London School of Economics and Political Science

An analysis of the determinants of access to medicines and health care in developing country settings

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Declaration

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I warrant that this authorization does not, to the best of my belief, infringe the rights of any third party.

Abstract

The research question of this thesis is what are the determinants of access to medicines and health care in developing countries? First, this thesis hypothesises that income is an important determinant of access to medicines and health care and that access is low for low income individuals. Second, this thesis hypothesises that an expectation of a high level of expenditure on medicines reduces the propensity to consume which implies a negative price elasticity.

This thesis sets out to understand demand structures to answer this research question. The first chapter conducts an exploratory exercise to study government demand for medicines using price procurement data across a sample of developing countries. A different approach is used to impute price elasticities for medicines and range from -1.0 and -2.0. This means that a 1% increase in medicine prices, government demand for medicines will drop from 1% to 2%.

The thesis begins the econometric analysis at the patient level using household survey data across a cross-section of 35 developing countries. Demand for health care is inelastic ranging from -0.19 to 0.6. The next two stages of empirical work use national household level data from India as a country case study. Price elasticities for outpatient care range from -0.17 to 0.43 and for inpatient care range from -0.13 to 0.03. Overall, the statistically significant price elasticity results are intuitive with a negative sign but are inelastic and at the lower end of the range found in the literature. The main determinants of health seeking behaviour are similar across different health settings studied in this thesis. These include having insurance and high household expenditure which implies that the poor will experience access problems. Other drivers include health status, gender, marital status, geographical location, education, employment and regulation.

This thesis contributes to the evidence base because current research is limited and has typically drawn from smaller datasets. With a particular focus on medicines, the empirical findings offer policy implications in settings where pharmaceutical policies are not well developed. A broader approach to pharmaceutical policy making is necessary that considers reform measures on the demand and supply side from a health systems perspective.

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Chapter 1 Thesis motivation, overview and scope

1.1 INTRODUCTION

Access to medicines is an important public health issue, particularly for those that can least afford to purchase them. The World Health Organization (WHO) estimates that about 1.3 to 2.1 billion people are without access to essential medicines (WHO 2004a). As part of their Access to Medicines Campaign, Médicins Sans Frontières estimated that one third are without medicines, and in the poorest parts of Africa and Asia, this figure rises to 50% (MSF 2007).

Globally the consumption of medicines is unequally distributed. In 1999 high income countries accounted for 15% of the world's population but consumed 90% of total medicines by sales; middle income countries accounted for 45% of the world's population and consumed 5.9% while low income countries accounted for 40% of the world's population and consumed 2.9% (WHO 2004a).

Patients use medicines to either improve or maintain their quality of life and health. Typically, patients living in developing countries require medicines to treat infectious disease but now many developing countries are also experiencing a rise in the prevalence of patients suffering from chronic conditions (such as diabetes, cardiovascular disease) which requires regular use of medicines for treatment. According to the WHO, "expenditure on medicines accounts for a major proportion of health costs in developing countries and therefore access to treatment is heavily dependent on the availability of affordable medicines" (WHO 2007).

This demand for medicines in developing countries raises important policy implications where health systems are cash constrained and medicines are not typically subsidised as they are in high-income countries. This thesis explores the issue of access to medicines in developing countries with the aim to fill a gap in the evidence base in an important area of health policy.

This chapter is organised as follows. The next section, 1.2, provides an overview of the thesis and the thesis research questions. Section 1.3 presents the thesis outline and its contribution to research.

1.2 THESIS HYPOTHESIS, RESEARCH QUESTIONS AND OBJECTIVES

The overall research question of this thesis is: what are the determinants of access to medicines and health care in developing countries? To answer this question, this thesis has two main hypotheses. First, this thesis hypothesises that income is an important determinant of access to medicines and health care and that access is low for low-income individuals. Second, this thesis hypothesises that an expectation of a high level of expenditure on medicines reduces the propensity to consume (which implies a negative price elasticity). This thesis sets out to understand demand structures to answer this research question in four analytical chapters and related sub-research questions presented below.

Table 1.1 Thesis research questions and research objectives

Overall research question	
What are the determinants of access to medicines and health care in developing countries?	
Chapter 4 Research objective	**Research questions**
Impute price elasticities for sales to government purchasers in selected low and middle-income countries	1) Is there variation in prices? 2) What are the mark-ups over marginal cost? 3) What is the imputed price elasticity and is price elasticity correlated with income?
Chapter 5 Research Objective	**Research questions**
Determine the factors which affect access to medicines and health care in primary	1) Does income affect access? 2) Does regulation affect access

and secondary care in selected low and middle income countries	to medicines? 3) What is the price elasticity?
Chapter 7 Research Objective Determine the factors which affect access to medicines in outpatient care in India	**Research questions** 1) Does income affect access in outpatient care in India? 2) Does regulation affect access to medicines in India? 3) What is the price elasticity in India?
Chapter 8 Research Objective Determine the factors which affect access to medicines in inpatient care in India	**Research questions** 1) Does income affect access in inpatient care in India? 2) Does regulation affect access to medicines in India? 3) What is the price elasticity in India?

1.2.1 RESEARCH QUESTION ONE

An exploratory exercise is presented in Chapter 4. The approach taken in this chapter is a first step to study prices paid by public authorities in a selection of low and middle-income countries. Procurement prices are used in this chapter. These prices are also referred to as upstream prices in the drug supply chain. This chapter first studies whether there is variation in prices or whether prices are uniform across countries using procurement pricing data for medicines. The chapter also explores the mark-ups over marginal cost which is applied to medicine prices. The next stage of analysis is to impute price elasticities based on the Ramsey pricing rule. This pricing rule states that where there are a high fixed costs market prices are a function of the elasticity of demand. These estimates are a first attempt to provide information on the degree of price responsiveness in these settings.

1.2.2 RESEARCH QUESTION TWO

Chapter 5 begins the econometric analysis at the patient level to study the determinants of access to medicines and health care. This chapter uses a cross section of household data for a sample of low and middle-income countries for cross county comparative analysis. Data on health care utilisation in primary and secondary care is used to first study whether income is a determinant. If this variable is significant and positively associated with utilisation then this finding suggests that low-income individuals will experience access problems. Next this chapter explores whether the regulatory environment has a positive effect on access. Finally, the extent to which access is affected by price is measured by computing price elasticities using patient level expenditure data. This information captures downstream prices, which refer to prices faced by patients.

1.2.3 RESEARCH QUESTION THREE

Chapters 7 and 8 extend the patient level analysis by using India as a country case study. Chapter 7 assesses the determinants which affect access to medicines in outpatient care using household level data. Chapter 8 studies which determinants affect access to medicines in inpatient care using household data. In both chapters, the analysis studies whether income is a driver for access. If income is significant, and positively associated with utilisation then this finding suggests that the poor are negatively affected. The regulatory environment of the state is tested for whether it has a positive effect on access. Finally, price elasticities are computed using patient level expenditure data.

1.3 OUTLINE AND CONTRIBUTION OF THESIS

The thesis begins with a discussion on the concepts applied in this thesis drawing from the theory of the health care market followed by a discussion on the health

policy context in low and middle-income countries in Chapter 2. Chapter 3 presents a review of the evidence on access to medicines and health care, empirical approaches used and gaps in the literature.

Chapter 4 conducts an exploratory and descriptive exercise of procurement prices of medicines in selected low and middle-income countries. This chapter explores variation in prices and markups for the same medicine across countries. This chapter uses a different approach to impute price elasticities ranging from -1 to -2. This means that for a 10% increase in price, government demand for medicines will drop from 10% to 20%.

The econometric analysis of this thesis is presented in chapters 5, 7 and 8. Chapter 5 analyses the determinants of access to affordable medicines in outpatient and inpatient care using a cross sectional household data from a sample of low and middle income countries. This chapter explores whether income is a significant factor, tests for the significance of the regulatory environment and computes the price elasticity of demand for health care. The results indicate that the price elasticity is 0.11 (5% significance) with estimates ranging from -0.19 to 0.6.

Chapter 6 uses India as a case study and presents a discussion on the pharmaceutical regulatory environment at the federal level in India. This discussion provides useful policy context to frame the analysis in the subsequent two chapters. Chapter 7 and 8 use household survey data to determine the factors which affect access to medicines in outpatient and inpatient care in India. Both chapters test for the significance of income, whether regulation at the state level has a positive effect on access to medicines and computes price elasticities.

In Chapter 7, price elasticities for outpatient care range from -0.17 to -0.16 (1% significance), and 0.16 (10% significance) with overall range from -0.17 to 0.43. In Chapter 8, price elasticities for inpatient care range from -0.13 to -0.10 (1% significance), -0.11 (5% significance) and 0.03 (10% significance) with an overall range of -0.13 to 0.03 for inpatient care.

The main determinants of health seeking behaviour are similar across different health settings studied in this thesis. These include having insurance and high household expenditure which implies that the poor will experience access problems. Other drivers include health status, gender, marital status, geographical location, education, employment and regulation. Overall the most significant price elasticity results are intuitive with a negative sign but are at the lower range found in the literature. A summary of the computed price elasticities is presented below.

Table 1.2 - Summary of elasticity results

Model	Key Assumptions	Sample	Description	Elasticity
MNL	IIA and IID hold	Cross country (Chapter 4)	Patient expenditure	-0.19 (hospital) 0.11** (clinic)
MNL	IIA IID hold	India (outpatient) (Chapter 6)	Patient expenditure	-0.16*** (public) -0.17***(private) 0.16* (self)
Nested	IIA and IID do not hold within nests. IIA and IID hold across nests	Cross country (Chapter 4)	Patient expenditure	0.03 (hospital) 0.63 (clinic)
Nested	IIA and IID do not hold within nests. IIA and IID hold across nests	India (outpatient) (Chapter 6)	Patient expenditure	0.26 (public) 0.43(private) 0.01(self)
Simple count models	Unobserved heterogeneity due to over dispersion of excess of zeros	India (inpatient) (Chapter 7)	Patient expenditure	-0.13*** to -0.10***

Two part hurdle	Address some of the heterogeneity with two part estimation using count models	India (inpatient) (Chapter 7)	Patient expenditure	-0.11** (2004) 0.03* (1995-96)

Note: *** p<0.01, ** p<0.05, * p<0.1

The implications of these estimates are discussed in more detail in Chapter 9. Chapter 9 presents the policy discussion by identifying high level issues, the policy implications for demand side and supply side pharmaceutical regulation and policy recommendations for the Indian case study. This chapter ends with a discussion on the limitations of the approaches used in this thesis and considerations for further research.

This thesis contributes to the evidence base because current research is limited and has typically drawn from smaller datasets. This research will contribute to the evidence base in two key areas. First, the research provides new evidence of the drivers of access to medicines and health care drawing on larger datasets, estimates price elasticities and the effect of regulation. Second, the empirical findings offer important policy implications for the role of public intervention. With a particular focus on medicines, the empirical estimates could inform pricing policies in low and middle income countries where pharmaceutical policies are not well developed. A broader approach to pharmaceutical policy making is necessary that considers reform measures on the demand and supply side from a health systems perspective. This research is timely because it will fill gaps in the current debate on access to medicines and inform an important area of health policy.

2 Chapter 2 Health care market and policy context

2.1 INTRODUCTION

This chapter provides background discussion to frame the thesis research questions and the analytical chapters that follow from it. Section 2.2 discusses health care market features relevant to the pharmaceutical market. The discussion then moves onto discussing the policy context and policy challenges of pharmaceutical regulation in low and middle-income settings.

2.2 HEALTH CARE MARKET CHARACTERISTICS

2.2.1 RATIONALE FOR GOVERNMENT INTERVENTION

This section presents the relevant features of the health care market as they relate to pharmaceutical policy issues. It is important to present this discussion as the theory motivates the empirical analysis of this thesis. Health economic theory draws on the neo-classical theory of the market. This theory provides a basis for the role of government in the regulation and provision of services in the health care market due to market failure. While the health economic literature encompasses a number of issues supporting the case for government intervention, the focus of this section is to raise the features relevant to pharmaceutical issues: asymmetric information, externalities, merit goods and economic growth, monopoly and equity.

A key characteristic of the health care market is the uncertain nature of the onset of ill health. This feature creates the need for insurance. In a market with full information for insurers and patients, insurance contracts would be set with premiums that are actuarially fair that would accurately account for the probability of the individual becoming sick.

In the insurance market, patients have more information about their health and high-risk individuals have an incentive to hide their true risk to avoid high premiums. The insurer however does not have full information on the insured due to this asymmetry of information so it is difficult to set the premium to the nature of risk. Without full information, the insurer raises premiums; the healthy drop out because they find premiums to be too expensive and results in the insurer having a more costly risk pool. This form of asymmetric information creates the problem of adverse selection and possibly no market at all. This creates inequities for those who cannot afford premiums. The market does not emerge for high-risk individuals, such as the elderly and the poor, because premiums would have to be set to the probability of becoming sick, which in these cases is close to 1. This is also inefficient because the outcome is that there are missing markets: patients would purchase insurance if the market worked well but they are excluded from the market.

In reality, there are various market failures. An important feature is asymmetric information. The two main areas this occurs in health care are between the patient and the insurer and second between the patient and health care provider. This is referred to as the principal-agent relationship where the principal (e.g. patient) is dependent on the agent (e.g. doctor) because of their medical knowledge in their diagnosis and treatment. The transaction costs associated with the patient having the same level of knowledge as the health care professional is too high and as a result, the patient's demand for health care services, referred to as derived demand, is a function of the provider's treatment and diagnosis. As a result, the condition of a perfectly informed consumer is not met in the health care market requiring some level of government intervention.[1]

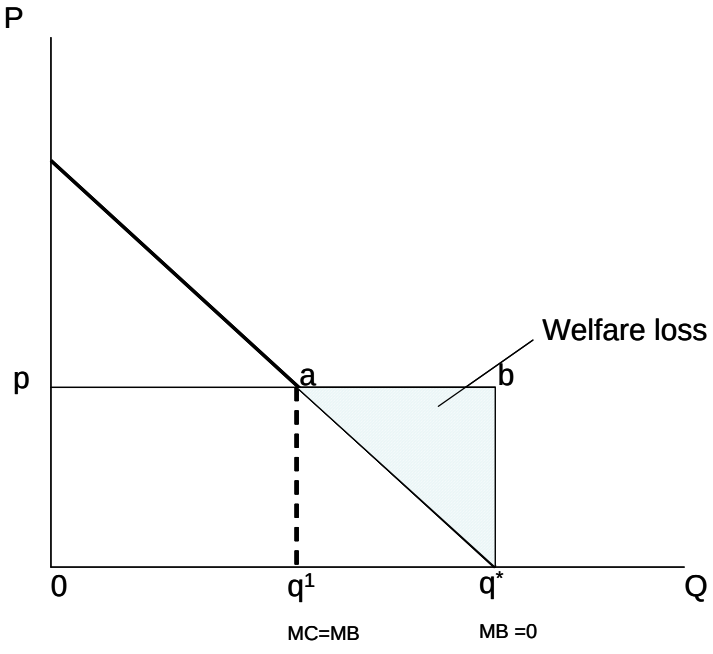
[1] The literature recognises the difficulty in understanding the meaning of 'demand' for health care due to the agency relationship between patients and health care providers, information, trust, cultural attitudes, and health professionals 'inducing' demand (Ellis and McGuire 1993). Demand is interpreted in a more limited way to be an empirical relationship between the degree of cost sharing and the quantity of use demand by the patient (Ellis and McGuire 1993). Empirical work indicates that the demand curve for health care is downward sloping (Ellis and McGuire 1993).

Another feature of insurance which arises from asymmetric information is the problem of moral hazard which can occur on the supply side or demand side. Supplier induced demand, refers to the financial incentives of how providers are paid which may encourage greater provision of health services (Donaldson C, Gerard K et al. 2004). For example, a fee-for-service payment system encourages higher levels of volume of care.

Demand side moral hazard refers to when an individual may engage in risky behaviour than if they were not insured, referred to as patient moral hazard (Donaldson and Gerard 2004). In other words, it is the increased use of services when the pooling of risks leads to decreased marginal costs for the service (Folland S, Goodman AC et al. 2004).

This is shown in the graph below, where a patient's demand for health care is assumed to be linear. If the patient has to pay for health care, the patient consumes q^1 at price p where the marginal cost (MC) of consumption is equal to the marginal benefit (MB) of consumption (MC=MB). If insurance covers all health care costs the patient has no incentive to constrain consumption and could over-consume. Health care becomes free. Price and MB is driven down to zero at q^*. Total cost of care is shown by rectangle $0pbq^*$, which is larger than rectangle $opaq^1$ if the patient had to pay for health care. This over-consumption is termed moral hazard and results in a welfare loss as shown by Δabq^*.

Figure 2.1 - Patient moral hazard



These distortions necessitate the government involvement to ensure the market for insurance exists. In low and middle-income settings the public and private insurance market is not well developed. Health systems are cash constrained and governments rely on individuals to finance much of their care. Therefore, this thesis studies patient demand for medicines in this context. As stated in Chapter 1, the WHO finds that medicines account for a major proportion of health costs in developing countries. The financial burden on patients is discussed in more detail in the next section.

In developing country settings, many governments introduced user fees to offset potential demand side moral hazard. In these cash constrained settings, these policies were also used for revenue generation. The effectiveness of user fees in meeting either objective depends crucially on patients' price elasticities. Some empirical work suggested that demand for health care was relatively inelastic which would suggest that user fees could be useful for revenue generation. Their effectiveness, however, was limited and is further discussed in Chapter 3.

While the focus of this thesis is not to test the presence of adverse selection or moral hazard, these issues were raised to provide general context for government intervention in the health care market. The aim of this thesis is to estimate price responsiveness using information on medicines prices and medicine expenditure. These issues are further explored in the subsequent chapters.

Two features which further necessitate government intervention relates to externalities and health care being a public good. Externalities refer to the costs or benefits that are not captured in the transactions between producers and consumers (Folland et al 2004). For example, in low and middle-income countries where there is greater prevalence of infectious disease, the provision of medicines directly benefits patients treated but this also prevents the transmission of the disease to others (World Bank. 1993; McPake B, Kumaranayake L et al. 2002; Mwabu, Schultz et al. 2007). In the case of medicines, an unregulated market would not account for an individual's willingness to pay for externalities, and the

medicine may be priced too high in private markets, resulting in too little medicines supplied, which makes a case for some level of price regulation (World Bank 1993; McPake et al. 2002; Mwabu 2007). Another argument is that the market may fail to produce 'public goods' (Mills AJ and Ranson KM 2006). In economics, this refers to goods that are non-rival which means that the consumption by one person does not reduce the consumption of another and are non-excludable which means that a consumer cannot be prevented from benefiting from the good (Varian HR 2003). For example, the herd effect from vaccination could be thought of as an externality or at the limit a public good. The free or subsidised provision of vaccines directly benefits those receiving the treatment but also reduces the risk of the spread of certain diseases to those who did not receive treatment (Mills and Ranson 2006).

Health care can also be argued to be a 'merit good' where society believes it should be provided. These goods (e.g. expensive medicines) might be under consumed because individuals may not be the best judge of what is in their own or public's interest (e.g. children or the mentally ill) (Mills and Ranson 2006). Government intervention is further justified on grounds that it will better promote economic wellbeing (World Bank 1993). Evidence supports the argument that human capital contributes to economic growth (Commission on Macroeconomics and Health 2001). Health is a component of human capital and it is linked to economic outcomes at both individual and country levels (Thomson S, Foubister T et al. 2009). Research has shown that a healthy labour force helps to secure labour supply, higher productivity, investment and savings (Thomson et al. 2009). In low and middle-income settings, access to health care and affordable medicine prices is extremely important as they will have knock-on effects for the economy, helping to raising the standard of living and reduce poverty (World Bank 1993).

Fourth, another reason for government intervention relates to monopoly power which can result in high prices than if the market were competitive. Monopoly power could be a pharmaceutical firm, a hospital, or even by the profession as a whole (e.g. medical profession) (Mills and Ranson 2006). The relevant issue for this thesis is that the pharmaceutical market has a monopoly element because for a defined period of time one company holds the patent for a medicine. This will

have implications for drug price setting. There have been some responses to this, namely price differentiation where prices of medicines are set according to demand responsiveness (i.e. price elasticity of demand) typically using GDP as proxy information to capture a country's income level. This thesis explores this topic in chapter 4.

The final argument for government intervention is based on equity principles. There will be individuals too poor to pay for medicines, health care, and health insurance. It can be argued that income redistribution would address this, but equitable access is of concern and it can be argued that providing benefits in kind is appropriate, particularly given the other rationales set out above (e.g. externality, merit good) (Mills and Ranson 2006). In developing country settings, the private sector is largely unregulated. In the public sector, medicines are typically cheaper or even free but there is poor stock availability which implies that patients resort to the private sector to purchases medicines which may be unaffordable and undermine patient access to medicines. In the subsequent chapters, this thesis examines the determinants of access to pharmaceutical care and implications for equity in developing countries.

While market failures are not specific to the health care market, it is widely recognised in the literature that the presence of uncertainty of ill health, asymmetric information and externalities and the degree to which they occur in the health care market make a strong case for government intervention, particularly in the area of health financing (Evans RG. 1984; McGuire A, Henderson T et al. 1988; McPake B, Kumaranayake L et al. 2002; Donaldson C, Gerard K et al. 2004; Folland S, Goodman AC et al. 2004). There is less agreement, however, on the extent to which government intervention should play a part in provision (Donaldson and Gerrard 2004).

Government involvement can take a variety of forms in health care. In pharmaceutical markets these include pricing and reimbursement of medicines, importation of drugs, which can be sold over the counter or require a doctor's prescription, quality control and licensing for imported and locally made drugs

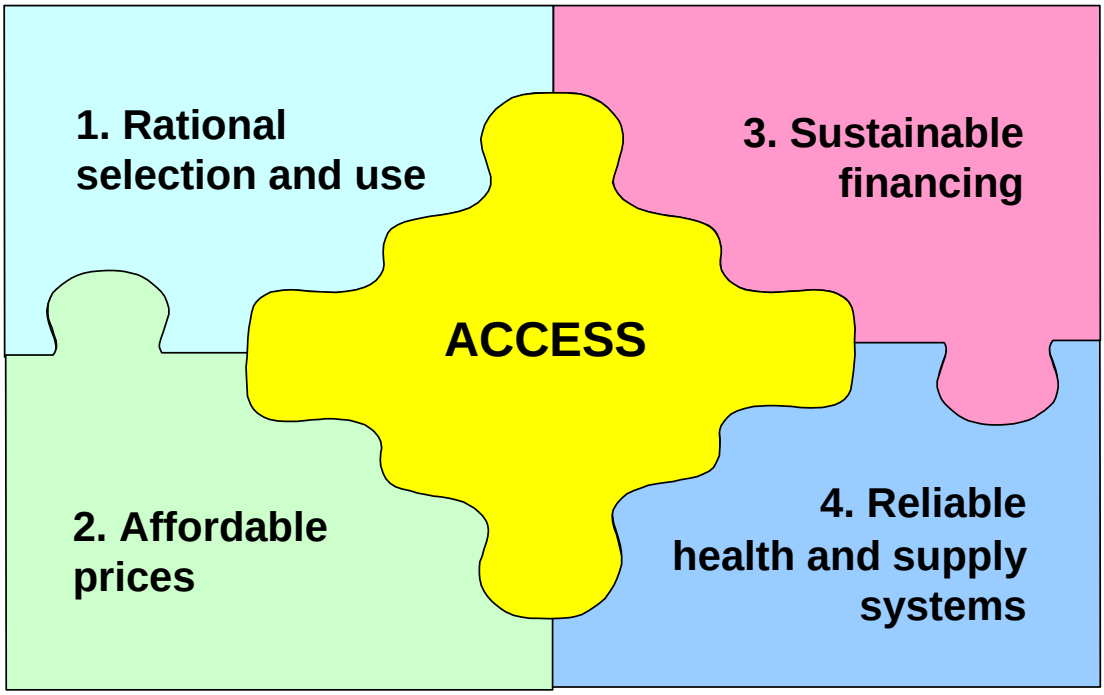
(Mills and Ranson 2006). Pharmaceutical issues in developing countries are further explored as they relate to the thesis in the following section.

2.3 PHARMACEUTICAL POLICY CONTEXT IN DEVELOPING COUNTRIES

While there are a number of policy issues in developing country settings that affect how health systems take care of their populations, such as revenue raising capacity, health financing, regulation of providers, historical patterns of development (e.g. colonial presence) and the power of different interest groups (Mills and Ranson 2006), this section focuses on the policy issues specific to pharmaceutical regulation in developing country settings. This discussion is important as it provides context to the empirical work carried out in the thesis which studies determinants of access to medicines.

To begin this discussion, it is useful to turn to the WHO framework of the determinants of access to medicines which considers four important components of access: rational selection and use, reliable health and supply systems, affordable prices and sustainable financing as shown below. Rational selection and use relates to how pharmaceutical regulation promotes and encourages cost-effective prescribing, (e.g. financial incentives to prescribe generics). Reliable supply is an important policy issue to ensure reasonable levels of stock and drug availability in these settings. Sustainable financing will have implications for the level of subsidisation for medicines or the extent to which patients are required to incur out-of-pocket (OOP) costs. This topic raises an important relationship with affordable prices. Medicine prices that are affordable to a wider population of patients will contribute to increased patient access to medicines.

Figure 2.2 - WHO Framework of access to medicines



While these four aspects play an important role in understanding access to medicines, the focus of this thesis relates to understanding access from the perspective of demand for medicines and implications of prices on access to medicines. In developing country settings, a key issue is that a large part of health care costs are not subsidised and so patients must incur these out-of-pocket (OOP) costs. The demand for health care is more a function of a patient's ability to pay for these costs or to forego care.

We now turn to discussing issues that are relevant to the approaches used in the theoretical and empirical specifications in studying the determinants of demand for medicines in this thesis. The discussion now turns to government policies, implications for patients and the pharmaceutical industry.

2.3.1 GOVERNMENT POLICIES IN DEVELOPING COUNTRIES

There are number of policy issues relating to government policies on pharmaceutical regulation. Some of the issues include financing, pricing, patients, pharmaceutical industry, market authorisation, pharmacovigilance, regulation of the supply chain, and incentives for providers. This section focuses on financing, pricing, patients and the pharmaceutical industry which are issues relevant to this thesis's analysis.

Revenue generation and health system financing

Sustainable financing is a key issue for governments in developing countries for financing of health services and in particular for medicines. Financing of health services refers to the raising or collection of revenue to pay for the operation of the system itself. This section highlights three important features relevant to this thesis: first public sector financing is smaller in these settings; second, drug expenditures constitute a greater share of total expenditures in these settings; third, patients typically finance a large portion of their health care. These three features are important to discuss because they have implications for this thesis as it focuses on understanding the determinants of demand for medicines.

The three important functions of health financing are to collect revenues, pool risks, and purchase health services (World Bank 2008). In high-income settings, collection of revenues, pooling of risks and purchasing of health services are more developed than in low and middle-income settings.

In low and middle-income settings the collection of revenue, pooling of risks and purchasing of services are less developed. Sources of financing include tax-based financing, user fees, private insurance, social insurance financing, and community-based health insurance (CBHI) and are described in the table below. It is important to note that donor aid is also a prominent feature in some developing country settings.

Table 2.1 - Types of Health financing

Tax-based financing: Health services are paid for out of general government revenue such as income tax, corporate tax, value-added tax, import duties, etc. Certain taxes may be earmarked for health care (e.g. cigarette taxes or 'sin taxes'). All low and middle-income countries draw on a smaller tax base source relative to high-income countries.

User fees: Patients pay directly according to a set health tariff. This is the common method of payment in the private and public sector. This policy was promoted in the 1980s particularly by the World Bank (Akin, Griffin et al. 1986). Many low and middle-income countries adopted this policy particularly in sub-Saharan Africa. The international literature heavily debated this policy (Gilson L 1988; Kanji N 1989). Overall the evidence suggested that this policy was regressive for low-income groups and showed to deter access for the poor. Some countries and many international agencies have now rejected user fees as a potential policy at least at the primary care level.

Private insurance: Premiums are related to the expected costs of providing services to the individual. High health risk users pay more than the low risk users. Cross-subsidy is limited and membership is usually voluntary. For-profit or not-for-profit companies operate.

Social insurance financing: Health services are paid from contributions to a health fund. The most common source is payroll where both the employer and employee pay a percentage of their salary. Membership is usually mandatory. The health fund should follow strict government regulations. Premiums are linked to the average cost of treatment to the entire group paying into the fund, not to the expected cost of care of the individual. There are explicit cross-subsidies from the healthy to the less healthy. Some international agencies, particularly the World Bank promoted the adoption of social health insurance. In practice, this is a more complicated policy to pursue and few low-income countries attempted this while

it was adopted in some middle-income countries such as Thailand.

Community-based health insurance: Premiums are set according to the average risk facing the population covered under the scheme. Enrolment is voluntary and a private non-profit entity is responsible for the funds. In the late 1980s and early 1990s, CBHI schemes emerged to address the problems of access created by user fees.

Donor aid: During the 1990s, the World Bank was the single largest donor for health, nutrition and population (HNP) related policies accounting for about 18 percent of global HNP aid, but by 2006, the World Bank's share was 6% in 2006 (Michaud C. 2003; World Bank 2008; IEG 2009). This large shift in funding highlights the entry of numerous international donors who are contributing significant sums of money to developing countries (IEG 2009). The changing environment of international aid raises more challenges to coordinate implementation, including aid relating to supporting country level pharmaceutical policies (World Bank 2008; IEG 2009).

Source: Bennett et al. (2008).

The extent to which the system of health financing is pro-poor depends on the interaction between various sources of financing (Kutzin J 2001). If a social insurance system exists for those in the formal sector and a tax-based system targets those outside, then the equity effects will depend on how a well the tax-based system can deliver a similar benefit package (Bennett S and Gilson L 2008).

The unique features of the health care market—in particular the uncertainty of ill health highlight the importance for policy makers to manage the risks associated with health care costs on the demand and supply side. Demand-side cost sharing is where patients pay in the form of say user fees or insurance deductibles. Supply-side cost sharing, however, sets incentives to health care providers to supply services (Ellis RP and TG. 1993). In practice this means that the price paid by the patient can be set separately from the price paid to providers who supply the service. On equity grounds, the literature notes that supply-side cost sharing is

considered to be superior to demand-side cost sharing, which will discourage care among lower income groups (Ellis and McGuire 1993).

Demand side cost sharing is heavily used in developing country settings, which raises equity implications for patients who can least afford to pay for treatment. The latest figures show that while in high-income countries government expenditure accounts for a large proportion of total health expenditure (61%), low and middle-income countries rely more on the private sector, 42% and 49% respectively (World Bank 2010).[2] This is because formal sector activity is small and as a result governments have a smaller tax base to generate revenues. Public health spending as a share of total government spending ranges from 5.9% to 9% in low and middle-income settings. Per capita health expenditure is lower in developing countries: $22 per capita in low-income settings, $155 in middle-income, while it is $4,266 in high-income settings (World Bank 2010).

In these settings, user fees play a much greater role to complement resources raised through the tax system. While community based health insurance is typically implemented in areas where there are very high user fees, their coverage is limited (Bennett et al 2008). Only a few have social insurance schemes (Mongolia, Pakistan, Senegal, Sudan and Vietnam) that account for more than 15 per cent of government expenditure (Bennett et al. 2008).

As shown in the table below, the figures indicate the low level of public sector financing: 38% to 55% of total health expenditure, while households tend to be the largest contributor of private expenditure ranging from 83% to 92%. The high level of OOP is a relevant issue for this thesis because a significant proportion is on pharmaceuticals (Cohen JC. 2000; Homedes N. and Ugalde A. 2001a; WHO 2004a; IEG 2009). Drug expenditure accounts for a greater share of total health expenditures in developing countries than in high-income countries, ranging from 7-20% in high-income countries, 15-30% in transitional countries and 24-66% in developing countries (Enemark U., Alban A. et al. 2005).

[2] World Bank development indicators for 2007 (World Bank 2010).

Table 2.2 - Patterns of financing in low and middle income countries

	Public health expenditure as a percentage of THE	OOP as a % of total private expenditure
Africa (35 countries)	45.6	83.4
South-East Asia (6)	43.8	83.4
Western Pacific (6)	55.3	77.9
Eastern Mediterranean (4)	37.8	91.6

Note: Share of private expenditure is the difference between 100 and column 2. Source: Bennett et al. (2008); WHO data (WHO 2003)

The discussion on financing has highlighted that public sector financing in health care is much lower in developing country settings. As a result patients face high OOP costs. The high share of OOP for patients has implications for access and demand for medicines because demand will depend on a patient's ability to pay or to forego treatment. This is discussed in more detail in section 2.3.3.

Pricing policies

Price regulation is an important element of government pharmaceutical policy and in high-income countries it can take a variety of forms. A number of approaches

exist: free pricing, international reference pricing, pricing relative to a substitute, price cuts, profit controls (OFT 2007a). In these settings, countries have well developed systems of health insurance including some level of coverage for drug expenditures. Furthermore, high-income countries have sufficient regulatory and enforcement capacity.

In contrast pricing policies in low and middle-income countries are less well developed. For example, few employ pricing policies such as external reference pricing (Espin J and Rovera J 2011). In these settings, there are typically weaker public authorities, and less developed relationships with regulatory bodies, the judiciary and police; as a result, wholesalers and retailers may ignore official price limits because the risk of prosecution is limited (Seiter A 2010). One response to making prices more affordable is price differentiation. This means prices of medicines should reflect a country's level of demand. This issue is discussed in the exploratory analysis in Chapter 4.

The outcome is that in developing country settings, evidence suggests that prices could be more affordable to patients (WHO/HAI 2006). Findings from a recent systematic comparative cross-section survey of selected medicines across low and middle-income countries found that there were wide variation in prices of branded drugs and generic drugs (WHO/HAI 2006). Price regulation and enforcement could in part address wide variation in prices. Furthermore, this survey found that government policies related to taxes, tariffs and import duties could raise the final price paid by patients, undermining access. This may in part be offset by lowering taxes/tariffs/duties and also less expensive prices supplied by international organisations and/or mission facilities. This survey also found that countries do not always procure at low prices (Cameron A, Ewen M et al. 2009).

