumption are minimal. This offers further evidence that health indicators are virtually unaffected by changes in income or economic outcomes.

5.4 Problems and Areas for Further Research

The design and structure of the model still demonstrates several deficiencies and weaknesses that can be improved in later versions or adaptations of this model. Several of these limitations are a result of unavailable or incomplete data. As data collection becomes more organized and systematic, it may be useful to analyze this model again, with a larger data pool and more observations. Additional adequate data will allow policy-makers and researchers to make more definitive and reliable conclusions regarding the relationships between variables included in the model, and better predictions as to the results of various policy tests.

Another shortcoming of the research presented is that the observation period is a short 3 months. Annual data restricted the number of observations, which made quarterly data the choice for the observation period for this model. Quarterly data may present a problem it is not necessarily smooth. Data, particularly financial data, often oscillates when it is collected on a quarterly basis. If observed on an annual basis, however, the

differences will be shown as an average, which is likely to show rises and falls in the variables as gradual and smooth, rather than rapid and abrupt. In addition, when quarterly data was not collected, it was disaggregated through estimation methods, which are not as reliable as raw data. Once the time and data are more available, then, annual data may offer more conclusive results.

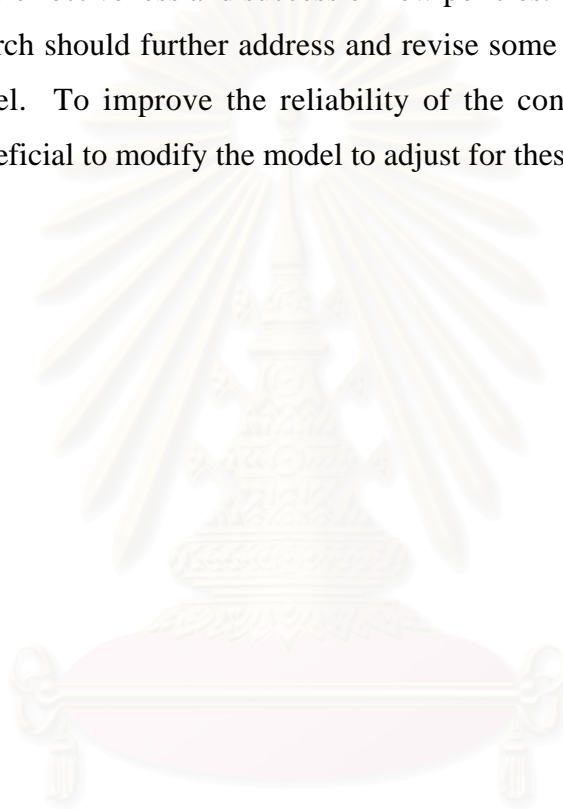
It is also important to take note of serial correlation inherent in this model. Serial correlation is an inevitable barrier present in any time-series estimation. Correcting this issue requires generating autoregressors or other statistics, which will effectively reduce the number of observations, and thus compromise the reliability and predictive power model. This problem with serial correlation is acknowledged, but corrections are quite complex and limited by the scope of and available data for this model. Therefore, it is important to note the possible problems that may arise, and this area may be pursued when more reliable and observations of data are available.

The relationship between education, health, and the economy is quite complex and serves as an important area for further investigation and interpretation. In the results discussed, this relationship is still quite unclear and inconclusive. Many past academics have noted the possible channels of interaction between health and education, as two social factors that complement each other but often fight for the same available money from government budgets. Several issues hinder the model. First, available data on education does not survey the number of people who have completed various levels of education, but only the people who are currently enrolled in school. This creates a somewhat distorted perspective on education in Thai society, because most people currently enrolled in school have similar characteristics, such as age and fertility. The second issue is that the model has not yet clearly stated the determination of the model. Therefore, it is difficult to make conclusive statements regarding status and links between education and other social and economic factors.

One omission from this model is the effects of imported medicines. Many Thais are of the general mentality that imported drugs are of a higher quality than domestically produced drugs, despite the fact that the structure of both drugs are identical. During the period of significant economic growth, most private consumers chose to purchase pharmaceutical drugs imported from abroad. Therefore, it may be interesting to study the patterns of the imports of pharmaceutical products abroad and how they may influence health indicators, as well as spending patterns and the amount of imports and how that may affect balance of trade.

An area of study that was neglected is the distribution of income among the population. In analyzing the results, incomes prove to have a positive effect with mortality, but one likely reason for this result is the differences in income distribution. Many studies show that during the period of significant economic growth, income disparity also grew. As the poor get poorer, their health will deteriorate more quickly, and it is important to define and study the links between income disparity or inequality and the social repercussions that result. This is a particularly important area that should offer further insight on the effectiveness and success of new policies.

Future research should further address and revise some of the problems that exist in the current model. To improve the reliability of the conclusions, it will be quite informative and beneficial to modify the model to adjust for these constraints.



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CHAPTER VI

SUMMARY AND CONCLUSIONS

6 Introduction

This paper designed a statistic model of the Thai economy, with a particular focus on the dynamic interaction between health and other factors in the economy. The introduction discussed the importance of health as a determinant of well-being, and the constant debate among policy-makers as to whether investments should be made toward the improvement of social factors or incomes and the progress of the economy. The literature review discusses a brief history of health care in Thailand, and also reviews studies that investigate the economic implications of health policy, including the effects of the health-poverty cycle and the effects of health insurance. In section three, the methodology of the model are explained in detail, to offer a better understanding of the rationale for the model's design. Section four offers a general overview of the data. Finally, section five offers a review of the results of the initial estimation and future tests of the effects of various scenarios and their effects on the important health and economic indicators.

6.1 Research Results

The analysis of this model and its tests have highlighted several conclusions:

- (a) Adjustments in the number of health care personnel and investments in medical care technology will affect the accessibility of health care services, which proves to have a substantial positive effect on health indicators.
- (b) The implementation of the universal coverage scheme (UCS), which provides health care to the whole population at minimal individual cost, has little effect on the health indicators but demonstrates a considerable effect on the consumption of health care goods and services
- (c) Government expenditures on health tend to have the most substantial effect on the health and economic factors or indicators included in the model
- (d) Effects of changes in education are quite complex and complicated, and interaction of education with health and economy needs further detailed investigation and tests
- (e) Income adjustments have virtually no effect on the health and well-being of the population, but instead demonstrates a considerable effect on the spending patterns in health versus non-health consumption

- (f) Price tends to be an indicator of the quality of health goods and services, so that as the price of health care rises, health indicators improve and as the price falls, health status in Thailand will decline

6.2 Policy Recommendations

The primary motivation for this research is to provide a tool to test proposed and future social and economic policy. Results from this research shows relevant and insightful recommendations for policy-makers concerning prioritization and proposal of social and economic programs:

- (a) Raising investments in medical care technology will show very subtle effects, but clearly reduces mortality and raises fertility
- (b) Increasing the number and accessibility of medical professionals is more effective than investments in medical technology, but tend to show that the better economy comes through higher private health care spending.
- (c) Fiscal policy aimed at improving the economy shows virtually no effect on health or other demographic factors, but demonstrates a prominent influence on the Thai economy
- (d) The universal coverage scheme (UCS) is ineffective in improving health, but reduces private health spending significantly
- (e) To produce the most positive results in both health and economy, governments should raise their investment in improving the accessibility, quality, and structure of the provision of health care services.

6.3 Areas for Further Research

Despite the prediction value of this model, several limitations to the research still exist. To offer better accuracy and reliability, several suggestions for further research are:

- (a) Annual data may be used instead of quarterly data, to offer data that averages out random variance and show smooth changes or adjustments in various data particularly financial data.
- (b) Data should be collected over a longer period of time. More data points means that the conclusions drawn from the model are statistically more reliable and are more useful for policy-makers. A longer period of observation can also provide more definitive and reliable results regarding the universal coverage scheme, which has not yet revealed conclusive results
- (c) A deeper investigation of the interaction between education, health, and the economy may be useful in the analysis of this model. This includes

finding different measures of education, health, and economic well-being as well as studying the possible relationships (linear or non-linear).

- (d) Data is primarily unavailable for imported pharmaceutical drugs and therefore are not addressed in this model. It is useful, however, to address this aspect of the economy and its potential interaction with health care and the health status of the population.
- (e) The equality of income distribution is ignored in this model, due to limited data availability and model constraints. It may be useful for analysis of economic well-being of the population, as well as an important factor determining the health indicators of the population.

6.4 Conclusion

This model demonstrates some of the key links between the health indicators and their effects on the economy. Any effect that changes in health may have on the economy are rather slight, but there is a clear trend that if investments are made to improve health, the economic effects are certain to follow. Government expenditures, in particular, will infuse money into the economy, by investing into the health care systems. This investment will cycle through the economy, thus improving output and incomes, and causing a virtuous cycle that will improve the well-being and wealth of the whole Thai population. The success of the model is shown in how policy-makers can utilize the model to identify directions for future policy and reform. The effects and scenarios tested in this model will offer some guidance in the vital areas for future health care, economic, and other social reform.



Appendices

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Appendix A. Burden of Disease by Age Groups

Table A1. Top Ten Causes of Disease Burden in Children (aged 0-14) by gender 1999

		Males		Females			
	Disease category	DALYs	%	Disease category	DALYs	%	
1	Low birth weight	91,934	11.6%	Low birth weight	83,879	12.7%	1
2	Birth trauma & asphyxia	66,575	8.4%	Birth trauma & asphyxia	57,475	8.7%	2
3	HIV/AIDS	45,345	5.7%	Lower respiratory tract infections	43,084	6.5%	3
4	Drownings	37,944	4.8%	Congenital heart disease	42,574	6.4%	4
5	Lower respiratory tract infections	37,407	4.7%	HIV/AIDS	3,975	6.0%	5
6	Traffic accidents	36,376	4.6%	Anemia	36,520	5.5%	6
7	Asthma	34,823	4.4%	Asthma	28,920	4.4%	7
8	Congenital heart disease	34,362	4.4%	Drownings	24,283	3.7%	8
9	Anemia	34,276	4.3%	Diarrhea	17,049	2.6%	9
10	Deafness	19,138	2.4%	Traffic accidents	16,601	2.5%	10

Table A2. Top Ten Causes of Disease Burden in Young Adults (aged 15-29) by gender, 1999

		Males		Females			
	Disease category	DALYs	%	Disease category	DALYs	%	
1	HIV/AIDS	346,363	28.8%	HIV/AIDS	172,995	30.2%	1
2	Traffic accidents	233,828	19.4%	Schizophrenia	47,442	8.3%	2
3	Drug dependence/harmful use	100,545	8.3%	Traffic accidents	40,107	7.0%	3
4	Alcohol dependence/harmful use	76,268	6.3%	Depression	36,285	6.3%	4
5	Suicides	63,349	4.3%	Anemia	25,471	4.4%	5
6	Homicide and violence	56,218	4.7%	Anxiety disorders	22,033	3.8%	6
7	Schizophrenia	51,279	4.3%	Suicides	19,406	3.4%	7
8	Drownings	24,772	2.1%	Sexually transmitted diseases	16,245	2.8%	8
9	Deafness	21,831	1.8%	Bipolar disorder	15,808	2.8%	9
10	Other intentional injuries	20,774	1.7%	Deafness	15,770	2.8%	10

Table A3. Top Ten Causes of Disease Burden in Adults (aged 30-59) by gender, 1999

Males				Females			
	Disease category	DALYs	%	Disease category	DALYs	%	
1	HIV/AIDS	561,368	23.1%	HIV/AIDS	157,174	11.1%	1
2	Traffic accidents	217,185	8.9%	Diabetes	121,267	8.6%	2
3	Liver cancer	146,256	6.0%	Depression	96,016	6.8%	3
4	Stroke	109,874	4.5%	Stroke	78,757	5.6%	4
5	Diabetes	85,988	3.5%	Osteoarthritis	75,391	5.3%	5
6	Homicide and violence	84,700	3.5%	Liver cancer	56,677	4.0%	6
7	Cirrhosis	82,764	0.3%	Traffic accidents	49,067	3.5%	7
8	Ischemic heart disease	80,914	3.3%	Deafness	48,604	3.4%	8
9	Suicides	75,546	3.1%	Anxiety disorders	41,888	3.0%	9
10	Depression	66,377	2.7%	COPD (emphysema)	36,641	2.6%	10

Table A4. Top Ten Causes of Disease Burden in the Elderly (aged over 59) by gender, 1999

Males				Females			
	Disease category	DALYs	%	Disease category	DALYs	%	
1	Stroke	150,915	13.2%	Stroke	196,042	15.4%	1
2	COPD (emphysema)	108,114	9.5%	Diabetes	134,040	10.5%	2
3	Liver cancer	96,952	8.5%	Cataracts	74,846	5.9%	3
4	Ischemic heart disease	75,386	6.6%	Ischemic heart disease	72,305	5.7%	4
5	Diabetes	69,959	6.1%	Dementia	66,560	5.2%	5
6	Lung cancer	51,564	4.5%	Liver cancer	59,461	4.7%	6
7	Cataracts	42,281	3.7%	COPD (emphysema)	55,636	4.4%	7
8	Tuberculosis	38,821	3.4%	Osteoarthritis	42,603	3.3%	8
9	Dementia	34,702	3.0%	Tuberculosis	34,807	2.7%	9
10	Osteoarthritis	31,157	2.7%	Nephritis & nephrosis	31,108	2.4%	10

Appendix B. Details of the Three Health Care Coverage Schemes in Thailand.