Furthermore, policy solutions should consider the local context as there can be wide differences within countries. For instance in Mozambique, local mark-ups are responsible for two-thirds of drugs' final prices in private pharmacies; statutory and profit ceilings are applied unevenly; the local market responds effectively to the urban population's diverse needs through its low-cost and high-cost segments (Russo and McPake 2010).

The public authority's ability to negotiate with the pharmaceutical industry will affect the prices at which the authority procures medicines for its population. For example, some countries that procure well based on this survey are Jordan, Lebanon, Peru, Tunisia, and Uganda. Data from this survey is analysed in Chapter 4 in an exploratory exercise to better understand the government demand and purchasing decisions of public authorities.

2.3.2 PHARMACEUTICAL INDUSTRY

A key policy challenge for all countries is to balance industrial policy goals with health policy goals. There are a number of issues related to the pharmaceutical industry including intellectual property rights, pricing of medicines, competition in pharmaceutical markets, R&D particularly in areas of neglected disease that afflict developing countries and unethical practices of advertising and direct advertising to patients. This section focuses on the monopoly element of the pharmaceutical sector and implications for pricing policies that are relevant to the analysis in this thesis.

Intellectual property rights are afforded to firms through the use of patents according to the World Trade Organization's legal framework found in the agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) (WTO 1994). This policy provides the legal framework for all countries that are part of the agreement to recognise patented pharmaceutical products. This has implications for pricing of medicines because the firm has a monopoly on the drug and in principle could set its price freely in a country's market. In developing countries, the implication is that high priced medicines would undermine access for patients. One proposed policy response is differential pricing (also referred to as Ramsey pricing or price discrimination). This policy means that pharmaceutical firms sell the same medicine to developing countries at different prices that reflect a country's price elasticity of demand (WTO and WHO 2001).

This policy is based on the Ramsey pricing rule (Ramsey 1927). Ramsey (1927) developed a model to determine the optimal level of tax rates to generate revenue from commodities. Ramsey was able to show that tax rates should be inversely proportional to the elasticity of demand and elasticity of supply. Elasticities are a unit less measure in economics. In the case of demand elasticities, there are three types of elasticities that can be measured: price elasticity, expenditure elasticity and income elasticity.[3]

Different types of elasticities can be computed. In case of medicines, arc elasticities measure the percentage change in price and quantity of the drug between two points on the demand curve. Point elasticities measure elasticity at a particular point on the demand curve. Constant elasticities use log-log regression and assume that elasticities are constant along the demand curve (Phelps CE. 1997).

The application of the Ramsey rule has been applied more broadly in the public sector pricing of goods and services. Markets are assumed to be independent of one another and that demand is well structured and downward sloping. His formula proposed that where markets have high fixed costs the regulator cannot set prices to marginal cost (also known as first best solution). Therefore, the Ramsey formula is referred to as a second best solution. His rule states that goods should have a higher mark-up over marginal cost where demand is not very responsive to price (referred to as inelastic), while goods should have a lower mark-up relative to marginal cost where demand is responsive (referred to as elastic). This allows optimal price setting for consumers while allowing the firm to cover its costs (Armstrong M, Cowan S et al. 1994). Ramsey pricing also has a place in the literature on price discrimination where it is referred to as third degree price discrimination (Varian 1985).

[3] Applying the elasticities to the drug market, price elasticity reflects uncompensated demand curve which measures the percentage change in drug consumption when there is 1 unit change in the price of the drug. Expenditure elasticity reflects the compensated demand curve which measures the total percentage change in drug expenditure when there is 1 unit change in the drug's price. Income elasticity measures the percentage change in drug consumption with respect to a 1 unit change in income. (Phelps C 1997).

While Ramsey's rule is proposed as a pricing solution for public authorities, it has been considered as a price setting rule from the perspective of the pharmaceutical industry to address inequities in access to medicines across low and middle-income countries (WTO and WHO 2001). The proposal of price differentiation is to set affordable medicine prices based on a country's ability to pay. A measure of country demand has typically been based on proxies such as GDP which are intended to be an index of demand. The extent to which this is carried out could be undermined by other factors such as the threat of parallel trade, and leakage to other markets, or companies offering discounts that are unrelated to income (Hausman JA and Mackie-Mason JK 1988; Maskus KE 2001; Scherer FM and Watal J 2001), resulting in uniform prices across all markets (Philips 1983). The issue of Ramsey pricing and the degree of price responsiveness is further discussed in chapter 4.

2.3.3 PATIENTS

Government policies and the interaction with the pharmaceutical industry have important implications for patients. Households face a significant burden in financing their health expenditure in these settings. This high level of demand-side cost sharing (OOP) is the most regressive form of financing. This creates inequities in access to care because only the wealthy are in a better financial position to cover their OOP costs (van Doorslaer, Wagstaff et al. 1992).

The second related issue is that a significant proportion of private expenditure is on pharmaceuticals (Cohen 2000; Homedes and Ugalde 2001a; WHO 2004a; IEG 2009) and drug expenditure accounts for a greater share of total health expenditures in developing countries than in high-income countries.

Furthermore, the private sector plays a large role in medicine dispensing in these settings. There are a number of different types of providers selling medicines such as pharmacies, unlicensed drug sellers and self-dispensing doctors (WHO/HAI 2006). While in many low and middle-income settings medicines may be

provided freely of charge in the public sector, these facilities are poorly stocked. As a result, patients resort to the private sector to purchase medicines where medicine prices are usually higher than the public sector, creating inequities in access to medicines.

To explore this issue, the patient level analysis begins with a sample of low and middle income countries in Chapter 5. While India tends to procure relatively efficiently, it has one of the highest levels of household OOP. These characteristics of India form the basis of it being a country case study in this thesis and are presented in Chapters 6 to 8.

The third related issue is that many countries have undergone or are in the process of going through an epidemiological transition (WHO 2002). The epidemiological transition refers to the changing nature of population disease burden from communicable disease to non-communicable disease. This transition occurs as a country moves through stages of modernisation and relates to higher income growth, increased sedentary lifestyles, and poor eating habits (Omran AR 1971; WHO 2002).[4] Communicable diseases account for 36 per cent of the disease burden in developing countries, higher than previously, while non-communicable account such as diabetes and heart disease accounted for 54%, with injuries accounting for the remainder (9.8%) (Jamison DT, Breman JG et al. 2006). The burden of morbidity and mortality, however is greatest among the poor (Gwatkin D and Guillot M 2000a).

[4] Omran (1971) divided the epidemiological transition of mortality into three phases. In the last phase chronic disease replaces infectious disease as the primary cause of death. The three phases are: *The Age of Pestilence and Famine*: mortality is high which precludes sustained population growth, with low and variable life expectancy between 20 and 40 years; *The Age of Receding Pandemics*: mortality declines, life expectancy increases steadily from about 30 to 50 years and population growth is sustained; and *The Age of Degenerative and Man-Made Diseases*: mortality continues to decline and eventually approaches a relatively low level, life expectancy exceeds 50 years, and chronic disease replaces infectious disease as the primary cause of death (Omran AR 1971).

These issues imply that not only do households face a significant burden to finance their own health care costs, a large share of their health expenditure is on medicines, with the poor facing greater problems to finance their medicine expenditure. Furthermore patients' demand for medicines is not only for infectious disease but also for non-communicable conditions. Such conditions require constant use of medicines for treatment. In these settings, the demand for health care is much more a function of what patients can afford rather than relying on a well-functioning publicly insured health system. Therefore it is crucial to understand how prices affect access to medicines.

2.4 SUMMARY

In summary, this chapter presented a discussion on health care market characteristics that are relevant to pharmaceutical policies. The discussion has shown that health system design and pharmaceutical regulation face numerous policy challenges. These policy challenges are exacerbated by a weak public sector entity and a large unregulated private sector. Access to medicines and more broadly health care in developing countries are undermined due to the high OOP costs patients face in these settings.

Empirical evidence on price responsiveness could give a more accurate picture of demand as insurance schemes are not well developed. This evidence is important for policy purposes. Affordable prices could increase access therefore information on price elasticities could better inform co-payment policies that take into account patient's price responsiveness to medicines. Thus, price elasticities are potentially important in price determination and could be an important element to inform pharmaceutical policy. Therefore this thesis sets out to better understand demand structures for medicines. The next chapter reviews existing evidence and identifies gaps this thesis aims to address in the subsequent empirical chapters.

3 Chapter 3 Review of the literature: evidence of access to medicines and health care

3.1 INTRODUCTION

This chapter provides a literature review of access to medicines and health care. First the discussion turns to measurement of access in section 3.2. Section 3.3 provides a review of the evidence, empirical approaches taken, knowledge gaps and limitations with existing research.

3.2 ACCESS TO HEALTH CARE SERVICES

3.2.1 DEFINING ACCESS

A significant amount of research has been devoted to the concept of access in the health literature since the 1970s (Donabedian 1972; Aday LA and Andersen R 1974; Penchansky R 1977; Gulliford M, Figueroa-Munoz J et al. 2002; Oliver A and Mossialos E 2004).

Donabedian (1972) defines proof of access to be the use of service not whether the facility exists. He proposed that access should be distinguished between two components: initiation and continuation (Donabedian 1972). Aday and Anderson (1974) note a distinction between the potential to utilise: 'having access' and initiation into the process or utilising a service: 'gaining access.'

An important distinction exists between access to treatment and receipt of treatment (Le Grand 1982; Mooney 1983). Access depends on opportunities while receipt of treatment depends both on these opportunities and whether individuals have availed themselves of them (Wagstaff A and van Doorslaer E 2000a). The

literature typically defines access to mean "receipt of treatment" (Wagstaff and van Doorslaer 2000).

Access is therefore a complex concept and it is widely recognised in the literature that access is a function of more than just the time and money costs in seeking health service (Le Grand 1982; Mooney 1983). Further extensions include income (Olsen EO and Rogers DL 1991), specifying services, quality, personal inconvenience, cost and information (Goddard and Smith 2001). Even though these distinctions were helpful to understand access in the health care context, some have argued that access should not strictly mean utilisation of health services (Penchansky 1977; Mooney 1983; Oliver and Mossialos 2004). Access describes a relationship between the individual and the health system and should reflect a "degree of fit" between the supply and demand related factors (Donabedian 1972; Penchansky 1977; Gulliford et el., 2002; Oliver and Mossialos 2004).

Gulliford et al (2002) proposed components of access:

- Health service availability which refers to the supply of health services
- Health service utilisation which includes overcoming financial, personal and organisational barriers
- Health service outcomes which refers to the relevance and effectiveness of services and their quality
- Equity of access which refers to whether people get access in proportion to their need

Similarly, Thiede et al. (2007) take a broader approach to define access as the "freedom to use health services" (Thiede et al., 2007, p. 105). These authors define access with respect to three dimensions: availability; affordability, acceptability. Availability refers to whether appropriate health services are available when they are needed. For example, this refers to geographic availability and also whether services are available equally to different groups of the population. Affordability refers to the financial access in the broadest sense (e.g. direct costs, indirect costs, household financial wealth). Acceptability refers to the

perception of health services among patients including attitude of health workers to patients, patients' cultural attitudes to health care services, condition of premises, waiting times, duration of consultations, and quality of care in public versus private facilities.

This discussion has highlighted that even though there is no agreed upon definition of access in the literature, there is an acceptance that access encompasses many aspects. For the purposes of this thesis, the definition according to Thiede et al. (2007) is conceptually preferred because of its broad approach. Equally important, this definition explicitly considers acceptability of health services which in low and middle-income settings is appropriate due to the wide array of cultural and contextual factors. The broad definition provides greater scope for analysis of access and is used as a basis to inform the empirical approach taken in this thesis.

3.2.2 MEASURING ACCESS

Measuring access is not a straightforward task because of the number of factors that affect the form of access people have including the availability of drugs, health facilities, money, knowledge, and beliefs (Hausmann-Muela S., Ribera J. et al. 2003). These complications result in using more simpler measures such as equality of expenditure (whether people have the same amount of money spent on them) or equality of utilisation (whether patients go to a health facility equally often) (Palmer N 2008). Measures of access include health care use, OOP payments, health status, mortality, or funding allocations from government (Brockerhoff M. and Hewett P. 2000; Castro-Leal F., Dayton J. et al. 2000; Makinen M., Waters H. et al. 2000; Wagstaff A. 2000b).

One approach is to look at the population according to subgroups for example by quintiles, to compare the richest 20 percent with the poorest 20 per cent. Groups could be divided according to economic status (Wagstaff 2000b), gender and ethnicity (Brockerhooff and Hewett 2000), health condition (Gakidou E., Murray

C. et al. 2000) geographical location, age, education or occupation (Gwatkin DR 2000b).

Different measures of economic status are applied to developing country settings. Household consumption, expenditure, or asset ownership, are common proxies and are considered better measures in these settings. The challenge is that consumption data are not necessarily collected alongside health indicators. Income data are not considered reliable measures because there can be under-reporting. Furthermore, they can be seasonally dependent and do not necessarily capture longer-term income or permanent wealth in low-income settings (Makinen et al. 2000; Palmer 2008). Education and occupation are more commonly used as proxies for social status. For example, data sets from the Demographic and Health Surveys allow analysis of household assets by creating an asset index and the application of principal component analysis (Filmer D and Pritchett L 2001).

The disadvantage of strictly using utilisation data is that it will not capture all aspects of access; in particular it will not reflect individuals who need health care but do not receive it (Aday LA and Andersen RM 1981). Furthermore, utilisation may identify equity challenges in the distribution of health care services but it may not fully capture the appropriate level of quantity or quality of care (Thiede et al. 2007). For instance the utilisation pattern may be skewed towards lower income groups but this may be because the alternatives for the poorer segments of the population are unaffordable (Thiede et al. 2007).

3.2.3 IMPLICATIONS FOR EQUITY AND NEED

Access therefore raises implications for equity and need for health services. Equity is considered to be a normative concept (Gwatkin D. 2002) that introduces the notion of fairness or social justice (Gulliford et al. 2002) while equality is an empirical one (Palmer 2008). Equality can be measured with respect to whether two people made the same number of health visits. Equity, on the other hand, is a value judgement and questions whether both patients should have had the same

number of visits. The literature recognises that definitions of what is equitable can vary between individuals and societies (Donaldson et al. 2004). Measuring equity, however, is not straightforward. The most common definitions in measuring this concept include equal health outcomes (Oliver and Mossialos 2004); equal access for equal need (Donaldson C and Gerard K 1993); and equal utilisation for equal need (Donaldson C and Gerard K 1993).

Utilisation data aims to capture some level of need for health care services. Typically need refers to those who are ill but this definition is limiting as it does not capture the non-ill who could benefit from preventive health care (Wagstaff and Doorslaer, 2000a). Culyer and Wagstaff (1993) proposed the following four definitions:

- need can be defined with respect to the individual's health status;
- the capacity to benefit from health care;
- the level of health care expenditure;
- or the minimum amount of resources required to exhaust capacity to benefit.

The authors note that the first definition does not capture preventive care; the second does not take account of resources spent, while the third definition does. The fourth combines need with capacity to benefit where need is assessed by considering the amount of expenditure required to reduce capacity to benefit to zero (Culyer and Wagstaff, 1993). This last definition, however, implies that someone who requires more expensive intervention has greater need than someone with a more urgent need but for less expensive treatment (Hurley J 2000). This fourth definition, however, is the most agreed upon in the literature (Folland et al. 2004).

From an empirical perspective, the most commonly used approach to capture need is self-assessed health (SAH) as a measure of health status (Le Grand 1978). SAH is an ordinal variable, which provides information on the individual's perceived health status. Typically in health surveys, individuals are asked to rank their health into five categories ranging from very good or excellent to poor or very

poor. SAH has been used in empirical work such as to examine the relationship between health and socioeconomic status (Adams, Hurd et al. 2003); socioeconomic inequities in health (vanDoorslaer, Wagstaff et al. 1997); and between health and lifestyles (Kenkel 1995).

Other SAH measures include information on individuals reporting the presence of chronic conditions or symptoms, referred to as quasi-objective measures. Some examples include identifying a specific chronic condition in a health survey (e.g. diabetes, asthma; cancer), or limitations in activities of daily living (ADL) such as eating, having a bath, or walking (Jones AM, Rice N et al. 2007).

The predictive power of SAH has also been studied. Research shows that SAH is a useful measure and objective measure of health status and is a strong predictor of mortality (Mossey and Shapiro 1982; Van Doorslaer, Wagstaff et al. 2000; Singh-Manoux, Martikainen et al. 2006) and on health care use (van Doorlsaer et al. 2000).

Even though there is evidence of the usefulness of SAH measures in empirical work, there may be reporting biases. Some of these include scale reference (Groot 2000); state-dependence (Kerkhofs and Lindeboom 1995); and response category cut-point shift (Sadana R, Mathers CD et al. 2000). Sen (2002) notes that different population groups may under or over report their health status relative to other groups. Hernández-Quevedo, Jones et al. (2006) find that different population groups have different cut-point levels of SAH while having equal levels of "true" health.

Researchers have found that the differences in how individuals assess their health state can be due to a variety of factors. Some of these factors include perceptions about disease (Barsky, Cleary et al. 1992), culture and language (Angel and Thoits 1987; Zimmer, Natividad et al. 2000), social context (Sen, 2002); gender and age (Lindeboom and van Doorslaer 2004); the ordering of the question and the medium in which questions are posed (e.g. written or face-to face) (Crossley TF and Kennedy S 2002).

The presence of potential biases has led to the development of a set of objective indicators. A comprehensive set of objective indicators was used to construct the McMaster Utility Index where Lindeboom and van Doorslaer (2004) found bias by age and gender but not by income. Health vignettes are another approach currently used in the World Health Organisation World Health Survey (Bago d'Uva T., Van Doorslaer E. et al. 2008). A third method uses biological markers of disease such as blood pressure and walking speed (Johnston DW, Propper C et al. 2007). The use of such information combined with SAH measures could improve accuracy of results (Banks, Marmot et al. 2006). Some biomarkers may be subject to bias. Johnston et al. (2007) found an income gradient bias when hypertension is measured by a nurse rather than by an individual. Masseria et al. (2007) identify challenges with data collection of biomarkers because they may reduce response rates. Overall, there has been a considerable amount of research to further refine and improve objective measures of health status.

Even though there are limitations with measures of access and need, a common approach in the literature to measure access uses the definition of equal utilisation for equal need and health status as a measure of need (Folland et al. 2004). For both conceptual and practical purposes this thesis will use the definition of equal utilisation for equal need to measure access. For practical purposes this thesis will use health status as a measure of need.

3.3 REVIEW OF EMPIRICAL WORK

The discussion now turns to evidence from the literature. Sections 3.3.1 and 3.3.2 present evidence on price elasticities for health care and for medicines. Evidence on the implications for utilisation, equity, revenue raising and efficiency issues are discussed along with evidence from other demand covariates in 3.3.3 to 3.3.5. These findings are considered for comparative purposes with findings from high income settings in 3.3.6. Section 3.3.7 summarises this chapter, identifies gaps in the literature and explains how this thesis aims to contribute to the evidence base.

A number of methods were used to identify relevant papers. The literature search for price responsiveness for medicines is comprehensive. Evidence on price responsiveness for health care discusses the main papers on the topic. While the literature search focussed on developing countries, evidence from high-income countries in section 3.3.6 presents an overview of some of the main papers on the topic for comparative purposes. The following existing literature reviews on demand for health care and price responsiveness served as a basis for the literature search: Creese (1991); McPake (1993); Gilson (1997); Sepehri and Chernomas (2001);Hutton (2004); Palmer et al. (2004); James et al. (2006); Lagarde and Palmer (2008). These existing reviews were not restricted to analysis which used regression techniques and included studies which did not adjust for the effects of user fees on demand. The search for relevant articles ended in December 2011.The literature search involved identifying articles which cited the existing literature reviews. Additional searches used the Internet, and databases such as PubMed, Econlit, IBBS, Science Direct, ISI Web of Knowledge. A combination of keywords was used as shown in the table below.

Table 3.1 - Literature search keywords

Keywords	Combinations with keywords
Cost sharing, user fees, price elasticity, drug, medicine, pharmaceuticals, health equity, health inequity, access, utilisation, willingness to pay, price discrimination, government procurement	Drugs, medicines, pharmaceuticals, health care, utilisation, developing country, India

3.3.1 PRICE ELASTICITIES FOR HEALTH CARE

While the focus of this thesis relates to medicines, it is important to place the thesis within the context of the health care literature. This section provides a review of the important empirical papers on this topic relating to the use of user

fees and willingness to pay. This is because there is a larger evidence base on this topic thereby allowing us to draw out conclusions about whether there are differences in price responsiveness for health care relative to medicines. Furthermore, information on medicine expenditure is a significant portion of household health expenditures which will have implications for access (WHO 2004a).

An important issue that should be highlighted concerns data availability. Data on prices of medicines and volume consumed is lacking in these settings. This is because in developing countries, secondary data is not well developed to include multiple health visits so utilisation data is usually limited to one health care visit. As a result, analysis necessitates imputation of price elasticities. The typical approach draws on patient or household level health care expenditure data to compute price elasticities. Health expenditure data, however, may or may not include information on medicine expenditure.

This lack of data availability has implications for the type of empirical analysis chosen in this thesis. The empirical models chosen use imputation methods to estimate price elasticities and are presented in the subsequent chapters. The studies reviewed in this section also use imputation methods to compute price elasticities.

The table below provides a summary of the studies reviewed. Most studies are regionally focussed, cross-sectional, and draw on household level data and analysed different types of health care settings including outpatient, inpatient and type of services (e.g. family planning). Most employed regression techniques to model health care demand and to compute price elasticities while some carried out descriptive analysis on price responsiveness. Earlier studies computed time and distance costs that were small in magnitude ranging from -0.02 to 0.003 with the exception of a more recent study Dzator et al. (2004) which found slightly larger estimates ranging from -0.36 to -0.13. Typically, recent studies have primarily focussed on direct health care visit costs with estimates of price responsiveness ranging from being highly elastic to highly inelastic: -10.2 to -0.000.

Table 3.2 - Price elasticity for health care from the literature

Dependent variable	Measure	Price elasticity	Country	Study
Outpatient visit	**Health visit related**			
	Cost of visit	-2.82 to -0.12	Cote d'Ivoire/Peru	Gertler and van der Gaag, (1990)
	Cost of visit	-1.88 to -0.11	Cote d'Ivoire/Peru	Gertler and van der Gaag, 1990
	Cost of visit	-4.26 to -1.16	Benin	Bolduc and Lacroix (1996)
	Cost of visit	-5.65 to -1.52	Benin	Bolduc and Lacroix 1996
	Cost of visit	-4.9 to -2.007	Benin	Bolduc and Lacroix 1996
	Cost of visit	-1.43 to -0.03	Peru	Gertler et al. (1987)
	Cost of visit	-1.33 to -0.88	Ethiopia	Asfaw et al. (2004)
	Cost of visit	-1.29 to 0.00	India	Borah (2006)
	Cost of visit	-1.686 to -1.069	India	Sarma (2009)
	Cost of visit	-1.07 to -0.01	China	Qian (2009)
	Cost of visit	-0.32	Swaziland	Yoder (1989)
	Cost of visit	-0.15 to -0.03	Malaysia	Heller (1982)
	Cost of visit	-0.20 to -0.03	Kenya	Mwabu GM and Wang'ombe J. (1997)
	Cost of visit	-2.2 to -0.7	Gabon	Issifou et al. (Issifou S and

			Kremsner PG 2004)
Cost of visit	-0.001 to 0.000	Philippines	Akin et al. (1986)
Cost of visit	-0.3 to -0.03	Kenya	Mwabu et al. (1986)
Cost of visit	-0.23 to -0.16	Nepal	Pokhrel et al. (2005)
Cost of visit	-0.14	South Korea	Kim et al. (2005)
Time related and distance related			
Distance cost	-0.36 to -0.13	Ghana	Dzator and Asafu-Adjaye (2004)
Distance cost	-0.005 to 0.002	Philippines	Akin et al. 1986
Distance to dispensary	-0.0003	Mali	Birdsall and Chuan (1983)
Distance to drug outlet	-0.0001	Mali	Birdsall and Chuan 1983
Distance time	-0.02 to -0.01	Malaysia	Heller, 1982
Distance time	-0.003 to 0.003	Philippines	Akin et al. 1986
Treatment time	-0.05 to -0.02	Malaysia	Heller, 1982
Waiting time	-0.02 to 0.02	Malaysia	Heller, 1982
Waiting time	-0.005 to 0.003	Philippines	Akin et al. 1986
Quality related			
Quality of	-0.18 to -1.81	Ghana	Lavy and

	treatment			Quigley (1993)
	Quality of dispensary	-0.18	Mali	Birsdall and Chuan 1983
	Quality of drug outlet	0.04	Mali	Birdsall and Chuan 1983
	Quality of treatment	-0.3 to -0.03	Kenya	Mwabu et al. 1986
Inpatient visit	**Inpatient**			
	Health care provider	-1.52 to -0.03	Peru	Gertler et al. 1987
	Cash price	0.001	Malaysia	Heller, 1982
	Time	0.001	Malaysia	Heller, 1982
Family planning visit	**Cash price**			
	Cash price	-0.23 to -0.007	Philippines	Schwartz et al. (1988)
	Cash price	-10.2 to -4.8	Columbia	Ojeda et al. (1994)
	Cash price	-0.82 to -0.31	Ecuador	Bratt et al. (2002)
	Time related			
	Distance time	-1.16 to -0.09	Philippines	Schwartz et al. (1988)
	Income related			
	Asset value	-0.02 to 0.155	Philippines	Schwartz et al. (1988)
Health care visit	**Intensity of treatment (1 to 4 consultations)**			
	Intensity of	-0.19 to -0.13	Ghana	Lavy and

	treatment			Quigley 1993
Log household medical expenditures	Cost of visit	-1.1	China	Zhang (2007)
	Income	0.7	Indonesia	Chernichovsky D and Meesook O, (1986)

Earlier studies such as Heller (1982) and Akin et al. (1986) were particularly influential in encouraging user fee policy in developing country setting because the authors found that price changes had little impact on changes in utilisation levels (McPake 1993). User fees were frequently adopted in part due to the economic crisis of the 1980s where governments in the developing world were looking for new revenue streams for cash strained sectors such as health care (Jiminez E 1987; Hutton 2004).

Heller (1982) drew on cross sectional regional data and estimated the demand for outpatient care, inpatient care, obstetric care as a separate inpatient model, and use of a traditional practitioner as separate demand models. Heller assumes that there is complementarity between outpatient and inpatient visits (Heller 1982). He used a two-stage least squares model approach. To model outpatient demand, the first stage regression included inpatient stay as a regressor to account for the endogeneity that an inpatient visit would precede and outpatient visit. Then demand for outpatient care was modelled using a logit regression. Similarly, for the inpatient model the outpatient visit variable was used as an independent variable in the first stage regression to account for endogeneity that an outpatient visit would precede an inpatient stay. The assumption between the complementarity between inpatient and outpatient visits must hold to support this analytical approach. A limitation with this technique is that information on the reason for the visit is not given so it is unclear whether the assumption of

complementarity is warranted in every case which may in part explain the insignificance of the economic variables.

Heller estimated price elasticities range from -0.15 to -0.03. Akin et al. (1986) found estimates ranging from -0.001 to 0.000. Heller found that for inpatient care the price elasticity of 0.001 was a result of the subsidised fee schedule for low income groups. Both studies found that poor health was an important determinant and that economic variables (e.g. cost of visit, household income) were not significant. Heller (1982) found that travel time, waiting time, treatment time, age and ethnic groups played some role in explaining the decision to seek care.

Even though some evidence suggested that economic variables were not significant or had little impact (Birdsall N and Chuan P 1983; Bol D 1990), Lewis (1985) however, found mixed evidence in a review of family planning policies in selected developing countries. The different design methodologies used in the studies made it difficult to draw general conclusions but the author found that in some cases, for example Kenya, increases in the price of health care reduced demand (Mwabu 1983).

More recent studies have found economic variables to play a significant role in affecting the demand for health services, questioning the validity of the results of these earlier studies (Bitran RA and McInnes DK 1993). One limitation of some of these early widely cited studies is that they have not corrected for endogeneity between the health expenditure variable and the decision to seek care. Some empirical work, however, has corrected for endogeneity between the health expenditure variable and the decision to seek care by using a hedonic pricing methods or by imputing expenditure values (Bolduc, Lacroix et al. 1996; Mwabu and Wang'ombe 1997; Asfaw, Braun et al. 2004; Qian, Pong et al. 2009). These studies found that the price variable was significant and found larger elasticities ranging from -5.65 to -0.03.except for Mwabu et al. (1997) which found a smaller range of demand -0.2 to -0.03.

Discrete choice models have been used, including the logit model and the multinomial logit model (MNL) to model the decision to seek care. These models

are used when the outcomes are qualitative and unordered. For instance a logit model is employed when there are two qualitative outcomes: the decision to see a GP or not to visit a GP. A MNL regression is employed for when there are more than two outcomes. For example a patient may have three choices: to see a GP, to see a specialist or to visit a traditional practitioner. The outcomes are coded but the numerical values are arbitrary and are simply to represent the choice made. These models are estimated using the maximum likelihood technique. This is discussed in more detail in Chapter 5.

A limitation with the multinomial model is the possible violation of two of its properties: the independence of irrelevant alternatives (IIA) and independence of error terms (IID). The IIA assumption assumes that the choices made are independent of one another. This implies that for example the decision to see a GP is independent of the decision to see a specialist. This assumption then follows from the error terms being independent which follow a normal distribution (IID). This assumption of independence between choices may not hold in the decision to seek care. This is discussed in more detail in Chapter 5.

Fewer studies have corrected for the violation these properties. In rural Benin, Bolduc et al (1996) found the MNL was violated and so compared their results with a multinomial probit function (MNP). The probit results found that the same fee increase in government hospitals would result in a 1.5% reduction to government hospitals, a 29% increase in visits to private clinics, and 7.5% increase in self-treatment. Own price elasticities were larger under this model and ranged from -5.97 to –2.37 versus -2.007 to-4.966 in the MNL model. The authors found that the cost of the visit, travel time, household income, household composition, poor health, education, the level of saving were important determinants in the decision to seek care.

Other empirical work has used the nested logit model to correct for the violation of the IID and IIA properties. A nested logit model groups alternatives together which allows for variances to differ across subgroups while maintaining the IIA property and IID property within groups (Greene WH 2008). For example, Gertler and van der Gaag (1990) used a nested logit model and found a significant

relationship between price elasticity of demand and income. The authors grouped the choice to seek care together which contained two alternatives: hospital visit or clinic visit. The sample size was small, and the authors used a cross sectional household survey data from a rural setting in Peru and Côte d'Ivoire. The authors found that lower income groups were more price responsive than upper income groups ranging from -2.82 to -0.12. The authors found that the main determinants to seek care included consumption, age, sex, poor health and household composition.

Asfaw et al. (2004) and Qian et al. (2009) applied the same modelling approach. Asfaw et al. (2004) used a nested logit model to analyse the health care demand behaviour of households in selected rural areas of Ethiopia to measure how poor households respond to changes in user fees at different health care providers. The authors grouped the choice seek care at a clinic together which contained two alternatives: public clinic and private clinic. The authors found that the price elasticity of demand was -1.06 for hospitals, -1.33 for public clinic, -0.88 for private clinic and -1.06 for traditional healers. The poor are more price sensitive to the user fees of public health clinics relative to the other providers studied. A 10% rise in the user fees in public clinics increases the probability of the richest quartile to withdraw from the health care market to self-care by 1.67% but by 2.55% for the lowest quartile (Asfaw et al. 2004). The authors found that the health settings behaved as substitutes with estimates ranging from 0.006 to 0.52. These results imply that a 1% increase in the cost of visiting a given provider will increase the probability of visiting an alternate provider from 0.006% to 0.52%. The main determinants to seek care include the cost of the visit, waiting time, household income, distance, poor health, gender, education of the mother, relationship of the patient to the household head and age of the household head.

Qian et al. (2009) studied household demand behaviour in a rural part of the Gansu province in China, which is one of the poorest provinces in China. The author applied a mixed multinomial logit model (MMNL). The MMNL assumes that the error term is extreme value *iid* and the random components of the utility specification can have any distribution which implies less restrictive assumptions than the multinomial logit model or the nested logit model (Borah 2006).

Distance, type of illness, being an older person, and price were important determinants of health care demand. Price elasticities ranged from –0.32 to –0.01 for public village clinic, -0.39 to –0.06 for private village clinic, -0.55 to –0.11 township health centre, to –1.07 to -0.16 for county hospital. Low-income individuals were more price responsive than high-income individuals. These three studies provide useful results but suffer from small sample size problem as they covered small rural areas in each country.

Evidence from national sample surveys to correct for the small sample size problem is limited. Sarma (2009) and Borah (2006) both used the NSSO household survey from India but only on the rural sample (the complete dataset is used in the empirical work in Chapter 7 and 8). Sarma (2009) applied a nested logit model which grouped formal care separate from self-treatment. Formal care contained three alternatives: public facility, private facility and private doctor. Sarma found more elastic results with elasticities ranging from -1.686 to -1.069 and Borah (2006) applied a MMNL model on the same dataset with elasticities ranging from -1.29 to 0.000. Sarma (2009) also computed cross price elasticities and found that the different health settings choices were substitutes and ranged from 0.10 to 0.70, which suggests that a 1% rise in the cost of a given provider will increase the probability of choosing an alternate provider from 0.1% to 0.7%. The MMNL has more usefulness for panel data or repeated-choice settings (Greene 2008). The MMNL has been less frequently applied to model the demand for health care than the nested model (Greene, 2008).

Borah (2006) and Sarma (2009) had similar findings with respect to regression coefficients where the cost of the visit, household consumption, household composition, distance, poor health and education were important determinants. Borah (2006) found that social caste mattered. Sarma (2009) found that age and sex were also important determinants.