Characteristics	CSMBS	SSS	UCS
I. Scheme nature			
beneficiaries	fringe benefit	compulsory	social welfare
model	public reimbursement model	public contracted model	public contracted model
covered population	government employees and their dependants ~4.15 million	private formal sector employees with >1 worker ~7.0 million	people not covered by SSS or CSMBS 45.3 million
II. Benefit package			
ambulatory services	public only	registered public and private	registered public and private
inpatient services	public and private	registered public and private	registered public and private
choice of provider	free choice	registration required	registration required
cash benefit	no	yes	no
conditions included	comprehensive package	work related illnesses are covered by WCF	comprehensive package
conditions excluded	no	15 conditions	12 conditions
maternity benefits	yes	yes	yes
annual physical check-ups	yes	no	yes
prevention and health promotion	no	health education, immunization	yes
services not covered	special nurse	private bed, special nurse	private bed, special nurse
III. Financing			
source of funds	general tax	tripartite, 1.5% of payroll each	general tax
financing body	Ministry of Finance	Social Security Office	National Health Security Office
payment mechanism	fee-for-service	capitation	capitation for OP; DRG for IP
co-payment	yes: IP at private hospital, IP private limits only for life-threatening care	maternity, emergency services, if beyond ceiling	yes, 30-baht per visit
per capita tax subsidy, 1999	2,106 baht	519 baht	1,275 baht (2001)

Appendix C. Millennium Development Goals, Targets and Indicators.

Goal 1: Eradicate extreme poverty and hunger

Target 1: Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day

- Proportion of population below \$1 (PPP) per day
- Poverty gap ratio (incidence x depth of poverty)
- Share of poorest quintile in national consumption

Target 2: Halve, between 1990 and 2015, the proportion of people who suffer from hunger

- Prevalence of underweight children under five years of age
 - Proportion of population below minimum level of dietary energy consumption
-

Goal 2: Achieve universal primary education

Target 3: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling

- Net enrolment ratio in primary education
 - Proportion of pupils starting grade 1 who reach grade 5
 - Literacy of 15- to 24-year olds
-

Goal 3: Promote gender equality and empower women

Target 4: Eliminate gender disparity in primary and secondary education, preferably by 2005, and to all levels of education no later than 2015

- Ratio of girls to boys in primary, secondary, and tertiary education
 - Ratio of literate women to men in 15- to 24-year-olds
 - Share of women in wage employment in the non-agricultural sector
 - Proportion of seats held by women in national parliament
-

Goal 4: Reduce child mortality

Target 5: Reduce by two thirds, between 1990 and 2015, the under-five mortality rate

- Under-five mortality rate
 - Infant mortality rate
 - Proportion of 1-year-old children immunized against measles
-

Goal 5: Improve maternal health

Target 6: Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio

- Maternal mortality ratio
 - Proportion of births attended by skilled health personnel
-

Goal 6: Combat HIV/AIDS, malaria, and other diseases

Target 7: Have halted by 2015 and begun to reverse the spread of HIV/AIDS

- HIV prevalence among 15- to 24-year old pregnant women
- Condom use to overall contraceptive use among currently married women aged 15-49
- Condom use among men and women aged 15-24
- HIV knowledge among men and women aged 15-24
- Ratio of school attendance of orphans to school attendance of non-orphans aged 10-14

Target 8: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases

- Prevalence and death rates associated with malaria
- Use of insecticide-treated bed nets and anti-malarial drugs in population under 5 years
- Prevalence and death rates associated with tuberculosis
- Proportion of tuberculosis cases detected and cured under DOTS

Goal 7: Ensure environmental sustainability

Target 9: Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources

- Proportion of land area covered by forests
- Ratio of area protected to maintain biological diversity to surface area
- Energy use per \$1 GDP
- Carbon dioxide emissions and consumption of chlorofluorocarbons
- Proportion of population using solid fuels

Target 10: Halve by 2015 the proportion of people without sustainable access to safe drinking water and sanitation

- Proportion of urban and rural population with sustainable access to improved water source
- Proportion of urban population with access to improved sanitation

Target 11: By 2020 to have achieved a significant improvement in the lives of at least 100 million slum dwellers

- Proportion of households with access to secure tenure
-

Goal 8: Develop a global partnership for development

Target 12: Develop further an open, rule-based predictable, non-discriminatory trading and financial system

- Net ODA, total, as a percent of donors' GNI
- Proportion of total bilateral, sector allocable ODA of donors to basic social services
- Proportion of bilateral ODA of donors that is untied

Target 13: Address the special needs of the least developed countries

- Net ODA, to LDCs, as percentage of the donors' GNI

Target 14: Address the specific needs of landlocked countries and small island developing States

- ODA received in landlocked countries as proportion of their GNIs
- ODA received in small island developing States as proportion of their GNIs

Target 15: Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term

- Total number of countries that have reached their Heavily Indebted Poor Countries Initiative (HIPC) decision points and number that have reached their HIPC completion points
- Debt relief committed under HIPC initiative, US dollars
- Debt service as percentage of exports of goods and services

Target 16: In cooperation with developing countries, develop and implement strategies for decent and productive work for youth

- Unemployment rates for 15- to 24-year-olds

Target 17: In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries

- Proportion of population with access to affordable essential drugs on a sustainable basis

Target 18: In cooperation with the private sector, make available the benefits of new technologies, especially information and communication

- Telephone lines and cellular subscribers per 100 population
 - Personal computers and Internet users per 100 population
-

Appendix D. The Declaration of Alma-Ata.**International Conference on Primary Health Care,
Alma-Ata, USSR, 6-12 September 1978**

The International Conference on Primary Health Care, meeting in Alma-Ata this twelfth day of September in the year Nineteen hundred and seventy-eight, expressing the need for urgent action by all governments, all health and development workers, and the world community to protect and promote the health of all the people of the world, hereby makes the following

Declaration:**I**

The Conference strongly reaffirms that health, which is a state of complete, physical, mental, and social wellbeing, and not merely the absence of disease or infirmity, is a fundamental human right and that the attainment of the highest possible level of health is a most important world-wide social goal whose realization requires the action of many other social and economic sectors in addition to the health sector.

II

The existing gross inequality in the health status of the people particularly between developed and developing countries as well as within countries is politically, socially and economically unacceptable and is, therefore of common concern to all countries.

III

Economic and social development, based on a New International Economic Order, is of basic importance to the fullest attainment of health for all and to the reduction of the gap between the health status of the developing and developed countries. The promotion and protection of the health of the people is essential to sustained economic and social development and contributes to a better quality of life and to world peace.

IV

The people have the right and duty to participate individually and collectively in the planning and implementation of their health care.

V

Governments have a responsibility for the health of their people which can be fulfilled only by the provision of adequate health and social measures. A main social target of governments, international organizations and the whole world community in the coming decades should be the attainment by all peoples of the world by the year 2000 of a level of health that will permit them to lead a socially and economically productive life. Primary health care is the key to attaining this target as part of development in the spirit of social justice.

VI

Primary health care is essential health care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain at every stage of their development in the spirit of self-reliance and self-determination. It forms an integral part both of the country's health system,

of which it is the central function and main focus, and of the overall social and economic development of the community. It is the first level of contact of individuals, the family and community with the national health system bringing health care as close as possible to where people live and work, and constitutes the first element of a continuing health care process.

VII

Primary health care:

1. reflects and evolves from the economic conditions and sociocultural and political characteristics of the country and its communities and is based on the application of the relevant results of social, biomedical and health services research and public health experience;
2. addresses the main health problems in the community, providing promotive, preventive, curative and rehabilitative services accordingly;
3. includes at least: education concerning prevailing health problems and the methods of preventing and controlling them; promotion of food supply and proper nutrition; an adequate supply of safe water and basic sanitation; maternal and child health care, including family planning; immunization against the major infectious diseases; prevention and control of locally endemic diseases; appropriate treatment of common diseases and injuries; and provision of essential drugs;
4. involves, in addition to the health sector, all related sectors and aspects of national and community development, in particular agriculture, animal husbandry, food, industry, education, housing, public works, communications and other sectors; and demands the coordinated efforts of all those sectors;
5. requires and promotes maximum community and individual self-reliance and participation in the planning, organization, operation and control of primary health care, making the fullest use of local, national and other available resources; and to this end develops through appropriate education the ability of communities to participate;
6. should be sustained by integrated, functional and mutually supportive referral systems, leading to the progressive improvement of comprehensive health care for all, and giving priority to those most in need;
7. relies, at local and referral levels, on health workers, including physicians, nurses, midwives, auxiliaries and community workers as applicable, as well as traditional practitioners as needed, suitably trained socially and technically to work as a health team and to respond to the expressed health needs of the community.

VIII

All governments should formulate national policies, strategies and plans of action to launch and sustain primary health care as part of a comprehensive national health system and in coordination with other sectors. To this end, it will be necessary to exercise political will, to mobilize the country's resources and to use available external resources rationally.

IX

All countries should cooperate in a spirit of partnership and service to ensure primary health care for all people since the attainment of health by people in any one country directly concerns and benefits every other country. In this context the joint WHO/UNICEF report on primary health care constitutes a solid basis for the further development and operation of primary health care throughout the world.

X

An acceptable level of health for all the people of the world by the year 2000 can be attained through a fuller and better use of the world's resources, a considerable part of which is now spent on armaments and military conflicts. A genuine policy of independence, peace, détente and disarmament could and should release additional resources that could well be devoted to peaceful aims and in particular to the acceleration of social and economic development of which primary health care, as an essential part, should be allotted its proper share.

The International Conference on Primary Health Care calls for urgent and effective national and international action to develop and implement primary health care throughout the world and particularly in developing countries in a spirit of technical cooperation and in keeping with a New International Economic Order. It urges governments, WHO and UNICEF, and other international organizations, as well as multilateral and bilateral agencies, non-governmental organizations, funding agencies, all health workers and the whole world community to support national and international commitment to primary health care and to channel increased technical and financial support to it, particularly in developing countries. The Conference calls on all the aforementioned to collaborate in introducing, developing and maintaining primary health care in accordance with the spirit and content of this Declaration.



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Appendix E. Wagstaff's Extension of the Grossman Model

Wagstaff's extension of the Grossman Model offers a graphical representation, which is less technical and more accessible to policy-makers. This allows government officials, who are not economics experts, to utilize the tool to analyze how potential effects of various health policies and interventions. The four-quadrant model represents and depicts consumer behavior regarding an individual's health.

In general consumer theory, individuals will demand goods and services to increase their utility, or happiness. Their demand is derived from tastes and preferences for the various goods and services available, which is expressed through consumers' indifference curves. Although an individual's want for goods and services is unlimited, he is limited in the number of purchases he can make. Specifically, his income will restrict what and how much he can purchase. Most consumers will maximize their utility subject to their budget constraints. Quadrant I of this model depicts consumers' indifference curves, which depicts consumer utility from the attainment of levels of health and other goods. As an individual gains more utility, he will move to a welfare possibilities frontier in the northeast direction, as shown in Figure E1.

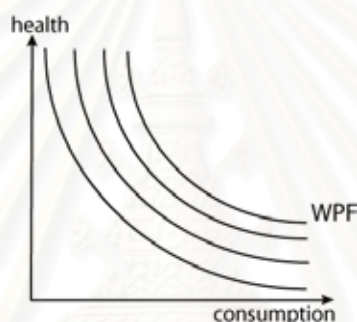


Figure E1. Welfare possibilities frontier (WPF).

All points along one indifference curve represent the same level of utility. The shape of these indifference curves resemble and reflect the trade-offs found in general consumer theory. According to general consumer theory, individuals maximize their utility subject to a budget constraint, which is set by their income. Grossman's model, however, defines health spending as an investment. Individuals do not gain utility from the outlay itself but from the health outcomes that result from that investment.

Quadrant III describes the budget constraint, which depicts combinations of health inputs and other consumption goods can be purchased based on a given level of income. The health inputs purchased produce improved health outcomes for the individual, which confer utility on the individual.

The relationship between health inputs and the subsequent health outcomes that result are expressed through the production function, which is given in Quadrant II. As the amount of health inputs rises, the marginal increase in health will gradually decline, giving the production function its bowed shape. The lowest level of health inputs will help prevent or treat well-known communicable diseases like the common flu or even tuberculosis, while even the highest amount of money can offer only slight improvements in comfort for sufferers of chronic illnesses like Parkinson's disease. This relationship between investment size and health output dictates the shape of the production function.

The final piece of this model is a 45-degree line in quadrant IV, which is used simply to convert the possible purchase of consumption goods defined by the budget constraint from the y-axis in Quadrant III to the x-axis in Quadrant I.

The effective budget constraint, which Wagstaff names the welfare possibilities frontier (WPF), is plotted in Quadrant I and is superimposed onto the indifference curves to determine that level at which consumers will optimize their utility. The consumer will maximize his utility subject to the WPF curve. In other words, the individual will choose to produce health and consume other goods at that level where his indifference curve is exactly tangent to the welfare possibilities frontier.

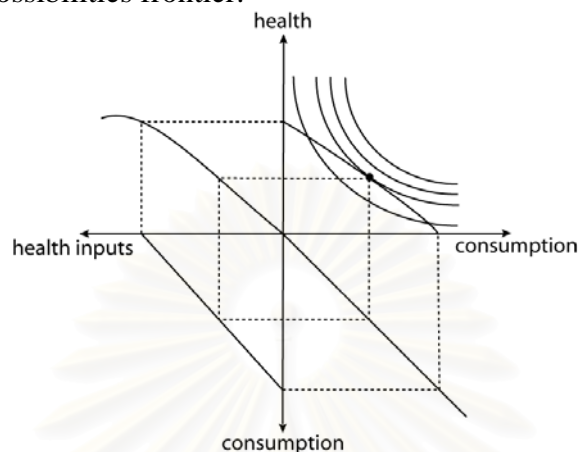


Figure E2. Equilibrium demand for health and other consumption goods.

Comparative statics

This model has significant implications in possible policy decisions. For example, if governments focus and successfully implement economic development policies, incomes will rise. Higher incomes are depicted by an outward shift of the budget constraint in quadrant III, as shown in Figure E3.

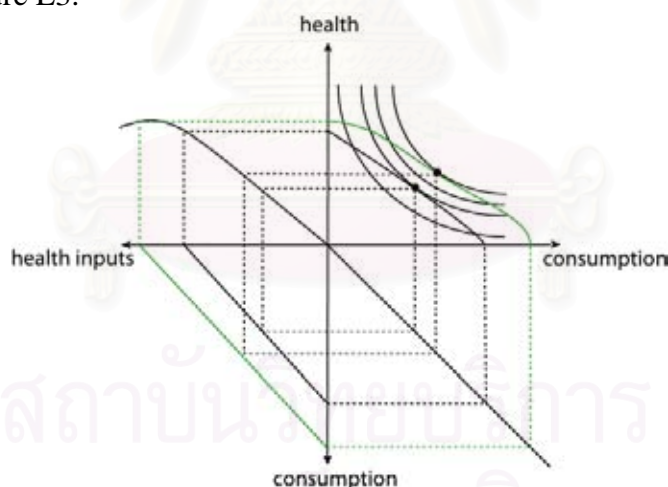


Figure E3. Health and consumption outcomes if incomes rise.