A feature of these four studies: Asfaw et al.2004; Borah 2006; Qian et al. 2009; Sarma 2009 is that they corrected for endogeneity by imputing the cost of the visit for the provider that was not chosen. This approach has its own limitation because the model is sensitive to the imputation approach and that it could reduce the

actual variance in the price and income variables and therefore may underestimate true price and income elasticities.

A limitation with household demand studies is to control for policy changes that may affect the household's decision to seek care. For comparative purposes, Zhang (2007) did not model the decision to seek care but carried out a difference-in-difference approach on the consumption of inpatient services in the city of Hangzhou in China. His study aimed to study the effect of a policy decision to reduce the co-payment amount on inpatient care. Zhang modelled the patient's visit cost in logs as the dependent variable. The main determinants were age, poor health, and insurance. He found that demand to be slightly elastic as a result of the policy decision to reduce the co-payment amount. He computed a price elasticity demand for inpatient care to be –1.10 as a result of a reduction in the deductible amount for inpatient care. This result is consistent with the evidence on user fees where utilisation increased as a result of reduction in user fees. Evidence on user fees is discussed in more detail in section 3.3.3.

Descriptive analysis of price responsiveness has found demand to be inelastic and was computed based on changes in price levels and utilisation levels (Shepard D and E 1988; De Bethune, S et al. 1989; Stanton and Clemens 1989; Waddington CJ and Enyimayew KA 1989; Yoder 1989; Ojeda G, Murad R et al. 1994; Bratt, Weaver et al. 2002). Yoder (1989) was one of the few of such studies which drew on national data to study a policy change of the introduction of an increase in user fees in government facilities. Demand was inelastic for government facilities and was -0.32. About one third of the drop was from low income groups. The decrease in utilisation was also observed for preventive health care services such as immunisations, diarrheal and sexually transmitted diseases, not for minor ailments.

Mataria et al. (2007) carried out a willingness to pay study. A contingent valuation method was used to model the demand and price elasticity for health care in Palestine. Demand becomes more elastic as user fees rise and price responsiveness depends on income level.

3.3.2 PRICE ELASTICITIES FOR MEDICINES

A relatively small number of studies have explicitly studied price responsiveness for medicines because most of the data pertains to price elasticities with respect to health care. Available evidence from developing countries suggests that patients are more price responsive to medicines and to health care services than in developed country settings. These studies have typically used cross section analysis, and small sample sizes. Such studies have found elasticity estimates that range from -0.000 to -1.44 as shown in the table below.

Table 3.3 - Price elasticity for medicines from the literature

Dependent variable	Measure	Price elasticity	Country	Study
Outpatient visit	**Drug related**			
	Drug cost	-0.000 to 0.006	Philippines	Akin et al. 1986
	Drug and travel cost	-0.79 (-1.44 to -0.12 by income)	Burkina Faso	Sauerborn et al. (1994)
	Demand for malaria treatment	-0.22 to -0.04	Ghana	Dzator and Asafu-Adjaye 2004
	Demand for malaria treatment	-1.05 to -0.49	Sub-Saharan Africa	Laxminarayan et al. (2006)
	Demand for malaria treatment	-3.39 to -0.85	Ghana	Asenso-Okyere et al. (1996)
	Demand for malaria treatment	-0.58 to -0.05	Brazil	De Bartolome and Vosti (1995)
	Utilisation for	-3.6 to -0.6	Sudan	Abdu et al.

malaria treatment			(2004)
Demand for deworming tablets	-0.580	Kenya	Kremer and Miguel (2007)

Akin et al. (1986), one of the earlier studies found no significant relationship between price and drug cost (-0.000 to 0.006) in a region of the Philippines. The authors used a household survey from data collected in 1978 and supplemented this information by conducting a survey in 1981 to collect provider information such as data on payment practices, hours of operation, transportation costs. The authors assumed that relative prices were constant. Data available on provider levels indicated that there were no significant changes in supply. Independent variables included cash price, drug cost, travel time, waiting time, travel cost, asset value, self-reported measure of severity of illness, availability of physician, age and sex of individual and urban/rural residence. The authors carried out multinomial logit regression to model choice of provider (public, private, traditional, no visit) by splitting the sample results for adults and children. The most significant variable was perceived severity of illness which explained choice of provider. This study has been criticised for the limited income range that was used which could have affected the insignificant results of the economic variables (McPake 1993). Quality which was measured as the probability of seeing a provider was inadequately considered which could have further undermined the significance of the economic variables (McPake 1993).

More recent studies have found economic variables to be significant. Sauerborn et al. (1994) and Daztor et al. (2004) De Bartolome et al. (1995), Asenso-Okyere et al. (1996) produced larger estimates but these studies did not correct for endogeneity between health expenditure and the decision to seek care ranging from -3.39 to -0.04. Sauerborn et al. (1994) found that larger estimates were found when separated by income. Dzator and Asafu-Adjaye (2004) found that own price elasticities ranged from -0.04 for a drug store, to -0.21 for a public provider to -

0.22 or a private provider. The authors also computed price elasticities for travel time which ranged from -0.13 (drug store), -0.33 (private) to -0.36 (public).

Laxminarayan et al. (2006) took a different approach and simulated the welfare effects for malaria treatment. The analysis combined the epidemiological models to account for malaria transmission and drug resistance and drew on economic models to consider the effect of demand for medicines with elasticities ranging from -1.05 to -0.49.

3.3.3 UTILISATION AND EQUITY ISSUES

Evidence on changes in utilisation levels has been largely based on price information of user fees in developing country settings. The literature shows that in general and consistent with the price elasticity measures, user fees result in a drop in utilisation. In some settings, utilisation remained below pre-charge levels (Bennett S 1989; Yoder 1989; Mwabu, Mwanzia et al. 1995).

Deininger et al (2004) found that the abolition of user fees in a region of Uganda resulted in increased take up of health services among the poor and lower probability of sickness. Furthermore, a number of reviews have found that user fees are inequitable, disproportionately affecting low-income individuals who are deterred from using health services (Creese 1991, McPake 1993, Gilson 1997, Sepehri 2001, Hutton 2004, Palmer 2004, James 2006, Lagarde 2008). The evidence suggests that utilisation drops for important services such as preventive services and not simply for 'frivolous' care (Creese 1991, p. 317). Bonilla and Rodriguez (1993) examined the effect of time loss and labour reallocations within the household due to the onset of malaria. The authors found that the impact of malaria afflicted men more than women but as a result, women bore a greater social and economic burden to care for the sick, and to look after farm production at the cost of reducing their own domestic tasks.

Evidence is mixed on the degree to which insurance schemes are designed to mitigate the effects of user fees. For example, in the review by Palmer et al.

(2004) the authors found that cash payments could encourage uptake but suffered from perverse incentives. Various forms of pre-payment such as national social insurance to community-based schemes have not achieved adequate levels of coverage particularly among the those these schemes aim to target –the poor (Preker, Carrin et al. 2002; Ekman 2004; Palmer N, Mueller D et al. 2004; Carrin, Waelkens et al. 2005). Inadequate coverage raises equity implications because patterns of use may become more unequal for those without coverage (Sepehri, Chernomas et al. 2005).

Furthermore, an important issue is to understand that many factors can affect a patient's decision to spend money once they decide to visit a health facility regardless of whether pre-payment schemes exist or not. These could relate to cultural factors, where additional payments are expected as a form of gratitude (Falkingham 2004), perceptions of quality of care such as expectations of improved quality of service through the form of OOP payments (Kondo and McPake 2007).

The welfare effects of such policies have been simulated in some studies. Consumer welfare losses could be partially offset with reinvestment such as in quality improvements (Mwabu and Mwangi 1986; Gertler and van der Gaag 1990). Gertler and van der Gaag (1990) found that such policies were still regressive with the lowest income groups experiencing a welfare loss of 10% of their income. Policy proposals to counteract this problem suggest some form of price discrimination or methods of exemption (Mwabu and Mwangi 1986; Ellis 1987; Gertler and van der Gaag 1990) (Ellis 1987; Gertler van der Gaag 1990; Mwabu and Mwangi 1986). Ellis (1987) proposed price discrimination for laboratory tests and geographical discrimination. Gertler and van der Gaag (1990) suggest geographical discrimination and Mwabu and Mwangi (1986) proposed selective user charges in hospital units of a referral health care system.

Evidence on long term analysis of utilisation levels as a result of price changes have shown mixed results. In some settings utilisation dropped but only to regain pre-charge levels (Waddington CJ and Enyimayew KA 1989; Chalker J 1995). For example, Chalker (1995) found that demand fell in the first year in two

districts in Nepal, but then increased in the second and third year as a result of greater availability of drugs (Chalker 1995). Other studies used data on utilisation of single providers and time series data to examine the introduction of user charges. These studies found a drop in utilisation after the introduction of the user charge, with a higher drop occurring among low-income groups (Parker 1986; Waddington CJ and Enyimayew KA 1989; Yoder 1989).

Typically, long-term studies focus on one type of provider and do not properly capture substitution effects to other potential providers (Bennett S 1989; Mbugua, Bloom et al. 1995; Shaw P and Griffin C 1995). The other limitation of long term studies is the reliability of the data. Most studies draw on attendance data at facilities to carry out descriptive analysis (Sepheri and Chernomas 2001) and there is evidence that the officially estimated fees may underestimate payments actually made (Deolalikar A and Vasjishta P 1992). A limitation of most of these studies is that the long term impact of fee changes have not been well measured because most could not isolate changes in user charges from other policy changes. Furthermore, the evidence base on long term analysis is limited because most studies have been cross-sectional.

The negative effects on utilisation and equity have caused a shift in the international debate on user fees. The WHO urged member countries to work towards universal coverage of maternal, newborn and child health with the adoption of prepaid mechanisms and pooled health financing systems passed in resolutions 58.31 and 58.33 (WHO 2005a; WHO 2005b). The World Bank's new strategy involves greater support to countries committed to support the removal of user fees for children and pregnant women (Meessen et al. 2009).

While a number of policy challenges arise in low and middle-income settings (Peters et al. 2009), a recent multi-country study review aimed to rather focus on documenting how countries formulated and implemented user fee removal to help policy makers draw on lessons of good practices (Meessen et al. 2011). The review found that utilisation increased (Meessen et al. 2011; Riddle et al. 2011; Orem et al. 2011; Sekabaraga et al. 2011; Nimpagaritse et al. 2011;Ponsar et al.

2011; Witter et al. 2011; Steinhardt et al. 2011) but there are a number of important policy lessons from this analysis.

In some settings, the introduction of subsidies led to gaming behaviour among health professionals (Riddle et al. 2011) and the abolition of user fees led to a rise in OOP (Orem et al. 2011). There are system-wide effects relating to capacity due to increased utilisation as a result of the increase in fees such as drug-stockouts or the capacity of facilities to recruit local staff (Nimpagaritse et al. 2011; Ponsar et al. 2011; Witter et al. 2011).

The evidence suggests that user fee removal should involve 6 important elements: analysis of the country's initial position with respect to user fees (e.g. exemption schemes); estimation of user fee removal on utilisation; additional human resource requirements, drugs and others inputs, mobilisation of additional resources and development of local-tailored strategies; building political commitment; and communicating policy change to all stakeholders (McPake et al. 2011).

3.3.4 REVENUE RAISING AND EFFICIENCY ISSUES

In developing country settings, one of the arguments to support user fee policies is that it could be a partial response to inject further funds into the health system. There are, however, important policy implications. Evidence on the impact of user fees has shown that cost recovery is low and revenue generated is modest and generally below the anticipated 10-20% of total government recurrent health expenditures to around 5-7% (Gilson 1997; Pearson 2004). In some African countries the proportion of recurrent costs covered by user charges ranged from 2.7% to 12.1% (Vogel R 1988). Yoder (1989) found that in Swaziland user fees recovered only 2% of the Ministry of Health Budget and contributed to 0.16% of total government revenue. To meet a contribution of 1% of total government revenue, user fees would have to be increased seven times above their current level, which would become highly regressive (Yoder 1989). In Uganda, fee recovery rates were 7% (Singh 2003).

An important related issue is the complexity of introducing exemption schemes to address inequities. Pricing structure and administrative costs will affect the level of cost recovery through user charges (Vogel 1988). For instance, inconsistent implementation of user charges and excessive use of exemptions have contributed to programme inefficiencies (Vogel 1988; Sepehri and Chernomas 2001). The administrative burden will not necessarily result in overall efficiency gains (Gilson 1997, McPake 1993). Success of such policies depends on the administrative capacity and leadership commitment (Preker et al. 2002).

The literature suggests that the success of such policies depends on how well they are implemented. Exemption methods may counteract the regressivity of user charges to address equity concerns. Exemption schemes have to address the problem of abuse and their overall effect on the administration costs to address efficiency concerns.

3.3.5 OTHER DEMAND COVARIATES

While the principle focus of demand studies has considered the impact of price, some empirical work has also explored the impact of quality, time and distance on demand for health care.

Typically the quality variable is estimated from a structural dimension such as drug availability, physician availability, machine availability and qualification of staff (Sepehri et al 2001). Perceived quality of care is an important determinant of health care utilisation and of the success of health system financing reforms (Annis 1981; Wouters 1991; Barnum H and Kutzin J 1993; Lavy and Quigley 1993). Studies which have looked at quality have produced mixed results of its effect on utilisation.

Some have shown positive effects where drops in utilisation are partially offset by quality improvements (Hutton 2004; James et al. 2006). For example, when combined with quality improvements, utilisation in smaller phased-in programmes increased in the long run (James et al 2006). Chalker (1995) found

that an increase in drug availability led to increases in utilisation after an initial drop due to the introduction of user fees. Few studies have tried to empirically estimate changes in demand while controlling for covariates and found estimates ranging from -1.81 to 0.04 (Lavy and Quigley, 1993; Birdsall and Chuan, 1983).

Simulation techniques have found that increasing user fees could dampen the negative effect on utilisation as a result of quality improvements. Using a simulation approach, greater availability of drugs, and improvements in working conditions led to an increase in utilisation in government clinics (Mwabu and Mwangi 1986). Denton H, Akin J et al. 1990) as reported in Wouters (1991) found that in a region of Nigeria three aspects of quality were significant: percentages of years drugs are available, operational cost per capita, and facility condition, while machinery (x-ray machine and laboratories), number of support personnel, nurses and doctors per capita were not. Investment in quality improvements however, were not offset by the revenue generation from user fees (Denton et al 1990).

In contrast, other studies have found results that were insignificant or with opposite signs. A measure of quality as the probability of being seen by a physician was insignificant (Heller 1982; Mwabu G, Ainsworth M et al. 1993). Haddad and Fournier (1995) found that in a rural setting in Zaire, the steady supply of drugs, the competence of nurses, and the improvements in infrastructure and machinery did not offset the reduction in utilisation. Greater availability of medicines was found to have a negative relationship on utilisation (Mwabu 1993).

Qualitative studies have been designed to capture information on quality (Waddington and Enyimayew 1989). Bitran (1989) and Yoder (1989) found that utilisation was lower where quality of care was perceived to be lower. Annis (1981) found that rural health posts had reasonable good quality of services but were not used. Even though these studies provide useful information on the importance of quality, they cannot control for the marginal impact of covariates on quality.

Quality is a difficult factor to capture in both cross-section and time series analysis (McPake 1993). Other important dimensions such as process and outcome are not captured (Sepehri and Chernomas 2001). This creates problems to control for endogeneity because of the multidimensional nature of this variable. For example drug availability is an important factor for patients but this measure is influenced by both demand and supply factors (Sepehri and Chernomas 2001). Even though drug availability provides useful information, it only captures one relevant aspect and cannot account for whether it would imply better treatment. This leads to a bias in the quantitative results because if price and quality are positively correlated, then the negative impact of user fees on utilisation could be weaker than empirically estimated (Deolalikar A 1998).

Overall there is a limitation with the studies which measured quality. Most of these studies suffer from being small scale, short time horizons and lack robust methods of research design (e.g. randomised). Some of the evidence on quality was not modelled but rather observed which makes it difficult to properly assess the impact of quality on utilisation.

The effect of distance has been more commonly modelled, in part because there are more reliable objective measures. Time related information is typically analysed as time spent travelling to the health facility while some empirical work has included waiting time and treatment time. Empirical work has found estimates that range from -0.36 to -0.0001. For example, Heller (1982) found that a 1% increase in waiting time will affect the probability of demand by -0.02% to 0.02%. Dzator et al. (2004) found that a 1% increase in distance will reduce the probability of demand for treatment by -0.36% at a public provider.

Findings related to time and distance provide useful information but not all studies collect detailed information at the household level and more rely on information at the aggregate level (e.g. village level) to compute this information.

3.3.6 PRICE ELASTICITIES FROM HIGH INCOME COUNTRIES

While the focus of this thesis is on developing countries, this section highlights for comparative purposes evidence from high-income settings. These findings are relevant because they highlight common themes that can affect access. A large body of empirical work on price elasticities for drugs and health care has occurred in high-income countries. This section draws on earlier reviews and major papers in this area.

Cutler (2002) provides a useful review of price elasticities which are presented in Appendix A. Evidence shows that increased levels of cost sharing on patients reduces the demand for pharmaceuticals (Leibowitz A 1985; Foxman B 1987; Goldman, Joyce et al. 2007)[5] and that poorer patients will be more responsive to cost sharing (Cunningham 2002; Reed 2005). Studies have shown that the price elasticity of demand ranges from -0.2 to -0.6 (Leibowitz A 1985; Blais L 2003).[6] These figures imply that a 10% increase in cost sharing would be associated with a 2% to 6% decline in prescription drug use or expenditures.

The empirical evidence on differential responses by therapeutic class is mixed. Some studies found substantial reductions in the use of discretionary (e.g. antihistamines) medications than essential (e.g. antihyperintensives) medications in response to increases in cost sharing (Harris, Stergachis et al. 1990; Landsman PB 2005) while others showed modest but inconsistent effects of higher cost sharing on use of essential and non-essential drug classes (Reeder CE 1985; Motheral B 2001).

The direct link between cost sharing and health outcomes is limited. Greater use of inpatient and emergency medical services was associated with higher levels of cost sharing for prescription drugs among chronically ill patients (e.g. diabetes) (Soumerai SB 1994; Cole JA 2006). When the population is not limited to chronic illnesses, increased cost sharing did not lead to more adverse events such as

[5] In Goldman et al. (2007), the authors provide a comprehensive summary of evidence presented in Box 2.1.

[6] The price elasticity of demand is used to measure the impact of cost sharing on drug spending.

outpatient visits, hospitalisations or emergency visits (Johnson, Goodman et al. 1997; Fairman KA 2003).

More broadly, medical care utilisation has been extensively studied in developed country settings. There is a significant amount of literature on the elasticity of demand for medical care. Studies have estimated elasticities ranging from -0.14 (Phelps and Newhouse 1972a) to -1.5 (Rosett and Huang 1973). The Rand Health Insurance Experiment estimated demand elasticities for medical spending and the overall conclusion of the study determined a price elasticity of -0.2 (Newhouse and Insurance Experiment Group 1993). This estimate has served as a benchmark in the literature for subsequent research and policy work (Cutler 2002). In summary, studies of cost sharing for medicines and for medical care use suggest relatively price inelastic elasticities in developed countries and more price responsiveness in developing country settings.

3.3.7 SUMMARY AND GAPS IN THE LITERATURE

The literature finds that low-income individuals are more price responsive than the wealthy. Therefore, charging for health services is inequitable as lower income groups are negatively affected. Despite differences in the type of health care (e.g. inpatient, outpatient setting), higher elasticities are found for low income groups. User charges had a modest impact on revenue generation and administrative challenges exist with the implementation of exemption mechanisms to provide financial protection to low-income individuals. This evidence highlights a shift in the policy environment. Empirical work on inelastic demand initially provided the basis for widespread promotion of user fee policy. A decade of research showing the negative impact has moved towards prioritizing work on equity and the importance of quality along with increased emphasis on exemption schemes.

The findings from the empirical work provide a useful guide on which factors seem to influence the demand for health care. The main determinants of health seeking behaviour include the price (e.g. or cost of the visit) which is negatively

related to the decision to seek care. Income (or some measure of household wealth) has a positive effect. Those in poor health are more likely to seek care. Education and insurance both have a positive effect in seeking care while distance has a negative relationship with the decision to seek care. The empirical work also distinguishes between the type of health care received (e.g. drug related, family planning) due to the heterogeneity of the provision of health care in outpatient and inpatient settings. The literature also emphasises that the availability of traditional forms of care and self-treatment are equally important to the provision of modernised medical care offered in public or private settings.

Age has shown to have a mixed effect: some studies point suggest that older age groups seek care. Other empirical work indicates that it is the younger ages that utilise health care which draws on human capital theory where families invest in the younger more productive members of the family. Sex has shown to have differing effects depending on the type of health care: men are more likely to seek care in general, but in particular cases women are more likely to seek care—for instance in relation to child delivery. Household size, travel time, and treatment time are important determinants. Many studies looked at rural samples which affect the decision to seek care. Quality if measured also has an effect on the decision to seek care but these measures have been quite simple. Marital status not commonly modelled had a positive effect on the decision to seek care.

The evidence base of empirical estimates of price elasticities could be improved as not all studies have controlled for covariates. This has also been confirmed by reviews in the literature of limited evidence on price responsiveness, small sample sizes and confounding factors (Sepheri et al. 2001; Palmer et al. 2004). Unlike high-income settings where estimation of price elasticities and determinants of health seeking behaviour come from well-funded and developed databases, a serious limitation is the availability of data from low and middle-income settings. Furthermore empirical work has not always considered the policy environment. Some work has more broadly considered implications for health policy financing, but not specifically related to pharmaceuticals. More evidence on the policy environment of pharmaceutical regulation and price setting in these settings is needed.

The aim of the empirical work of this thesis is to contribute to the evidence base on determinants related to health seeking behaviour and implications for demand for medicines. This thesis uses health expenditure information which includes information on medicine expenditure in its analysis of health seeking behaviour because empirical work is limited. Second, existing studies are largely drawn from small sample sizes of regions or districts, confined to either specific rural or urban areas. This thesis aims to fill the knowledge gap by carrying out analysis over country level data sets to understand health seeking behaviour and price responsiveness across rural and urban settings. Third, this thesis contributes to the evidence base to address endogeneity issues related to health expenditure and health seeking behaviour. Finally, information on price responsiveness has implications for policy. This thesis contributes to this topic by considering the pharmaceutical policy making environment. The subsequent chapters now present the empirical work related to determinants of access to medicines and health care.

4 Chapter 4 Analysis of prices paid by developing countries

4.1 INTRODUCTION

This section carries out an exploratory exercise on the issue of price sensitivity at the government level across a cross section of low and middle-income settings. The research objective and research questions are presented below.

Table 4.1 - Chapter 4 Research objective and research questions

Chapter 4 Research objective	Research questions
Impute price elasticities for sales to government purchasers in selected low and middle income countries	1) Is there variation in prices? 2) What are the mark-ups over marginal cost? 3) What is the imputed price elasticity for individual countries? Is price elasticity correlated with income?

The standard economic approach for measuring price responsiveness is to calculate price elasticities, which requires data on prices and on volume (or quantity). Developing countries, in general, do not have robust data on prices and the quantities of medicines consumed. As such the estimation of price elasticities through conventional approaches is generally not possible. Therefore, the gap in empirical evidence is largely because of an acute lack of data.

Chapter 3 highlighted that many individual studies are based on primary data collection. The quality of secondary data is beginning to improve but there remains a general scarcity of data—especially for the smaller and lower income countries. Recent health related surveys have only begun to collect information on medicine prices but volume information is still lacking in developing countries.

In this section, volume information was not available. To overcome the lack of volume information, this chapter takes a different approach to determine price elasticities. Information on prices and mark-ups were used in conjunction with the general Ramsey formula. The Ramsey formula states that prices are inversely related to their demand elasticities (Ramsey 1927). Ramsey (1927) developed this relationship to determine optimal tax rates but this rule has had significant contribution to the public economics literature and has been applied more generally (Auerbach AJ and Feldstein M 1985).

The findings from this section are based on a simple exploratory exercise and should therefore be viewed as suggestive. These findings point to the possibility that developing countries are price sensitive. The evidence is however weakly supportive of the finding that price elasticities are correlated with income. This implies that other factors beyond a country's income affect a country's ability to secure low prices. This underpins the importance of a robust procurement framework. These issues are further discussed in the policy implications in Chapter 9.

This chapter is organised as follows. Section 4.2 provides the theoretical framework, and section 4.3 presents evidence from the literature. The chapter then turns to the data and methods in 4.4, results and limitations in 4.5 followed by a policy discussion and conclusion in section 4.6.

4.2 THEORETICAL FRAMEWORK AND APPLICATION

4.2.1 THEORETICAL FRAMEWORK OF PRICING MODELS

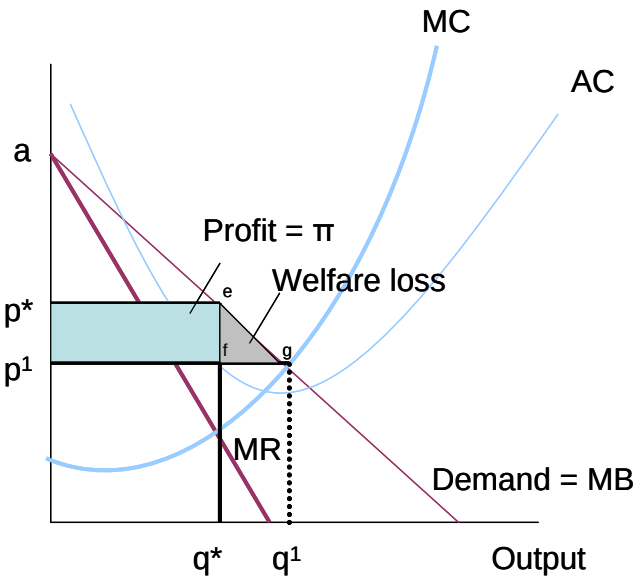
A brief background on the theoretical framework of pricing models is presented. While many aspects could be discussed, this section focuses on pricing in markets with a monopoly element, and marginal cost pricing (also referred to as a first best solution) before moving to second best solutions such as the Ramsey model and

its application to the pharmaceutical sector. This discussion is important as it provides a basis for the empirical work carried out in this chapter.

We begin the discussion by revisiting the issue of monopoly, one of the features of market failure. This issue is relevant for the pharmaceutical market because of the monopoly element present in these markets is due to patenting of medicines.

Let us begin the discussion with the extreme case where one firm, which supplies the market with a good, could freely set its prices. This is depicted in the figure below which assumes linear demand where the marginal revenue (MR) curve and market demand curve share the same vertical intercept, a. The MR curve is twice as steep in slope as the demand curve, as follows from the assumptions of monopoly and linear demand. The marginal cost curve is shown as MC and average cost is AC. From the firm's perspective, optimal output, q*, is where MR=MC. The market demand price at q* is read off the demand curve at p*. The firm maximises profit at price at p* and output q*. This is not socially optimal level, however. The market demand curve is also the marginal benefit (MB) curve. The regulator would prefer output to be at q^1, where MC=MB and price is lower at p^1. Not all consumers would be able to afford the price charged at p* and would result in a loss of welfare because output is less at q* rather than at q^1. The amount of consumer surplus not captured results in a deadweight loss, as shown by the shaded triangle area, Δefg.

Figure 4.1 - Monopoly with linear demand



Source: Varian 2003

Based on this example, the implication for the pharmaceutical market is that if a medicine were priced at p*, the pricing of medicines well above marginal cost at p*. This loss in consumer welfare identifies two problems that the regulator must address. First, prices set above marginal cost would result in an inefficient allocation of resources and there is a clear benefit to find ways to reduce allocative inefficiency (Armstrong et al. 1994). The second problem is that monopolies have no clear incentive to cut costs as long as there are the only firm in the market, in the extreme case, or the one with significant market power (Armstrong et al. 1994). Thus, productive inefficiency results. Furthermore, a firm with monopoly power may be less quick to introduce new products as they would otherwise in a market with a number of competing firms. Although this is a static model, some would argue that profit is required for future research and development (R&D) to maximise future consumers' surplus.

In principle the regulator has two broad policy responses, which is to introduce regulation to discourage the firm to freely set its prices or second, to introduce more competition in the market (Armstrong et al. 1994). There are trade-offs involved, however. These issues are relevant to the pharmaceutical sector because low prices could benefit consumers in the short-run but this may impose a price-floor, where prices do not move any lower, to the detriment of consumers in the long run. Prices closer to marginal cost in a competitive market aim to give firms incentives for cost reduction and innovation (Armstrong et al. 1994).

Economic theory proposes that the first best solution for regulators is marginal cost pricing. For marginal cost pricing to hold, certain market conditions must be met. Marginal cost pricing assumes that price of public goods are controlled, while uncontrolled prices equal marginal costs in the public sector. The private sector is perfectly competitive, distribution of lump-sum incomes is optimally chosen so the model deals with compensated demand. There is no revenue-cost constraint on the public sector and quality levels are fixed. There is no informational asymmetry and the regulator is well informed of the firm's cost structure.

The reason this is optimal can be shown by considering this situation where price exceeds the marginal cost. The consumer and firm could be made better off if the firm produced a further unity of the good in return for a payment somewhere between price and cost. The efficient allocation without making either party worse off is where the consumer pays a price for the marginal unit that is equal to the cost of producing that unit.

This can also be shown as follows: Let C(Q) be the firm's cost of producing total output Q, and let C'(Q) denote the marginal cost. If aggregate demand at price P is Q(P), then marginal cost pricing, which is the efficient solution holds where at P* if P*=C'(QP*).

There are two important caveats where marginal cost may not be optimal. The first reason is due to externalities. For example, if a firm's production of a product harms the environment by D(Q), then the total costs are C(Q) + D(Q). Price should then be set to equal total marginal cost C'(Q) + D'(Q).

The second reason is that there may be other distortions in the market. For example, if the firm's output is used as an input by other firms (e.g. utility industry) then it may be desirable to set price below marginal cost to counterbalance the price/cost mark-up practiced by these firms who do not operate in competitive markets (Armstrong et al. 1994).

These two caveats highlight that the cost structure of the firm affects the extent to which pricing at marginal cost is possible. Marginal cost pricing is not the solution in cases where the industry has high fixed costs or increasing returns to scale. This issue is particularly relevant for the pharmaceutical industry which is characterised as having high fixed costs (WTO and WHO 2001).

While there are other forms of pricing options when there are high fixed costs, such as average cost pricing, and non-linear tariffs (e.g. two-part tariffs), Ramsey pricing has been proposed as pricing option for the pharmaceutical industry. This rule sets prices to vary according to price elasticity of demand. The development of this pricing rule is discussed further in the next section.

4.2.2 THEORETICAL FRAMEWORK OF RAMSEY PRICING

We now turn the discussion to the theoretical framework of the Ramsey pricing rule. This discussion is important because it highlights that a key feature of the Ramsey model took demand information into account in order to set prices optimally in markets where prices set to marginal cost were suboptimal. This section first presents the Ramsey model and then discusses its application to the pharmaceutical sector and its relevance for the analysis carried out in this chapter.

Ramsey (1927) developed a model to determine the optimal level of taxation of commodities to generate revenue while trying to address distortions in the market. The discussion below highlights Ramsey's main findings. Please refer to Ramsey (1927), Boiteux (1971) and Baumol and Bradford (1970) for more detailed discussion.

Ramsey assumed that such a pricing structure required segmented markets. This means that there is no threat of leakage or spill over from markets. He assumed that demand was well-structured as shown by downward sloping demand curve where the commodities were taxed. He assumed that the regulator has full information of demand and supply. He further assumed that all commodities were independent, with their own demand and supply equations.

Ramsey set out in his model that there are *n* commodities of quantities,
$x_1, x_2..x_n$

Denote $u = F(x_1..x_n)$ is the net utility of producing and consuming the quantities

Let the tax rates levied on these commodities be $\lambda_1, \lambda_2..\lambda_n$

Equilibrium which maximises *u* is $\frac{\partial u}{\partial x_r} = \lambda_r \quad r = 1,..n$ (4-1)

Revenue is the product of the taxes levied on the commodities where R = $\sum \lambda_r x_r$

Utility, *u*, is a maximum subject to $\sum \lambda_r x_r$ = R where λ_r is $\frac{\partial u}{\partial x_r}$

$$0 = du = \sum \lambda_r dx_r$$

Subject to

$$0 = dR = \sum \lambda_r dx_r + \sum_r \sum_s x_s \frac{\partial \lambda_s}{\partial x_r} dx_r$$

Then,

$$\frac{\lambda_1}{\sum_s x_s \frac{\partial \lambda_s}{\partial x_1}} = \frac{\lambda_2}{\sum_s x_s \frac{\partial \lambda_s}{\partial x_2}} = \frac{\lambda_n}{\sum_s x_s \frac{\partial \lambda_s}{\partial x_n}} \qquad (4\text{-}2)$$

Or

$$= \frac{R}{\sum\sum \frac{\partial \lambda_s}{\partial x} x_r x_s} = -\theta$$

He showed that taxes reduce in the same proportion the production of each taxed commodity as $\frac{dx_1}{x_1} = \frac{dx_2}{x_2} = \frac{dx_n}{x_n}$

Ramsey assumed that utility is a non-homogeneous quadratic function of the x's which means that the λ's are linear.

For the *r*th commodity

Let $p_r = \phi(x_r)$ be the demand price

Let $q_r = f_r(x_r)$ be the supply price

$$\lambda_r = p_r - q_r = \phi_r(x_r) - f_r(x_r)$$

Ramsey determined that $\frac{\partial \lambda_r}{\partial x_s} = 0$, r ≠ s

With (4-2) Ramsey showed that

$$\frac{\lambda_1}{x_1\{\phi_1'(x_1) - f_1'(x_1)\}} = \frac{\lambda_2}{x_2\{\phi_2'(x_2) - f_2'(x_2)\}} = ..= -\theta$$

Let u_r, an *ad valorem* tax, be applied on the *rth* commodity

Where

$$\lambda_r = u_r q_r = u_r f_r(x_r)$$

And $\phi_r(x_r) = f_r(x_r) + \lambda_r = (1+u_r) f_r(x_r)$

$$\therefore \theta = \frac{-\lambda_r}{x_r\{\phi_r'(x_r) - f_r'(x_r)\}} = \frac{+u_r}{x_r \frac{f_r'(x_{r)}}{f_r(x_r)} - (1+u_r)x_r \frac{\phi_r'(x_r)}{\phi_r(x_r)}}$$

He showed that

$x_r \frac{f_r'(x_r)}{f_r(x_r)}$ is the inverse of the elasticity of supply of the commodity which is positive for diminishing returns and

$-x_r \frac{\phi_r'(x_r)}{\phi_r(x_r)}$ is the inverse of the elasticity of demand which is positive for a normal good

He simplified this equation where ρ_r is the elasticity of demand and ε_r is the elasticity of supply so that

$$u_r = \theta\left(\frac{1}{\varepsilon_r} + \frac{1+u_r}{\rho_r}\right)$$

Or

$$u_r = \frac{\left(\frac{1}{\varepsilon_r} + \frac{1}{\rho_r}\right)\theta}{1 - \frac{\theta}{\rho_r}}$$

He assumed that revenue is small enough and for infinitesimal taxes θ is infinitesimal so that

$$\frac{u_1}{\frac{1}{\varepsilon_1} + \frac{1}{\rho_1}} = \frac{u_n}{\frac{1}{\varepsilon_n} + \frac{1}{\rho_n}}$$

Therefore Ramsey's analysis showed that the tax on each commodity is proportional to the sum of the reciprocals of the supply and demand elasticities. Under his model, elasticity information was a necessary condition for the model to determine the level of tax rates for a given range of commodities.

The application of this rule has been applied more broadly in the pricing of goods and services.[7] A special case of this rule has been considered in the public sector pricing for the demand of a good, prices are inversely related to the elasticity of demand.

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[7] For example, in the utility industry where demand is typically inelastic (e.g. water) Ramsey pricing can be used in two-part tariffs. The fixed charge is set high enough to cover the shortfall in profits while usage prices are set close to approximate marginal cost. Ramsey pricing can be applied to peak load pricing. This is where there are systematic fluctuations in demand (e.g. demand for heating is greater in the winter than in the summer). During a peak period, demand will be relatively inelastic, and so Ramsey prices are set high, while they are set lower during off-peak periods (Armstrong et al. 1994).

To show this result, total welfare is defined at the weighted sum of consumer surplus and firm profit. Consumer surplus V(P) is a function of a vector of prices **P**= (P_1, … P_n,)which satisfies

$$\partial V(\mathbf{P}) \Big/ \partial P_i = -Q_i(\mathbf{P})$$

The firm's profit is

$$\pi(\mathbf{P}) \equiv \sum_{i=1}^{n} P_i Q_i(\mathbf{P}) - C(\mathbf{Q}(\mathbf{P}))$$

The optimal prices where consumer welfare is maximised subject to the profit constraint of

$$V(\mathbf{P}) + \alpha\pi(\mathbf{P}) \text{ subject to } \pi(\mathbf{P}) \geq 0$$

is where the optimal prices **P*** are

$$\lambda Q_i(\mathbf{P}^*) = -\sum_j [P_j - C_j(\mathbf{Q}(\mathbf{P}^*))] \frac{\partial Q_j}{\partial P_i}(\mathbf{P}^*) \text{ for each } i$$

The prices that solve this are referred to as Ramsey prices. The added term of λ, a constant factor, is the main difference between this formula and that of unregulated profit maximising prices. The constant factor, λ, is necessary but not sufficient condition for prices to be below marginal cost in one or more markets, where

$\partial Q_j / \partial P_j < 0$ for some $i \neq j$ (Armstrong et al. 1994).

A special case is where consumer demand is independent so there are no cross price effects. The price/cost mark-up divided by the demand elasticity is constant across all products. The formula is then reduced to

$$\frac{P_i^* - C_i}{P_i^*} = \frac{\lambda}{n_i}$$

This is referred to as the inverse-elasticity rule

$$\text{Or } n_i \equiv \frac{-P_i(\partial Q_i / \partial P_i)}{Q_i} \qquad (4\text{-}3)$$

is the elasticity of demand for product *i*

The Ramsey rule is also known in the literature on price discrimination as third degree price discrimination where consumers are charged different prices to reflect demand sensitivities but each consumer pays a constant amount for each unit bought such as student discounts or senior discounts (Varian 1985).[8]

According to this rule, prices should be closer to marginal cost where demand for medicines is more sensitive to price. Where demand is not sensitive to the medicine's price, also referred to as inelastic then price should be set high enough to cover any shortfalls in the firm's profits.

It is important to recall the assumptions of this model in relation to the previous discussion on marginal cost pricing. Ramsey pricing, like marginal cost pricing,

[8] Third degree price discrimination could apply also where marginal cost is similar across markets, because then it is optimal both for consumers and for the firm to price products differently to cover its costs. (Armstrong et al. 1994). Two other types of price discrimination exist. First degree price discrimination characterises a market where firms charge a different price for each unit of the good where the priced charged to each consumer is the maximum willingness to pay for that unit (Varian, 1985). Second degree price discrimination occurs where prices depend on the quantity sold but not across consumer such as quantity discounts or premia.

assumes that the regulator has information about consumer demand and knowledge of the firm's costs. All demand elasticities are assumed to be negative but prices can lie above or below marginal costs. Unlike marginal cost pricing, however, Ramsey pricing assumes that the regulator is restricted by an exogenously fixed deficit or profit.

Therefore, Ramsey prices face challenges in implementation, particularly due to informational requirements. When informational requirements are relaxed because the regulator does not have information of the cost structure of the firm, productive efficiency cannot be easily met. The regulator may not necessarily be well informed of consumer demand or the industry cost structure to implement Ramsey pricing.

One solution is transfers are used to improve productive efficiency but these are difficult to implement in practice as previously discussed (Laffont and Tirole 1993). To address information requirements, other responses have been considered such as price cap regulation, and yardstick competition but again cost and demand conditions are required to be stable over time. For a more detailed discussion please refer to Armstrong et al. (1994).

Thus, in a simple framework, the regulator is informed about demand and conditions in the industry. This is where Ramsey pricing is possible. More complex situations are where the regulator does not have as much information as the firm about its costs and effort level. Therefore the three trade-offs for the regulator are between allocation efficiency (set prices as close to marginal cost), productive efficiency (keep the firm's cost as low as possible), and minimise the adverse distributional effect of the excess profits of the firm due to its informational advantage (Armstrong et al. 1994).

The aim of this section provided an overview of Ramsey pricing to motivate the empirical work presented later in this chapter. While the theoretical work discussed the role of the public authority, the following section moves to application of Ramsey pricing in the pharmaceutical sector from the industry's perspective. The literature proposes that Ramsey pricing for medicines could be

desirable because marginal cost pricing would result in deficits for the firm (WTO and WHO 2001).

4.2.3 RAMSEY PRICING IN THE PHARMACEUTICAL SECTOR

This section discusses the application of the Ramsey rule in the pharmaceutical sector. The application of this rule has been proposed as a potential policy response for unaffordable medicine prices where it is the pharmaceutical firm which sets prices according to the Ramsey rule to take account of its costs and mark-ups. The prices that pharmaceutical firms should in principle vary according to a country's elasticity of demand for the medicine (World Bank/WTO 2001). While the previous section presented the pricing problem from the perspective of the government authority according to the theoretical framework, this section moves to the application of this pricing rule and to motivate the empirical work which follows.

The pharmaceutical industry has become a global business. Global sales in 2010 show that high income regions such as North America (39%), Europe (24%), Japan (11%) account for 74% of total spending. Branded drugs account for the same amount in spending but this is expected to decline as patents expire and lead to a rise in generic drug spending (IMS Institute for Healthcare Informatics 2011).

This large industry has key features that are relevant to the application of Ramsey pricing. First, the pharmaceutical sector is characterised as having a monopoly element. Firms are rewarded a patent if they undertake research and development (R&D) in pursuit of improved medical technologies.[9] A patent grants a firm market exclusivity, which can last 20 years or more (as shown in the figure

[9] According to intellectual property rights (IPRs) rules as set out by the World Trade Organization agreement (WTO), Trade-Related Aspects of Intellectual Property Rights (TRIPS). Patent here refers to a product patent as defined in TRIPS.

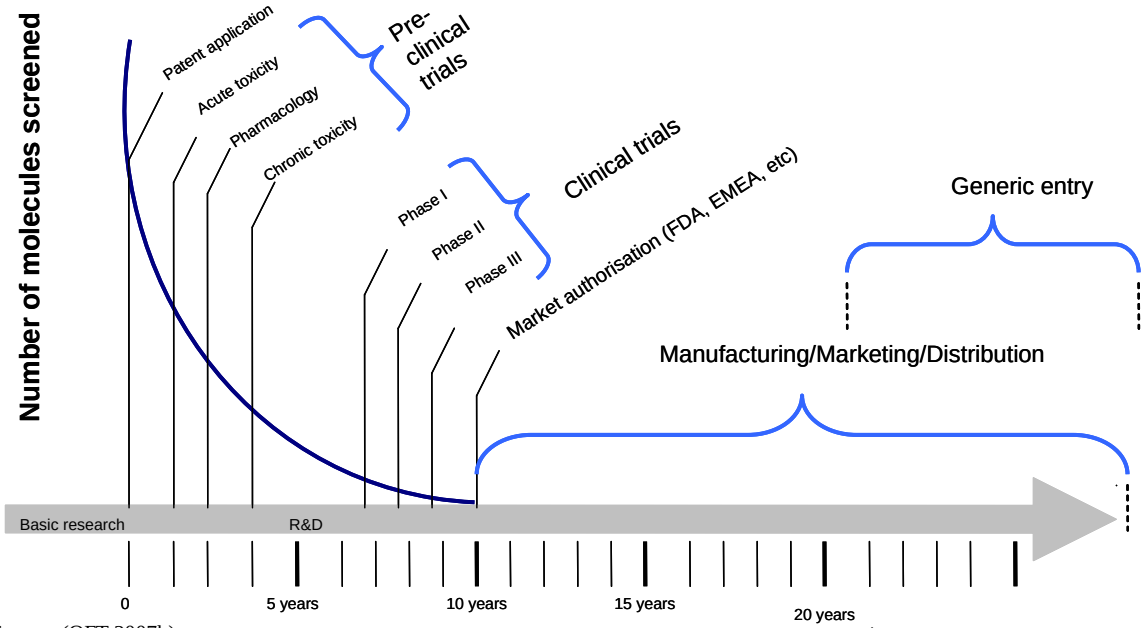
below).[10] The extent to which a firm has market power for the patent it receives depends on the availability of therapeutic substitutes.

Second, this industry is characterised as having high fixed costs, which may or may not be exclusively attributable to research and development (R&D). Some studies suggest the average expenditure of R&D alone is $802 million per approved new drug (DiMasi, Hansen et al. 2003). However, the industry has unique features concerning its cost structure. The costs involved in developing, producing and marketing a drug can be categorised depending on where they are incurred and whether they vary with the volume of sales and/or the countries in which the drugs are sold (OFT 2007b). R&D is considered an international activity (considered a global cost) because it can be located anywhere in the world and once the drug is developed, R&D does not have to be incurred again (see box below) (OFT 2007b). The second type of cost relates to manufacturing which is usually concentrated in certain locations for economies of scale. Transport costs are involved to reach different markets. The remaining costs are specific to the country of sale and include distribution costs, marketing costs and interactions with government authorities for pricing and reimbursement negotiations (OFT 2007b).

Once a high proportion of R&D and manufacturing costs are incurred for drug development, the drug is potentially available in any country's market, provided the country can afford to purchase the drug. The nature of these costs means that the regulatory solutions available for an industry strictly located within one nation's borders may not be applicable to the pharmaceutical industry in other countries.

[10] Patent extensions are used by firms to extend their product's patent life and monopoly power in the market.

Figure 4.2- Lifecycle of a drug



Source: (OFT 2007b)

Box 4.1 - Stages in the lifecycle of a drug

1. Basic research is conducted (e.g. within public sector institutions, universities, etc.).

2. Pharmaceutical companies can acquire patent protection once basic research has identified promising new molecular entity (NME).

3. Pre-clinical trials involve testing of NMEs in laboratories. Less than 1% of compounds successfully make the transition from pre-clinical to clinical trials.

4. Three stages of clinical trials are carried out on humans before market authorisation (licensing) is granted. An estimated 21.5 per cent of drugs successfully pass through clinical trials.

- Phase I conducted on 20-100 healthy adults
- Phase II in 100-300 patients to determine drug safety and efficacy
- Phase III in 1,000-3,000 patients to collect further data on drug safety and efficacy

5. Market authorisation (licensing) must be obtained before the drug is available in the country's market (e.g. the FDA in the US, EMEA in Europe, or national licensing authority).

6. Phase IV, pharmacovigilance trials begin once the drug is available in the market to identify adverse drug reactions and continue throughout the drug's

lifetime.
7. Generic manufacturers are able to enter the market and sell generic copies of the drug after the drug's patent (and any supplementary protection certificate (SPC) has expired).

Source: OFT(2007b)

Ramsey pricing is a potential approach for pricing from the perspective of the profit maximising firm. In this sector, firms will not set prices equal to marginal cost because this would result in a loss. They would prefer to set prices above marginal cost. From the firm's perspective, if country markets are well segmented, IPRs are protected and there is little threat of parallel trade or leakage into other country markets, Ramsey pricing could be used. To implement Ramsey pricing, the firm, however, requires information about demand. One argument put forward in the literature is that a country's income could be used as a proxy for a country's price elasticity to inform price levels. Prices could therefore be set higher in high income markets (e.g. more inelastic) and lower in low income (e.g. more elastic).

These features of the pharmaceutical market highlight the important relationship between the pharmaceutical industry and countries that purchase drugs on behalf of their population. The relationship is one of negotiation between the firm and the country (e.g. the government authority charged with negotiating). The country behaves as a monopsonist on behalf of their population.

In practice, high-income countries have a higher degree of market power as a monopsonist when negotiating with firms due to the potentially high profit stream available in that country. Low and middle-income countries are cash constrained, do not reflect high profit markets and as a result, do not have the same degree of buyer power in price negotiations.

In developing country settings, pharmaceutical policies are not typically well developed. Some countries have begun to use legal provisions under the WTO TRIPS agreement to have access to generic versions of patented medicines. Brazil and Thailand have issued compulsory licenses to generic manufacturers to

produce antiretroviral medicines because the price offered by the patent holder were too high (Ford, Wilson et al. 2007). Mexico recently negotiated savings reductions in the purchase of public sector patented medicines. Some medicine prices remained the same while others fell leading to a net result of cost savings (Tamayo 2008).

Non-government actors play an important role in procurement of medicines. International donor agencies have an interest to secure low prices for developing countries. Institutions such as the Clinton Foundation negotiate the procurement of medicines on behalf of many countries while other institutions such as the Global Fund to Fight Aids TB and Malaria work with a consortium of campaign groups to set low prices for medicines. Recent price negotiations underway would be to subsidise the majority of wholesaling costs of manufacturers to provide low cost malaria medicines (Mackenzie 2008).

In summary, there is some theoretical basis that pharmaceutical firms with market power are likely to employ Ramsey type approaches in setting prices of pharmaceuticals. There is less agreement however, on the policy implications of this. While some argue that price sensitivity for a country is likely to be strongly correlated with income and hence the application of Ramsey pricing by companies alone would likely lead to an equitable outcome (with poorer countries being offered lower prices), there is a strong argument that other factors are likely to drive price sensitivity, in particular the effectiveness of procurement policies in developing countries. These issues are further explored in Chapter 9. The next section reviews evidence from the literature on the application of Ramsey pricing in the pharmaceutical sector before moving onto the empirical work.

4.3 LITERATURE REVIEW OF PHARMACEUTICAL PRICING

4.3.1 THEORETICAL WORK

This section reviews existing evidence on pharmaceutical pricing. This provides useful background information on this topic before moving to the analysis in this

chapter. Section 4.3.1 presents theoretical work, followed by evidence of empirical work in 4.3.2; section 4.3.3 summarises this review and identifies gaps in the literature.

The empirical application of Ramsey pricing has appeared in various parts of the literature when there are significant high fixed industry costs. Common applications of Ramsey pricing of goods occurred in transportation (Martin-Cejas 2010), utility (Berry SK 2000), environment and agriculture sectors (Bourgeon and Chambers 2008). In these circumstances, Ramsey pricing is considered a more optimal pricing strategy than marginal cost pricing (Bös D 1985).

The application of Ramsey pricing to the health sector has been limited. Harris (1979) applied the Ramsey pricing rule to study the pricing rule of hospitals. Harris (1979) considers the hospital pricing decisions as a problem of public enterprise pricing. The empirical results show that the hospital is able to cross-subsidise its services among ancillary, special procedures and daily accommodations. Allowing prices to deviate from costs compensates for significant distortions and inequities in existing health insurance coverage and shows significant welfare gains under a Ramey pricing rule. While the focus of this thesis is determinants related to pharmaceutical care, the findings from the Harris model emphasise the importance of pricing decisions of health care which have implications for access to health care.

Theoretical work on Ramsey pricing in the pharmaceutical sector has explored static (Dumoulin 2001) and dynamic effects (long term effects of R&D) of price discrimination (Hausman JA and Mackie-Mason JK 1988; Malueg and Schwartz 1994).

For example, Hausman and Mackie-Mason (1988) found that welfare gains occur under static efficiency and dynamic efficiency scenarios because price discrimination allows patent holders to open new markets and to achieve economies of scale or learning and so has positive effects on R&D.

Mauleg and Schwartz (1994) conclude that price discrimination has positive effects on welfare over a uniform price when there are large differences in demand, a term referred to as demand dispersion. The authors also found that when price discrimination is applied across a designated group of markets (e.g. group countries according to a certain level of income) it is more welfare enhancing than uniform pricing and unrestricted market price discrimination.

An important assumption in this work is that markets are independent of one another. This condition allows firms to set prices rationally in each market. When markets are not segmented, there is a threat of leakage and arbitrage where firms will move to uniform pricing across all markets (Philips 1983; Tirole 1988). Two confounding factors could discourage Ramsey pricing: the threat of parallel trade at the international level and spill overs in domestic markets.

In the pharmaceutical sector, the threat of parallel trade occurs when the branded drug is exported from a lower priced country to a higher priced country without the authorisation of the patent holder (Malueg and Schwartz 1994; Szymanski and Valletti 2005). Therefore parallel trade discourages firms from price discriminating across country markets and as a result they may offer a uniform price across all markets. A uniform price will not be equitable as low-income countries will not be able to afford purchasing the drug. Empirical work confirms that the threat of leakage such as parallel trade (Malueg and Schwartz 1994; Szymanski and Valletti 2005) or smuggling has shown to weaken the incentive for price discrimination (Hornbeck and Ortun 2005).

Furthermore, firms may be unable to price discriminate within a domestic market. Problems in market segmentation may result in firms offering high prices to offset internal spillovers between high and low-income segments of the market in a country that has high income inequality (Maskus KE 2001). This situation reflects a ‘kinked’ demand curve (Scherer FM and Watal J 2001). Even though a particular drug is offered in a low-income country, it may be priced for high-income individuals so it is unaffordable for the low-income individuals in that country (Maskus 2001).

Jack and Lanjouw (2005) develop a more comprehensive indirect utility model which considers the distributional effects for low-income countries. The two main conditions assumed under the standard model are that the prices should at least cover marginal costs in each country and second that pricing structures should be related to those that normally arise under a monopoly pricing regime (Jack and Lanjouw, 2005). The authors incorporate the effect of income on demand elasticity and health needs on demand elasticity. The authors find that when distributional concerns are accounted for, low-income countries may not necessarily be able to cover their own marginal costs of drug production and distribution. Furthermore, the price structure does not relate to what would be chosen by a monopolist in a proportional way (Jack and Lanjouw, 2005). They find that the relative markup is smaller when weight is given to social welfare than that would be chosen by a price discriminating monopolist (Jack and Lanjouw, 2005).

Evidence is mixed on the long run effects. In the long run, mark-ups should move to competitive levels (Stole, Armstrong et al. 2007). Hoffler (2006) notes that market entry of competitive suppliers in the long run could have adverse effects on competition. This is because suppliers may be attracted to the price insensitive markets to charge higher mark-ups. As a result market entry may be more aggressive in these markets than in price elastic markets (Hoffler 2006).

Even though the theoretical work has shown that there could be welfare gains from pricing goods relative their demand sensitivities, there is some empirical work on understanding and explaining the pattern of demand in the pharmaceutical sector. The next section turns to this topic with evidence from the literature.

4.3.2 EMPIRICAL WORK

While evidence from theoretical work in the previous section provides useful frameworks for demand analysis we now further extend the discussion and turn to empirical work. This area of research has used prices of medicines to understand

demand structures in developing country settings. This literature estimates price elasticities using upstream prices such as ex-manufacturer prices. The findings from this literature reflect demand decisions potentially at the procurement level and so differ from those presented in sections 3.3.1 and 3.3.2 which reflect decisions at the patient/retail level which occurs further down the pharmaceutical supply chain. Data and data collection on medicine prices in developing country settings is limited thereby currently restricting more robust demand analysis.

This section moves to provide empirical evidence on pharmaceutical pricing. Some studies have applied econometric methods while others are simple descriptive analysis. Econometric studies typically use per-capita income to quantify the relationship between wealth and price. This relationship is a proxy to explain that prices are related to demand. Descriptive studies have been carried cross country or within country analysis and include upstream and downstream prices.

An early study found a strong positive relationship between price level and gross domestic product (GDP) per capita across a cross section of low, middle and high-income countries (32) using data from 1975 (Schut and van Bergeijk 1986). A simple OLS regression was used to model the relationship between price and the explanatory variables. A 10% increase in per capita income was associated with an average increase of 8% higher drug prices. The study found that besides income, regulation played an important role. Direct price control measures resulted in an average 20% price reduction. Policies such as procurement through a central government agency, promotion of generics and to a lesser extent, excluding patent protection were successful in lowering the general price level of pharmaceuticals. One of the limitations to this study was that it used aggregate data (price index) to explain movements in the price level.

More recently, panel data sets have been used to shed light on the patterns of price movements over time. Scherer and Watal (2001) used wholesale price data and income using data for 15 AIDS drugs in 18 low and middle-income countries

between 1995-1999[11]. International price variations were correlated with GNP per capita at around 0.21. OLS regression was used where wholesale price was regressed against GNP, and dummy variables for type of drug, pharmacy, hospital setting and patent protection of the drug. The study found that per capita income helped to explain price differences but more importantly, this relationship weakened over time as the pharmaceutical firms offered discounts that were unrelated to per capita income. A limitation with this study is that it used a simple OLS technique and sensitivity analysis on the model's robustness was not performed.

Rojas (2005) studied the wholesale price of a sample of drugs in eleven therapeutic groups across Central American countries. A panel-data regression technique was used to test whether the same drugs are sold at different prices across the countries and results show that there are significant differences in the price of drugs across the countries (Rojas, 2005). Countries differ according to per capita income, income distribution, and the nature and extent of the public health system. The author recommends the implementation of a regional price-discrimination strategy. The analysis is limited because the regression model uses country dummies and did not include other characteristics of countries health systems or their systems of pharmaceutical regulation to control for differences in price levels.

Findings from the US Congressional Budget Office (CBO) come to a similar conclusion that government regulation plays an important role in affecting price levels (CBO 2004). The study, however, carried out analysis across high-income countries to determine differences in prescription drug prices. The study found that on average patented drug prices are 35% to 55% lower in high-income countries relative to the US. These differences are in part explained by the degree of pharmaceutical regulation to control prices and the buying power of government related authorities (CBO 2004).

[11] Argentina, Brazil, Central America, Chile, Colombia, the Dominican Republic, Africa, India, Indonesia, Malaysia, Mexico, Peru, the Philippines, South Africa, Thailand, Uruguay and Venezuela

Two important papers have found support for Ramsey pricing and are widely cited in the literature. Danzon and Furukawa (2003)(2003) found that a relationship between price and income in high-income countries only. They calculated average price levels for pharmaceuticals in nine countries: Canada, Chile, France, Germany, Italy, Japan, Mexico, United Kingdom and the United States. The study sample used comprehensive price information. The authors constructed price indices based on manufacturer prices that included 249 leading molecules in the country sample and accounted for 30 to 60% of sales in these countries. Brand name, generic and OTC products with the active ingredient were included in all presentations (e.g. capsules, tablets, etc). The authors find that drug price differentials reflect income differences in 7 of the 9 countries except for Chile and Mexico. In these two countries, price differentials are five times greater than income differentials, implying that drugs are not affordable to most people. A limitation with this study is that the basket of drugs only captures 33% of drug spending in Chile and Mexico and is less representative than for the high countries used in the sample so the conclusions about these two countries should be viewed with caution.

Danzon and Furukawa (2008) carried out similar analysis and expanded the set of countries from 9 to twelve (adding Australia, Spain and Brazil). The price differentials roughly reflect income differences but only in the high-income countries (9 of the 12 countries). In the less affluent countries price differentials are greater than income differentials: Brazil and Chile (3 times greater), Mexico (4 times greater). This study used more representative price information where the molecules used accounted for 64% to 80% of the country's sales. The authors argue that high drug prices in the Latin American countries partly reflect the skewed income distribution of income and the manufacturer's tendency to target prices to the affluent minority but overall drug prices are unaffordable, contributing to lower per capita use of drugs in these countries (Danzon and Furukawa 2008). A limitation with this study is that prices indices are sensitive to the basket used which could mask distribution effects at the molecule level.

Descriptive analysis has found differences in prices for the same drug across countries with similar income levels. Maskus (2001) looked at ex-manufacturer prices for 20 major brand name molecules in a mix of high, middle and low income countries (14) for the period 1994 to 1998.[12] He compared prices per dosage and found that prices for the same drug in Canada, Italy and Spain were lower than in Brazil, Mexico and South Africa (Maskus, 2001). For 10 out of 18 drugs in Italy, Spain and South Africa, South Africa had the highest price. Brazil and Mexico had the second and third highest average prices relative to Canada, Italy, Spain and Japan.

A study in the Asia Pacific region among selected developing countries carried out a descriptive analysis of downstream prices (retail prices) where prices for the same medicine varied from 233% to 32,757% (Balasubramaniam 1996). Similarly, Myhr (2000) also carried out a descriptive analysis and compared prices and availability of medicines in Eastern African countries (Ethiopia, Kenya, Uganda, and Tanzania). Information on duties, taxes and mark-ups were also collected in rural and urban areas. The author found that prices at the retail level were sometimes double those in European countries.

Pitaknetinan et al. (1999) carried out within country analysis in Thailand to study prescribing practices in a sample of nine hospitals in the city of Bangkok. Three hospitals were public, and six were private (three for-profit and three not for-profit) were private. Mark-ups were estimated in the study using government price data. The authors found that prices of the same medicine in private hospitals were higher than in private pharmacies. Private hospitals had higher mark-ups on the medicine to cover hospital services. The government fee schedule suggests mark-ups in the range of 15% to 30%. Some medicines in government hospitals had mark-ups of 400%. The study did not carry out further analysis to understand the reasons underlying the variation in mark-ups.

[12] Brazil, Canada, Czech Republic, India, Italy, Japan, Korea, Mexico, Sweden, Spain, South Africa, Thailand, UK, USA.

More recent and comprehensive analysis by the WHO and Health Action International (HAI) confirmed these literature findings across a large cross section of countries comparing prices at the molecule level (WHO/HAI 2006). There is evidence to suggest that distribution margins (wholesale and retail pharmacy), particularly in low-income countries account for a larger share of the drug's overall price than the manufacturer's price (WHO/HAI, 2006). Furthermore this study highlighted that there are significant price variations for the same medicine within a country depending on whether it is offered in the public or private sector.

A challenge with country price comparison studies is that there are many methodological issues that can affect the results including the types of prices compared, the source of the price data used, the methodology used to make the comparison and the parameters used in constructing price indices. All these factors make it difficult to draw out straightforward policy conclusions. A comprehensive review of international price studies found that these studies need to be viewed with caution because these studies along cannot clearly respond to general questions of whether prices in one country are too high with taking account of important factors such as rebate schemes, exchange rate movements, and a detailed understanding of the country's policy and market environment (OFT 2007c).

4.3.3 SUMMARY AND GAPS IN THE LITERATURE

In summary the theoretical work has led to similar conclusions with the underlying Ramsey proposition that prices should reflect demand but there are distributional concerns on how well this could be achieved. The empirical work on explaining patterns of demand with price is mixed. These studies have typically looked at the relationship between price and income but are not based on a clearly defined theoretical model of demand. The evidence also highlights the importance of regulation in influencing price levels.

The aim of the empirical work in this chapter is to provide evidence on the pattern of demand in low and middle-income countries. This analysis uses upstream price

information at the molecule level because empirical work in this area is limited. This study also draws on a large sample size across a cross section of low and middle income countries to improve the evidence base on demand for medicines. While the empirical work on the application of Ramsey pricing is mixed, the analysis draws on the Ramsey pricing rule for estimation purposes. Therefore, the empirical work in this chapter is only an exploratory exercise to impute price elasticities as the current evidence base is limited. The empirical work in this chapter has important implications for policy and for improving pharmaceutical regulation in these settings.

4.4 DATA AND METHODS

4.4.1 DATA SOURCES

Data on government procurement prices across a sample of 16 low and middle-income countries were used. The procurement prices are the prices that the government and other purchasers pay to procure medicines, generally through a tendering process. Data on tenders or orders tend to be collected at central stores or facility level. The procurement prices for the public sector are either collected in the administrative centre (procurement offices or central medical stores). Only a few situations the procurement prices included local taxes and handling charges (WHO/HAI 2006).

The data on procurement come from the authority charged with procurement such as the central or regional medicine store or the Ministry of Health for 9 out of the 16 countries. Four out of the 16 countries used a combination of data from both procurement authorities and government affiliated public hospitals while the remaining four collected procurement data from either government hospitals, or tenders from wholesalers.

Data from government hospitals were used in situations where the central procurement data were unavailable or if data from the hospitals would be more reflective of the procurement price. This is because the survey documentation notes that many other parties are involved in procurement in low and middle-income settings. While government authorities may procure, hospitals in these settings may directly negotiate with wholesalers to achieve an even lower procurement price (WHO/HAI 2006). This issue and the implications for the results of the analysis are further discussed later in this chapter.

The dataset comes from WHO and Health Action International (WHO/HAI) database for one year, 2003. The price information covers 18 therapeutic areas and 48 branded drugs in 16 countries.[13] The table below summarises the therapeutic areas included in the analysis.

Table 4.2 - Therapeutic areas for analysis

Therapeutic area	Number of drugs
Antacids	2
Antibiotics	6
Antifungal	3
Antihistamine	1
Antiinfective	1
Antiinflammatory	2
Antiparasitic	2
Antiviral	4
Asthma	2
Cardiovascular	14

[13] China, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, Malaysia, Morocco, Nigeria, Pakistan, Peru, Philippines, South Africa, Syria, Tunisia and Uganda.(Qiang S 2005; Ye L 2005; Drug Information Centre Kazakhstan 2005; Bader R 2007; Ball et al. 2005; Drug Information Centre Kyrgystan 2005; Karam R 2004; Ministry of Health Morocco 2004; Federal Ministry of Health Nigeria 2004; Network for Consumer Protection 2004; HAI Latin American Office 2007; Babar et al. 2005; Batangan et al 2005; Sallouta R et al. 2003; Ministry for Public Health Tunisia 2004; Ministry of Health Uganda 2004; WHO/HAI South Africa 2001).

Contraceptive	1
Diabetes	3
Nervous system disorders	7

Source: (WHO/HAI 2007)

The WHO/HAI database contains a cross section of price data of branded drugs for 2003 on the following 16 countries: China, Jordan; Kazakhstan; Kuwait; Kyrgyzstan; Lebanon; Malaysia; Morocco; Nigeria; Pakistan; Peru; Philippines; South Africa ; Syria; Tunisia; and Uganda. [14] Government procurement price in $USD for the originator branded drug in each country is used for each respective drug in each country.

Prices for each country are presented as the median price and at the presentation level: drug molecule name; pack size and strength. Price information covers 18 therapeutic areas and 48 drugs: antacids (2); antibiotics (6); antifungal (3); antihistamine (1); anti-infective (1); anti-inflammatory (2); anti-parasitic (2); antiviral (4); asthma (2); cardiovascular disease (14); contraceptive (1); diabetes (3); and nervous system disorders (7). This data set includes for the first time price information at a detailed level for many developing countries using the same survey methodology in each country setting. Data from the WHO/HAI database was extracted for all branded drugs across all countries where available.

For estimation purposes, data on marginal costs were required. Two adjustments were made for this analysis. First, marginal costs of the branded drug were unavailable. The closest proxy available was the price of the generic drug in the market. The use of generic information as a proxy for marginal cost implies that all branded drugs studied were off patent.

The second adjustment was for a small number of drugs only when generic data were unavailable. In this instance, average international procurement prices were

[14] China data were collected for two provinces: Shandong; and Shanghai and these observations were calculated separately but prices were not too dissimilar. Data for South Africa were collected for the province of Kwa-Zulu-Natal.

used as a proxy for marginal cost. This information was supplied from Management Science for Health (MSH). MSH maintains a database of international procurement prices offered by international suppliers to developing countries. This dataset is a standard source of international procurement prices and is considered a gold standard (Russo et al. 2010). In the WHO/HAI survey, the MSH price data are used as a benchmark. Countries are considered efficient if their procurement prices are close to the MSH price data. A summary of the data used are shown below.

Table 4.3 - Price data sources

Source	Sample	Year	Variables
WHO	16 countries	2003	Procurement prices at presentation level and pack size
MSH	16 countries	2003	International reference procurement price at presentation level and pack size

Source: WHO/HAI (2006)

Table 4.4 - Income and expenditure data sources

Source	Sample	Year	Variables
World Bank	16 countries	2003	GDP per capita, GNI per capita[15], total health expenditure as a % of GDP, per capita total health expenditure, per capita government health expenditure

Source: World Bank Development Indicators (2005)

4.4.2 EMPIRICAL SPECIFICATION

[15] GNI per capita measures the sum of all income earned within a country.