The outward shift of the budget constraint will also shift the welfare possibilities frontier (WPF) to the green line in quadrant I. As depicted in Figure E3, a rise in incomes will cause health outcomes and consumption of goods to rise. The respective proportions of the rise in each purchase are dependent on the shape of the indifference curves and the production function of health outcomes. Consumers who put a higher value on consumption goods will increase their consumption more than their health, as shown above. Alternatively, people who value their health may purchase more inputs and be able to produce a significantly higher level of health. In particular, at lower levels of health, a small additional investment in health is likely to result in a significant improvement in health outcomes.

Figure E4 illustrates the effects of a change in the price of health inputs. This change will cause the budget constraint to pivot at the y-axis, depicted as the blue line. The effects of cheaper health inputs are similar to those that result from a rise in incomes. As the price of health inputs fall, purchasing the same amount of health inputs and consumption is less expensive and the individual will have more money available for the purchase of *both* health inputs and consumption goods. The amount of each that an individual will choose to purchase is conditional on the income and substitution effects. It is clear, though, that a fall in the price of health inputs will raise health outcomes overall.

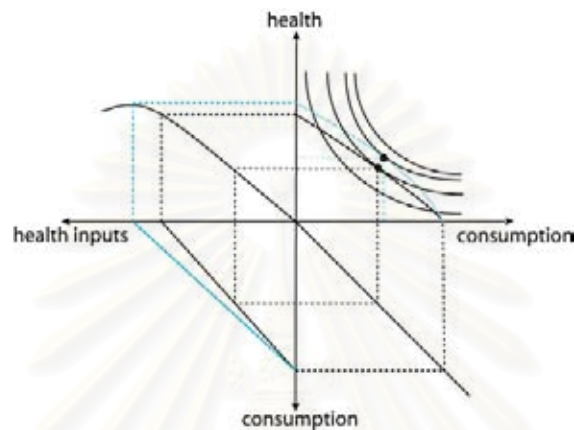


Figure E4. Effects of Fall in Price of Health Inputs

The final effect is an improvement in technology, which will change the rate at which health inputs are converted into health outcomes. If new technology allows health to be improved more efficiently, the production function will shift upward, as shown in red in Figure E5. The potential changes that may or may not result in consumption are based on the shape of indifference curves. Steep indifference curves, like those shown in Figure E5, will display minimal or no change in consumption. Flatter curves mean that individuals value their consumption more than their health. They are willing to maintain the same level of health, and reduce their purchase of health inputs in order to have more money to purchase consumption goods. Assuming that health inputs are already purchased, an exogenous improvement in technology will have an effect *only* on health, and result in no change in consumption patterns. These effects show an apparent positive effect on health outcomes, confirming theories presented by several other authors. (Rifkin 1986; Jha 2004)

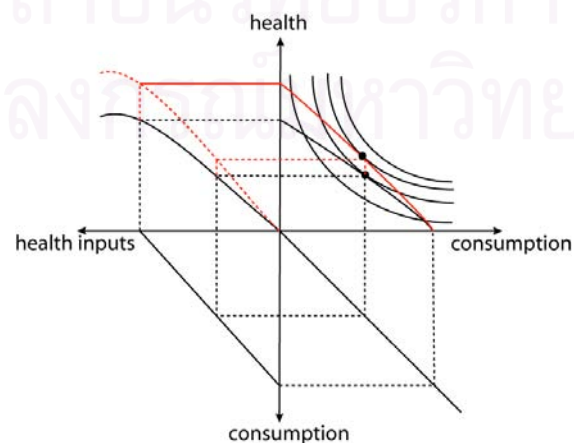


Figure E5. Effects of Improved Technology

Appendix F. Extension of Grossman Model Presented by Goodman, *et. al.*

Goodman, *et. al.* present a further extension of models presented by Grossman and Wagstaff, presenting the consumer decisions in a more general equilibrium framework. The model is based on the premise that consumers do not receive utility from the purchase of goods and services, but will attain utility from their production of *home goods* and *market goods*, or goods that produce health outcomes. The consumer will simultaneously make four decisions: (1) the labor-leisure decision; (2) production of health and other goods; (3) purchases of inputs to produce health and other goods; and (4) level health investment in the long-term. The two-quadrant model is shown in Figure F1.

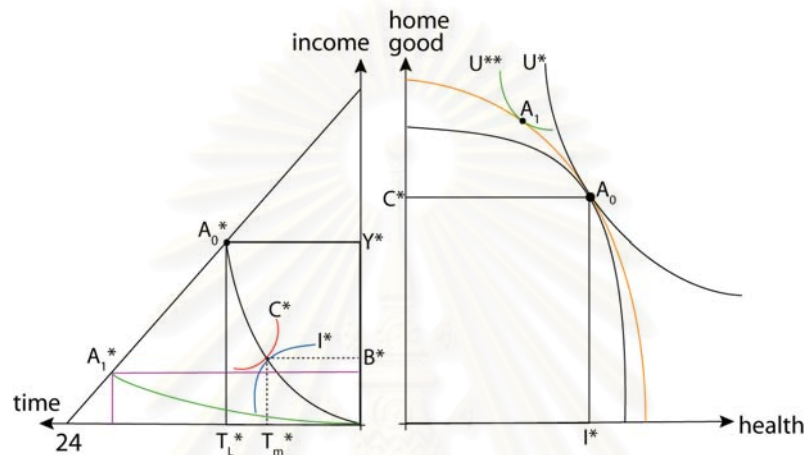


Figure F1. Consumer equilibrium in the Goodman model.

Quadrant I depicts the utility maximization decision, while quadrant II illustrates the labor-leisure decision. The straight line in quadrant II, which has a slope of the wage rate, w , shows all combinations of income and leisure time that an individual can choose. Since the opportunity cost of leisure is the forgone income lost, a person will choose to work a certain number of hours according to his preferences for and the opportunity costs of leisure time, as well as the price of goods to purchase.

Each point along the labor-leisure constraint defines an Edgeworth box. The Edgeworth box is a concept common to general equilibrium theory; it defines the resources available to produce goods in an economy or sector. In this model, the consumer draws utility from goods that he produces using inputs he has purchased; he does not receive utility directly from purchased goods. The Edgeworth box, enlarged in Figure F2, outlines the income and time resources available to the individual to produce two types of goods: market goods and home goods. Just as in general equilibrium theory, the relation between the inputs and production of outputs is expressed through the isoquants. Efficient production of each good is identified as those points where isoquants for each of the two goods are tangent. All the tangencies are connected by the contract curve, which is given as $0-A^*$ in Figure F1.

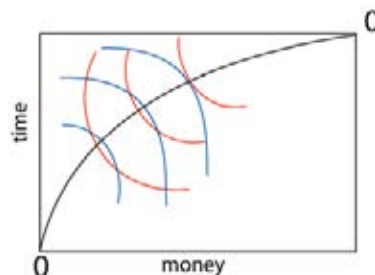


Figure F2. Enlargement of the Edgeworth Box shown in Figure F1.

Each point on the contract curve corresponds to some combination of health and home goods, which are in turn plotted onto a production possibilities curve in Quadrant I. The bowed curvature of the production possibilities curve is similar to the explanation for the curvature of most production possibilities frontier. The two inputs, time and money, are not equally suited to the production of both goods. The production of health may be more time-intensive, so that even all resources are converted to health, many purchased inputs may produce less health than an additional unit of time. This difference in the factor-intensities determines the shape of each production possibilities curve. Because each point along the labor-leisure constraint represents a different Edgeworth box, a different production possibilities curve can be plotted according to each point on the line. The outer-limit of all these curves is given as the production possibilities frontier, shown in (*orange*) in Figure F1. This curve is the absolute maximum combination of goods that can be produced, given the labor-leisure restriction.

Each Edgeworth box will produce an efficient point at which technical and allocative efficiency will be reached; consumer utility, however, is not necessarily maximized. The consumer considers this, too, in his decisions and will continue to move along the labor-leisure line until his utility is maximized, which is denoted as A_0 in Figure F1.



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Appendix G. Demand for Health Model Presented by Paglin.

Most economic experts justify the purchase of health services as an investment into future economic productivity and output growth. In his model, Paglin highlights health as a consumption good, which individuals choose to purchase to improve their standard of living. People choose to purchase health services or other consumption goods. Consumption goods can have one of two effects on the benefits of health services. Most goods will compete with health services; the purchase of these goods detracts income available to purchase health services. Some goods, like food and education, will complement the benefits of health services. The purchase of these goods in sufficient but not excessive measure will enhance the positive effects of health services.

The model produces iso-life-expectancy (ILE) curves, which resemble indifference curves in general consumer theory. Like isoquants, each point along the ILE curve represents a combination of health services and other goods that will produce a constant level of life expectancy. The curves are bowed away from the origin because overuse of either good will reduce health results. Health services are important to extending life expectancy up to a certain point. If health is purchased instead of other goods that contribute to health, such as food and clothing, then medical care will not improve health outcomes significantly.

Wants and desires are unlimited, but societies are constrained by the available resources. These resources can be used to invest for the future, or to produce health services or other consumption goods for the economy. Some existing capital in an economy tends to be more specialized in the production of either health services or other goods, such that it is completely interchangeable between the production of the two types of goods. For example, operating tables tend to be used in the provision of medical services. As the demand for health services falls, this capital may have to be reallocated to the production of other consumption goods. Operating tables, then, may be converted hotel beds, or put to some other use for which it is not well-suited. This specificity of capital causes the production possibilities curve to bow outward, away from the origin. The production possibilities frontier displays the combination of resources that may be used in the production of health and other consumption goods.

When the production possibilities curves and iso-life expectancy curves are superimposed, the combination of health services and other goods that maximizes life expectancy can be easily identified. This refers to the point where the iso-life expectancy curve is tangent to the production possibilities curve. It is clear from Figure G1 that as more resources become available, the potential life expectancy in a community also rises.

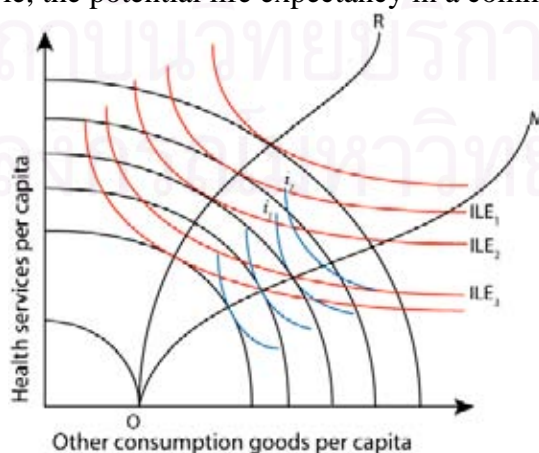


Figure G1. Consumer equilibrium in the Paglin Model

Appendix H. The Grossman Model for Demand for Health.

In 1972, Michael Grossman presented one of the first and most prominent models of the demand for medical care. According to his model, every individual has a stock of health capital, which is used to produce output. Health capital, like any form of capital, will depreciate at some given rate. Individuals must maintain their health capital stock, to remain a productive participant in the workforce or in the household. Maintenance usually refers to the purchase of medicine, doctors' visits, or other forms of health care. According to this structure, then, the demand for medical services is not based on one's *need* but rather based on a number of other factors that affect the demand for other goods and the rate of depreciation of one's health stock. Grossman uses this model to make several predictions regarding consumer behavior with respect to medical care services.

Grossman describes individuals as rational consumers who will choose to maximize their lifetime utility in terms of health (h_t) and a vector of all other goods and services available in the market (Z_t). The lifetime utility function is expressed as:

$$U = U(h_0, \dots, h_T; Z_0, \dots, Z_T) \quad (\text{H1})$$

where one's health (h_t) is produced from a stock of health endowed to each person (K_t^h), which is given as the function:

$$h_t = \phi_t(K_t^h), \quad \phi_t' > 0 \quad (\text{H2})$$

The health stock of a person will change with each successive year, following a general pattern. When a person is young, their health stock should increase to a certain point usually in their late 30s or early 40s then gradually falls as they age, until their death. Their health will improve as they *invest* in their health (I_t^h). The overall change from year-to-year change in health stock, then, is the difference between the rise from investment and the fall from depreciation, which can be expressed as:

$$K_{t+1}^h - K_t^h = I_t^h - \delta_t K_t^h \quad (\text{H3})$$

The health stock (K_t^h) is always greater than some value deemed the death stock (\bar{K}^h), except in the last period of life (T):

$$K_t^h > \bar{K}^h, \quad \text{except at } T \text{ when } K_T^h \leq \bar{K}^h \quad (\text{H4})$$

Both investment in health (I_t^h) and the purchase of market goods and services (Z_t), are functions based on the time (T_t), education (E_t) and other inputs (X_t):

$$Z_t = Z_t(X_t^Z, T_t^Z, E_t) \quad (\text{H5})$$

$$I_t^h = I_t^h(X_t^h, T_t^h, E_t) \quad (\text{H6})$$

where the first line represents the purchase of market goods, which is a function of the market inputs, time and education used to produce those goods. The second line represents the investment in health, expressed as a function of medical care, time spent investing in health, and education.