The aim of this section is to better understand the demand structures at the government level in low and middle-income settings and draws on the previous theoretical and empirical discussion. The empirical approach is to calculate price elasticities to better understand this pattern of demand. Since the WHO/HAI dataset only contained information on prices and not on volume, the empirical method used the Ramsey pricing rule to impute price elasticities which only requires price information. A number of assumptions on firm behaviour are made in order to compute the elasticities. Therefore an important caveat is that we assume that these conditions must hold for the firm which may not take place in practice. Therefore, it is important to note that the empirical work presented is an exploratory exercise to impute price elasticities as the type of data available for more detailed analysis were unavailable.

The lack of volume information resulted in taking an uncommon approach from the literature. The analysis adopted the formulation of Ramsey pricing given as

$$\frac{P_j - MC_j}{P_j} = \frac{1}{-\varepsilon_j} \tag{4-4}$$

where the procurement pack price of the branded medicine is P_j for medicine j. A true estimate of the marginal cost (MC_j) of producing a given drug is not available. For this reason, the pack price of the generic medicine was used as an estimate of the marginal cost of producing the drug.[16]

The model assumes that firms are profit maximisers, they have fixed costs, firms break even, and MCs are not zero. This model further assumes that cross-price elasticities are zero, and that there are no perfect complements. This analysis assumes that for branded products, there remains a monopoly element, that price is related to demand and that firms take cognisance of price-cost mark-ups.

[16] Note: Pack sizes for some medicines varied across countries. The marginal cost of the medicines was proxied using the generic pack price, which varied across countries. The survey methodology of WHO/HAI collected pack prices of medicines because they were identified to be the most common unit of consumption.

The left hand side of the equation will estimate the differences between price and marginal cost as a fraction of price. According to the Ramsey pricing rule, the left hand side of the equation should be inversely related to the demand elasticity. Rearranging this formula, the elasticities computed in this chapter are calculated as follows. Prices were not aggregated and kept at the presentation level to provide as close an estimate of the price elasticity. Therefore this measure provides a lower bound of price elasticity due to the assumptions outlined above.

$$\varepsilon_j = -\frac{P_j}{P_j - MC} \tag{4-5}$$

This analysis requires a number of assumptions of firm behaviour to compute price elasticities and these may not be borne out in practice. While these conditions are required to hold for the estimation of price elasticities, it is important to note that the analysis is an exploratory exercise. As a result, a number of sensitivity tests are carried out to test to validity of the results and are presented later in this chapter.

4.5 RESULTS

4.5.1 DESCRIPTIVE STATISTICS

The WHO/HAI survey attempted to collect price information on the same drug in each country, but this was not possible because in many cases the same drug was not available. A total of 139 observations were available for analysis.[17] In the data sample, the highest number of countries with the same drug was 7 for carbamazepine (treatment of epilepsy), 6 for ceftriaxone (antibiotic) and salbutamol (treatment of asthma).

[17] Note: Data from China was sampled in two regions and the corresponding elasticities were calculated separately.

Prices of medicines show significant variation by therapeutic class of drugs and even within therapeutic classes across countries. Even when data were normalised to price per pill, there still appeared to be variation across medicines even though in some cases variation was reduced. According to pack size, the top prices of branded drugs ranged from US$325 (fluconazole an antifungal drug in Tunisia, zidovudine and nevirapine are antiviral drugs used to treat HIV/AIDS in Lebanon) to less than a US$ 1.00. Most medicines were priced less than $US 50.00 with Jordan and Kazakhstan having the lowest prices. Antiviral drugs had the highest prices per pack while most antibiotics (except for ciproflaxin) were the least expensive for both branded and generics.

The top prices of generics per pack ranged from US$ 62 (indinavir, zidovudine, nevirapine are antiviral drugs used to treat HIV/AIDS in Morocco, Malaysia and Lebanon) to less than US$ 1.00. Most medicines were priced less than US$ 10.00 with Kazakhstan and Kyrgyzstan having the lowest prices.

According to prices per pill, the top branded prices per pill (fluconazole, ciproflaxin, fluoxetine an antidepressant in Tunisia, Morocco, Philippines) ranged from US$ 90 with most less than US$30 with Jordan, Peru and Pakistan with the lowest prices. The top generic prices per pill (ciproflaxin, fluoxetine, captopril an antihyperintensive in Morocco and Shanghai) ranged from US$ 25 with most less than US$10.00. There were also variations within a country. For example, Morocco also had one of the lowest generic prices for pill for an anxiolytic drug along with Jordan and the Philippines.

The figures below show the standard error in prices by pill and pack size. Both figures show wide variations for certain antifungal and antibiotics drugs. There are also wide variations for antiparasitic drugs according to price per pill and for antiviral drugs by pack size.

For example according to pack size, the standard error for most (14 out of 25) was less than five. Seven drug categories had standard errors from 30 to 160, and four drug categories had standard errors less than fifteen. (See Appendix B for a summary).This issue would need to be further explored by examining the system

of pharmaceutical regulation in each country to better understand price differences, but is outside the scope of this thesis.

Figure 4.3 - Standard error in prices per pill

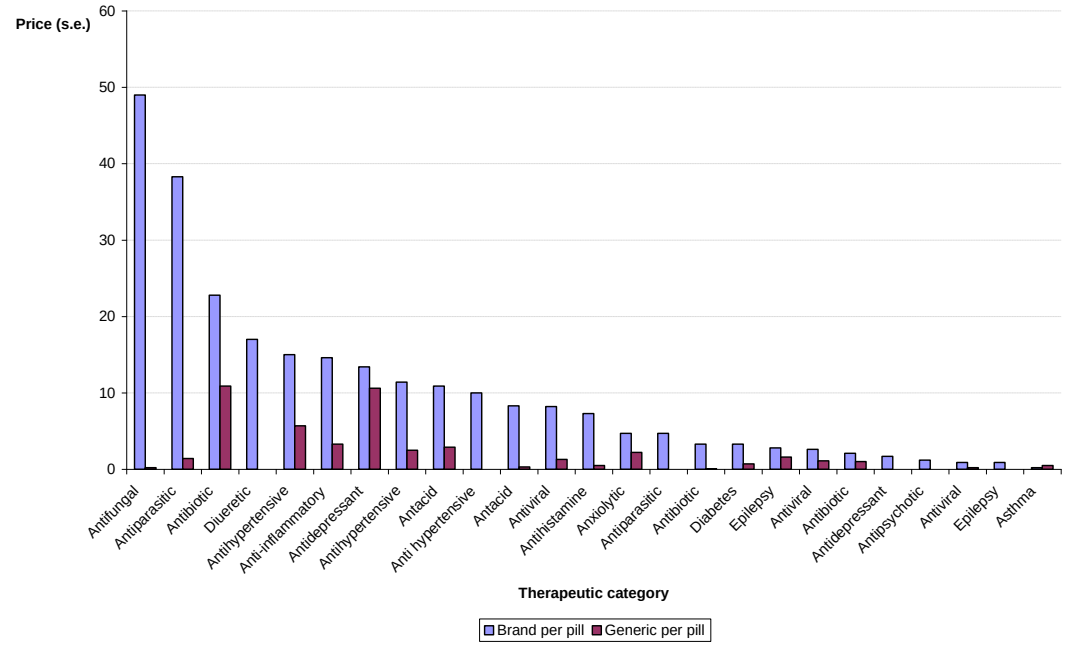
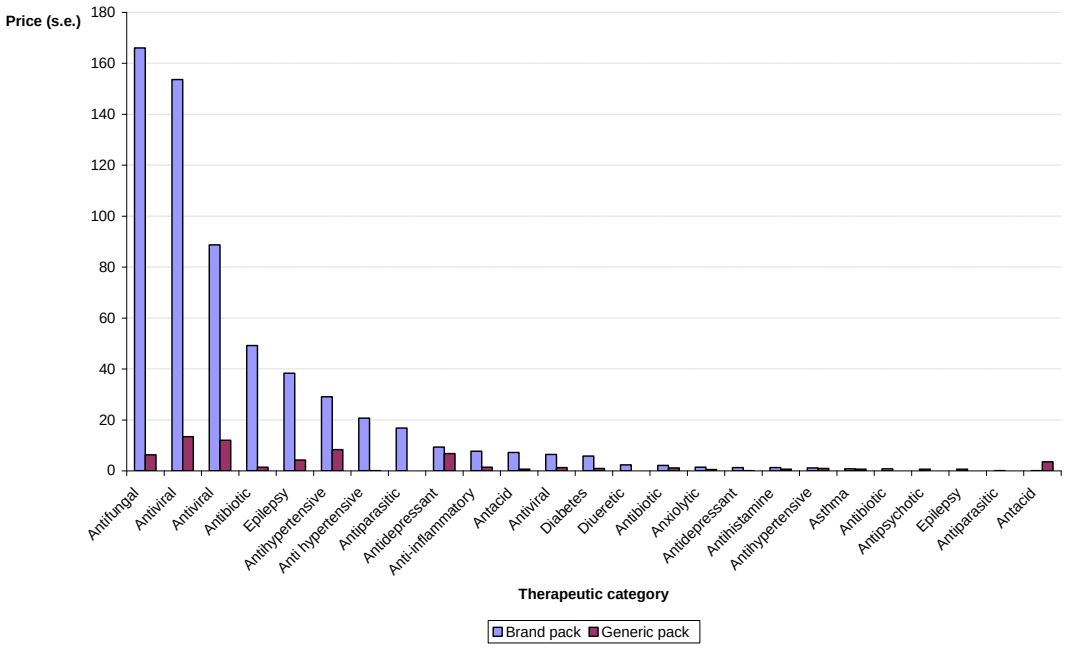


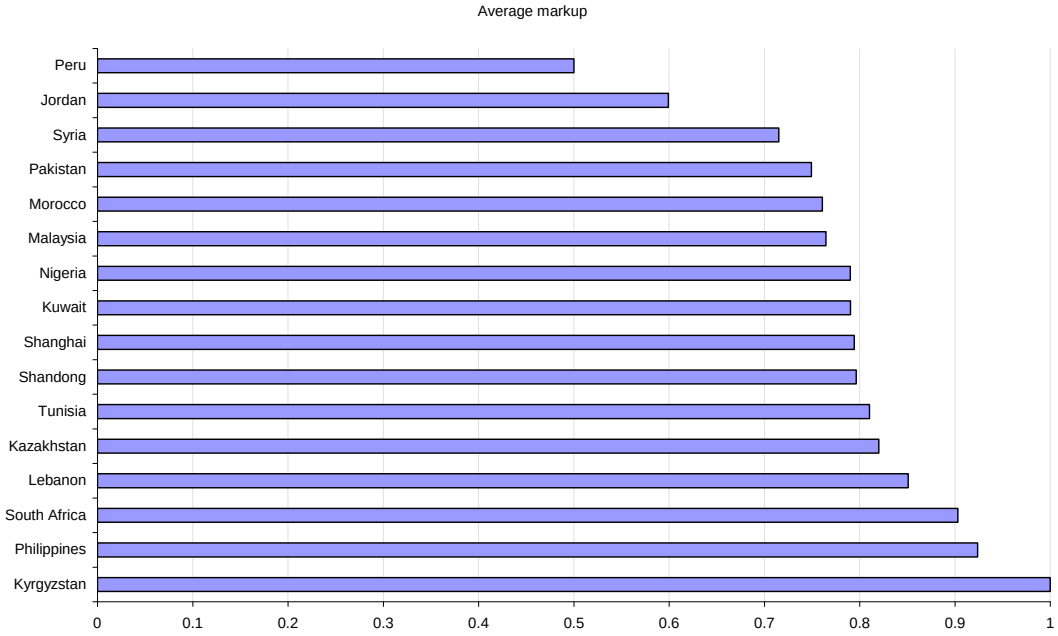
Figure 4.4 - Standard error by pack size



Mark ups vary across the countries ranging from 50% to 100% with Peru (50%), Jordan (60%) having the lowest and South Africa, Philippines and Kyrgyzstan

having the highest (90% to 100%) as shown in the figure below. Most countries have average mark-ups ranging between 70% and 80%.

Figure 4.5 - Average mark-ups across countries



Note: Peru is based on only one observation

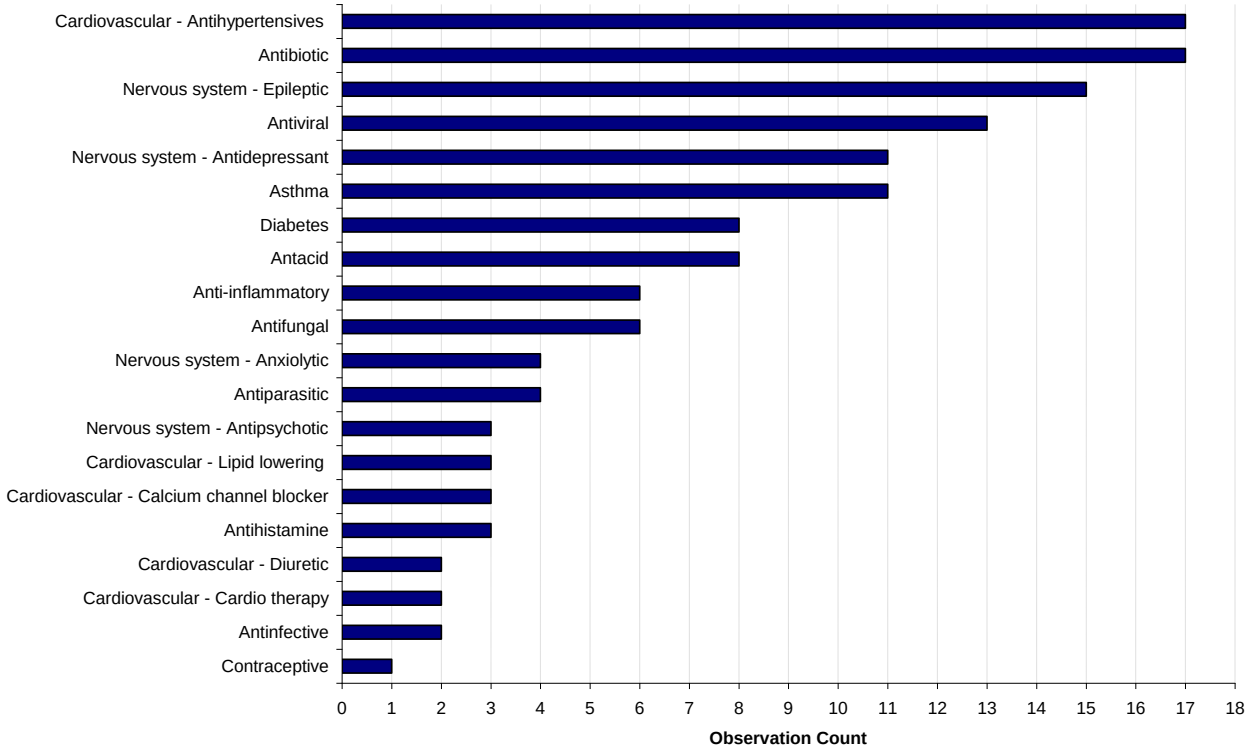
The top therapeutic categories with the most number of observations were 17 for antihypertensives and antibiotics and 15 for epileptic drugs as shown in table and figure below. Details of the data are found in Appendix B.

Table 4.5 - Summary of drug data

Therapeutic Category	Drug Name	Observations	Dose
Antacid	Omeprazole	4	20 mg
	Ranitidine	4	150 mg
Antibiotic	Ceftriaxone	7	1 g
	Ciprofloxacin	5	500 mg
	Co-trimoxazole	2	8+40 mg/ml
	Amoxicillin	1	250 mg
	Benzathine benzylpenicillin	1	1.2 MIU vial
	Streptomycin	1	1 g vial
Antifungal	Fluconazole	3	200 mg
	Fluconazole	2	150 mg
	Itraconazole	1	100 mg
Antihistamine	Loratadine	3	10 mg
Antinfective	Pyrazinamide	2	500mg
Anti-inflammatory	Diclofenac	5	25mg
	Paracetamol	1	500mg
Antiparasitic	Mebendazole	2	100 mg
	Metronidazole	2	500 mg
Antiviral	Aciclovir	5	200 mg
	Indinavir	3	400 mg
	Zidovudine	3	100 mg
	Nevirapine	2	200 mg
Asthma	Salbutamol	7	0.1 mg
	Beclometasone	4	50 mcg
Cardiovascular - Calcium channel blocker	Amlodipine	2	5 mg
	Diltiazem	1	60 mg
Cardiovascular - Cardio therapy	Digoxin	1	0.25 mg
	Isosorbide dinitrate	1	10 mg

Cardiovascular - Diuretic	Furosemide	2	40 mg
Cardiovascular -			25 mg
Antihypertensives	Captopril	5	
	Losartan	4	50 mg
	Atenolol	2	50 mg
	Nifedipine Retard	2	20 mg
	Enalapril	1	20 mg
	Lisinopril	1	10 mg
	Methyldopa	1	250 mg
	Prazosin	1	1 mg
Cardiovascular - Lipid lowering	Simvastatin	3	20 mg
Contraceptive	Medroxyprogesterone	1	150 mg
Diabetes	Metformin	6	500 mg
	Glibenclamide	1	5 mg
	Insulin neutral	1	100ml
Nervous system - Antipsychotic	Fluphenazine	3	25 mg
Nervous system - Anxiolytic	Diazepam	4	5 mg
Nervous system - Antidepressant	Fluoxetine	6	20 mg
	Amitriptyline	5	25 mg
Nervous system - Epileptic	Carbamazepine	8	200 mg
	Phenytoin	5	100 mg
	Valproic Acid	2	200 mg
	TOTAL	**139**	

Figure 4.6- Frequency table of observations by therapeutic category



4.5.2 PRICE ELASTICITY ESTIMATES

Due to data constraints, price elasticities were imputed without recourse to volume information. Only price information at the presentation level for the 16 countries in the sample was available. Therefore price elasticities were computed using the Ramsey rule as shown in equation (4-5). The computation of price elasticities contributes to a currently limited evidence base on empirical estimates for many of these countries. The sample of countries represents a broad group which was used for analysis. A sample of the calculations for the drug metformin used in the treatment of diabetes is presented in the table below. Full results are found in later in Appendix B.

Table 4.6 - Price estimates for Metformin (500mg)

Country	Procurement brand pack price	Procurement generic pack price	Price elasticity
Nigeria	7.1	1.4	-1.2
Pakistan	1.7	0.7	-1.6
Shanghai (China)	15.3	2.8	-1.2
Philippines	11.0	1.8	-1.2

Note: Pack size (100 tablets)

Price elasticities have similar ranges both according to countries and across molecules. Estimates of the price elasticities for different therapeutic products and countries range from between -1 to -2. These measures of elasticity suggest that if the procurement price of the drug increases by 10%, demand for the drug could drop by 10% to 20%. This implies that developing countries are fairly responsive to changes in the price of medicines and if these estimates represent a good first approximation, as expected, certainly more so than high-income countries (Dzator and Asafu-Adjaye 2004; Goldman, Joyce et al. 2007).

The figure below (Figure 4.7) shows that across countries estimates are within the range without significant outliers. Similarly, the second figure (Figure 4.8) shows that across drugs, estimate are also fairly consistent. The outliers appeared random which suggests that there does not appear to be any systematic bias in the results, either by country or by drug. Details of these figures can be found in later in Appendix B.

Out of a sample of 139 observations, 90 observations were kept for analysis and 49 were dropped for two reasons. In the first case, observations where the branded price was below the generic price were not amenable to our method (19 observations were dropped). The second case resulted in implausible estimates of price elasticities ranging between -3 and -27 (30 observations) where the branded and generic pack price were relatively similar in value. While this is not an insignificant reduction in the sample size, the pattern and range of elasticities were consistent across drugs and across countries. These data constraints are therefore further studied in the sensitivity analysis below.

Figure 4.7 - Price elasticity by country

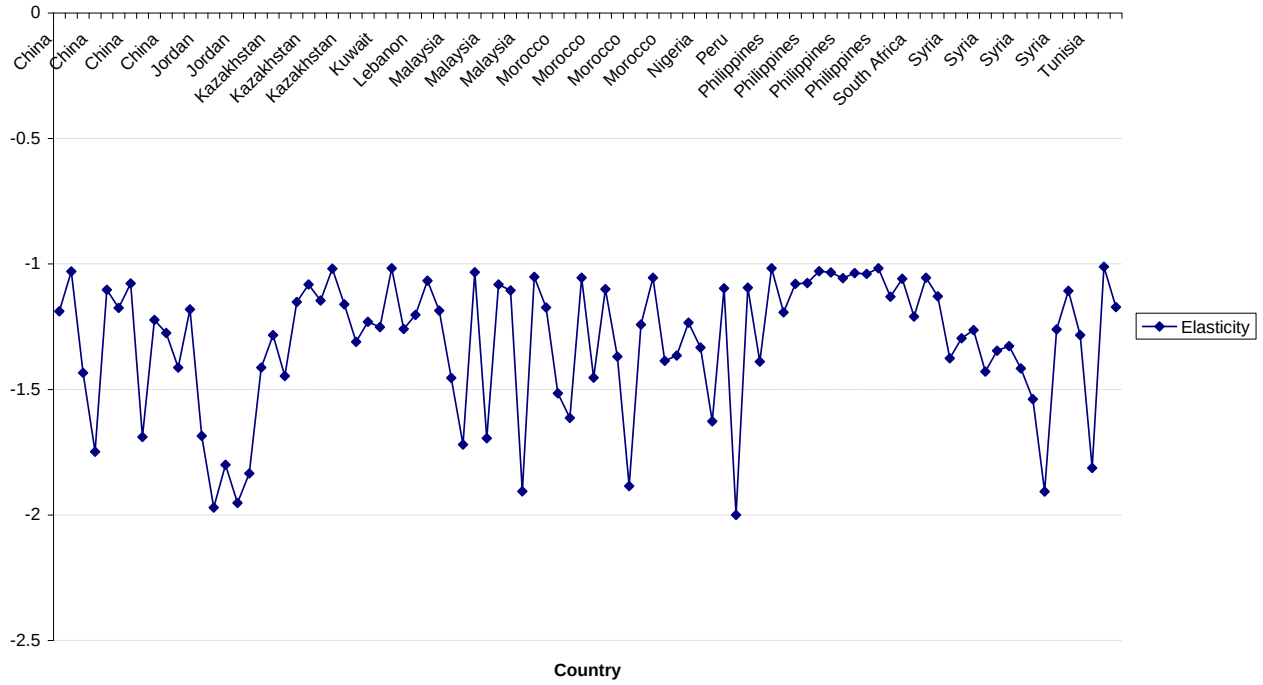
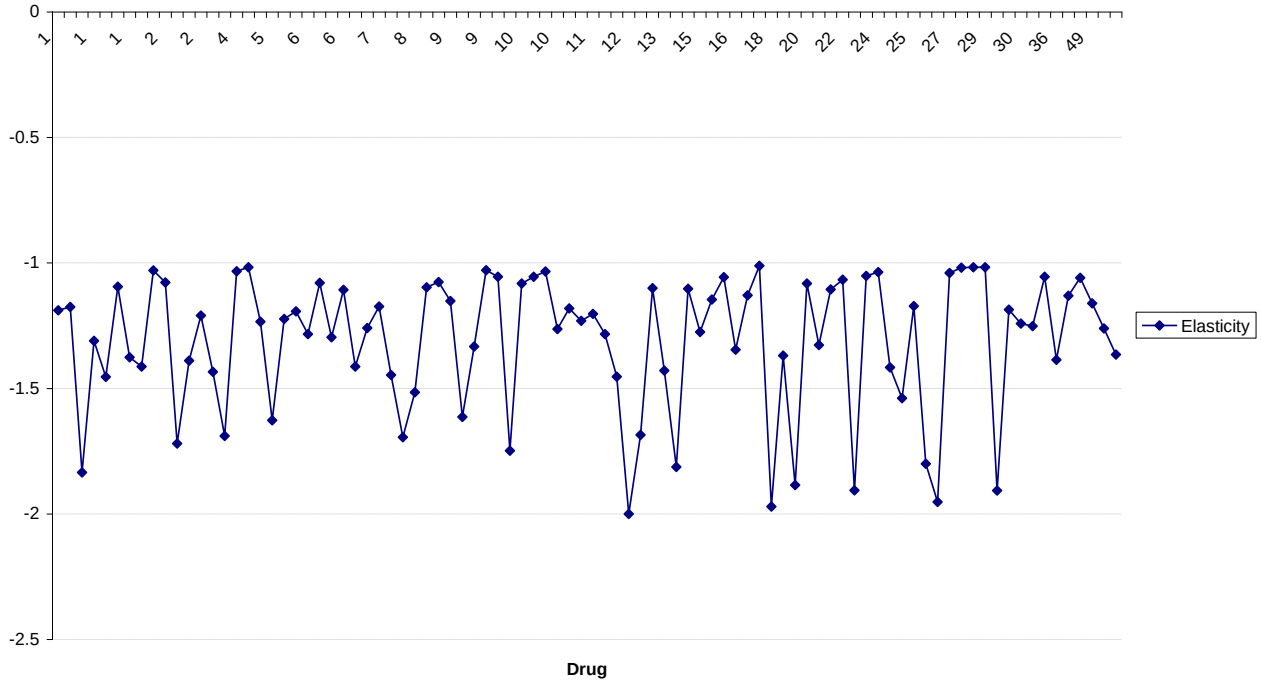


Figure 4.8 - Price elasticity by drug



Three approaches were taken to test the robustness of the results. First, the estimates were tested for robustness using sensitivity analysis. Generic prices were used as proxies, which were varied to see if the results would significantly change the results. Prices of generic drugs were increased and decreased by 5% and 10%. The results showed that estimates stayed within the range with very few changes in the country and drug specific results.

Second, these estimates may be verified to some extent through comparison with the existing literature but the evidence on using procurement data is limited and employed different techniques. The analysis has studied the relationship between income and price (Schut et al. 1986, Scherer and Watal 2001; Rojas 2005), while this chapter's analysis assumes that the Ramsey formula holds. As a result estimates are not directly comparable but they have a similar implication which suggests that demand is elastic in developing country settings.

Finally, data from developed countries were cross checked with these estimates to ascertain whether similar estimates would be found in developed settings where results are calculated at the patient level and so are not directly comparable. The findings from this chapter are more elastic than the patient level estimates found from developed countries where the range is between -0.2 and -0.6 (presented in Chapter 2). The data were not easily comparable due to differences in collection of price data, but these results are at least consistent that low-income countries had more elastic price elasticities.

Previous empirical work examined correlations between price of the branded drug and the country's GDP per capita, which is used as a proxy index of demand. Empirical work has found mixed results.

Correlations were calculated between price and measures of income: GDP per capita, gross national income (GNI) per capita.[18] The analysis also extended the calculations to test for correlations between price and expenditure to assess

[18] GDP per capita measures the total value of goods and services created domestically or abroad for a country. GNI per capita measures the sum of all income earned within a country.

whether prices had some relationship with the level of health expenditure in the country. Three measures were used: per capita government health expenditure (PHE); total health expenditure as a % of GDP (HE); and per capital total health expenditure (HE). These results are presented below.

Table 4.7 - Correlations between price and income, price and expenditure

	GDP per capita	**GNI per capita**	**PHE per capita**	**HE % GDP**	**HE per capita**
Pack price	-0.000	-0.011	0.066	0.120	0.215
Price per pill	0.007	-0.004	0.008	-0.022	0.050

The results suggest almost no relationship with income measures (-0.01 to 0.007) and a weak relationship with expenditure measures (0.008 to 0.2). There was a small negative correlation between the price of the drug and the country's wealth. This result is not consistent with other findings where a positive association between a country's income and price was found (Schut et al. 1986; Scherer and Watal 2001). Expenditure measures between government health expenditure and the price of the drug suggest a small positive relationship. This implies that higher government expenditure on health is related to having higher priced drugs. These results have intuitive appeal and are consistent with literature findings (WHO 2004). A study which examined the Global Fund data on pricing and procurement of retroviral drugs found that prices in lower middle-income countries prices were high compared with per capita income of the country. The study concluded that such price levels limit government purchasing power (Vasan, HoosII et al. 2006). Overall the results from this analysis are quite small to suggest strong relationships.

4.5.3 LIMITATIONS

There are limitations with the analysis which should be highlighted. The analytical approach assumes that firms follow the Ramsey pricing rule. This assumption was required because volume data were not available for direct computation of price elasticities. Volume information would have allowed for further analysis by drawing on a more robust data set. Furthermore, it was not possible to model the interaction between the government authority charged with procurement and firm behaviour. This would have empirically provided more insight into the role of Ramsey pricing in these settings. The mode assumed that firms are profit maximisers, they have fixed costs, firms break even and marginal costs are not zero. In practice firms may not exhibit all these characteristics. While the empirical work on Ramsey pricing in the literature is mixed and some suggest an absence of Ramsey pricing, this analysis assumes that this pricing rule holds which may not be borne out in practice and could not be tested in this exercise.

Second the results assume that the proxy for marginal cost: generic prices or international procurement prices are a reliable measure. Under the assumption of a monopoly market with Ramsey pricing, generics would not be present in the market as pure complements would not exist and products would still be on patent. Therefore, companies are likely to enjoy less market power which will limit their ability to apply Ramsey pricing.

The approach to measuring price elasticity of demand draws on government procurement prices and while in most cases prices come from public authorities, a minority of cases come from government operated hospitals which procure directly with wholesalers to achieve a lower price. This limitation should not however, significantly change the results. Furthermore, elasticities were calculated using standardised pack sizes which may not necessarily be representative of pack sizes in each country.

Furthermore, out 139 observations, 90 observations were kept for the analysis. The observations that were dropped were not amenable the method of calculation and so this limitation could affect the quality of data and the analytical method used.

The empirical analysis is cross-sectional for the sample of countries and did not allow analysis over time. The extent to which the data are representative of each country would have to be verified with more detailed data for each country.

This analysis could not pick up some of the more disaggregate features of the regulatory environment and could potentially mask important information within and across countries. Furthermore, non-governmental actors play an important role in procurement in these settings including international donor groups. These factors are not explicitly accounted for in the model and could confound the findings. For instance, international donor agencies may provide medicines free of charge which would have implications for the estimates and ranges of price elasticities imputed. The role of the regulatory environment n these settings would have to be supplemented with more qualitative information so clearer links could be made with the quantitative findings and the policy setting environment.

However this analytical approach ought to be viewed against the substantial data constraints faced in estimating demand curves for pharmaceutical products in developing countries because volume data are severely lacking. Even indirect methods of estimation could be useful because without which little can be said empirically concerning the welfare implications of price changes.

While there are a number of caveats with this analysis, and the empirical approach adopted is not a technically sophisticated method, the analysis should be considered a first step and an exploratory exercise. This is because the data constraints allowed for only an indirect imputation of price elasticities and are therefore not a direct estimation of price elasticities. While the estimation method requires a number of assumptions, the sensitivity analysis does support the robustness of the results as the estimates were robust to sensitivity checks.

4.6 DISCUSSION AND CONCLUSION

The aim of this chapter was to better understand the pattern of prices of medicines across countries and country price responsiveness. The data set covers a large sample of countries and provides detailed information of elasticities at the presentation level. This empirical work aims to contribute to the evidence base because empirical findings at this detailed level are limited.

The findings indicate that price elasticities at the government level range between –1 and –2 across all therapeutic classes studied. Sensitivity tests found that the results stayed within this range. While the technique required a number of assumptions of the Ramsey rule which may not be borne out in practice, these estimates are a first attempt at better understanding demand structures in these settings and are therefore the result of an exploratory exercise. While this specification in not a sufficient method to estimate price elasticities it is an adequate approach in light of the given data constraints. It would have been preferable to have data both on prices and volume which would have given a more accurate picture of demand in these settings. Due to a number of caveats with the data and the assumptions in the analysis, the estimated price elasticities are only

proxies as an indirect method was used in estimation because direct estimation was not possible and should therefore be viewed as suggestive.

While the evidence cannot provide information on how governments negotiate with firms, simple descriptive analysis of the countries in the data sample showed that the countries vary with respect their procurement practices. Some are more efficient than others when compared to the average international procurement prices according to MSH data as shown in the table below.[19] According to the WHO/HAI survey, even within countries, degrees of efficient procurement vary as shown between the regions of Shandong and Shanghai in China. Efficiency also varies depending on whether the drug was branded or generic. For example Kuwait is efficient only for generic drug procurement while Syria is less efficient for certain branded and generic drugs and the Philippines is relatively better at procuring branded drugs than generic drugs. For instance, countries such as Jordan have relatively lower markups and could be potential areas of future research.

Table 4.8 - Procurement performance

Efficient	Not efficient
Shandong, Jordan, Kuwait[20], Kyrgyzstan, Lebanon, Peru, Syria[21], Tunisia, Uganda	Pakistan, Malaysia Shanghai, Kazakhstan, Morocco, Nigeria, Philippines[22]

Note: Source WHO/HAI 2006

This result underpins the importance of robust procurement strategies. Some previous empirical work suggests that regulation plays a role in affecting price levels (Schut et al. 1986, CBO 2004). There is anecdotal evidence in the case of AIDS/HIV drugs that countries are not in a position to purchase expensive

[19] Efficient according to the HAI study is where procurement prices are close to IRP or a ratio of 1.

[20] Only for generics

[21] Except for certain branded and generics

[22] More inefficient for generics than for branded drugs

medicines and attempt to negotiate with firms for price reductions on branded drugs (Ford, Wilson et al. 2007).

While government procurement is an important policy issue, government authorities are not the only ones involved in procuring medicines (Seiter 2010). Another important and related issue is the role of non-government actors in procuring medicines in these settings. In low and middle-income settings there is a complex relationship between the government and a variety of actors because in addition to the central medical store, a considerable amount of procurement activity is led directly by public providers as well as by actors in the private sector along with donor organisations. The findings from the exploratory exercise cannot properly account for the non-governmental actors in these settings because in some settings government procurement could play a small role in medicine access.