The total time per period (Ω_t) is then restrained according to the time, which is the total of time committed to work (T_t^w), production of market inputs (T_t^Z), production of health (T_t^h), and sick time (T_t^u):

$$\Omega_t = T_t^w + T_t^Z + T_t^h + T_t^u \quad (\text{H7})$$

Substitution with equation (H2) results in

$$\Omega_t - T_t^u = h_t = \phi_t(K_t^h) \quad (\text{H8})$$

At the same time, consumers face a budget constraint where the spending on health and all other market goods is based on the wage and non-wage income:

$$\sum_0^T \frac{P_t^Z X_t^Z + P_t^h X_t^h}{(1+r)^t} = \sum_0^T \frac{W_t T_t^w}{(1+r)^t} + A_0 \quad (\text{H9})$$

Maximization of the utility functions subject to the constraints on the stock of health, available time, and the budget constraint shown above will results into the equilibrium condition for new marginal investment:

$$\frac{U_{\phi_t} (1+r)^t}{\lambda} \frac{\phi_t'}{MC_{t-1}^h} + \frac{W_t \phi_t'}{MC_{t-1}^h} = r + \delta_t - \tilde{MC}_{t-1}^h \quad (\text{H10})$$

In other words, the sum of the marginal benefits from health investment is equal to the marginal user cost of health capital. If studying only the utility maximization of current consumption, the second term will equal zero, giving:

$$\frac{U_{\phi_t} (1+r)^t}{\lambda} \frac{\phi_t'}{MC_{t-1}^h} = r + \delta_t - \tilde{MC}_{t-1}^h \quad (\text{H11})$$

On the other hand, studying only the investment in health, the other term will equal zero, giving the for maximizing investment in health:

$$\frac{W_t \phi_t'}{MC_{t-1}^h} = r + \delta_t - \tilde{MC}_{t-1}^h \quad (\text{H12})$$

This equilibrium condition is the basis of Grossman's model for determining the theoretical and empirical studies of the demand for health.

Appendix I. Description of Mankiw-Romer-Weil version of the Solow Model.

The Solow Model is a widely known and accepted model of economic growth. It predicts that each country approaches its steady state income level. The steady state level of income is a sort of equilibrium level of output. A country that falls far below its steady state level will display rapid growth as it approaches its steady state. As the country's economy approaches the steady state level of income, economic growth will slow significantly. In its original formulation, the steady state income was determined by the rates of savings, population growth, and capital depreciation in the country only. This version excluded the effects of health capital, which is quickly gaining worldwide acceptance as an important input of economic growth and development.

According to the original Solow Model, a rise in population growth will have a negative effect on per capita growth, which reflects a Malthusian perspective of population growth: rapid rises in population will also raise the dependency ratio, which in turn will lower growth of per capita GDP. Mankiw *et. al.* provide the variation needed to consider health as an input in economic production and factor of economic growth. (Mankiw 1992) Beginning with the same Cobb-Douglas production function used in the Solow Model, the authors alter the equation to include health capital. Instead of explaining the production function in the traditional Cobb-Douglas format of:

$$Y(t) = K(t)^\alpha (A(t)L(t))^{(1-\alpha)} \quad (I1)$$

The modified production function includes a measure of human capital, separate from the former total factor productivity variable:

$$Y(t) = K(t)^\alpha H(t)^\beta (A(t)L(t))^{(1-\alpha-\beta)} \quad (I2)$$

This minor change in the production function plays out through the rest of the Solow Model in an interesting manner. The pertinent equations in each of these steps are given in Table I1.

	Solow Model		Modified Solow Model	
production function	$Y(t) = K(t)^\alpha (A(t)L(t))^{(1-\alpha)}$	(I 1)	$Y(t) = K(t)^\alpha H(t)^\beta (A(t)L(t))^{(1-\alpha-\beta)}$	(I 2)
per effective laborer	$y = k^\alpha$	(I 3)	$y = k^\alpha h^\beta$	(I 4)
growth of capital	$\dot{k}(t) = sy(t) - (n + g + \delta)k(t)$	(I 5)	$\dot{k}(t) = s_k y(t) - (n + g + \delta)k(t)$ $\dot{h}(t) = s_h y(t) - (n + g + \delta)h(t)$	(I 6)
steady state level of capital	$k^* = [s/(n + g + \delta)]^{1/(1-\alpha)}$	(I 7)	$k^* = \left[\frac{s_k^{(1-\beta)} s_k^\beta}{(n + g + \delta)} \right]^{\frac{1}{(1-\alpha-\beta)}}$ <i>and</i> $h^* = \left[\frac{s_h^\alpha s_h^{(1-\alpha)}}{(n + g + \delta)} \right]^{\frac{1}{(1-\alpha-\beta)}}$	(I 8) (I 9)
income growth	$\ln \left[\frac{Y(t)}{L(t)} \right] = \ln A(0) + gt + \frac{\alpha}{1-\alpha} \ln(s) - \frac{\alpha}{1-\alpha} \ln(n + g + \delta)$	(I 10)	$\ln \left[\frac{Y(t)}{L(t)} \right] = \ln A(0) + gt\delta \frac{\alpha + \beta}{1-\alpha-\beta} \ln(n + g + \delta) + \frac{\alpha}{1-\alpha-\beta} \ln(s_k) + \frac{\beta}{1-\alpha-\beta} \ln(s_h)$	(I 11)

Table II. Comparison of the Solow Model with the Solow Model inclusive of Human Capital,

Modification of the model has some interesting mathematical predictions on the effects of each variable on economic change. The clearest and most obvious differences between the two models can be observed in the equations I12 and I13, which relate the rate of economic growth to the rates of labor, technological change and capital depreciation.

Two very specific differences between the two models will have subsequent effects on the economic predictions of each. The effect of capital investment on output is higher in equation I13, health human capital is included in the production function. Notice that because of the constraints on α and β , the coefficient on capital investment is always larger in equation I13:

$$\frac{\alpha}{(1-\alpha)} < \frac{\alpha}{(1-\alpha-\beta)}$$

In addition, the incorporation of health capital in this model will also change the effects of those other determinants in the model, namely population growth and depreciation. Originally, a one-unit change in the rate of depreciation of physical capital is negated by an equal one-unit change in the rate of population growth. This effect is observed mathematically in equation I12, where the coefficients on s and $(n+g+\delta)$ are equal but opposite in sign:

$$\frac{\alpha}{(1-\alpha)}$$

Once health human capital is added, however, the effects of population growth are clearly more pronounced. The inclusion of health enhances the effect of population growth on the steady state level, and thus economic growth and development within the country:

$$\frac{\alpha}{(1-\alpha-\beta)} < \frac{\alpha+\beta}{(1-\alpha-\beta)}$$

Specifically, the effects of population growth are higher than the effects of investment in physical capital. The changes made to the Solow model prove to have a significant effect on the predictions and policy implications on economic growth and development.

Appendix J. Estimation Results for the Simultaneous Equations Model.

Dependent Variable: ln(TFR)				
$\ln(TFR_t) = \beta_0 + \beta_1 GDP_t + \beta_2 ED_t + \beta_3 IMR_t + \beta_4 GH_t + \beta_5 MRATIO_t + \beta_6 PD_t + \beta_7 MTECH_t + \beta_8 UC_t$				
Method: Two-Stage Least Squares				
Sample(adjusted): 1990:3 2003:4				
Included observations: 54 after adjusting endpoints				
Convergence achieved after 16 iterations				
Backcast: 1990:2				
Instrument list:	CPI_EN	CPI_FOOD	GH	GO
	RWAGE	LD	UC	POP15
	MTECH	IMR	PD	MLR
	GKR	PKR	M2A	EC
	NIR	PM	PM_NOIL	YOTH
	WEN	WFOOD		
Lagged dependent variable & regressors added to instrument list				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.1610	0.3952	15.5890	0.0000
GDP	-0.0001	0.0001	-0.7663	0.4473
ED	0.0003	0.0002	1.8886	0.0651
IMR	0.0094	0.0073	1.2920	0.2027
GH	-0.0002	0.0012	-0.1989	0.8432
MRATIO	0.0373	0.0085	4.4017	0.0001
PD	0.0011	0.0033	0.3235	0.7477
MTECH	0.0245	0.0044	5.5642	0.0000
UC	0.0061	0.0228	0.2671	0.7905
R-squared			0.9353	
Adjusted R-squared			0.9243	
S.E. of regression			0.0338	
F-statistic			85.332	
Prob(F-statistic)			0.0000	
Mean dependent variances			7.3892	
S.D. dependent variances			0.1229	
Sum squared residual			0.0538	
Durbin-Watson statistic			0.9388	

Table J1. Estimation Results for the Determination of Total Fertility Rate (TFR).

Dependent Variable: ln(TMR)				
$\ln(TMR_t) = \beta_9 + \beta_{10}GDP_t + \beta_{11}ED_t + \beta_{12}GH_t + \beta_{13}GH_{t-1} + \beta_{14}MRATIO_t + \beta_{15}PD_t + \beta_{16}MTECH_t + \beta_{17}UC_t$				
Method: Two-Stage Least Squares				
Sample(adjusted): 1990:4 2003:4				
Included observations: 53 after adjusting endpoints				
Convergence achieved after 6 iterations				
Lagged dependent variable & regressors added to instrument list				
Instrument list:	CPI_EN	CPI_FOOD	GH	GO
	RWAGE	LD	UC	POP15
	MTECH	IMR	PD	MLR
	GKR	PKR	M2A	EC
	NIR	PM	PM_NOIL	YOTH
	WEN	WFOOD		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.6903	0.7283	2.3208	0.0248
GDP	0.0000	0.0002	0.0334	0.9735
ED	0.0012	0.0003	3.9749	0.0002
GH	-0.0022	0.0025	-0.8896	0.3783
GH(-1)	-0.0024	0.0025	-0.9461	0.3491
MRATIO	-0.0126	0.0152	-0.8332	0.4090
PD	-0.0031	0.0061	-0.5097	0.6127
MTECH	-0.0142	0.0065	-2.2060	0.0324
UC	0.0323	0.0429	0.7527	0.4555
R-squared			0.7996	
Adjusted R-squared			0.7648	
S.E. of regression			0.0633	
F-statistic			22.460	
Prob(F-statistic)			0.0000	
Mean dependent variances			1.6756	
S.D. dependent variances			0.1306	
Sum squared residual			0.1845	
Durbin-Watson statistic			1.4078	

Table J2. Estimation Results for the Determination of the Total Mortality Rate (TMR).

Dependent Variable: ln(LFR)				
$\ln(LFR_t) = \beta_{18} + \beta_{19} \ln(RWAGE_t) + \beta_{20} ED_t + \beta_{21} PKR_t + \beta_{22} GKR_t$ $+ \beta_{23} EL_{t-1} + \beta_{24} UC_t + \beta_{25} EC_t + \beta_{26} EC_t * PKR_t + \beta_{27} EC_t * GKR_t$				
Method: Two-Stage Least Squares				
Sample(adjusted): 1991:3 2003:4				
Included observations: 50 after adjusting endpoints				
Convergence achieved after 115 iterations				
Instrument list:	CPI_EN	CPI_FOOD	GH	GO
	RWAGE	LD	UC	POP15
	MTECH	IMR	PD	MLR
	GKR	PKR	M2A	EC
	NIR	PM	PM_NOIL	YOTH
	WEN	WFOOD	EL(-1)	
Lagged dependent variable & regressors added to instrument list				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.7504	0.2255	-3.3271	0.0018
ln(RWAGE)	0.0863	0.0301	2.8648	0.0063
ED	-0.0002	0.0001	-2.5733	0.0134
PKR	-0.0002	0.0001	-1.3109	0.1965
GKR	-0.0008	0.0003	-3.0204	0.0042
EC	-0.2500	0.0448	-5.5789	0.0000
EC*PKR	0.0003	0.0002	1.5232	0.1347
EC*GKR	0.0013	0.0003	3.7848	0.0005
EL(-1)	-0.0268	0.0840	-0.3194	0.7509
UC	0.0073	0.0090	0.8018	0.4269
R-squared			0.8900	
Adjusted R-squared			0.8680	
S.E. of regression			0.0159	
F-statistic			41.982	
Prob(F-statistic)			0.0000	
Mean dependent variances			-0.2939	
S.D. dependent variances			0.0436	
Sum squared residual			0.0113	
Durbin-Watson statistic			1.6630	

Table J3. Estimation Results for the Labor Force Participation Rate (LFR).

Dependent Variable: HC				
$HC_t = \beta_{28} + \beta_{29}DY_t + \beta_{30}PD_t + \beta_{31}MTECH_t + \beta_{32}MRATIO_t + \beta_{33}EC_t + \beta_{34}UC_t$				
Method: Two-Stage Least Squares				
Sample(adjusted): 1990:2 2003:4				
Included observations: 55 after adjusting endpoints				
Convergence achieved after 12 iterations				
Instrument list:	CPI_EN	CPI_FOOD	GH	GO
	RWAGE	LD	UC	POP15
	MTECH	IMR	PD	MLR
	GKR	PKR	M2A	EC
	NIR	PM	PM_NOIL	YOTH
	WEN	WFOOD		
Lagged dependent variable & regressors added to instrument list				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-9.9823	14.2302	-0.7015	0.4863
DY	0.0140	0.0040	3.5088	0.0010
PD	0.0861	0.0846	1.0177	0.3138
MTECH	0.5390	0.1145	4.7071	0.0000
MRATIO	0.1899	0.3364	0.5646	0.5749
EC	-3.2200	0.8108	-3.9716	0.0002
UC	0.1080	0.8137	0.1327	0.8950
R-squared			0.9147	
Adjusted R-squared			0.9042	
S.E. of regression			1.2382	
F-statistic			87.430	
Prob(F-statistic)			0.0000	
Mean dependent variances			17.772	
S.D. dependent variances			4.0012	
Sum squared residual			75.119	
Durbin-Watson statistic			1.0181	

Table J4. Estimation Results for Determination of Medical Care Consumption (HC).

Dependent Variable: NONHC				
$NONHC_t = \beta_{35} + \beta_{36}DY_t + \beta_{37}CPI_t + \beta_{38}EC_t + \beta_{39}(MLR_t - INEX_t) + \beta_{40}EC_t * DY_t + \beta_{41}EC_t * (MLR_t - INEX_t)$				
Method: Two-Stage Least Squares				
Sample(adjusted): 1990:2 2003:4				
Included observations: 55 after adjusting endpoints				
Instrument list:	CPI_EN	CPI_FOOD	GH	GO
	RWAGE	LD	UC	POP15
	MTECH	IMR	PD	MLR
	GKR	PKR	M2A	EC
	NIR	PM	PM_NOIL	YOTH
	WEN	WFOOD		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-518.94	137.91	-3.7630	0.0005
Y	0.0709	0.1286	0.5514	0.5839
CPI	12.0026	3.2626	3.6788	0.0006
EC	930.76	232.63	4.0010	0.0002
MLR-INEX	-1.2012	1.9113	-0.6285	0.5327
EC*Y	0.2975	0.1378	2.1583	0.0359
EC*(MLR-INEX)	-12.230	2.6509	-4.6135	0.0000
EC*CPI	-12.609	3.9055	-3.2284	0.0022
R-squared			0.9937	
Adjusted R-squared			0.9927	
S.E. of regression			13.278	
F-statistic			1075.4	
Prob(F-statistic)			0.0000	
Mean dependent variances			559.80	
S.D. dependent variances			155.85	
Sum squared residual			8463.2	
Durbin-Watson statistic			1.6866	

Table J5. Estimation Results for Non-Health Care Consumption (NONHC).

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Dependent Variable: YL				
$YL_t = \beta_{61} + \beta_{62}POPW_t + \beta_{63}ED_t + \beta_{64}TMR_t + \beta_{65}LFR_t + \beta_{66}EC_t + \beta_{67}INEX_t$				
Method: Two-Stage Least Squares				
Sample(adjusted): 1991:2 2003:4				
Included observations: 51 after adjusting endpoints				
Convergence achieved after 54 iterations				
Backcast: 1990:2 1991:1				
Instrument list:	CPI_EN	CPI_FOOD	GH	GO
	RWAGE	LD	UC	POP15
	MTECH	IMR	PD	MLR
	GKR	PKR	M2A	EC
	NIR	PM	PM_NOIL	YOTH
	WEN	WFOOD		
Lagged dependent variable & regressors added to instrument list				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-777.91	129.89	-5.9887	0.0000
POPW	0.0351	0.0023	15.127	0.0000
ED	-0.0100	0.0455	-0.2209	0.8261
TMR	-24.777	5.8993	-4.2001	0.0001
LFR	-386.19	118.60	-3.2564	0.0021
EC	-38.695	7.7552	-4.9896	0.0000
INEX	5.8641	2.4956	2.3498	0.0229
R-squared			0.9900	
Adjusted R-squared			0.9888	
S.E. of regression			10.420	
F-statistic			809.91	
Prob(F-statistic)			0.0000	
Mean dependent variances			308.56	
S.D. dependent variances			98.266	
Sum squared residual			5320.2	
Durbin-Watson statistic			1.3588	

Table J6. Estimation Results for Earned Labor Income (YL).

Dependent Variable: I				
$I_t = \beta_{42} + \beta_{43} \left(\frac{M2A_{t-1}}{CORE_{t-1}} \right) + \beta_{44} CAPU_{t-1} + \beta_{45} EC_t + \beta_{46} (MLR_{t-1} - INEX_{t-1}) + \beta_{47} I_{t-1}$				
Method: Two-Stage Least Squares				
Sample(adjusted): 1990:2 2003:4				
Included observations: 55 after adjusting endpoints				
Instrument list:	CPI_EN	CPI_FOOD	GH	GO
	RWAGE	LD	UC	POP15
	MTECH	IMR	PD	MLR
	GKR	PKR	M2A	EC
	NIR	PM	PM_NOIL	YOTH
	WEN	WFOOD	MLR(-1)	INEX(-1)
	M2A(-1)	CORE(-1)	I(-1)	CAPU(-1)
Lagged dependent variable & regressors added to instrument list				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	60.431	144.35	0.4186	0.6773
M2A(-1)/CORE(-1)	0.0013	0.0013	1.0335	0.3065
CAPU(-1)	0.3284	1.2542	0.2618	0.7945
EX	-51.771	20.778	-2.4916	0.0162
MLR(-1)-INEX(-1)	-4.4662	1.5751	-2.8356	0.0066
I(-1)	0.7008	0.1020	6.8688	0.0000
R-squared			0.9030	
Adjusted R-squared			0.8931	
S.E. of regression			21.472	
F-statistic			91.188	
Prob(F-statistic)			0.0000	
Mean dependent variance			232.37	
S.D. dependent variance			65.660	
Sum squared residuals			22592.	
Durbin-Watson statistic			2.2837	

Table J7. Estimation Results for the Determination of Private Investment (I).

Dependent Variable: M				
$M_t = \beta_{48} + \beta_{49}GDP_t + \beta_{50}\left(\frac{PM_t * EX_t}{GDP_t}\right) * 100 + \beta_{51}CAPU_{t-1} + \beta_{52}EC_t + \beta_{53}M_{t-1} + \beta_{54}EC_t * M_t$				
Method: Two-Stage Least Squares				
Sample(adjusted): 1990:3 2003:4				
Included observations: 54 after adjusting endpoints				
Convergence achieved after 15 iterations				
Instrument list:	CPI_EN	CPI_FOOD	GH	GO
	RWAGE	LD	UC	POP15
	MTECH	IMR	PD	MLR
	GKR	PKR	M2A	EC
	NIR	PM	PM_NOIL	YOTH
	WEN	WFOOD		
Lagged dependent variable & regressors added to instrument list				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-836.43	202.49	-4.1307	0.0001
GDP	0.3470	0.1036	3.3503	0.0016
((PM*EX)/GDP)*100	0.8699	0.2180	3.9909	0.0002
CAPU(-1)	3.1535	1.5718	2.0064	0.0505
EC	329.23	91.950	3.5805	0.0008
M(-1)	1.0601	0.1427	7.4272	0.0000
EC*M(-1)	-0.5737	0.1614	-3.5551	0.0009
R-squared			0.9801	
Adjusted R-squared			0.9777	
S.E. of regression			29.945	
F-statistic			395.08	
Prob(F-statistic)			0.0000	
Mean dependent variance			524.23	
S.D. dependent variance			200.36	
Sum squared residuals			43041	
Durbin-Watson statistic			1.5731	

Table J8. Estimation Results for Determination of Imports (M).

Dependent Variable: ln(CORE)				
$\ln(CORE_t) = \beta_{55} + \beta_{56} \ln(PM_NOIL_{t-1}) + \beta_{57} \ln(CORE_{t-1})$				
Method: Two-Stage Least Squares				
Included observations: 53 after adjusting endpoints				
Convergence achieved after 11 iterations				
Backcast: 1990:3				
Instrument list:	CPI_EN	CPI_FOOD	GH	GO
	RWAGE	LD	UC	POP15
	MTECH	IMR	PD	MLR
	GKR	PKR	M2A	EC
	NIR	PM	PM_NOIL	YOTH
	WEN	WFOOD		
Lagged dependent variable & regressors added to instrument list				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.1185	0.0407	2.9117	0.0053
ln(PM_NOIL(-1))	-0.0008	0.0070	-0.1189	0.9058
ln(CORE(-1))	0.9762	0.0155	63.106	0.0000
R-squared			0.9984	
Adjusted R-squared			0.9984	
S.E. of regression			0.0055	
F-statistic			16703.1	
Prob(F-statistic)			0.0000	
Mean dependent variances			4.5035	
S.D. dependent variances			0.1375	
Sum squared residual			0.0016	
Durbin-Watson statistic			0.9779	

Table J9. Estimate Results for CPI, excluding food and energy (CORE).

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Dependent Variable: INEX				
$INEX_t = \beta_{58} + \beta_{59}CORE_t + \beta_{60}INEX_{t-1}$				
Method: Two-Stage Least Squares				
Sample(adjusted): 1990:2 2003:4				
Included observations: 55 after adjusting endpoints				
Instrument list:	CPI_EN	CPI_FOOD	GH	GO
	RWAGE	LD	UC	POP15
	MTECH	IMR	PD	MLR
	GKR	PKR	M2A	EC
	NIR	PM	PM_NOIL	YOTH
	WEN	WFOOD		
Lagged dependent variable & regressors added to instrument list				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.3299	0.8514	2.7366	0.0085
CORE	-0.0191	0.0087	-2.1999	0.0323
INEX(-1)	0.3711	0.1268	2.9278	0.0051
R-squared			0.2900	
Adjusted R-squared			0.2627	
S.E. of regression			0.7201	
F-statistic			10.608	
Prob(F-statistic)			0.0001	
Mean dependent variances			0.9365	
S.D. dependent variances			0.8387	
Sum squared residual			26.966	
Durbin-Watson statistic			2.0728	

Table J10. Estimation Results for Expected Inflation (INEX)

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Appendix K. List of equations and Variables included in the Model.

$$\ln(TFR_t) = \beta_0 + \beta_1 GDP_t + \beta_2 ED_t + \beta_3 IMR_t + \beta_4 GH_t + \beta_5 MRATIO_t + \beta_6 PD_t + \beta_7 MTECH_t + \beta_8 UC_t \quad (1)$$

Where TFR = Total fertility rate
 GDP = Gross domestic product (millions of Baht)
 ED = Population currently enrolled in at least the secondary school level
 IMR = Infant mortality rate (per 1,000 livebirths)
 GH = Public health expenditures (millions of Baht)
 MRATIO = Medical personnel per 1,000 population
 PD = Price index for health care goods and services
 MTECH = investment in medical technology (millions of Baht)
 UC = Universal coverage scheme dummy variable

$$\ln(TMR_t) = \beta_9 + \beta_{10} GDP_t + \beta_{11} ED_t + \beta_{12} GH_t + \beta_{13} GH_{t-1} + \beta_{14} MRATIO_t + \beta_{15} PD_t + \beta_{16} MTECH_t + \beta_{17} UC_t \quad (2)$$

Where TMR = Total mortality rate

$$\ln(LFR_t) = \beta_{18} + \beta_{19} \ln(RWAGE_t) + \beta_{20} ED_t + \beta_{21} PKR_t + \beta_{22} GKR_t + \beta_{23} EL_{t-1} + \beta_{24} UC_t + \beta_{25} EC_t + \beta_{26} EC_t * PKR_t + \beta_{27} EC_t * GKR_t \quad (3)$$

Where LFR = Labor force participation rate
 RWAGE = Real wage rate
 PKR = Capital formation originating in the private sector
 GKR = Capital formation originating in the public sector
 EL = Effective employment rate
 EC = Economic crisis dummy variable

$$HC_t = \beta_{28} + \beta_{29} Y_t + \beta_{30} PD_t + \beta_{31} MTECH_t + \beta_{32} MRATIO_t + \beta_{33} EC_t + \beta_{34} UC_t \quad (4)$$

Where HC = Private consumption in health and medical care (millions of Baht)
 Y = Total income (millions of Baht)

$$NONHC_t = \beta_{35} + \beta_{36} Y_t + \beta_{37} CPI_t + \beta_{38} EC_t + \beta_{39} (MLR_t - INEX_t) + \beta_{40} EC_t * Y_t + \beta_{41} EC_t * (MLR_t - INEX_t) \quad (5)$$

Where NONHC = Private consumption in non-health care commodities (millions of Baht)
 CPI = Consumer price index
 MLR = Medium lending rate
 INEX = Expected inflation rate

$$I_t = \beta_{42} + \beta_{43} \left(\frac{M2A_{t-1}}{CORE_{t-1}} \right) + \beta_{44} CAPU_{t-1} + \beta_{45} EC_t + \beta_{46} (MLR_{t-1} - INEX_{t-1}) + \beta_{47} I_{t-1} \quad (6)$$

Where I = Private investment (millions of Baht)
 M2A = Real money supply
 CORE = Consumer price index, excluding food and energy
 CAPU = Capacity utilization

$$M_t = \beta_{48} + \beta_{49} GDP_t + \beta_{50} \left(\frac{PM_t * EX_t}{GDP_t} \right) * 100 + \beta_{51} CAPU_{t-1} + \beta_{52} EC_t + \beta_{53} M_{t-1} + \beta_{54} EC_t * M_{t-1} \quad (7)$$

Where M = Imports (millions of Baht)
 PM = Import price index
 EX = exchange rate

$$\ln(CORE_t) = \beta_{55} + \beta_{56} \ln(PM_NOIL_{t-1}) + \beta_{57} \ln(CORE_{t-1}) \quad (8)$$

Where PM_NOIL = Price index of consumer goods

$$INEX_t = \beta_{58} + \beta_{59}CORE_t + \beta_{60}INEX_{t-1} \quad (9)$$

$$YL_t = \beta_{61} + \beta_{62}POPW_t + \beta_{63}ED_t + \beta_{64}TMR_t + \beta_{65}LFR_t + \beta_{66}EC_t + \beta_{67}INEX_t \quad (10)$$

Where YL = Earned labor income

$POPW$ = Work-eligible population (ù000 people)

$$CPI_t = CORE_t(1 - WEN_t - WFOOD_t) + (WEN_t * CPIEN_t) + (WFOOD_t * CPIFOOD_t) \quad (11)$$

Where WEN = Weight assigned to energy in CPI bundle

$WFOOD$ = Weight assigned to food in CPI bundle

$CPIEN$ = Price index for energy

$CPIFOOD$ = Price index for food

$$EL_t = \frac{LD_t}{LS_t} \quad (12)$$

Where LD = Labor demand (ù000 people)

LS = Labor supply (ù000 people)

$$SR_t = 1 - \left(\frac{TMR_t}{1000} \right) \quad (13)$$

Where SR = Survival rate

$$TPOP_t = SR_t * TPOP_{t-1} + BIRTHS_t \quad (14)$$

Where $TPOP$ = Total population (ù000 people)

$BIRTHS$ = Number of births (ù000)

$$WPOP_t = TPOP_t - POP15_t \quad (15)$$

Where $POP15$ = Population under 15 years of age (ù000 people)

$$LS_t = WPOP_t * LFR_t \quad (16)$$

$$CONS_t = HC_t + NONHC_t \quad (17)$$

Where $CONS$ = Total private consumption (millions of Baht)

$$G_t = GH_t + GOTH_t \quad (18)$$

Where G = Total government expenditure (millions of Baht)