For instance, it was noted in the country survey report that in Kazakhstan, hospitals are keen to achieve greater price discounts and so negotiate directly with suppliers and therefore this information was available for data collection (Drug Information Centre Kazakhstan 2005). The analysis cannot account for this complex relationship. For a minority of the countries studied, procurement prices were taken both from the central medical store and public hospitals. Therefore in some cases, the imputed elasticities are capturing the role of more than one procurement body.

The evidence raises an important question on what are the main drivers of these estimates. Income is weakly correlated which suggests that other factors are important because these results cannot directly suggest the extent to which access problems occur at the patient level. The empirical work in this thesis aims to address this issue and analyses determinants of access to medicines and health care at the patient level in chapters 5, 7 and 8.

5 Chapter 5 Analysis of determinants of patient access to medicines across countries

5.1 INTRODUCTION

The empirical work explores downstream prices at the patient level to better understand determinants of access to medicines. This chapter aims to address the following research questions as shown below.

Table 5.1 - Chapter 5 Research objective and research questions

Chapter 5 Research Objective	Research questions
Determine the factors which affect access to medicines and health care in primary and secondary care in selected low and middle-income countries	4) Does income affect access? 5) Does regulation affect access to medicines? 6) What is the price elasticity?

Chapter 3 highlighted that the financial cost of a health visit can undermine access to care, particularly in developing country settings where insurance schemes are not well established in the health system. High medicine costs may undermine the decision to seek care. Furthermore the literature showed that there are equity implications for patients that cannot afford the cost of the care. This in turn creates a welfare trade off, particularly in developing country settings where the raising the price of health services is a means to generate revenue for the cash strapped health care sector. A revenue generating mechanism will undoubtedly lead to welfare loss for patients who cannot afford the cost of care and the extent of the welfare loss is a function of the price elasticity.

It is important to note that data constraints in these settings make it impractical to calculate price elasticities directly since these require information on both prices and volume. For this reason, studies on the demand for health care in developing country settings have used patient health expenditure data for the computation of

price elasticities. This method permits a less direct method of demand estimation but does give a useful picture of demand structure in these settings.

The aim of this chapter is to contribute to the evidence base by drawing on larger data sets for analysis and using robust methods because current evidence is limited. The data used in this chapter draw on patient level expenditure for the imputation of price elasticities as only this information was available for analysis. Patient health expenditure data is used to estimate price elasticities which contain medicine expenditure data. As medicine expenditure data account for the largest share of health expenditure in the data set, the price elasticity estimates have implications for patient access to medicines and health seeking behaviour. These issues are explored in this chapter using a cross section of household data from developing countries.

The findings indicate that certain variables affect the decision to seek care and these include, gender, marital status, health status, insurance, urban settings, education, employment, and households with large monthly expenditures. The results suggest that demand is inelastic for hospitals and clinics and patients are not very price sensitive. Those more likely to choose a hospital go for reasons related to child birth, asthma, heart disease, bodily injury, minor surgery or other reason not specified. These responses seem intuitive and seem to capture the main types of services that hospitals provide to treat serious health problems. Those visiting a clinic are more likely to go for antenatal or dental care reasons. Price elasticities range from –0.19 to 0.6, but only an estimate of 0.11 was significant (5% level). While this range includes counterintuitive estimates as well, the empirical analysis in the subsequent chapters builds on this analysis to improve estimation techniques.

This chapter is organised as follows: section 5.2 presents a discussion on the theoretical approaches used to examine health care utilisation. Section 5.3 presents the data sources used and methodology. Results from the descriptive and econometric analysis are presented in 5.4. Finally section 5.5 presents a discussion and conclusion.

5.2 THEORETICAL MODELS

5.2.1 CHOICE MODELS

A number of modelling approaches have been explored in the health economics literature to model health care use. As the literature review showed in Chapter 3, discrete choice models are typically applied to model the decision to seek care and to understand the determinants of health care demand.

A logit model is typically employed where there are two qualitative outcomes. In the case where the outcome involves more than two answers, a multinomial logistical regression is employed. The outcomes are coded, for example, 1, 2, 3, but the numerical values are arbitrary. An important property of the multinomial logit model is that the dependent variable is an unordered categorical variable, unlike in an ordered limited dependent model. A multinomial logit model is applied to the data used in this chapter.

A random utility model can be applied to an unordered choice model where the *i*th consumer faced with *J* choices has a utility of choice *j* such that (Greene, 2008)

$$U_{ij} = z'_{ij}\theta + \varepsilon_{ij} \qquad (5\text{-}1)$$

Greene (2008) shows that if the consumer makes choice *j* then the model assumes that the U_{ij} is the maximum among the *J* utilities. The statistical model is driven by the probability that choice *j* is made which is denoted as

$$\mathrm{Prob}(U_{ij} > U_{ik}) \text{ for all other } k \neq j \qquad (5\text{-}2)$$

The model depends on the distribution of the disturbances. The probit model has had less application because of the need to evaluate multiple integrals of the normal distribution. The logit model has become commonly used in a variety of research disciplines. McFadden (1974) has shown that if the *J* disturbances are

independent and identically distributed with Gumbel (type 1 extreme value) distribution then

$$F_{(\varepsilon_{ij})} = \exp(-\exp(-\varepsilon_{ij})) \tag{5-3}$$

Let Y_i be a random variable that indicates the choice made then

$$\mathrm{Pro}b(Y_i = j) = \frac{\exp(z'_{ij}\,\theta)}{\sum_{j=1}^{J}\exp(z'_{ij}\,\theta)} \tag{5-4}$$

Greene (2008) shows that z_{ij} includes aspects specific to the individual and to the choice made. These should be distinguished for analysis where $z_{ij} = [x_{ij}, w_i]$ and similarly θ is split as follows $[\beta', \alpha']$. This partitioning allows for x_{ij} to refer to the attributes which vary across the choices and the individuals whereas w_i refers to the characteristics of the individual and is the same for all choices.

With this information the model becomes

$$\mathrm{Pro}b(Y_i = j) = \frac{\exp(x'_{ij}\,\beta + w'_i\,\alpha)}{\sum_{j=1}^{J}\exp(x'_{ij}\,\beta + w'_i\,\alpha)} = \frac{[\exp(x'_{ij}\,\beta]\exp(w'_i\,\alpha)}{[\sum_{j=1}^{J}\exp(x'_{ij}\,\beta)]\exp(w'_i\,\alpha)} \tag{5-5}$$

For estimation purposes, it is useful to examine the two types of data separately (Greene 2008). For choice models where the data are individual specific the model is set out as a multinomial logit model

$$\mathrm{Pro}b(Y_i = j \mid w_i) = \frac{\exp(w'_i\,\alpha_j)}{\sum_{j=1}^{J}\exp(w'_i\,\alpha_j)} \tag{5-6}$$

A normalisation is required because the probabilities sum to one so this implies that *J* parameter vectors are needed to determine *J* = 1 probabilities. In this case, $\alpha_0 = 0$. The equation can be rewritten as

$$\mathrm{Prob}(Y_i = j \mid w_i) = P_{ij} = \frac{\exp(w'_i \alpha_j)}{1 + \sum_{k=1}^{J} \exp(w'_i \alpha_k)} \quad j = 0, 1, \ldots, J, \ \alpha_0 = 0 \qquad (5\text{-}7)$$

For example, if the choice model had three possible outcomes the coefficients would be estimated as follows: $\beta^{(1)}, \beta^{(2)}, \beta^{(3)}$ where y=1 is set as the base outcome and $\beta^{(1)}$ is set to 0.

$$\mathrm{Prob}(y = 1) = \frac{1}{1 + e^{x\beta^{(2)}} + e^{x\beta^{(3)}}}$$

$$\mathrm{Prob}(y = 2) = \frac{e^{x\beta^{(2)}}}{1 + e^{x\beta^{(2)}} + e^{x\beta^{(3)}}}$$

$$\mathrm{Prob}(y = 3) = \frac{e^{x\beta^{(3)}}}{1 + e^{x\beta^{(2)}} + e^{x\beta^{(3)}}}$$

The computed coefficients, $\beta^{(2)}, \beta^{(3)}$ measure the change relative to y=1. Any of the three outcomes could be set to one. The difference is that the coefficients will have different interpretations but the predicted probabilities for y=1, 2, 3 will be the same.

In the multinomial logit model, there are two important assumptions. The first is that the error terms are independent and identically distributed (IID). The second is the ratio P_{ij} / P_{ik} is independent of other choices, this assumption is known as the independence of irrelevant alternatives (IIA) and follows from the error terms being IID.

These two properties have important implications for the discrete choice analysis of the decision to seek care. The IIA assumption assumes that the choices made are independent of one another. This property therefore assumes that the decision to see a GP is independent of the decision to see a specialist. This assumption then follows from the error terms being independent which follow a normal distribution (IID). This assumption of independence between choices may not

hold in the decision to seek care. Therefore the violations of these properties should be tested for their violation. To address this problem, the nested model is one solution. These issues are further analysed and empirically tested in later in this chapter.

For estimation purposes the log-likelihood is derived for each individual where $d_{ij} = 1$ if alternative j is chosen by individual *i* and 0 if not for the *J* + 1 possible outcomes.

$$\ln L = \sum_{i=1}^{n} \sum_{j=0}^{J} d_{ij} \ln \Pr ob(Y_i = j \mid w_i) \tag{5-8}$$

The coefficients cannot be easily interpreted so by differentiating equation (5-8) the marginal effects on the probabilities are

$$\delta_{ij} = \frac{\partial P_{ij}}{\partial w_i} = P_{ij}\left[\alpha_j - \sum_{k=0}^{J} P_{ik}\alpha_k \right] = P_{ij}\left[\alpha_j - \overline{\alpha}\right] \tag{5-9}$$

This equation indicates that α enters every marginal effect through the probabilities and through the weighted average. Greene (2008) notes that for any particular $w_{ik}, \partial P_{ij} / \partial w_{ik}$ does not necessarily have the same sign as α_{jk}

These models aim to capture the probability of seeking care while controlling for health, socio demographic and income information. Jones et al (2007) succinctly identify the common regressor variables used in examining health care utilisation in the literature.

Table 5.2 - Health utilisation variables

Category	Variables employed
need/morbidity variables	self-assessed status, indicators of chronic conditions and limited activity, days of sickness/restricted activity and ideally objective health measures

Age	accounting for imperfect health status measurement but also individual preferences
Sex	accounting for gender-specific health care requirements and tastes
ability to pay and other socio-demographic factors	income, wealth, marital status, education level attained, labour market status and job characteristics
prices	price of health care and characteristics of insurance coverage
proxies for access	time costs and accessibility

The data available for analysis is presented in the following section.

5.3 DATA AND METHODS

5.3.1 DATA SOURCES

The data used for this section draws on a cross sectional household survey from the WHO World Health Survey Data 2003. The World Health Survey is a household survey that was carried out in developed and developing countries in 2003.[23] The survey carried out a systematic approach to surveying households in developing countries. This survey collected information on socio demographic characteristics, health state descriptions, health state valuations, risk factors, mortality, health care utilisation, health system responsiveness and health goals and social capital. This dataset provides a useful cross section of household information relating to the use of health services in 38 low-income and lower

[23] With the exception of China carried out 2002, Pakistan carried out in 2003/2004, and Kenya carried out in 2004.

middle-income countries as defined by the World Bank measure of GNI per capita.[24]

The WHO World Health Survey collected information on medicine costs. This information is important for analysis because current empirical work is limited. Furthermore, this survey provides a large data set for analysis, unlike many existing small sample studies, and draws on a sufficient number of developing countries to carry out cross sectional analysis. The WHO survey is a relatively recent cross-country survey, which provides a reasonably new dataset for analysis of developing countries.

The sample selection included 35 countries. Patients were asked about their decision to seek care if they felt ill within the past year. Patient responses fell into one of four categories: not sick, sick patients seeking care in hospital, seeking care in a clinic or sick patients choosing to do nothing. Adult visits to a health facility within the past year were used for analysis because this dataset was more complete than the data set for children.

The following data were used in this survey and aimed to capture relevant health information concerning patient's health status, socio demographic information relating to accessing health services as noted in Jones et al. (2007).

The age, sex and marital status of the patient were used in the analysis. Two variables about the patient's health were drawn from self reported health and whether the patient was diagnosed with any of the following chronic conditions: arthritis, angina, asthma, depression, schizophrenia or psychosis, diabetes, tuberculosis.

Socioeconomic information was collected from a series of variables and included whether the patient had education, was employed, whether the patient lived in a rural or urban setting, whether the patient had private health insurance and the

[24] Low income countries were defined as having GNI per capita of US $765 and lower middle income were defined as GNI per capita US$766 to $3035 in 2003 according to the World Bank.

number of members living in the household. An indicator for wealth or income was drawn from the households' expenditure as no direct income information was collected. Data on the previous month's household expenditure was collected and included food expenditure, utilities, education, health expenditure, health insurance premium expenditure and other related household expenditure.

Monthly household health expenditure included hospital expenditure, health professionals, traditional healers, dentist, medicine, health products, diagnostics and other related health expenditure. Household expenditure data contained some observations with extremely large values of expenditure that exceeded even average per capita monthly expenditures when compared with World Bank development indicator data. The common approach in the literature is to standardise expenditure data (Jones et al. 2007). The data were converted into US$PPP and then transformed into logs. To smooth out any kinks in the data, two times plus or minus standard deviation from the log normal of household expenditure and log normal of health expenditure per visit was included for analysis. This process dropped extreme values, 6,572 observations (5.2% of the sample) of household expenditure data and 8,140 observations (6.4% of the sample) of health expenditure per visit data from the analysis.

Patients reported on their OOP costs related to the visit and included doctor's fees, medicine costs, diagnostic tests, transportation costs and other related expenditure. OOP were transformed into logs to account for non linearities in the data in two settings: clinic and hospital. Data on whether the patient was treated in a public or private setting was incomplete and was excluded from the analysis. In the survey, patients could indicate whether they were treated at home. While it would have been desirable to include this choice in the model, there were missing data on health expenditures so this response was excluded from analysis.

One approach in the literature to address the endogeneity between price and the decision to seek care is to impute prices across all alternative choices but this method is subject to the limitation of reducing the variance in the price variable and thereby underestimating the price elasticity. To avoid this potential problem, the method used in this thesis estimates the predicted health expenditure for clinic

and hospitals as a regressor (Asfaw et al. 2004). The predicted health expenditure per visit was averaged over rural and urban settings within each country. The predicted health expenditure was calculated regressing the log expenditure in a clinic or hospital against age, sex, employed, education, urban or rural setting, log household expenditure and the reason for the visit.

The reason for the visit included the following categories: high fever, severe diarrhoea or cough, immunisation, antenatal consultation, family planning, childbirth, dental care, arthritis, asthma, heart disease, bodily injury, minor surgery or other.

5.3.2 EMPIRICAL SPECIFICATION

Limited dependent models were used to estimate the likelihood of visiting a provider. In the WHO World Health Survey, patients were asked the following question:

Question Q7016: When you last needed care where did you get care?
Four responses were considered, whether the patient visited a hospital, visited a clinic, chose to do nothing, or was not sick. Each of the outcomes took the following values: hospital =1, clinic=2, do nothing =3 and not sick = 4.

As a result of multiple responses, a multinomial logit model was used to determine the likelihood of visiting a provider.

$$\mathrm{Prob}(Y_i = j \mid w_i) = P_{ij} = \frac{\exp(w'_i \alpha_j)}{1 + \sum_{k=1}^{4} \exp(w'_i \alpha_k)} \quad j = 1, 2, 3, \text{ or } 4, \quad \alpha_4 = 0 \qquad (5\text{-}10)$$

$\mathrm{Prob}(Y_i = 4)$ where the individual was not sick was set as the base outcome. The following regression model was run for the *i*th individual across *j* alternatives where j= 1, 2, 3, 4 in country *p*. The variables that were chosen were based on health economic theory, findings from the literature and variables available in the

dataset. The regressors were chosen to capture information on the patient's health status, utilisation, and socioeconomic information.

$$Y_{ijp} = \beta_{ijp} + X age_{ijp} + X age^2_{ijp} + X sex_{ijp} + X self reported health_{ijp} + X chronic_{ijp} + X education_{ijp} + X employed_{jp} + X marital status_{ijp} + X household size_{ijp} + X urban_{ijp} + X health insurance_{ijp} + X \log household \exp enditure_{ijp} + X \log predicted \exp enditure_{ijp} + X country dummy_{ijp} + X reason for visit_{ijp} \quad (5\text{-}11)$$

The Grossman model modifies what might be predicted from epidemiology theory alone: we would expect to find that health utilisation increases with age (Omran 1971). There may be non- linearities with age so this term is also squared and included in the regression. Health status variables should suggest that those with good self reported health are less likely to seek care while those with chronic conditions are more likely to seek care.

The effect of education and being employed should have a positive effect on the probability of seeking care according to health economic theory. Furthermore, those who are more educated and employed are likely to be able to afford the OOP cost associated with care. The insurance variable is treated as exogenous given the characteristics of the health care market as discussed in Chapter 2 and we would expect insurance to have a positive effect on seeking care. The evidence suggests that high OOP expenditures have a negative effect on the probability to seek care while household expenditures (e.g. a measure of household wealth) have a positive effect on the probability to seek care.

Women should be more likely seek care due to their health needs in particular relating to child health and child delivery, however the literature points to mixed evidence suggesting that men are more likely to seek care. Similarly, the effect of marital status is ambiguous on the probability of seeking care. Household size is ambiguous and may be a proxy for capturing wealth of a household. Larger households may have lower wealth and are more likely to seek care. Alternatively, smaller households could reflect greater wealth and suggest that the wealthy are more likely to seek care because they can afford it. The effect of the urban dummy

variable is ambiguous as well. Patients living in urban settings may be more likely to seek care because there are likely to be more facilities available in urban settings. Alternatively, rural patients may be more likely to seek care if this variable is also a proxy for need: poor rural patients may struggle with health conditions and could be more likely to seek care.

The country dummies aim to account for the heterogeneity and in part reflect the regulatory environment so the direction of the sign of these dummies *a priori* is ambiguous. The model requires one country dummy to be its reference base which is assigned arbitrarily. Dummies that capture the reason for visit were also included and the direction of the sign of these dummies *a priori* is ambiguous. Estimations were run with and without sampling weights but the results were consistent. Estimates without sampling weights are presented in this chapter.

Table 5.3 - Expected signs of regressors

Variable	Expected Sign
Age	+
Sex	+/-
Good SRH	-
Chronic health	+
Education	+
Employed	+
Marital status	+/-
Insurance	+
Urban	+/-
Household expenditure	+
Predicted expenditure	-
Country dummy	+/-
Reason for visit	+/-

5.4 RESULTS

5.4.1 DESCRIPTIVE STATISTICS

The data set contained a cross section survey of 38 developing countries with 126, 806 observations. Approximately 20% of the sample reported being ill within the past year of the survey. For purposes of analysis, missing data were removed along with extreme values, which resulted in 35 countries containing observations for analysis.[25] The cross-sectional dataset contained a total of 42,668 observations for analysis. The regressions were run using STATA software. The countries used for analysis are presented below.

Table 5.4 - Country sample

	Country	Observations	Percent of sample %
1	Bangladesh	2,215	5.19
2	Bosnia and Herzegovina	414	0.97
3	Burkina Faso	1,286	3.01
4	Chad	471	1.1
5	China	998	2.34
6	Comoros	193	0.45
7	Congo	261	0.61
8	Cote d'Ivoire	695	1.63
9	Dominican Republic	1,546	3.62
10	Ecuador	751	1.76
11	Ethiopia	625	1.46
12	Georgia	686	1.61
13	Ghana	1,037	2.43
14	Guatemala	1,800	4.22
15	India	2,908	6.82
16	Kazakhstan	2,073	4.86
17	Kenya	461	1.08

[25] Latvia, Swaziland and Zimbabwe were removed

18	Lao	438	1.03
19	Malawi	1,847	4.33
20	Mali	381	0.89
21	Mauritania	448	1.05
22	Morocco	1,225	2.87
23	Myanmar	1,848	4.33
24	Namibia	772	1.81
25	Nepal	3,266	7.65
26	Pakistan	2,223	5.21
27	Paraguay	2,690	6.3
28	Philippines	1,974	4.63
29	Russia	464	1.09
30	Senegal	342	0.8
31	Sri Lanka	1,882	4.41
32	Tunisia	1,688	3.96
33	Ukraine	771	1.81
34	Vietnam	831	1.95
35	Zambia	1,158	2.71
	TOTAL	42,668	100

The table below summarises the descriptive statistics of the variables used.

Table 5.5 - Descriptive statistics

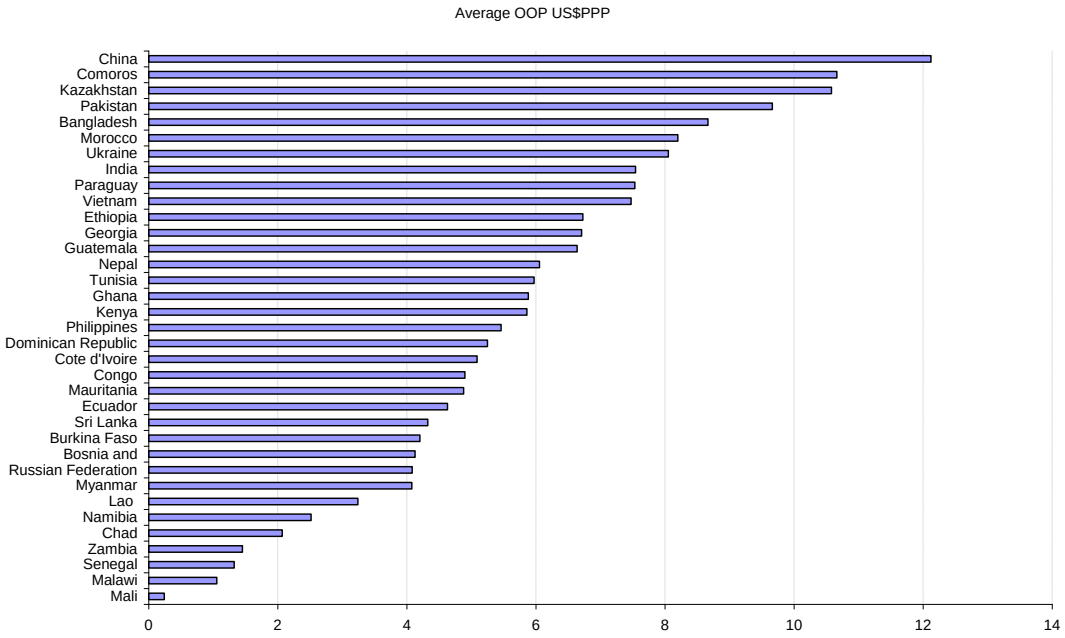
Variable	Description	Mean
Age	Age of adult patient	41.9
Sex	1 if patient is female and 0 otherwise	0.53
Marital status	1 if married or cohabitating and 0 otherwise	0.64
Self reported health	1 if self reported health is good or very good and 0 otherwise	0.56
Chronic condition	1 if chronic condition present and 0 otherwise	0.35
Education	1 if patient has primary education or a higher and 0 otherwise	0.53
Employed	1 if patient is working and 0 otherwise	0.60

Urban setting	1 if patient lives in an urban or semi urban setting and 0 otherwise	0.41
Health insurance	1 if patient has health insurance and 0 otherwise	0.18
Household size	Number of members living in the household	4.77
Household expenditure	Previous month's household expenditure (US$PPP)	366.88
Predicted OOP expenditure	Predicted OOP expenditure (US$PPP)	6.17

The cross sectional sample has an average adult age of 42 years, and is fairly evenly split between men and women and whether the individual has at least primary education or not. Close to two thirds of the sample are married and employed, one third have a chronic condition, 40% live in urban settings and less than 20% have private health insurance. Among those who reported being ill within the past year of the survey, the majority (93%) of these sought care, with most seeking outpatient care (86%), while a smaller percentage visited a hospital (6%) and 8% did nothing.

Medicine expenditure accounted the largest share of OOP expenditure with an average of 57% or by setting: 57% in clinic setting and 51% in hospital setting. Average expenditure in a clinic was higher than in inpatient settings as most patients sought outpatient care with an average expenditure of US$PPP 5.40 in clinic and US$PPP 0.41 in hospital. OOP expenditure by country ranged from US$PPP 12 in China to US$PPP 0.24 in Mali with most countries spending on average US$PPP 6 as shown in the figure below.

Figure 5.1 - Average OOP US$PPP



5.4.2 MULTINOMIAL LOGIT MODEL

The coefficients of the multinomial logit regression are presented below. Each of the columns presents the coefficients for patients who reported being ill relative to not being sick which is the base outcome. While the actual coefficients are difficult interpret, the sign of the coefficient indicates its effect (positive or negative) on seeking care in a hospital, a clinic or choosing to do nothing when sick. Full results of all regressions are shown in Appendix C.

Table 5.6 - Multinomial regression results

Regressor	Hospital	Clinic	Do nothing
Age	-		
	0.0296***	-0.0213***	-0.0304***
Age^2	0.000171*	0.000111***	0.000202**
Sex	0.281***	0.392***	0.194***

Marital status	0.349***	0.321***	0.157***
Self reported health	-0.633***	-0.461***	-0.670***
Chronic condition	0.596***	0.453***	0.159***
Education	-0.101	0.0819***	-0.198***
Employed	-0.120*	0.0112	-0.00659
Urban setting	0.189***	0.153***	-0.204***
Health insurance	0.658***	0.401***	-0.222*
Household size	-0.0179	-0.0132***	0.000331
Log house expenditure	0.0423	0.106***	-0.0630*
Log predicted expenditure	0.0633	0.371***	1.306***
Immunisation	-0.310	-0.261	-2.239***
Antenatal	0.268	0.441***	-1.538***
Family planning	0.342	0.153	-0.862**
Childbirth	1.420***	-1.945***	-1.721***
Dental care	-0.965***	0.680***	-0.0805
Arthritis	0.246	0.130**	0.413***
Asthma	1.173***	0.219**	0.00351
Heart disease	0.946***	0.0707	-0.364**
Bodily injury	0.855***	-0.172***	-0.761***
Minor surgery	0.902***	-1.302***	-1.724***
Other reason	0.370***	0.0680**	-0.171***
Bangladesh	1.243***	2.509***	1.324***
Bosnia and Herzegovina	0.168	0.522***	-2.479**
China	-0.162	-0.0887	-2.184***
Côte d'Ivoire	0.749***	0.636***	-0.382
Congo	1.742***	0.562***	0.272
Comoros	1.182**	-0.183	-1.495***
Dominican	1.284***	1.057***	-1.233***

Republic			
Ecuador	0.263	0.0136	-1.890***
Ethiopia	-0.556	0.679***	1.335***
Georgia	-1.256***	-1.278***	-1.534***
Ghana	1.069***	0.839***	0.703**
Guatemala	0.195	0.621***	-2.924***
India	0.482	0.937***	-1.662***
Kazakhstan	0.257	0.407***	-0.611
Kenya	-0.273	-0.255*	1.396***
Laos	1.240***	-0.726***	-1.168***
Sri Lanka	2.279***	1.465***	-1.727***
Morocco	0.267	0.258**	1.803***
Mali	-1.128*	0.0111	-1.156**
Myanmar	0.0493	0.722***	0.0611
Mauritania	0.272	0.620***	-0.382
Malawi	1.323***	1.489***	1.798***
Namibia	1.825***	0.973***	-0.974***
Nepal	-0.295	0.590***	1.128***
Pakistan	0.795**	1.464***	-1.099***
Philippines	0.225	-0.456***	-1.010***
Paraguay	0.0288	1.193***	2.466***
Russia	1.064***	0.265*	0.995**
Senegal	1.070***	0.458***	-0.0398
Chad	0.0255	-0.127	0.512**
Tunisia	-0.956**	-0.0155	-2.056***
Ukraine	0.620**	-0.285**	-0.720**
Vietnam	0.918***	0.339***	-1.554***
Zambia	1.906***	1.313***	0.822***
Constant	-3.082***	-0.860***	-1.160***
N	42,668		
Pseudo R^2	0.1155		
Chi-sq.	9499.3***		
Log likelihood	-36387.1		

Note: *** p<0.01, ** p<0.05, * p<0.1

All results are presented relative to not being sick. The results suggest those in urban settings and those with health insurance are more likely to seek care at a hospital or clinic. These findings suggest that the poor will have access problems relative to those who can afford insurance. The results also indicate that women, adults who are married, adults with a chronic condition are more likely to seek care. Adults with good self-reported health are less likely to need care.

Those more educated are more likely to go to a clinic and less likely to do nothing when unwell. For household expenditures, the sign was positive for clinic and negative for those who chose to do nothing. The age variable was negative for all choices and close to 0 while the age-squared term was 0. These results do not give a clear pattern of the importance of age and appear to be specific to the sample. The predicted expenditure variable was significant for those who choose a clinic and those who choose to do nothing. These results are not easily interpretable but the elasticity results presented below give a clearer indication of the importance of this variable.

The dummies that capture the reason for visit had a mix of significance depending on the outcome chosen. All dummies are compared relative to the base dummy which captures those who have high fever, cough or severe diarrhoea. Reasons for visit to the hospital include child birth, asthma, heart disease, bodily injury, minor surgery and other reasons not specified. Individuals are more likely to go to a clinic for antenatal care, dental care, arthritis, and asthma, while only patients with arthritis are more likely to do nothing when unwell.

The country dummies may partly reflect the regulatory environment. Burkina Faso is used as the reference base and was assigned arbitrarily in the STATA algorithm. It should be noted that any country could be used as the reference base. These results should be interpreted with caution as the dummies provide a simple macro effect of each country. In relation to Burkina Faso, the majority of dummy coefficients indicate that regulation has a positive effect on seeking care in a

hospital or clinic setting or both. A few countries such as Kenya, Mali, Philippines, and Tunisia regulation had a negative effect on seeking care.

Since the regression coefficients from the multinomial logit output are not easily interpretable, calculation of marginal effects gives a better understanding of the importance of the regressors. These were estimated using post estimation techniques. These coefficients indicate their marginal impact on the probability of the outcome chosen. For example, in the hospital column, the marginal effect of marital status increases the probability of choosing a hospital visit by 0.00373.

Table 5.7 - Marginal effects from multinomial model

Regressor	Hospital	Clinic	Do nothing
Age	-0.000386*	-0.00427***	-0.000522**
Age^2	2.39e-06	2.13e-05**	4.02e-06*
Sex	0.00112	0.0887***	-0.00130
Marital status	0.00373**	0.0716***	-0.00113
Self reported health	-0.00825***	-0.0907***	-0.0118***
Chronic condition	0.00799***	0.0978***	-0.00387**
Education	-0.00342**	0.0251***	-0.00750***
Employed	-0.00304*	0.00454	-0.000308
Urban setting	0.00253	0.0384***	-0.00894***
Health insurance	0.0113***	0.0887***	-0.0129***
Household size	-0.000243	-0.00298**	0.000260
Log house expenditure	-0.000424	0.0266***	-0.00386***
Log predicted expenditure	-0.00467	0.0666**	0.0332***
Immunisation	-0.00296	-0.0436	-0.0277***
Antenatal	0.000194	0.113***	-0.0271***
Family planning	0.00724	0.0418	-0.0194***
Childbirth	0.150***	-0.430***	-0.0215***

Dental care	-0.0202***	0.165***	-0.0128***
Arthritis	0.00392	0.0193	0.0115***
Asthma	0.0411***	0.0246	-0.00502
Heart disease	0.0335***	0.00200	-0.0112***
Bodily injury	0.0357***	-0.0504***	-0.0162***
Minor surgery	0.0752***	-0.310***	-0.0225***
Other reason	0.00825***	0.0144**	-0.00665***
Bangladesh	-0.0129***	0.376***	-0.0153***
Bosnia and Herzegovina	-0.00325	0.134***	-0.0304***
China	-0.00182	-0.00219	-0.0290***
Côte d'Ivoire	0.00952	0.137***	-0.0176***
Congo	0.0650***	0.0736**	-0.00488
Comoros	0.0606*	-0.0625	-0.0241***
Dominican Republic	0.0174	0.211***	-0.0290***
Ecuador	0.00774	0.0151	-0.0276***
Ethiopia	-0.0161***	0.120***	0.0415**
Georgia	-0.0117**	-0.280***	-0.0192***
Ghana	0.0145	0.153***	0.00344
Guatemala	-0.00403	0.157***	-0.0347***
India	-0.00297	0.213***	-0.0327***
Kazakhstan	0.000336	0.100***	-0.0188***
Kenya	-0.00510	-0.110***	0.0994***
Laos	0.0880***	-0.199***	-0.0184***
Sri Lanka	0.0514***	0.241***	-0.0332***
Morocco	-0.000407	-0.0142	0.108***
Mali	-0.0165***	0.0255	-0.0215***
Myanmar	-0.00853*	0.162***	-0.0107*
Mauritania	-0.00285	0.143***	-0.0172***
Malawi	0.00484	0.232***	0.0283**
Namibia	0.0490***	0.170***	-0.0264***
Nepal	-0.0130***	0.111***	0.0312**

Pakistan	-0.00537	0.289***	-0.0307***
Philippines	0.0147	-0.105***	-0.0173***
Paraguay	-0.0154***	0.155***	0.101***
Russia	0.0310*	0.0141	0.0352
Senegal	0.0272*	0.0847***	-0.00952
Chad	0.00185	-0.0435	0.0235**
Tunisia	-0.0150***	0.0232	-0.0294***
Ukraine	0.0279*	-0.0734**	-0.0139**
Vietnam	0.0246**	0.0750***	-0.0270***
Zambia	0.0354**	0.211***	-0.00499

Note: *** p<0.01, ** p<0.05, * p<0.1

These results suggest that those with health insurance are more likely to seek care at a hospital or clinic and less likely to do nothing. Again this result highlights that income and having insurance are important determinants, which implies that the poor will have access problems.

Married individuals and adults with a chronic condition are more likely to seek care at a hospital or clinic. Those with a chronic condition are less likely to do nothing when unwell. Women are more likely to seek care in a clinic. Those in urban settings are likely to seek care in a clinic and less likely to do nothing. Adults with good self- reported health are less likely to need care. The more educated are likely to seek care at a clinic rather than doing nothing when unwell. Both the educated and employed are less likely to seek care at a hospital.