$GOTH$ = Government expenditure in non-health sectors (millions of Baht)

$$Y_t = YL_t + YOTH_t \quad (19)$$

Where $YOTH$ = Unearned income

$$GDP_t = CONS_t + I_t + G_t + X_t - M_t \quad (20)$$

List of Variables in the Model

BIRTHS = Number of births ('000)
 CAPU = Capacity utilization
 CONS = Total private consumption (millions of Baht)
 CORE = Consumer price index, excluding food and energy
 CPI = Consumer price index
 CPIEN = Price index for energy
 CPIFOOOD = Price index for food
 EC = Economic crisis dummy variable
 ED = Population currently enrolled in at least the secondary school level
 EL = Effective employment rate
 EX = exchange rate
 G = Total government expenditure (millions of Baht)
 GDP = Gross domestic product (millions of Baht)
 GH = Public health expenditures (millions of Baht)
 GKR = Capital formation originating in the public sector
 GOTH = Government expenditure in non-health sectors (millions of Baht)
 HC = Private consumption in health and medical care (millions of Baht)
 I = Private investment (millions of Baht)
 IMR = Infant mortality rate (per 1,000 livebirths)
 INEX = Expected inflation rate
 LD = Labor demand ('000 people)
 LFR = Labor force participation rate
 LS = Labor supply ('000 people)
 M = Imports (millions of Baht)
 MLR = Medium lending rate
 MRATIO = Medical personnel per 1,000 population
 MTECH = investment in medical technology (millions of Baht)
 M2A = Real money supply
 NONHC = Private consumption in non-health care commodities (millions of Baht)
 PD = Price index for health care goods and services
 PKR = Capital formation originating in the private sector
 PM = Import price index
 PM_NOIL = Price index of consumer goods
 POPW = Work-eligible population ('000 people)
 POP15 = Population under 15 years of age ('000 people)
 RWAGE = Real wage rate
 SR = Survival rate
 TFR = Total fertility rate
 TMR = Total mortality rate
 TPOP = Total population ('000 people)
 UC = Universal coverage scheme dummy variable
 WEN = Weight assigned to energy in CPI bundle
 WFOOD = Weight assigned to food in CPI bundle
 Y = Total income (millions of Baht)
 YL = Earned labor income
 YOTH = Unearned income

Appendix L. Graphical Results of Model Estimation and Calibration, 1990-2003.

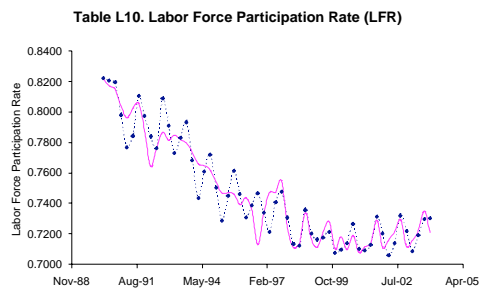
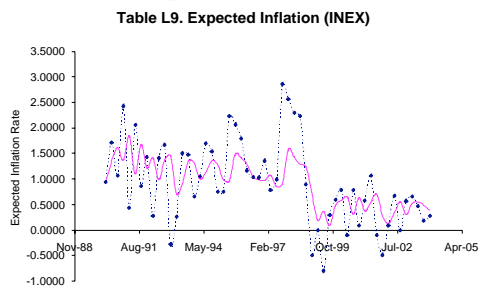
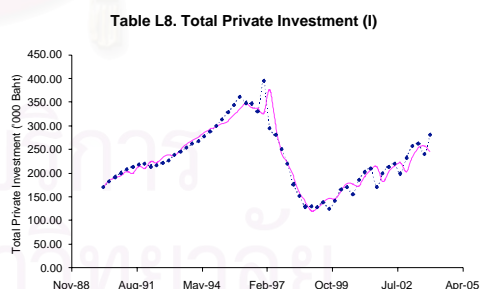
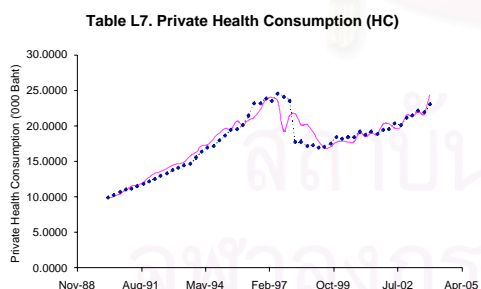
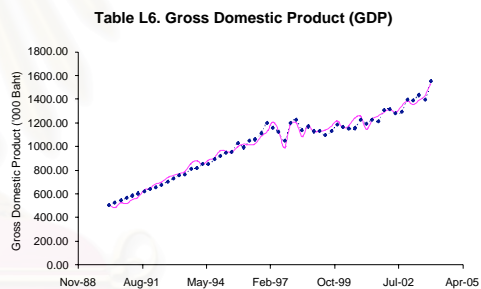
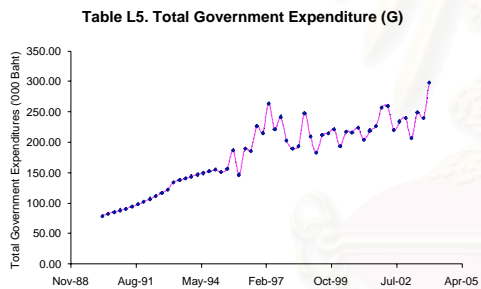
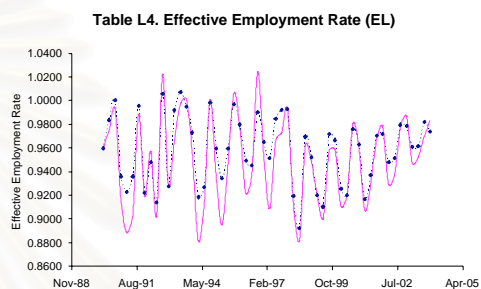
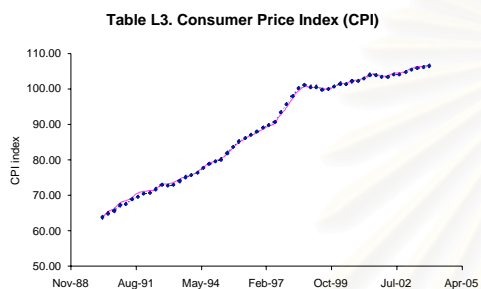
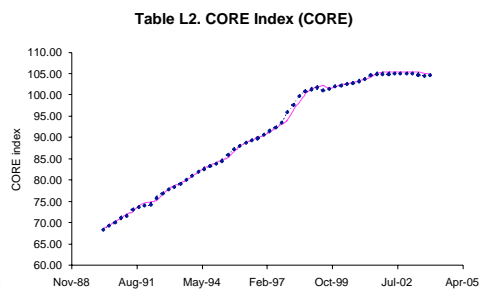
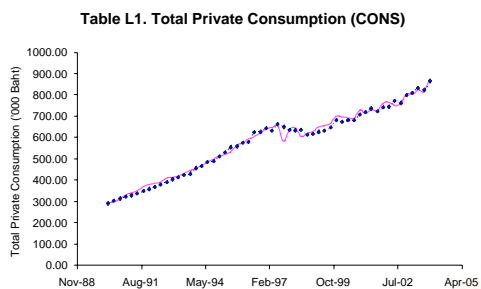


Table L11. Labor Supply (LS)

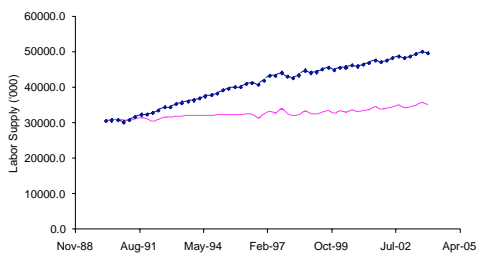


Table L12. Total Imports (M)

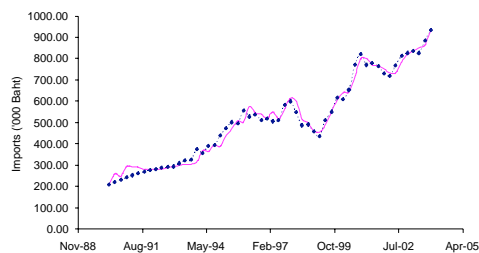


Table L13. Non-Health Consumption (NONHC)

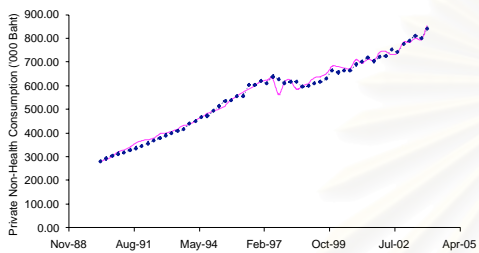


Table L14. Work-Eligible Population (POPW)

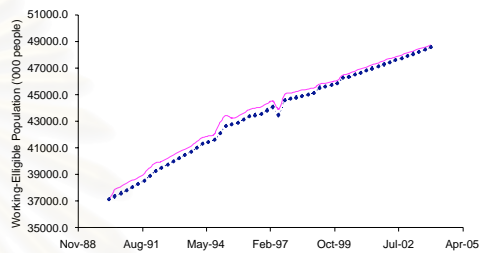


Table L15. Survival Rate (SR)

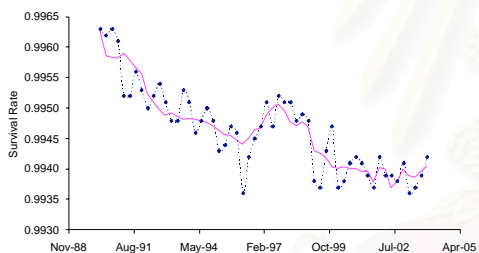


Table L16. Total Fertility Rate (TFR)

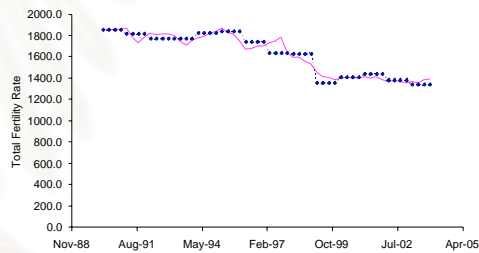


Table L17. Total Mortality Rate (TMR)

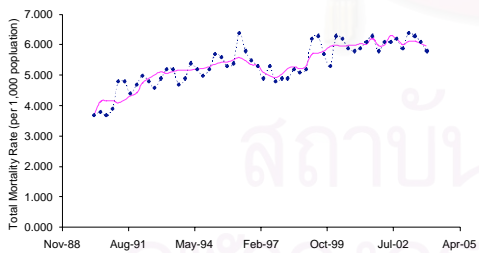


Table L18. Total Population (TPOP)

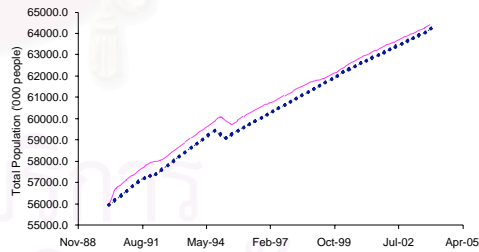


Table L19. Total Income (Y)

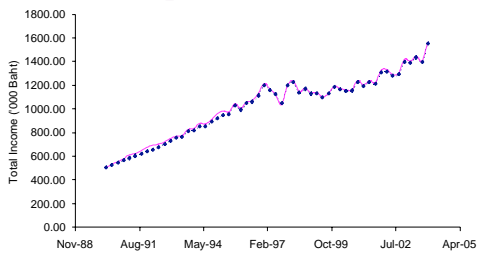
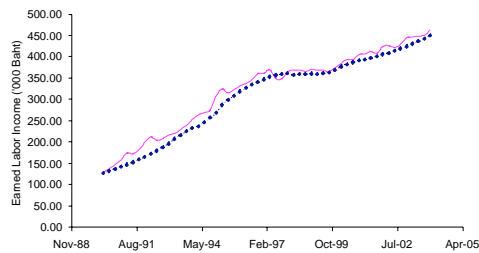


Table L20. Earned Labor Income (YL)



Appendix M. Numeric Comparison of Model Estimation and Calibration, 1990-2003.

obs	CONS		CORE		CPI		EL	
	raw	test	raw	test	raw	test	raw	test
Mar-90	291.98	291.98	68.40	68.40	63.90	63.90	0.9601	0.9601
Jun-90	303.79	299.99	69.40	69.41	65.00	65.55	0.9839	0.9839
Sep-90	314.65	312.37	70.10	70.40	65.70	66.39	1.0007	1.0007
Dec-90	324.56	332.65	71.20	71.09	67.30	68.02	0.9363	0.9363
Mar-91	329.96	342.08	71.70	72.17	67.60	68.57	0.9230	0.8851
Jun-91	339.36	353.42	73.10	72.67	69.00	69.41	0.9363	0.8889
Sep-91	349.22	371.24	73.80	74.05	69.60	70.76	0.9961	0.9652
Dec-91	359.53	381.88	74.10	74.74	70.60	71.28	0.9224	0.8849
Mar-92	370.31	387.17	74.40	75.04	70.80	71.41	0.9481	0.8911
Jun-92	381.55	393.52	75.90	75.33	71.80	71.82	0.9145	0.8395
Sep-92	393.24	412.32	77.00	76.82	73.00	73.19	1.0063	0.9428
Dec-92	405.40	415.71	77.90	77.90	72.80	73.22	0.9278	0.8546
Mar-93	415.58	422.36	78.50	78.79	73.00	73.71	0.9921	0.8753
Jun-93	425.61	433.92	79.20	79.38	74.10	74.58	1.0072	0.8963
Sep-93	431.57	448.52	80.20	80.07	75.20	75.37	0.9951	0.8935
Dec-93	457.76	455.08	81.10	81.05	75.70	75.78	0.9731	0.8440
Mar-94	468.10	470.94	82.10	81.94	76.50	76.74	0.9187	0.7668
Jun-94	485.82	485.65	82.70	82.92	77.80	78.02	0.9272	0.7810
Sep-94	490.79	502.08	83.40	83.51	79.00	79.15	0.9987	0.8507
Dec-94	514.02	513.10	84.00	84.20	79.60	79.76	0.9596	0.7947
Mar-95	533.08	522.47	84.60	84.79	80.20	80.43	0.9346	0.7435
Jun-95	556.01	535.77	86.00	85.38	82.00	81.72	0.9598	0.7707
Sep-95	560.23	563.58	87.30	86.76	83.70	83.49	0.9971	0.8145
Dec-95	576.41	578.14	88.10	88.03	85.20	84.99	0.9799	0.7873
Mar-96	579.80	594.10	88.80	88.82	86.20	85.98	0.9494	0.7359
Jun-96	626.48	607.09	89.40	89.51	87.10	86.95	0.9457	0.7363
Sep-96	627.86	624.26	89.90	90.10	88.00	87.90	0.9904	0.7919
Dec-96	645.69	642.07	90.70	90.60	89.20	88.79	0.9650	0.7412
Mar-97	635.24	648.87	91.60	91.38	89.90	89.55	0.9514	0.6997
Jun-97	664.45	655.56	92.50	92.27	90.80	90.47	0.9850	0.7328
Sep-97	651.02	582.94	93.60	93.15	93.40	92.85	0.9923	0.7510
Dec-97	636.24	641.03	96.00	94.22	95.80	94.86	0.9933	0.7550
Mar-98	635.41	645.15	97.80	96.57	98.00	97.47	0.9197	0.6902
Jun-98	636.46	606.26	99.80	98.34	100.20	99.49	0.8923	0.6586
Sep-98	615.05	620.84	100.90	100.32	101.10	100.72	0.9697	0.7189
Dec-98	618.40	630.58	101.40	101.40	100.60	100.45	0.9525	0.7032
Mar-99	628.07	652.24	101.80	101.89	100.60	100.47	0.9203	0.6781
Jun-99	634.19	656.65	101.10	102.29	99.80	100.25	0.9105	0.6623
Sep-99	650.08	669.44	101.50	101.59	100.10	100.03	0.9720	0.7049
Dec-99	682.77	701.99	102.10	101.98	100.70	100.60	0.9669	0.7002
Mar-00	675.63	698.99	102.30	102.55	101.50	101.68	0.9258	0.6676
Jun-00	683.76	694.75	102.60	102.76	101.40	101.61	0.9201	0.6675
Sep-00	683.74	691.65	102.90	103.04	102.20	102.57	0.9763	0.7153
Dec-00	710.50	730.30	103.30	103.33	102.30	102.59	0.9632	0.6965
Mar-01	721.06	715.27	103.80	103.71	102.90	103.13	0.9167	0.6571
Jun-01	737.96	733.43	104.70	104.21	104.00	104.10	0.9371	0.6695
Sep-01	723.73	726.96	105.00	105.09	103.90	104.26	0.9709	0.7031
Dec-01	742.44	763.36	105.00	105.38	103.40	103.73	0.9718	0.7030
Mar-02	745.55	766.74	105.00	105.39	103.50	103.75	0.9484	0.6684
Jun-02	773.93	752.66	105.10	105.39	104.20	104.45	0.9519	0.6711
Sep-02	764.02	761.20	105.10	105.48	104.20	104.49	0.9798	0.7033
Dec-02	798.56	806.72	105.10	105.48	104.80	105.03	0.9788	0.7029
Mar-03	812.16	804.82	105.10	105.47	105.50	105.78	0.9614	0.6739
Jun-03	834.39	825.17	104.80	105.48	106.00	106.41	0.9616	0.6765
Sep-03	824.60	818.82	104.60	105.18	106.20	106.51	0.9820	0.6936
Dec-03	866.41	879.90	104.70	104.98	106.50	106.69	0.9741	0.6967

obs	G		GDP		HC		I	
	raw	test	raw	test	raw	test	raw	test
Mar-90	79.35	79.35	508.24	508.24	9.927	9.927	171.59	171.59
Jun-90	82.53	82.53	528.88	487.86	10.329	10.074	182.69	184.99
Sep-90	85.72	85.72	549.09	529.12	10.698	10.448	192.49	190.85
Dec-90	88.91	88.91	568.85	519.29	11.035	10.949	200.97	195.58
Mar-91	91.24	91.24	586.84	554.84	11.218	11.556	208.63	204.18
Jun-91	94.77	94.77	606.25	576.31	11.538	11.725	214.31	200.02
Sep-91	98.64	98.64	625.74	634.28	11.873	12.103	218.49	215.14
Dec-91	102.85	102.85	645.32	651.21	12.224	12.828	221.17	210.89
Mar-92	107.41	107.41	657.22	685.96	12.591	13.363	214.58	225.12
Jun-92	112.31	112.31	680.09	702.40	12.973	13.645	217.36	222.93
Sep-92	117.55	117.55	706.14	742.17	13.370	14.040	221.76	234.32
Dec-92	123.13	123.13	735.39	756.63	13.783	14.512	227.76	239.36
Mar-93	134.94	134.94	757.93	774.20	14.130	14.721	238.93	237.99
Jun-93	138.39	138.39	765.49	794.57	14.471	14.914	246.72	250.04
Sep-93	141.10	141.11	815.35	859.90	14.674	15.806	254.68	261.83
Dec-93	144.34	144.34	819.50	882.16	15.564	16.319	262.82	269.76
Mar-94	147.10	147.10	854.12	854.43	16.383	17.236	268.44	276.51
Jun-94	149.83	149.83	853.07	887.95	17.004	17.412	278.02	286.51
Sep-94	152.59	152.59	894.98	907.45	17.178	18.201	288.87	294.19
Dec-94	155.33	155.33	921.92	968.15	17.991	19.039	300.97	298.18
Mar-95	151.71	151.71	949.03	964.04	18.658	19.655	314.34	304.85
Jun-95	156.68	156.68	959.50	951.36	19.460	19.608	328.98	310.76
Sep-95	187.36	187.36	1032.82	1004.01	19.608	20.692	344.87	324.37
Dec-95	146.97	146.97	995.10	1021.85	20.174	20.167	362.02	335.79
Mar-96	189.75	189.75	1049.72	1016.31	21.453	20.842	348.84	348.85
Jun-96	186.51	186.51	1063.12	1027.24	23.180	21.260	347.34	338.97
Sep-96	226.97	226.97	1116.43	1089.76	23.231	22.397	330.65	337.66
Dec-96	215.86	215.86	1202.60	1128.09	23.890	23.771	395.45	327.41
Mar-97	264.36	264.36	1159.39	1210.70	23.504	24.051	295.18	377.41
Jun-97	222.00	222.00	1126.92	1133.05	24.585	23.479	281.21	304.08
Sep-97	242.26	242.26	1049.89	993.07	24.088	19.287	251.45	243.26
Dec-97	203.09	203.09	1201.95	1192.61	23.541	21.457	220.64	221.55
Mar-98	190.31	190.31	1230.28	1203.50	17.791	21.730	177.06	194.48
Jun-98	194.30	194.30	1139.36	1087.12	17.821	20.184	152.09	159.76
Sep-98	247.86	247.86	1171.77	1179.47	17.221	20.216	129.68	140.57
Dec-98	210.39	210.39	1130.65	1128.46	17.315	19.227	130.02	120.76
Mar-99	183.50	183.50	1131.44	1134.11	16.958	17.865	128.65	126.50
Jun-99	212.19	212.19	1097.99	1143.15	17.123	16.929	138.77	139.15
Sep-99	215.48	215.48	1131.33	1175.06	17.552	17.092	125.35	147.85
Dec-99	221.89	221.89	1185.92	1219.37	18.435	17.765	142.77	146.10
Mar-00	194.24	194.24	1169.84	1161.21	18.242	17.906	165.54	162.87
Jun-00	217.89	217.89	1152.60	1179.38	18.462	17.789	170.75	178.67
Sep-00	216.57	216.57	1158.08	1245.45	18.461	17.791	156.22	177.61
Dec-00	224.50	224.50	1230.44	1257.51	19.183	19.114	186.64	173.25
Mar-01	204.63	204.63	1194.14	1149.33	18.748	18.538	202.82	194.19
Jun-01	219.78	219.78	1230.83	1233.25	19.240	19.025	209.85	208.01
Sep-01	227.08	227.08	1216.67	1261.64	18.920	18.831	171.19	214.45
Dec-01	257.12	257.12	1311.37	1293.41	19.459	20.294	200.83	183.01
Mar-02	259.82	259.82	1318.40	1315.72	19.588	20.317	214.30	203.26
Jun-02	220.84	220.84	1281.94	1291.46	20.382	19.722	220.23	215.84
Sep-02	234.40	234.40	1295.68	1344.31	20.167	19.916	199.42	222.95
Dec-02	240.45	240.45	1400.85	1387.07	21.125	21.537	233.25	204.23
Mar-03	207.39	207.39	1391.70	1359.04	21.529	21.413	258.22	234.73
Jun-03	249.97	249.97	1437.11	1394.03	22.163	22.011	262.99	254.18
Sep-03	240.58	240.58	1400.55	1433.64	21.946	21.693	240.62	258.41
Dec-03	298.27	298.27	1557.87	1537.82	23.102	24.446	282.40	246.09

obs	INFEX		LFR		LS		M	
	raw	test	raw	test	raw	test	raw	test
Mar-90	0.9479	0.9479	0.8221	0.8221	30531.8	30531.8	209.60	209.60
Jun-90	1.7214	1.3527	0.8208	0.8173	30675.9	30958.6	222.04	261.56
Sep-90	1.0769	1.6208	0.8195	0.8152	30820.1	31066.0	233.58	249.63
Dec-90	2.4353	1.3684	0.7982	0.8042	30198.9	30840.5	244.23	296.49
Mar-91	0.4458	1.8518	0.7770	0.7964	30845.3	30726.8	254.14	293.82
Jun-91	2.0710	1.1040	0.7845	0.8025	31651.6	31142.5	262.93	292.65
Sep-91	0.8696	1.6806	0.8107	0.8058	32259.8	31494.2	270.77	280.91
Dec-91	1.4368	1.2215	0.7974	0.7872	32345.4	31130.5	277.65	283.82
Mar-92	0.2833	1.4264	0.7841	0.7645	32772.4	30495.1	283.56	282.22
Jun-92	1.4124	0.9926	0.7764	0.7767	33432.2	31067.8	288.52	283.75
Sep-92	1.6713	1.3833	0.8092	0.7870	34349.2	31664.4	292.52	288.14
Dec-92	-0.2740	1.4586	0.7913	0.7818	34363.4	31636.4	295.56	296.24
Mar-93	0.2747	0.7197	0.7733	0.7849	35274.4	31945.7	310.47	300.03
Jun-93	1.5068	0.9120	0.7834	0.7821	35643.2	32015.0	323.28	305.82
Sep-93	1.4845	1.3561	0.7935	0.7798	35984.6	32102.6	326.36	305.91
Dec-93	0.6649	1.3289	0.7686	0.7737	36339.4	32097.0	375.57	317.16
Mar-94	1.0568	1.0077	0.7436	0.7663	36819.8	32018.2	358.86	369.47
Jun-94	1.6993	1.1343	0.7610	0.7650	37466.9	32063.7	393.08	366.53
Sep-94	1.5424	1.3615	0.7723	0.7621	37728.8	32057.4	394.25	398.39
Dec-94	0.7595	1.2901	0.7506	0.7540	38167.6	32379.5	440.36	390.43
Mar-95	0.7538	0.9882	0.7289	0.7471	39075.5	32460.3	475.38	440.28
Jun-95	2.2444	0.9748	0.7453	0.7472	39698.7	32307.3	503.26	472.93
Sep-95	2.0732	1.5017	0.7616	0.7463	39992.2	32365.1	498.42	510.08
Dec-95	1.7921	1.4137	0.7463	0.7395	40060.7	32261.4	556.84	505.58
Mar-96	1.1737	1.2943	0.7310	0.7439	40899.1	32655.2	529.80	577.52
Jun-96	1.0441	1.0516	0.7388	0.7364	41256.5	32412.0	538.91	547.03
Sep-96	1.0333	0.9923	0.7467	0.7129	40700.8	31453.3	511.59	541.68
Dec-96	1.3636	0.9788	0.7341	0.7339	41891.9	32544.8	518.94	521.79
Mar-97	0.7848	1.0864	0.7216	0.7476	43255.7	33301.3	507.36	551.91
Jun-97	1.0011	0.8545	0.7411	0.7475	43312.7	32838.6	512.13	519.97
Sep-97	2.8634	0.9179	0.7478	0.7551	44048.3	33995.4	584.20	564.75
Dec-97	2.5696	1.5885	0.7308	0.7240	42968.8	32666.9	601.42	616.46
Mar-98	2.2965	1.4345	0.7137	0.7113	42611.8	32189.4	549.17	603.11
Jun-98	2.2449	1.2993	0.7125	0.7138	43357.3	32374.4	488.65	518.36
Sep-98	0.8982	1.2422	0.7360	0.7344	44700.5	33379.2	492.21	501.20
Dec-98	-0.4946	0.7218	0.7204	0.7168	44045.1	32633.8	458.87	463.99
Mar-99	0.0000	0.1955	0.7165	0.7115	44275.2	32593.3	437.77	457.11
Jun-99	-0.7952	0.3714	0.7178	0.7213	45043.1	33100.6	512.71	490.40
Sep-99	0.3006	0.0896	0.7216	0.7284	45530.5	33500.4	552.42	550.55
Dec-99	0.5994	0.4889	0.7080	0.7103	44839.6	32736.5	617.45	606.53
Mar-00	0.7944	0.5888	0.7100	0.7186	45568.8	33399.3	612.45	641.77
Jun-00	-0.0985	0.6572	0.7140	0.7099	45605.4	33080.7	654.85	646.97
Sep-00	0.7890	0.3204	0.7266	0.7193	46137.6	33642.0	773.24	715.16
Dec-00	0.0978	0.6443	0.7103	0.7080	45845.0	33241.6	821.76	801.10
Mar-01	0.5865	0.3805	0.7093	0.7118	46330.7	33529.1	771.73	802.13
Jun-01	1.0690	0.5522	0.7129	0.7141	46884.7	33748.2	781.43	772.63
Sep-01	-0.0962	0.7145	0.7317	0.7293	47623.1	34574.1	765.18	766.69
Dec-01	-0.4812	0.2765	0.7203	0.7112	47086.8	33832.2	733.24	754.30
Mar-02	0.0967	0.1335	0.7060	0.7163	47524.8	34184.9	721.40	734.24
Jun-02	0.6763	0.3479	0.7141	0.7214	48207.9	34518.8	770.42	735.24
Sep-02	0.0000	0.5613	0.7323	0.7297	48718.2	35029.6	813.93	786.02
Dec-02	0.5758	0.3103	0.7220	0.7120	48174.5	34295.8	828.20	821.11
Mar-03	0.6679	0.5242	0.7089	0.7158	48618.9	34579.4	837.13	838.96
Jun-03	0.4739	0.5583	0.7194	0.7228	49310.2	35020.2	828.00	853.05
Sep-03	0.1887	0.4919	0.7298	0.7355	49996.5	35742.8	888.25	867.18
Dec-03	0.2825	0.3899	0.7305	0.7209	49613.6	35134.2	936.23	933.47