Households with fewer family members are less likely to seek care at a clinic while households with large monthly expenditures are more likely to seek care at a clinic and less likely to do nothing when unwell. The age variable was negative for all choices relative to not being sick while the age-squared term had a mix of significance. Again, these results do not give a clear pattern of the importance of age and may be specific to the sample, but suggest that age is not a driving factor relative to the other regressors when seeking care.

The reason for visit dummies are computed relative to those who have fever, cough or severe diarrhoea. Those more likely to choose a hospital go for reasons related to child birth, asthma, heart disease, bodily injury, minor surgery or other reason not specified. These responses seem intuitive and seem to capture the main types of services that hospitals provide to those with more serious health problems. Those visiting a clinic are more likely to go for antenatal or dental care reasons.

The marginal effects of the regulation dummies indicate that overall, regulation had a positive effect on seeking care and had negative effect on doing nothing. Again, these results should be interpreted with caution and are relative to Burkina Faso as the base case. This does not imply however, that regulation had a positive effect on seeking care simultaneously for the countries concerned. For example, Namibia, Sri Lanka, and Vietnam dummies suggest that regulation has a positive effect on seeking care in a hospital or clinic and a negative effect on doing nothing. The results suggest that typically most countries have a positive effect on seeking care in a clinic (21 out of 35) while only 10 have a positive effect on seeking care in a hospital as shown below. The marginal effects for the clinic results are overall greater in magnitude than the marginal effects for the hospital results.

Table 5.8 - Country regulation dummy marginal effects from MNL model

Clinic	Hospital	No significance or negative in provider settings
Bangladesh, Bosnia and Herzegovina, Côte d'Ivoire, Congo, Dominican Republic, Ethiopia, Ghana, Guatemala, India, Kazakhstan , Sri Lanka, Myanmar, Mauritania,	Congo, Comoros, Laos, Sri Lanka, Namibia, Russia, Senegal, Ukraine, Vietnam, Zambia	China, Ecuador, Georgia, Kenya, Morocco, Mali, Philippines, Chad, Tunisia

Malawi, Namibia, Nepal, Pakistan, Paraguay, Senegal, Vietnam, Zambia

One aspect of regulation which has been systematically surveyed in a subsample of the countries is found in the WHO/HAI survey, which reports that procurement ability varies as shown in the table below. Using this descriptive information, countries that are inefficient procurers had mixed results on the decision to seek care. Some had positive effects: Kazakhstan, Pakistan, Senegal, Ukraine, and Vietnam, while others had negative effects: Chad, Mali, Morocco. For example, in the Ukraine and Vietnam, private sector prices tend be less than the public sector. The regression results, however, indicate that both countries had a positive effect on the probability of seeking care in the hospital. Others who procure efficiently found patients were less likely to seek care such as in Kenya and Tunisia. Branded drugs are not sold in the public sector in some countries which may in part explain the positive dummy effect found for India and Ethiopia. Mark ups that are known for some of these countries are not significantly higher than the average (WHO/HAI 2006). These findings, however, make it difficult to properly assess the possible within country effects.

Table 5.9 - Summary of procurement efficiency

Efficient	Not efficient
Burkina Faso, Ethiopia, Ghana, India, Kenya, Tunisia	Chad, Ecuador, Kazakhstan, Mali, Morocco, Pakistan, Philippines[26], Senegal, Ukraine, Vietnam

Due to lack of data on volume of health care services consumed, elasticities were not calculated in the usual fashion but calculated using post estimation techniques. The elasticity of the predicted expenditure variable was calculated. This variable had mixed significance in the multinomial regressions. The elasticity here is defined as the percentage change in the predicted probability of whether choosing

[26] More inefficient for generics than for branded drugs

to seek care at a provider as a result of a 1% increase in the expenditure of the same provider evaluated at the sample means. The result for hospital is -0.19 and 0.11 for clinic. This implies that a 1% increase in expenditure at the hospital will reduce the probability of seeking care by 0.19%.

The elasticity results are mixed. The sign of the hospital elasticity is negative which suggests a downward sloping demand curve but this result is not significant. The result for clinic is not negative but the result is significant at the 5% level. The clinic result is counterintuitive and may be the result of model misspecification.

Table 5.10 - Elasticity results from multinomial model

Regressor	Hospital	Clinic
Log predicted expenditure	-0.19071 (p-value 0.482)	0.11687** (p-value 0.015)

Note: ** p<0.05

The MNL model is a restrictive functional form of demand because the model assumes that the error terms are independent (IID property) and that the ratio of probabilities is independent of other choices (IIA property). The odds ratio of choosing say provider x over provider y is independent of the characteristics of any other alternative provider (Sepheri and Chernomas, 2001). Under this assumption, if user fees were increased by one provider, this would affect demand proportionately for all other alternate providers. There may, however, be unobserved influences that may affect the choice outcome that is different across the alternatives (Hensher DA, Rose JM et al. 2005).

To test whether these properties are violated, a Hausman test is recommended to determine whether the multinomial logit is correctly specified. The standard Hausman test has limitations because the test for the estimator assumes the variance matrix V(b-B) as V(b) – V(B) is a feasible estimator only asymptotically (STATA, 2007). The standard Hausman test was carried out on the multinomial

model and was undefined which is a common result with the standard Hausman test.

To address this problem, a generalised Hausman test is recommended. This test was carried out using the suest command and the output is shown in Appendix C. The results indicate that the null hypothesis that the IIA property holds is rejected with a Chi-square of 4582.83. This result suggests that a nested model approach is recommended.

5.4.3 NESTED LOGIT MODEL

The nested logit model allows the variances to be different across the alternatives. The model also assumes that the ratio of the probabilities of choosing one alternative over the other may not be exactly independent. This implies that some correlation may exist across subsets of alternatives. Therefore the two assumptions (IID and IIA) are relaxed in the nested logit model.

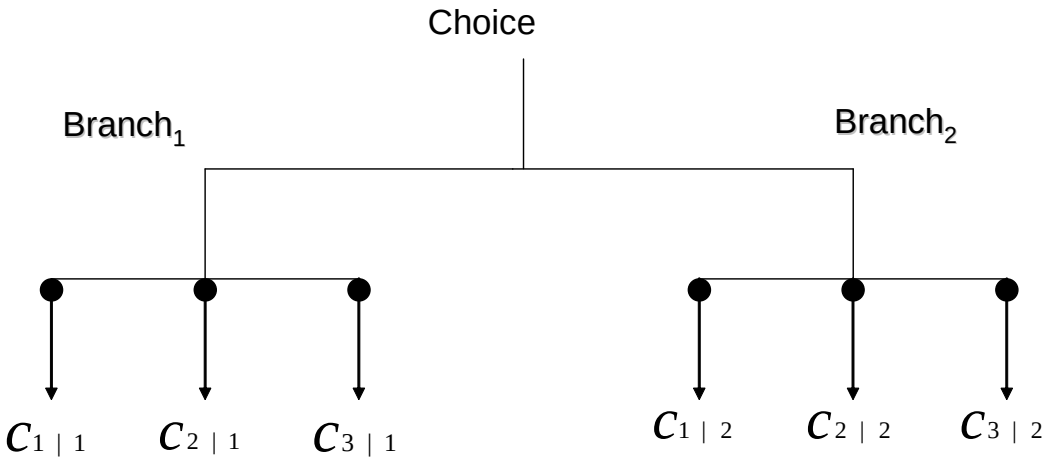
The nested logit model does not make any assumptions about the way in which alternatives are assessed in making a choice; that is, it does not define a decision process that links behavioural choices (Hensher et al. 2005).

As a choice model, the nested model must also adhere to the rule of utility maximisation. Supposes that the *J* alternatives can be divided into *B* subgroups (branches) such that

$$[c_1,...,c_j] = [(c_{1|1},...,c_{J_1|1}),(c_{1|2},...,c_{J_2|2})...,(c_{1|B},...,c_{J_B|B})] \quad (5\text{-}12)$$

The choice structure may involve say B choice sets and then a specific choice within the chosen set. The nested model is simply a set of linked MNL models. The decision tree which helps in the development of applying the nested model, consists of conditional choices and marginal choices. The diagram of a tree structure which for two branches and six choices (twigs) could be shown is as follows:

Figure 5.2 Decision Tree in a Nested Logit Model



The choices modelled in this example involve the individual choosing between $c_{1|1}$ to $c_{3|2}$. These are referred to as the elemental alternatives. These choices are conditional on the individual either choosing $Branch_1$ or $Branch_2$ which are also referred to as composite alternatives. The calculation of the nested model estimates the conditional choices, which refer to the various alternatives at the bottom level of the tree ($c_{1|1},\ldots,c_{3|2}$). The marginal choices are reflected at the very top level of the tree even though they are the last choice modelled ($Branch_1$ or $Branch_2$).

The relaxation of the two assumptions allows for some correlation to exist across subsets of alternatives. For example, there may be an unobserved influence A that affects two elemental alternatives (say $c_{1|1}$ and $c_{1|2}$) which implies that the error term for these two alternatives are likely to be correlated to a certain degree because of the effect of A. These two elemental alternatives may have similar variance or even identical. This implies that A will have a unique effect specific to $c_{1|1}$ and a unique effect specific to $c_{1|2}$ and a common component that affects both. This common component engenders the correlation (Hensher et al. 2005).

Let $x_{ij|b}$ be the attributes of the choices and let z_{ib} be the attributes of the choice sets. The mathematical form of the model can be written as

$$P_{ijb} = P_{ij|b}P_b = \left(\frac{\exp(x'_{ij|b}\,\beta)}{\sum_{j=1}^{J_b}\exp(x'_{ij|b}\,\beta)} \right) * \left(\frac{\exp(z'_{ib}\,\gamma)}{\sum_{l=1}^{L}\exp(z'_{ib}\,\gamma)} \right) * \frac{\left(\sum_{j=1}^{J_b}\exp(x'_{ij|b}\,\beta)\right)\left(\sum_{l=1}^{L}\exp(z'_{ib}\,\gamma)\right)}{\left(\sum_{l=1}^{L}\sum_{j=1}^{J_l}\exp(x'_{ij|b}\,\beta + z'_{ib}\,\gamma)\right)}$$

The model assumes that the attributes of the elemental alternatives that are linked to a composite alternative influence the choice between the composite alternatives. This information is included in the utility expressions of each composite alternative through an index of *expected maximum utility (EMU)*. This term is most commonly referred to as the *inclusive value (IV)*.

This is shown as for the *l*th branch as

$$IV_{ib} = \ln\left(\sum_{j=1}^{Jb}\exp(x'_{ij|b}\,\beta) \right) \qquad (5\text{-}13)$$

which is the natural logarithm of the denominator of the MNL model associated with the elemental alternatives.

The probabilities can be rewritten as

$$P_{ij|b} = \frac{\exp(x'_{ij|b}\,\beta)}{\sum_{j=1}^{J_b}\exp(x'_{ij|b}\,\beta)} \text{ and } P_b = \frac{\exp[\tau_b(z'_{ib}\,\gamma + IV_{ib})]}{\sum_{b=1}^{B}\exp[\tau_b(z'_{ib}\,\gamma + IV_{ib})]}$$

Here Greene (2008) uses τ to refer to the scale parameter squared. The IV coefficients allow the model to incorporate some degree of heteroscedasticity. Where τ =1, the model reverts to a MNL. The scale parameter is further discussed below.

The variance of the unobserved effects in the nested logit model needs to be formally defined and is referred to as the scale parameter or λ shown below.

$$\sigma^2 = \frac{\pi^2}{6\lambda^2}$$

This parameter squared explains the profile of the variance of the unobserved effects (Hensher et al. 2005). In the MNL, all variances are set to 1 which means that the scale parameter is 1.283.[27]

The ratio of the scale parameter between the top and bottom level of the tree is also the IV parameter at the top level of the tree. This ratio must lie between 0 and 1 to satisfy utility maximisation rules. This is because the variance at the top level of the tree incorporates the sources of variation from the bottom level of the tree. This implies that the variance at the top level of the tree will be greater than the variance at the bottom level. Since the scale parameter is inversely proportional to the variance, the scale parameter at the top level will be less than the scale parameter at the bottom level. Hence the ratio of the scale parameter will have to be less than 1. If the ratio is greater than 1, the model violates utility maximisation rules. When the ratio equals 0, the choice models are completely independent and called the degenerate outcome. When the ratio equals 1, this reverts to a MNL.

In the application of the nested model to health care utilisation, there may be factors that could make the choices not strictly independent of one another. Factors such as distance to health facility may affect the patient's choice or the OOP costs may be significantly higher at one facility relative to another and may affect the patient's decision to seek care. The relaxation of this assumption allows for the ratio of the choice probabilities not to be strictly independent of one another.

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[27] The scale parameter is $\lambda = \sqrt{\frac{\pi^2}{6\sigma^2}}$ where $\sigma^2 = 1$

The nested logit model has not been frequently applied in the context of health care utilisation. This, in part, may be due to the complicated nature of defining a tree structure that meets the required assumptions of estimating a nested logit model.

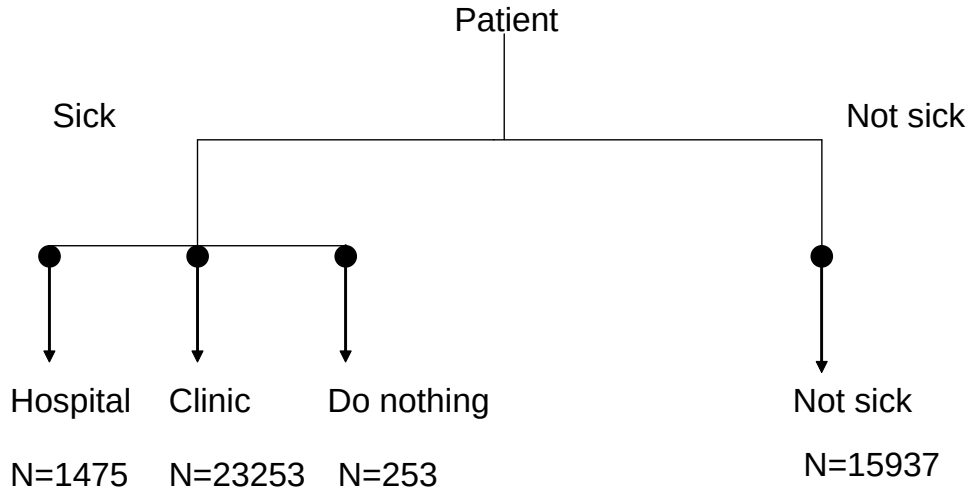
In this chapter, the dataset used for the multinomial logit model was used to develop a nested logit model. The nested model was set up as follows to account for the choices a patient faces when deciding to see a provider. The computer code used for this analysis is found in Appendix C.

In the first level of the tree, the patient is either sick or not sick. Those who are sick have a choice to seek care, either at a hospital or a clinic or do nothing. Those who are not sick remain not sick for the entire modelling exercise. A total of 42,668 observations were used. Approximately 63% of individuals reported being sick in the past year. Out of the total sample, about 58% sought care, with the majority visiting a clinic. A little over a third reported not being sick in the past year. The sample of observations in each of the k categories is shown in the table below. For estimation purposes, the model creates duplicate observations that are equivalent to the number of possible choices. In this model, four outcomes are possible for each individual. STATA creates 42,668 * 4 observations for each individual for estimations purposes, which results in a sample size of 170,672 observations.

Table 5.11 - Sample size of choice categories

Choices	N	k	%
Branch 1 - Sick			
Hospital	42,668	1,477	3.46
Clinic	42,668	23,196	54.36
Do Nothing	42,668	2,106	4.94
Branch 2 -Not sick			
Not sick	42,668	15,889	37.24
Total	170,672	42,668	100

Figure 5.3 - Nested Tree Structure



The variables were regressed as done in the multinomial logit. The nested logit calculation computes coefficients for variables that are common across all alternatives relative to the base case of not being sick because these values do not vary among the elemental alternatives. These variables were age, age squared, sex, marital status, self reported health, chronic condition, education, employed, urban setting, health insurance, household size, log household expenditure. The predicted OOP expenditure was computed separately for hospitals and clinics relative to the base case of do nothing. The coefficient results are presented in Appendix C.

The results indicate that the IIA property is violated and the likelihood ratio test rejects the null that the model is IIA , which follows from the error terms being IID. The test shows that Chi-sq of 149.88 is significant and the null is rejected with a P-value of 0.0000. A drawback of this test, however, is that it is specific to the tree structure which implies that different specifications could give different results. The parameter which measures independence between choices is 0.459299, is the ratio of the scale parameter and satisfies utility maximisation rule. This parameter should lie between 0 and 1. The nested logit results appear to be fairly consistent with the multinomial results and are shown below.

Table 5.12 - Nested logit results

Regressor	Coefficient
Age	-0.0307***
Age^2	0.000200***
Sex	0.359***
Marital status	0.323***
Self reported health	-0.511***
Chronic condition	0.434***
Education	0.0475*
Employed	0.00478
Urban setting	0.161***
Health insurance	0.386***
Household size	-0.0133***
Log house expenditure	0.0526***
Log predicted expenditure hospital	0.0768***
Log predicted expenditure clinic	1.186***
Bangladesh	1.756***
Bosnia and Herzegovina	0.284**
China	0.188
Côte d'Ivoire	0.374***
Congo	0.670***
Comoros	0.0979
Dominican	0.396***

Republic	
Ecuador	0.111
Ethiopia	0.118
Georgia	-1.171***
Ghana	0.221**
Guatemala	0.593***
India	0.931***
Kazakhstan	-0.222**
Kenya	-0.529***
Laos	-0.563***
Sri Lanka	1.287***
Morocco	-0.0905
Mali	-0.669***
Myanmar	0.00879
Mauritania	0.375***
Malawi	0.866***
Namibia	0.765***
Nepal	0.00926
Pakistan	1.504***
Philippines	-0.359***
Paraguay	0.718***
Russia	-0.228*
Senegal	0.0526
Chad	-0.289***
Tunisia	0.0985
Ukraine	-0.0911
Vietnam	0.0912
Zambia	0.667***
Immunisation	-0.401**
Antenatal	0.298***
Family planning	0.0954
Childbirth	-1.249***
Dental care	0.577***

Arthritis	0.163***
Asthma	0.253***
Heart disease	0.0886
Bodily injury	-0.172***
Minor surgery	-1.064***
Other reason	0.0513*
Constant	
N	170,672
Chi-sq.	17487***
Log likelihood	-46271
Ratio scale parameter	0.459***
LR test IIA	149.88***

Note: *** p<0.01, ** p<0.05, * p<0.1

Those more likely to seek care include those who have insurance and households with high expenditures. Household expenditure is a useful proxy for income in developing country settings. These findings indicate that the poor will have access problems relative to the wealthy. Other important determinants include women, being married, having a chronic condition present, the educated, and those who live in urban settings. Those with good health and small households are less likely to seek care. Those more likely to seek care include reasons related to antenatal, dental care, arthritis, asthma, bodily injury, minor surgery and other reason not specified.

The country level regulation dummies produced mixed results. As mentioned previously, dummy effects should be interpreted with caution. About half of the dummies have a positive effect on seeking care relative to doing nothing (15 out of 35) whereas 8 country dummies have a negative effect as shown below. Fewer countries had positive significance in the nested model compared with the MNL model. These include Comoros, Ethiopia, Laos, Myanmar, Russia, Senegal, Ukraine, Vietnam, and Kazakhstan. Negative or not significant country dummies

in the MNL model were consistent with the results in the nested model. The dummy coefficients are also greater in magnitude than those found with the MNL model.

The results of the country dummies were more in line with the WHO/HAI descriptive survey findings related to procurement efficiency. India and Ghana which are efficient procurers had a positive effect on the decision to seek care. Pakistan, however, which is relatively inefficient, had a positive effect while all other inefficient procurers either had a negative effect or were not significant.

Table 5.13 - Country regulation dummy effects from nested model

Positive	Negative	Not significant
Bangladesh, Bosnia and Herzegovina, Côte d'Ivoire, Congo, Dominican Republic, Ghana, Guatemala, India, Mauritania, Malawi, Namibia, Pakistan, Paraguay, Sri Lanka, Zambia	Georgia, Kazakhstan, Kenya, Laos, Mali, Philippines, Russia, Chad	China, Comoros, Ecuador, Ethiopia, Morocco, Myanmar, Nepal, Senegal, Tunisia, Ukraine, Vietnam

Variations of the model were run to include the perceived level of quality of services received and the time allotted for travel to the facility and produced similar results. These results are shown in Appendix C.

Measuring price responsiveness was carried out using a post estimation technique (Greene, 2008). Elasticities and marginal effects were calculated for patients that sought care at a hospital or clinic setting. STATA does not have a written post estimation command to generate these calculations. This code was written to carry out these calculations. Please see Appendix C for details on the calculations.

In a discrete choice model, the price elasticity is defined as the percentage change in the predicted probability of seeking care from a health care provider *j* as a

result of a 1% increase in the average expenditure of the same provider *j* evaluated at the sample means (Asfaw et al. 2004).

Price elasticity and marginal effects were calculated for the hospital and clinic setting. The results are shown in the table below.

Table 5.14 – Price elasticity and Marginal Effect Results from Nested Model

Provider	Hospital	Clinic
Price elasticity	.0360931	.6388549
Marginal effect	.0190891	.2948294

The results indicate the patient's expenditure in a hospital or clinic setting is inelastic. These results are not negative but are not significant. The marginal effect of seeking care in a clinic is larger than in a hospital setting based on the predicted probabilities of seeking care.

The hospital result (0.03) is fairly close to zero and falls in line with results in the literature whereas the clinic result (0.63) is counterintuitive. One possible explanation is model misspecification. Another reason could be that other factors matter more in explaining health seeking behaviour to a clinic such as informational and cultural factors which are not captured in the model.

These estimates indicate the percentage change in the predicted probability of seeking care from a health care provider *j* as a result of a 1% increase in the average expenditure of the same provider *j* evaluated at the sample means is inelastic. This indicates that patient's demand for health care is generally inelastic. For example a 1% increase in hospital expenditure results in a 0.03% change in the probability of seeking care.

In summary the price elasticity results computed thus far are shown in the table below.

Table 5.15 – Summary of elasticity results

Model	Key Assumptions	Sample	Description	Elasticity
MNL	IIA and IID hold	Cross country (Chapter 5)	Patient expenditure	-0.19 (hospital) 0.11** (clinic)
Nested	IIA and IID do not hold within nests. IIA and IID hold across nests	Cross country (Chapter 5)	Patient expenditure	0.03 (hospital) 0.63 (clinic)

Note: *** p<0.01, ** p<0.05, * p<0.1

5.4.4 LIMITATIONS

While the modelling approaches aimed to properly adjust for the data used in the analysis, the limitations with the analytical approach used in this chapter should be highlighted.

The estimation of price elasticities was based on health expenditure information. This information was limited in the survey to include information only on one episode and in one health setting which was either in a clinic or in a hospital. An important estimation issue between utilisation and health expenditure is the direction of causality. That is, an important distinction is whether utilisation explains high levels of utilisation or, conversely, whether high expenditures explain utilisation levels. The endogenous relationship between these two variables requires some method to correct for the bias in the estimated coefficients. The method used in this chapter was to estimate predicted health expenditure rather than using actual health expenditure. This approach aimed to

purge the disease and socioeconomic effects in the generated price variable. While this technique aims to eliminate some of the potential bias and is a common method used in the literature, not all of the potentially endogeneity could be accounted for. Furthermore, the expenditure information related to only direct health care costs. Indirect costs of seeking care were not collected such as travel, waiting at health care facilities or providing care to family members (McIntyre D et al. 2006). The estimates of predicted health expenditure are therefore lower than the true costs of health care.

While the World Health Survey contains useful information on health systems (Ustun et al. 2003), a study on the reliability and validity of the expenditure variables were mixed (Xu et al. 2009). The authors computed the intra-class coefficient (ICC) index of total household expenditure and household health expenditures. The greater attention to health expenditures has resulted in a higher estimate of health expenditures compared with other household surveys (Living Standards Measurements Surveys, Household Income and Expenditure Surveys, Household Budget Surveys and Socio-Economic Surveys) and a lower estimate in the other household expenditures. The recall period for expenditure information in this survey was one month while the other surveys had various recall periods. While longer recall periods may increase recall bias, it could capture more infrequent spending. The overall effect is not clear. In the case of WHS, while the recall period is one month, the respondent may include spending that took place earlier than the past month which could cause upward bias.

Despite using a large dataset, the analysis is based on one wave of cross-sectional data. The data do not permit a time series analysis, which would shed light on the factors that would affect demand for health care over time or the cumulative effects of illness, access to care and health care spending over time.
This information is important because understanding the dynamic effects between these and other factors (e.g. the loss of income from illness) is particularly important as chronic illness prevalence increases globally (Wagner et al. 2011).

While, the modelling approach assumed additive effects or their equivalent within the logged equation, there could be interactions between certain regressors such as

gender and health problem (e.g. childbirth, antenatal planning). This information could provide more information on health seeking behaviour. There was incomplete information on whether the patient was treated in a public or private setting, or for those treated at home so this information could not be included in the analysis. This information would have provided useful information on health seeking behaviour and how the relative importance of factors varies between provider settings and would have given a more comprehensive picture on health seeking behaviour.

The household survey does not adequately capture those with unmet need including those who needed care but did not avail themselves of services and those who sought care but did not find their needs were properly met. Information on their circumstances and the factors that affected this sub-sample of patients would provide useful information on those who chose not to present themselves to the health care system, which is of important policy relevance in these settings where traditional medicine practices are widely followed.

Information on traditional medicine practices and their relationship with the uptake of western medicines would have provided a more nuanced discussion on medicine consumption in these settings. For instance, it would have been useful to have information on whether western medicines are viewed more as complements than substitutes, and whether that varies depending on the patient's health condition, socioeconomic circumstances, etc. The data are also not able to adequately capture information on adherence which would give a more complete picture on access. The data do not collect information on all members of the household and thus may misclassify households with respect to need and access (Wagner et al. 2011).

While household surveys provide important information for analysis from the patient's perspective, data on supply side information is limited for analysis. More information on supply/provider information would better control the supply factors on demand for medicines. At a disaggregated level, these could include density measures of health professionals, and number of hospital beds, number of health facilities per capita, or number of traditional healers per capita.

Finally, while the importance of the regulatory environment is tested using dummies, this approach is limited as it cannot account for country differences in greater detail such as procurement efficiency. This could potentially mask important information within and across countries. Furthermore, non-governmental actors play an important role in procurement in these settings which are not explicitly accounted for in the model and could confound the findings. There could be differences for diseases areas or due to differences in private sector providers or international organisations which could affect the price elasticity of demand. The role of the regulatory environment in these settings would have to be supplemented with more qualitative information so clearer links could be made with the quantitative findings and the policy setting environment.

5.5 DISCUSSION AND CONCLUSION

This chapter aimed to identify determinants of access to medicines and health care at the patient level and to estimate price responsiveness. The dataset covers a large cross section of countries and includes urban and rural settings. The large household survey dataset allowed for more robust estimates to contribute to the evidence base, which is typically drawn from smaller sample sizes and selected rural or urban regions. The additional feature of the data set was that it included information on medicine costs because current empirical work is limited with this data. The empirical methods also corrected for endogeneity between the cost of the care and the decision to seek care.

The findings indicate that certain variables affect the decision to seek care and these include gender, marital status, health status, insurance, urban settings, being education, employment, and households with large monthly expenditures. These findings are consistent with the literature and suggest that the poor will have access problems relative to those who can afford insurance. This is consistent with the survey findings which indicates that among the 7% that could not get care, 46% reported they could not afford it. Furthermore, among those patients that

received a prescription, 13% were not able to get all the medicines required and about half of them could not afford it.

Medicines costs accounted for the largest share of OOP costs for the patient, which suggests that the price elasticities also capture information on medicine costs. The results suggest that the predicted probability of seeking care from a health care provider *j* as a result of a 1% increase in the average expenditure of the same provider *j* evaluated at the sample means is inelastic. Elasticities were -0.19 (hospital), 0.03 (clinic) under the MNL model and 0.03 (hospital) and 0.63 (clinic) in the nested model. The results for hospital are fairly close to estimates in the literature even though the MNL result was not significant. The clinic results were counterintuitive and could be result of model misspecification or other factors, which were not captured in the modelling approach. While this range includes counterintuitive estimates as well, the empirical analysis in the subsequent chapters builds on this analysis to improve estimation techniques.

The counterintuitive price elasticity estimate suggests that price elasticities could be not strictly negative and inelastic. This could in part be due to model misspecification such as the missing indirect expenditure information or bias in the recall period. Respondents were asked to provide information on their most recent visit which could have occurred within the past year. The potential bias should be low as most of the respondents indicated that their most recent visit occurred within the past month. Other reasons for these counterintuitive results could relate to factors that affect the patient's decision to spend money once they decide to visit a health facility. These could be due to cultural factors relating to the relationship between health professionals and patients (e.g. expression of gratitude), the potential demand for additional fees once the patient is at the facility by the health professional, or perceptions of improved quality of care if the patient pays more money once they are at the facility.

While perceived health status is an important factor, there could be elements of perceived health status that this variable failed to capture in the sense that for a given perceived health status, those with lower incomes (proxy using household expenditures) are less likely to seek care. Direct price and volume information

would have provided a clearer picture on the determinants of health seeking behaviour.

Furthermore, while household expenditures are the common proxy for income in these settings, this variable may not appropriately capture differences in true income between households. This variable will also be biased by the data sample for those with unmet need that were not included in the analysis which could bias this proxy of income variable. Such factors could therefore be masking a clear negative relationship between price and the health visit as is commonly reported in the literature.

Another approach would be to estimate price elasticities for each country and to include interaction effects rather than computing one overall estimate. Since a large number of observations had to be dropped for the regression analysis, the approach taken in this chapter and in this thesis was to draw on larger datasets for analysis as the country samples were quite small and ranged from a few hundred to a couple of thousand observations.

At the household level, expenditure on medicines is a significant proportion of total health expenditure, which indicates that demand for medicines is a necessity. The policy implication is that if OOP are likely for patients, low price setting of medicine prices could have a positive welfare impact on patient access to care.

The findings from both the MNL and nested logit model indicate that regulation has an effect on seeking care. In the MNL model, the results suggest that typically most countries have a positive effect on seeking care in a clinic (21 out of 35) while only 10 have a positive effect on seeking care in a hospital.

Similarly in the nested model, 15 out of the 35 countries indicate a positive effect on seeking care relative to doing nothing whereas 8 country dummies have a negative effect. The remaining 8 country dummies were insignificant. The dummy coefficients are also greater in magnitude than those found with the MNL model.

While the results of the country dummies appeared to be somewhat consistent with the descriptive analysis of country procurement efficiency, the data cannot provide more disaggregate information which could better explain country differences. For instance, there could be differences within countries which are masked with an aggregate country dummy measure.

Another key issue in these settings is that governments are not the only procurers of medicines in low and middle-income settings. For instance, some countries could have very high procurement prices and therefore it would be useful to understand the factors which underpin high procurement prices. Procurement efficiency could be an important predictor in the model but since this information was not available at a more disaggregate measure, the dummy variable could confound the results. While the descriptive information on procurement efficiency provides some contextual information, it cannot capture the private sector actors which are also key procurers in these settings (Russo and McPake 2010). The country dummy results are therefore limited in their interpretation and would have to be supplemented with more in country analysis. The subsequent chapters extend the analysis at the country level. These chapters study the policy context and determinants of access to medicines in outpatient and inpatient care at the patient level using India as a country case study.

6 Chapter 6 A case-study of India and the pharmaceutical policy context in India

6.1 INTRODUCTION

As a precursor to the Indian case study analysis, this chapter presents information on the policy context and regulation in India. This will provide a useful policy backdrop to inform the empirical analysis in Chapters 7 and 8.

The case study on India is due to four main reasons. First, India tends to publicly procure medicines efficiently relative to other low and middle-income countries based on international reference prices (WHO/HAI 2006). This is useful information because efficient procurement should have a positive effect on patient access to medicines.

Second, health financing in India places a disproportionate burden on households: it has one of the highest levels of household expenditure as a share of total health expenditure (72%) among developing and developed countries (Garg CC and Karan AK 2005). High OOP are found to be regressive and so will have negative implications for access.

Third, the empirical findings from the thesis analysis in chapter 5 indicate that dummy for the regulatory environment in India, had a positive effect on the probability of seeing a provider in the nested model and positive effect on seeking care in a clinic in the MNL model.

Fourth, the data set from India comes from a well-developed health survey questionnaire for analysis, which is not always available in developing country

settings.[28] Since the current evidence base is limited, this large dataset allows us to extend the analysis by using a large household survey from India.
This chapter sets out to discuss the main features of the Indian health system and policy environment relevant to this thesis. This discussion is useful as it provides context to the empirical analysis that follows from it. This chapter is organised as follows: section 6.2 presents an overview of the Indian health system and policy context; section 6.3 discusses pharmaceutical regulation; 6.4 provides an overview of the pharmaceutical industry in India which is a major player in medicine production and distribution in India, as well as other developing countries and more recently in high income countries. Section 6.5 provides evidence from the literature on drug utilisation in India and implications for access before moving onto the empirical findings in Chapters 7 and 8.

6.2 INDIAN POLICY CONTEXT

6.2.1 OVERVIEW OF THE INDIAN HEALTH SYSTEM

India gained her independence in 1947. During a time of nation building activities, the government came out with a policy document on health care, found in the Bhore Committee Report (Bhore JR 1946). The Committee focussed on primary health care which was seen as simple curative and preventive care that could be provided in a clinic or home setting. Access to primary care was a basic right and not contingent on ability to pay. Health policy in India paid little attention to the private sector which continued to grow. India adopted its first national health policy in 1983 and it was the first time that the central government recognised that it should work with the private sector (Peters 2002).