obs	NONHC		POPW		SR		TFR	
	raw	test	raw	test	raw	test	raw	test
Mar-90	282.05	282.05	37141.9	37141.9	0.9963	0.9963	1855.0	1855.0
Jun-90	293.47	289.92	37375.3	37877.5	0.9962	0.9959	1855.0	1864.1
Sep-90	303.96	301.93	37608.8	38109.4	0.9963	0.9958	1855.0	1849.7
Dec-90	313.52	321.70	37839.0	38349.1	0.9961	0.9958	1855.0	1862.6
Mar-91	318.74	330.52	38069.1	38583.5	0.9952	0.9959	1816.5	1870.5
Jun-91	327.82	341.70	38303.1	38807.1	0.9952	0.9958	1816.5	1784.5
Sep-91	337.34	359.14	38560.4	39086.4	0.9956	0.9957	1816.5	1730.7
Dec-91	347.31	369.05	38922.0	39545.9	0.9953	0.9956	1816.5	1783.5
Mar-92	357.72	373.81	39283.6	39890.7	0.9950	0.9952	1773.0	1819.3
Jun-92	368.58	379.88	39525.7	39998.6	0.9952	0.9951	1773.0	1806.9
Sep-92	379.87	398.28	39768.8	40231.9	0.9954	0.9950	1773.0	1814.3
Dec-92	391.61	401.19	40005.7	40468.5	0.9951	0.9949	1773.0	1818.7
Mar-93	401.45	407.64	40242.5	40702.4	0.9948	0.9949	1773.0	1801.5
Jun-93	411.14	419.00	40481.6	40933.9	0.9948	0.9949	1773.0	1750.3
Sep-93	416.90	432.71	40720.7	41168.4	0.9953	0.9948	1773.0	1710.8
Dec-93	442.19	438.76	41022.2	41483.8	0.9951	0.9948	1773.0	1756.4
Mar-94	451.71	453.70	41323.7	41785.5	0.9946	0.9948	1824.0	1774.3
Jun-94	468.81	468.23	41471.7	41915.1	0.9948	0.9948	1824.0	1789.3
Sep-94	473.62	483.87	41612.0	42061.8	0.9950	0.9948	1824.0	1820.3
Dec-94	496.03	494.06	42129.3	42941.6	0.9948	0.9947	1824.0	1839.6
Mar-95	514.42	502.81	42646.5	43451.1	0.9943	0.9946	1839.5	1871.3
Jun-95	536.55	516.16	42770.3	43240.0	0.9944	0.9946	1839.5	1831.0
Sep-95	540.62	542.89	42894.0	43367.5	0.9947	0.9946	1839.5	1818.5
Dec-95	556.24	557.97	43131.8	43625.9	0.9946	0.9945	1839.5	1748.1
Mar-96	558.35	573.26	43369.6	43895.2	0.9936	0.9944	1740.5	1672.8
Jun-96	603.30	585.83	43477.4	44011.2	0.9942	0.9945	1740.5	1682.3
Sep-96	604.63	601.86	43585.2	44117.6	0.9945	0.9946	1740.5	1705.0
Dec-96	621.79	618.30	43834.8	44345.9	0.9947	0.9947	1740.5	1704.4
Mar-97	611.73	624.82	44084.3	44544.3	0.9951	0.9949	1638.0	1734.6
Jun-97	639.87	632.08	43480.2	43930.0	0.9947	0.9950	1638.0	1750.7
Sep-97	626.94	563.66	44582.8	45023.0	0.9952	0.9951	1638.0	1782.3
Dec-97	612.70	619.57	44693.7	45119.1	0.9951	0.9950	1638.0	1644.3
Mar-98	617.61	623.42	44804.6	45256.8	0.9951	0.9948	1628.5	1594.4
Jun-98	618.64	586.07	44915.8	45354.4	0.9948	0.9947	1628.5	1596.0
Sep-98	597.83	600.63	45028.7	45452.4	0.9949	0.9948	1628.5	1556.6
Dec-98	601.08	611.35	45140.1	45529.7	0.9948	0.9947	1628.5	1535.4
Mar-99	611.11	634.38	45528.9	45810.4	0.9938	0.9943	1356.0	1449.8
Jun-99	617.07	639.72	45642.2	45893.2	0.9937	0.9943	1356.0	1413.3
Sep-99	632.53	652.34	45758.2	45989.2	0.9943	0.9942	1356.0	1408.0
Dec-99	664.34	684.22	45866.2	46087.7	0.9947	0.9940	1356.0	1385.1
Mar-00	657.39	681.09	46274.6	46480.2	0.9937	0.9940	1409.5	1403.5
Jun-00	665.30	676.96	46342.9	46598.6	0.9938	0.9940	1409.5	1406.5
Sep-00	665.28	673.85	46517.0	46773.7	0.9941	0.9940	1409.5	1407.8
Dec-00	691.32	711.18	46670.6	46948.4	0.9942	0.9940	1409.5	1402.3
Mar-01	702.31	696.73	46826.3	47103.6	0.9941	0.9940	1443.5	1413.3
Jun-01	718.72	714.40	46980.4	47262.5	0.9939	0.9940	1443.5	1399.1
Sep-01	704.81	708.13	47134.4	47405.2	0.9937	0.9938	1443.5	1415.3
Dec-01	722.98	743.07	47287.4	47573.0	0.9942	0.9940	1443.5	1387.7
Mar-02	725.96	746.43	47441.8	47722.6	0.9939	0.9940	1384.5	1372.9
Jun-02	753.55	732.93	47597.5	47852.8	0.9939	0.9937	1384.5	1379.7
Sep-02	743.85	741.29	47754.5	48008.5	0.9938	0.9938	1384.5	1371.2
Dec-02	777.44	785.19	47911.9	48168.8	0.9941	0.9940	1384.5	1357.3
Mar-03	790.63	783.41	48069.3	48308.5	0.9936	0.9939	1342.0	1371.0
Jun-03	812.23	803.15	48226.6	48451.8	0.9937	0.9939	1342.0	1356.4
Sep-03	802.65	797.12	48383.8	48599.7	0.9939	0.9940	1342.0	1382.4
Dec-03	843.30	855.45	48573.5	48736.5	0.9942	0.9940	1342.0	1394.4

obs	TMR		TPOP		Y		YL	
	raw	test	raw	test	raw	test	raw	test
Mar-90	3.700	3.700	55961.7	55961.7	508.24	508.24	127.45	127.45
Jun-90	3.800	4.143	56183.3	56685.5	528.88	534.34	132.78	138.23
Sep-90	3.700	4.174	56405.0	56905.6	549.09	558.96	138.10	147.97
Dec-90	3.900	4.175	56617.3	57127.4	568.85	584.48	143.41	159.04
Mar-91	4.800	4.104	56829.5	57343.9	586.84	614.11	147.72	174.98
Jun-91	4.800	4.206	57046.5	57550.5	606.25	626.22	153.44	173.41
Sep-91	4.400	4.332	57234.5	57760.5	625.74	648.19	159.56	182.00
Dec-91	4.700	4.427	57319.3	57943.2	645.32	679.20	166.08	199.96
Mar-92	5.000	4.759	57404.1	58011.2	657.22	697.74	172.59	213.10
Jun-92	4.800	4.903	57614.8	58087.7	680.09	705.76	180.07	205.74
Sep-92	4.600	5.028	57826.7	58289.8	706.14	726.92	188.12	208.90
Dec-92	4.900	5.123	58031.3	58494.1	735.39	755.80	196.74	217.15
Mar-93	5.200	5.073	58235.9	58695.8	757.93	770.98	208.07	221.12
Jun-93	5.200	5.127	58442.9	58895.2	765.49	778.51	216.96	229.99
Sep-93	4.700	5.180	58649.8	59097.5	815.35	830.08	225.56	240.29
Dec-93	4.900	5.168	58842.4	59304.0	819.50	839.35	233.87	253.72
Mar-94	5.400	5.182	59034.9	59496.7	854.12	880.75	238.21	264.83
Jun-94	5.200	5.211	59243.7	59687.1	853.07	875.45	247.41	269.78
Sep-94	5.000	5.240	59444.0	59893.8	894.98	913.69	257.78	276.49
Dec-94	5.200	5.292	59278.5	60090.8	921.92	961.26	269.34	308.68
Mar-95	5.700	5.367	59112.9	59917.5	949.03	986.79	287.64	325.40
Jun-95	5.600	5.437	59281.9	59751.6	959.50	976.22	299.32	316.04
Sep-95	5.300	5.445	59450.8	59924.3	1032.82	1046.54	309.95	323.68
Dec-95	5.400	5.523	59600.6	60094.7	995.10	1008.46	319.54	332.89
Mar-96	6.400	5.590	59750.4	60276.0	1049.72	1060.41	327.63	338.31
Jun-96	5.800	5.484	59897.9	60431.7	1063.12	1074.33	335.28	346.49
Sep-96	5.500	5.358	60045.3	60577.7	1116.43	1136.48	342.07	362.11
Dec-96	5.300	5.328	60198.0	60709.1	1202.60	1217.35	347.98	362.73
Mar-97	4.900	5.108	60350.6	60810.6	1159.39	1176.30	353.72	370.63
Jun-97	5.300	5.002	60499.8	60949.6	1126.92	1119.73	357.60	350.41
Sep-97	4.800	4.937	60648.9	61089.1	1049.89	1038.71	360.33	349.15
Dec-97	4.900	5.046	60799.0	61224.4	1201.95	1205.79	361.90	365.74
Mar-98	4.900	5.224	60949.0	61401.2	1230.28	1241.31	359.10	370.13
Jun-98	5.200	5.293	61098.7	61537.3	1139.36	1149.73	359.65	370.01
Sep-98	5.100	5.231	61248.4	61672.1	1171.77	1178.12	360.32	366.67
Dec-98	5.200	5.308	61399.9	61789.5	1130.65	1140.72	361.12	371.19
Mar-99	6.200	5.705	61551.2	61832.7	1131.44	1141.94	359.58	370.09
Jun-99	6.300	5.743	61704.1	61955.1	1097.99	1105.59	361.63	369.23
Sep-99	5.700	5.806	61856.7	62087.7	1131.33	1133.08	364.80	366.55
Dec-99	5.300	5.961	62002.9	62224.4	1185.92	1192.29	369.07	375.45
Mar-00	6.300	5.991	62192.1	62397.7	1169.84	1177.37	378.25	385.78
Jun-00	6.200	5.967	62336.1	62591.8	1152.60	1163.56	383.25	394.21
Sep-00	5.900	5.988	62481.4	62738.1	1158.08	1164.43	387.85	394.21
Dec-00	5.800	5.989	62609.1	62886.9	1230.44	1244.86	392.06	406.48
Mar-01	5.900	6.045	62741.1	63018.4	1194.14	1207.03	394.61	407.50
Jun-01	6.100	6.034	62871.0	63153.1	1230.83	1245.76	398.53	413.46
Sep-01	6.300	6.218	63001.1	63271.9	1216.67	1223.09	402.55	408.98
Dec-01	5.800	5.977	63130.4	63416.1	1311.37	1329.98	406.68	425.29
Mar-02	6.100	6.009	63261.2	63542.0	1318.40	1335.23	410.18	427.01
Jun-02	6.100	6.316	63393.3	63648.6	1281.94	1290.42	414.82	423.31
Sep-02	6.200	6.205	63526.9	63780.9	1295.68	1305.38	419.87	429.57
Dec-02	5.900	6.011	63660.9	63917.9	1400.85	1420.89	425.32	445.36
Mar-03	6.400	6.116	63795.0	64034.2	1391.70	1407.97	431.17	447.44
Jun-03	6.300	6.132	63928.8	64154.2	1437.11	1449.23	437.43	449.54
Sep-03	6.100	6.043	64062.6	64278.5	1400.55	1408.10	444.09	451.64
Dec-03	5.800	5.951	64238.0	64401.0	1557.87	1570.43	451.15	463.71

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Education

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- Coursework includes Education and Writing, International Trade Theory, Economics and Politics, and Analytical Chemistry

Work Experience

PROMPT Professional Resources & Career Services September 2005-March 2006

- Position as Management Trainee
- Main tasks include: discussion of ideas and drafting proposals for marketing, with a particular focus on the university student target audience

Full-A-Kids September 2004-present

- Position as Substitute Co-teacher
- Leading in singing songs and story-time for children ages 1-5 years

Beckman Scholars Program March 2000-June 2002

- Researcher and Grant Recipient
- Conduct research in synthetic organic chemistry, under Dr. David Haines
- Presentation of research at National Beckman Scholars Conference in Orange County, CA in July 2002 and at American Chemical Society National Meetings in Orlando, FL (April 2002) and Chicago, IL (September 2001)

Publications

The Demise of Distance? The Declining Role of Physical Distance in Knowledge Transmission (2006). Co-authored with Dr. Daniel K.N. Johnson and Amy Brown. *Growth and Change: A Journal of Urban and Regional Policy*.

Honors & Awards

- William J. Fulbright Grant recipient, 2002
- Graduated *Magna Cum Laude* from Wellesley College, 2002
- Inductee to Sigma Xi, 2002
- Natalie Bolton Faculty Prize in Economics, 2002