Under the Indian constitution, health system delivery is a shared responsibility between the central, state and local governments (Peters 2002). Today, India has

[28] Most health surveys in developing countries do not include health expenditure which separates consumption on medicines separately from other items of health expenditure.

twenty eight states and seven union territories. Delivery is effectively a state responsibility but decentralisation of state authority varies by state. State and local governments account for about 75% of public spending on health, but the size of state budgets vary widely (Peters 2002). India's health care delivery system is divided into four levels of care: rural health centres, district hospitals, tertiary care hospitals and teaching hospitals (Roy Chaudhury, Parameswar et al. 2005).

6.2.2 EXPENDITURE

Total health expenditure in India is 5% of GDP, which is higher than most lower middle income countries such as China, Sri Lanka, Thailand, Indonesia and Pakistan as shown in the table below (Roy K and Howard DH 2007; WHO 2009). Health expenditure per capita, however, is in the middle relative to these countries at $US 30.40.

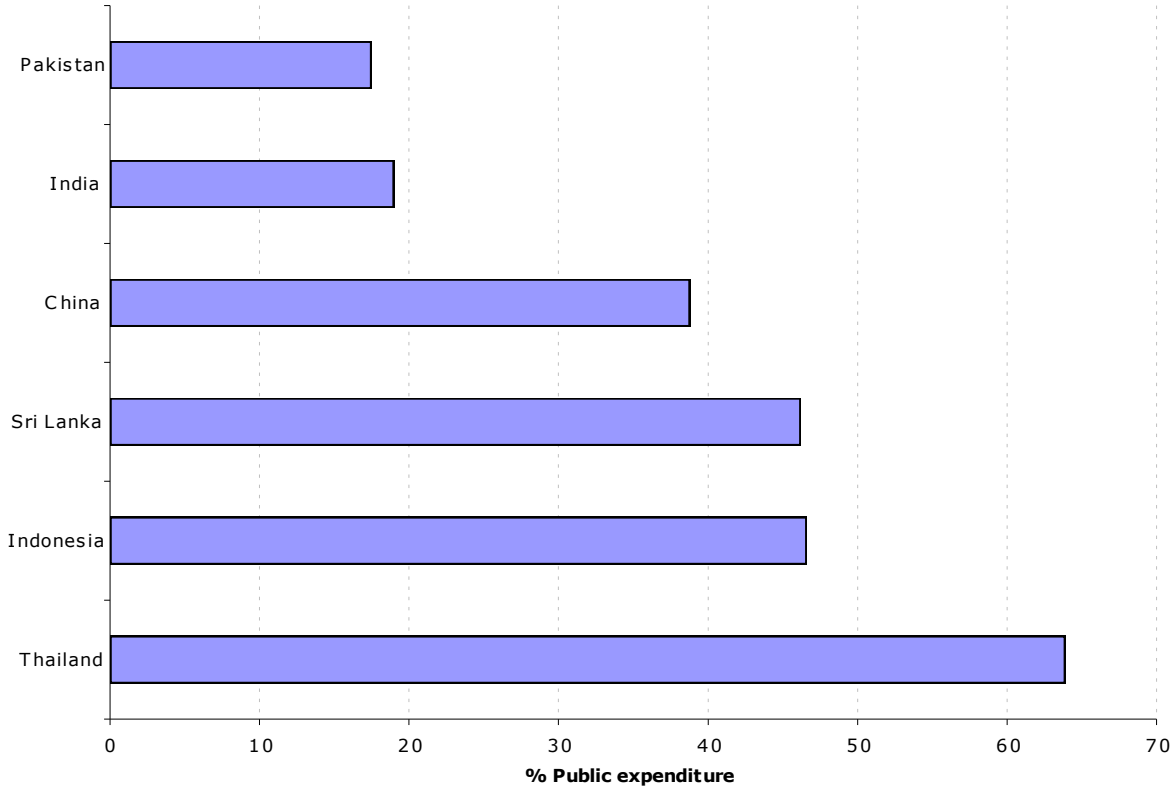
Table 6.1 - Health expenditure as a share of GDP for select countries 2005

	Total health expenditure as % GDP	GDP per capita income ($US)	Total health expenditure per capita ($US)
India	5.0	740.15	30.40
China	4.7	1715.03	76.49
Sri Lanka	4.1	1240.89	50.20
Thailand	3.5	2674.20	94.90
Indonesia	2.1	1304.08	25.4
Pakistan	2.1	703.59	18.46

Source: World Development Indicators (World Bank 2005).Note: Lower middle income economies as defined by the World Bank.(World Bank 2005)

Public spending as a percentage of total health expenditure in India is one of the lowest relative to the same countries as shown in the figure below (close to 20%). Latest figures of public spending in India for 2008 were 1.1% of GDP (WHO 2009).

Figure 6.1 - Share of public expenditure in select countries 2005



Source: World Development Indicators (World Bank 2005)

Furthermore the pattern of expenditure across states varies. According to the WHO National Health Account data, public health expenditure across the larger states, ranges from 42% (58% private expenditure) in Himachal Pradesh to 9% (91% private expenditure) in Kerala (WHO 2005). This does not necessarily imply that health outcomes in Kerala are worse than other states. Kerala has historically had better health indicators relative to most states on infant mortality, birth rate, proportion of institutional birth and life expectancy (NSSO 1998).

Households account for the majority of health expenditure (Garg CC and Karan AK 2005; O'Donnell O 2005). In 2004-05, households accounted for 71% of total health expenditure (3% of GDP), followed by state (12%), central (6.8%), private

insurance (5.7%), external aid (2.3%) (bilateral or multilateral) and social insurance (1.1%) (WHO 2009). Patients finance much of their care and the majority of patient expenditure is on medicines. In rural inpatient settings expenditure on medicines ranges from 38% to 66% followed by doctor fees (26% to 27%). In urban inpatient settings expenditure on medicines ranges from to 62% to 66% in urban settings, followed by costs related to diagnostic tests (12% to 15%) (WHO 2005).

Less than 10% have some form of health insurance (Garg CC and Karan AK 2005; O'Donnell O 2005). This is illustrated by the low level of household expenditure on premiums of 1.5% (US$ 231 million) of total household expenditure (US$ 15 billion) (WHO 2005). Health insurance schemes run by public sector bodies and private companies are in operation but have problems with coverage (Tripathi, Dey et al. 2004).

6.2.3 PROVISION AND UTILISATION

India has public and private provision in health system delivery. In both sectors, the main area of expenditure is on curative services (74%), with the remaining spent on other services (e.g. family planning and maternal care) (Peters 2002). The public system is characterised as being under funded, not large enough to meet the health needs of the country, and poorly managed (Peters 2002).

In the private sector, provision ranges in primary care and secondary care from solo practices and small inpatient facilities to large corporate hospitals and includes ancillary services (e.g. diagnostic centers, ambulance services and pharmacies). The private sector provides western medicine treatment (allopathic), which is the dominant form of provision, as well Complementary and Alternative Medicine (CAM) such as Ayurveda and Unani.[29] Reliable estimates on the

[29] There are six systems of Indian medicine: Ayurvedic, Siddha, Yoga, Unani, Homeopathy, and Nature Cure (AYUSH. (2007). "Department of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy." Retrieved June 2007, from http://indianmedicine.nic.in/.

number of CAM practitioners are not available, however, CAM is believed to be widely practised among patients (Kumar, Bajaj et al. 2006).

The private sector is growing quickly but is undirected and unregulated (Peters 2002). In 1947, the private sector was less than 10% in size; estimates between 1981-1998 suggest it is the dominant source of provision: the majority of doctors (80-85%), hospitals (93%) and the percentage of beds (63%) were found in the private sector (Peters 2002). Data on health care providers indicate that 70% of all funds flow to health care providers in the for profit private sector while 23% was spent on public providers (WHO 2005).[30]

Compared with other low-income countries, the per capita number of health professionals (per 1,000) in India is low which will affect access. Physicians per capita, however, is about average (1.0) whereas the ratios for nurses (0.9), midwives (0.2) and hospital beds (0.7) are below average as shown in the table below. Similarly, the data suggest that inpatient utilisation in the public and private sectors combined is lower than in low-income countries but outpatient is close to the average.[31]

Table 6.2 - Figures on health care work force and health service utilisation, 1990-1998 in India

Country	Physicians	Nurses	Midwives	Hospital Beds		Inpatient	Outpatient
India public sector	0.2	-	0.2	0.4		0.7	0.7
India total	1.0	0.9	0.2	0.7		1.7	3.9
Low income countries	0.7	1.6	0.3	1.5		5	3

Note: Figures for physicians, nurses, midwives, and hospital beds is per 1,000

Note: Inpatient and outpatient figures are on a per capita basis, per year (percent).

Source: (Peters 2002)

[30] Data on NGO providers is incomplete but work is underway to fill this gap (WHO 2005).

[31] It is important to treat these figures with caution because data on outpatient visits and hospitalisations do not necessarily capture disease levels accurately and differences in definitions and data collection methods in countries vary. (Peters, 2002).

6.2.4 INSURANCE

The affluent urban population have employer-based coverage and unconstrained access to needed care whereas those in rural areas and those working in the informal sector depend on tax-based public facilities for free or subsidised care (Roy K and Howard DH 2007). Recent studies suggest that the declining quality and inaccessibility of the public health system combined with the growing private sector have forced the poor to resort to private care (Gwatkin DR 2000b).

Some recent policies have been introduced to address inadequate insurance coverage. The National Rural Health Initiative, launched in 2005 by the health ministry provides an insurance mechanism to rural areas. Goals of the scheme involve outreach delivery of services, integrated access to primary care, reduction in high infant and maternal mortality rates, and coverage of medicine expenditure but the effects are too early to tell (Deolalikar, Jamison et al. 2007).

A national health insurance scheme came into effect on 1 April 2008. The Ministry of Labour implemented this policy with support from the International Labour Organization (ILO). The scheme targets the unorganised sector and families receive Rs. 30,000 on an annual basis. Three quarters is subsidised by the central government and 25% from the state government. The government plans to roll out the programme across the country over a five year period (ILO 2010).

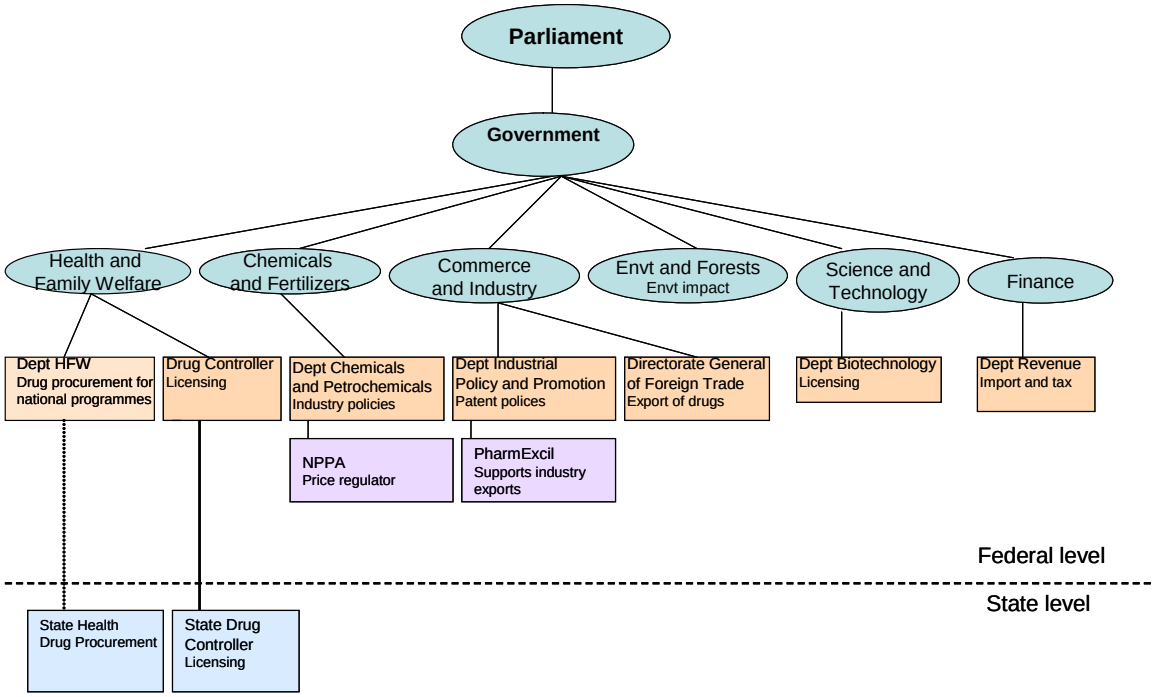
6.3 PHARMACEUTICAL REGULATION

Regulation of pharmaceuticals in India is found in the India Drugs and Cosmetics Act (1940). There are many actors in the pharmaceutical system. The main authorities involved at the central level are the Ministry of Health and Family Welfare (MOHFW), the Ministry of Chemicals and Fertilizers, the Ministry of Finance and the Ministry of Commerce and Industry. Other ministries include the Ministry of Environment and Forests, and Ministry of Science and Technology. The main areas of regulation are shown in the table below and figure below.

Table 6.3 - Key areas of pharmaceutical regulation

Area	Authority responsible
Financing of pharmaceuticals and procurement in public facilities	• MOHFW national programmes • State health authorities
Pricing Policy	
Price controls Customs duty and taxes	• NPPA (Ministry of Chemicals and Fertilizers) • Department of Revenue (Ministry of Finance)
Licensing and quality control	
Market authorisation	• Central Drug Controller (MOHFW) • Department of Biotechnology (Ministry of Science and Technology) • Department of Environment (Ministry of Environment and Forests)
License to manufacture approved drugs and quality control	• State Drug Controller
Industrial policy	
Patent regulation	• Department of Industrial Policy and Promotion (Ministry of Commerce and Industry)
Drug Export	• Directorate General of Foreign Trade (Ministry of Commerce and Industry)
Government support to the industry	• Ministry of Chemicals and Fertilizers • Ministry of Commerce and Industry

Figure 6.2 - Pharmaceutical regulatory framework



Note: At the state level drug procurement and licensing is carried out. State level drug controllers license drugs approved by the Central Drug Controller. They issue licenses for manufacture and regulate quality control. Dotted lines are shown to illustrate that the State Health authority is the counterpart body responsible at the state level.

In India, the objectives of the national medicines policy (NMP) were set out in 1986 and revised as the Pharmaceutical Policy of 2002 to take account of changes for when India would become compliant to the agreement on TRIPS in 2005 (Patel, Thawani et al. 2004). A NMP outlines a country's goals and provides a framework for achieving them, setting out roles and responsibilities of the main actors in both public and sectors in pharmaceutical regulation (WHO 2004a). The policy document was prepared by the Department of Chemicals and Petrochemicals which is mainly responsible for industrial policy.

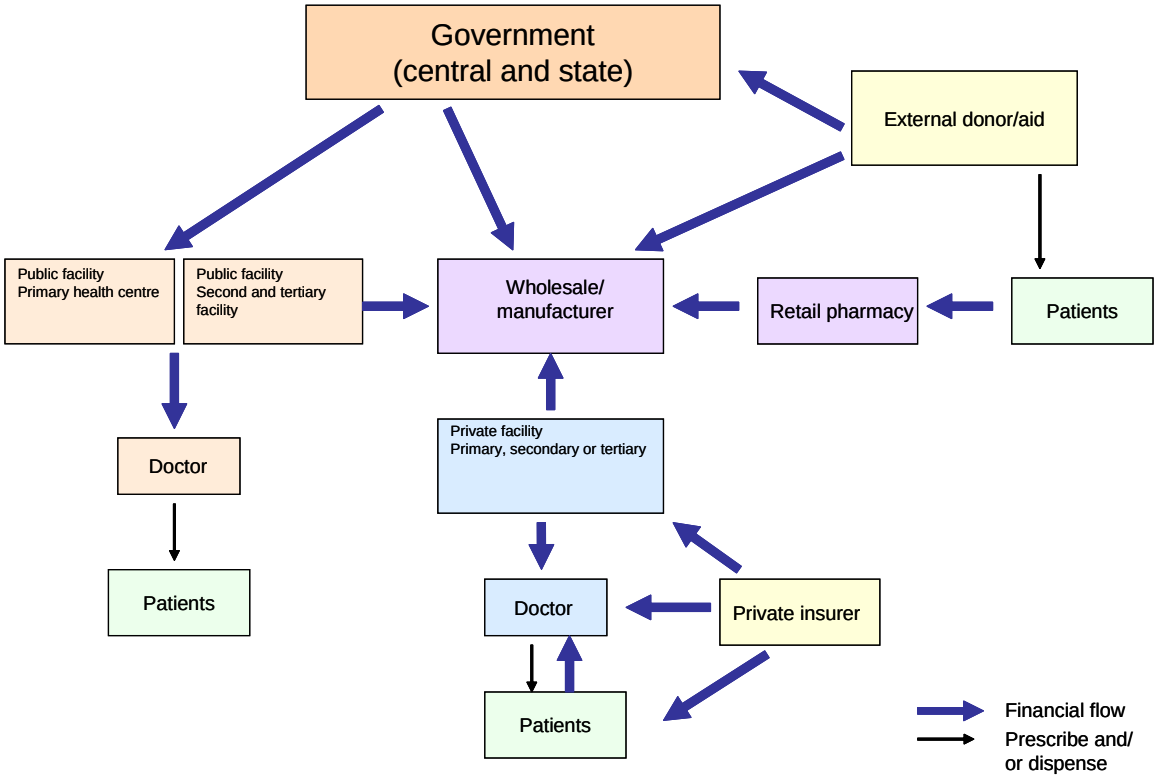
The policy's main objectives are the following (NPPA 2002):

- ensure availability of medicines at reasonable prices,
- strengthen domestic capability in production and exports of pharmaceuticals by reducing barriers to trade,
- ensure quality control, promote rational use of pharmaceuticals,
- encourage R&D in the pharmaceutical sector and with a focus on diseases prevalent in India.

6.3.1 PHARMACEUTICAL FINANCING AND SOURCES OF FUNDING

This section discusses pharmaceutical expenditure, the different sources of funding and government procurement. The diagram below provides an overview of financial flows relating to expenditure on pharmaceuticals.

Figure 6.3 - Financial flows of pharmaceuticals



Note: For ease of exposition, public facilities include government run facilities for government employees. A primary health centre (PHC) is supplied medicines directly from the government central store. Retail pharmacies are reported to dispense medicines without a doctor's prescription. Public facilities and external donors may charge a nominal fee.

In India, private expenditure accounts for the largest share of total health expenditure (78.05) while public accounts for 19.7% and external aid 2.3% as shown in the figure below 2004-05 from the National Health Accounts (NHA) for India 2004-05 (WHO, 2009).

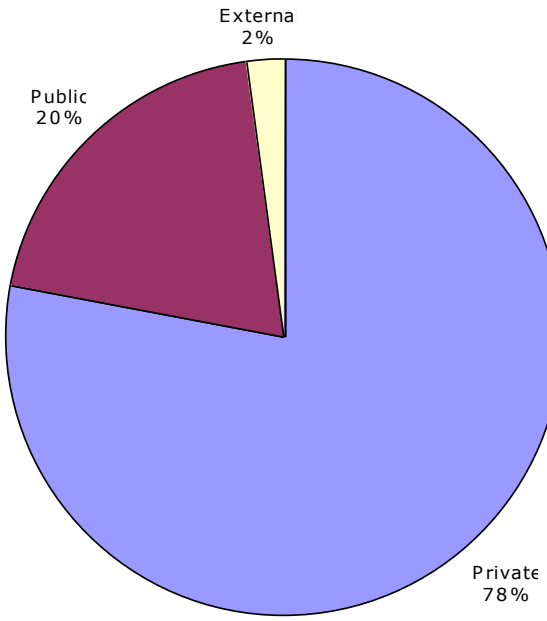


Figure 6.4 - Distribution of total health expenditure in India 2004-05

After household expenditure, the remaining sources of expenditure is smaller: state expenditure is 12%, followed by central (6.8%), private insurance (5.7%) and external aid (2.3%) (bilateral or multilateral), and social insurance (1.1%) (WHO 2009). A breakdown is provided in the tables below. These shares have remained similar to the previous release of NHA from India 2001-02.

Table 6.4 - Health expenditure components in India 2004-2005

Source	% of THE	$US Billions	$US per capita

Private			
Households	71.1	21.1	18.9
Firms	5.7	1.7	1.5
Social insurance	1.1	0.3	0.30
NGOs	0.07	0.02	0.02
Subtotal	**78.05**	**23.2**	20.8
Public			
State	12.0	3.6	3.2
Central	6.8	2.0	1.8
Local bodies	0.92	0.3	0.24
Subtotal	**19.7**	**5.8**	**5.2**
External support			
Central	1.6	0.5	0.42
NGO	0.5	0.1	0.13
State	0.2	0.07	0.07
Subtotal	**2.3**	**0.7**	**0.61**
TOTAL	**100.0**	**29.7**	**26.60**

Source: NHA, India 2004-05 (WHO, 2009)

Data on household expenditure indicate that individuals spent the largest share on outpatient care (66.1%), 23.5% was spent on inpatient care, 3.4% on delivery care and 2.8% on family planning services (WHO 2009). Rural households account for a larger share of household expenditure than urban households: 62% versus 38% (WHO 2009).

Data from inpatient care show that in both public and private settings, medicines accounted for the largest share of household expenditure (38% to 66%) as shown below. Doctor's fees were the next largest share in private settings whereas diagnostic tests were the next largest component in public settings.

Table 6.5 - Distribution of household expenditure (%)

Hospital	Sector	Medicine	Doctor fee	Bed	Diagnostic test	Blood	Food	Total
Private	Rural	40	26	17	9	3	5	100
	Urban	38	27	17	11	4	3	100
Public	Rural	66	4	4	12	4	9	100
	Urban	62	5	6	15	5	8	100

Source: NHA, India 2004-05 (WHO, 2009)

Government spending on medicines indicates that a small proportion of public budgets is spent is medicines. In the MOHFW's budgets, it accounts for 1.4% (Rs. 392 million, or US$ 8 million) out of Rs. 28,463.7 million (US$ 598 million) (WHO 2005). At the state level it accounts for 1.7%, Rs. 2,832.4 million (US$ 59 million) out of Rs. 166,757.2 million (US$ 3.5 billion) (WHO 2005). The NHA system of classification estimates overall expenditure to be Rs. 4,585 million (US$ 96 million) or 0.4% out of total health expenditure, Rs. 1,057,341 million (US$ 22 billion) (WHO 2005).

In West Bengal, Tripathi (2004) reports that co-payments/fees for medicines vary. In some states primary health care is offered free of cost. In some states, a nominal fee is charged. Treatment cost is borne by patients, although this may be subsidised at referral hospitals. In hospitals, medicines are free in public hospitals. Public facilities freely supply only drugs from the NEML (Tripathi, Dey et al. 2004).

Patel et al. (2004) reports that in the state of Maharashtra, freedom fighters, and those that have a card indicating their income is below poverty level are exempt. These authors report that it is official policy to supply all medicines for free at the primary health care level.

Patel et al. (2004) and Tripathi et al. (2004) report the following medicines are freely provided in public facilities: TB, malaria, oral rehydration salts, family planning in both Maharashtra and West Bengal. Tripathi (2004) also reports that vaccines covered by the Universal Immunization Programme, iron, folic acid,

simple antibiotics (e.g. amoxicillin, metronidazole); simple analgesics like paracetamol are freely provided in West Bengal.

6.3.2 PROCUREMENT

The government is responsible for drug procurement in public facilities where medicines are (for most states) free of charge. The central government procures medicines for its national programmes (e.g. HIV/AIDS, TB, malaria) that are delivered in public facilities. At the state level, medicines are typically procured by central tender and supplied for health care delivery (Patel, Thawani et al. 2004).

The recent WHO/HAI survey found that among Indian states surveyed all typically procured medicines prices lower than international procurement prices. These states were Tamil Nadu, Haryana, Karnataka, Maharashtra, Rajasthan and West Bengal (WHO/HAI 2006).

6.3.3 LICENSING OF MEDICINES AND QUALITY CONTROL

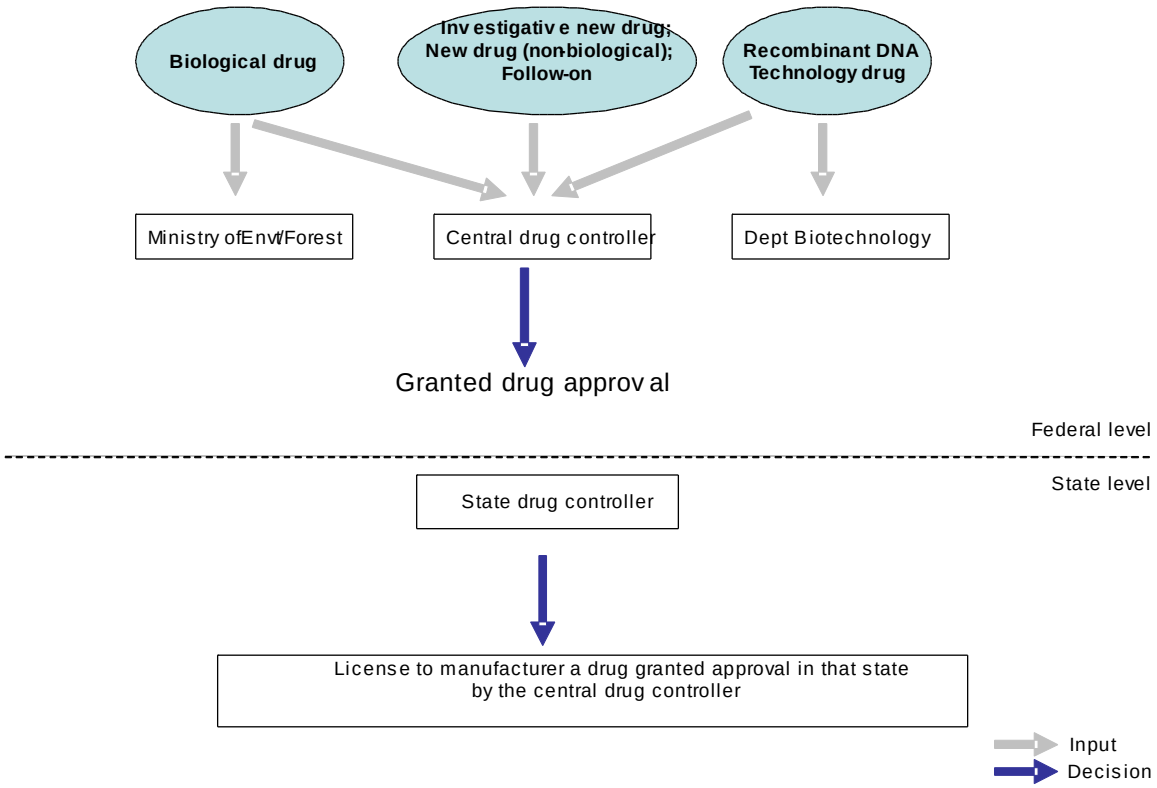
Under the MOHFW, the DCGI is responsible for licensing and standards according to the Indian Drugs and Cosmetics Act, 1940. There is a division of authority between the central drug controller and the state level drug controllers.

The central authority is responsible for approval of new drugs, provision of standards, clinical trials in the country, quality control over imported drugs, coordination of activities of state drug authorities and supplying advice over the uniformity of the Drugs and Cosmetics Act (WHO 2004a).

States have their own system of licensure for the manufacture, sale, and distribution of approved drugs and are responsible for the approved drug's quality. For domestic consumption, states issue a license to manufacture a drug that has already been granted market authorisation by the central drug controller. The

quality of production is not uniform and some state controllers are lax in adhering to GMP (Good Manufacturing Practice) guidelines (World Bank 2002). The diagram below describes the separation in responsibility.

Figure 6.5 - Licensing of pharmaceuticals



The Central Drug Controller grants market authorisation to three categories of drugs: investigative new drug; new drug and follow-on products. Market authorisation grants a license but there is no explicit policy on the length of time to approve a drug. Decision times can be short (in less than a year) or range from 1 to 3 years. There is also no explicit policy on periodic reviews.

As the figure illustrates, an investigative new drug, a new drug that is not a biological product or a follow-on product is approved only by the DCGI. For a biological drug, the Ministry of Environment and Forests reviews the environmental impact assessment of the production process to ensure that safety procedures are in place for a biological drug. The Genetic Engineering Approval

Committee is responsible to review applications that involve medicines using biotechnology.

For a drug that uses recombinant DNA technology, the Department of Biotechnology within the Ministry of Science and Technology is involved. The Department of Biotechnology is approves pre-clinical studies and recommends human clinical trials to the DCGI. This is carried out on case-by-case basis.

Once the drug is on the market, phase IV (pharmacovigilance) studies are mandatory but it is not well enforced. Post marketing surveillance is a challenge in high and low-income settings, but in developing countries there tends to be little post-marketing safety monitoring (Edwards 1997; Lindquist and Edwards 2001).

The DCGI located in Delhi manages the aspect of drug quality in India. Actual administration, however, is handled by state controllers. Processes vary across states and efficiency of state level operations varies. For example, Gujarat, Maharashtra, Southern states have stronger regulatory authorities than the north and eastern states (e.g. Himalchal, Uttranchal, Sikhim) where regulatory systems are lax (World Bank 2002).

The two main problems with quality control relate to regulatory capacity and laboratory capacity (World Bank 2002). First, most of the state quality control agencies have a shortage of staff and lack well trained staff. Second, quality testing takes place in government laboratories but facilities are not well equipped to conduct tests. The World Bank reported that out of the 19 state drug testing laboratories, only 7 could perform the full range of tests (World Bank 2002).

GMP came into force in June 2006 (Schedule M of the Drugs and Cosmetics Act, 1940), but it has not been applied consistently to pharmaceutical firms. For domestic consumption, quality control is not enforced. In practice, a small to medium sized company may receive a license to manufacture without having to meet the required quality standards, which exacerbates the problem of counterfeit medicines and appropriate packaging standards in the Indian market. This

incentive may encourage the states to offer tenders to firms that do not produce quality medicines but offer a low price.

In contrast, drugs for export to more regulated markets such as the US and Europe are required to meet the importing country's standards, which are likely to be higher than domestic quality standards.

6.3.4 PRICING POLICY

The NMP policy document's main focus is on pricing policy. The guiding principle for price regulation is based on two components: whether the medicine has mass consumption and whether there is absence of sufficient competition for the medicine (NPPA 2002). Drugs with high sales and a market share of more than 50% are targeted.[32] Competition in the pharmaceutical market can be defined in different ways. The Indian pharmaceutical market is characterised as having a high volume generic drugs, which implies that competition is largely between medicines with identical active ingredients.

The NPPA regulates prices of Active Pharmaceutical Ingredients (APIs), also referred to as bulk drugs, which are used for consumption as or as an ingredient in any formulation. Currently, the NPPA regulates the prices of 74 APIs that are commonly used according to a standard formula (please see Appendix D). These are referred to as scheduled medicines. The NPPA sets the maximum retail price (exclusive of local taxes). These medicines constitute less than 20% of the market and include imports or domestically manufactured products. Please see Appendix D for a complete list. Just under half of these (30) are not on India's list of essential medicines.

[32] The drugs considered for price regulation from the basket of drugs for selection will be chose if the annual value is more than Rs. 250 million and the percentage share is 50% or more; or if the drug's annual value is more than Rs. 100 million but less than Rs. 250 million with a percentage share of 90% or more. (NPPA, 2002).

Margins are fixed only for scheduled medicines: the wholesale margin is 8% and the retail margin is 16% (NPPA 2002). An NPPA study, however, showed much higher margins. The study found that retailer margins could be as high as 300% for scheduled and non-schedule medicines (NPPA, 2002). Three medicines were surveyed and margins varied from 100-500%.

There had been lobbying efforts to reduce government tariffs on drugs because studies show that taxes, duties, and markups contributed more to the final retail price than the manufacturer's price (Levison and Laing 2003; WHO/HAI 2006). In the government's 2008 budget, the government responded to these efforts. The countervailing duty applied to pharmaceutical imported products for retail purposes dropped from 16% to 8%. The effective reduction is not as high as 8% but actually around 4-5% (Corporate Law Group 2008). There is a 4% VAT charged on all medicines in the public and private sector (Kotwani and Levison 2007).

For drugs not under price control, firms are free to set the maximum retail price (MRP). The NPPA will intervene if drugs have significant sales and where the annual price increases by more than 10%.This level was changed in April 1, 2007 from 20% to 10%. About 10,000-20,000 manufacturers are monitored (NPPA 2002).

When price increases occur beyond the allowable limit, the NPPA will issue notices and if required, fix a price. The law permits NPPA to step in, but this action was infrequent during the first nine years of the NPPA's existence. As of November 2007, about 54,000 medicine packs were being monitored. Prices are based on information given in the monthly retail store audit report from 4000 stockists (NPPA 2002).

6.3.5 INDUSTRIAL POLICY

There is considerable government support for the pharmaceutical industry in India. Industrial policy development is led by the Department of Chemicals and

Petrochemicals and the Ministry of Commerce and Industry. The Department of Chemicals and Petrochemicals is responsible to develop policies to stimulate industry growth. The Ministry of Commerce and Industry supports the industry on issues concerning exports, trade and patents.

The Ministry of Commerce and Industry set up the Pharmaceutical Export Promotion Council (Pharmexcil) having its headquarters in Hyderabad and Regional Offices in Mumbai and Delhi in 2004. The Council's objectives are to extend assistance to the industry which involves delegations to various countries, business meetings, and funding support for export activities.

To export a drug from India, a firm is required to show the order form to the Directorate General of Foreign Trade. A license is not required for export. The firm, however, is required to follow the importing country's conditions.

India became TRIPS compliant on January 1, 2005 and research suggests that this will have implications for industry growth and patient access to medicines (Grace 2005). The Department of Industrial Policy and Promotion is the agency responsible for IPRs and issues relating to patents. TRIPS will apply to patents from January 1, 2005 but not before 1995. The contentious area is for patents granted between 1995 and 2005. In this case, a firm that produced a generic version can continue to produce its drug as long as it made significant investments. If this occurs, the generic firm is required to pay reasonable royalties to the originator firm. Alternatively, if a generic firm did not wish to pay the royalties, it could challenge the patent application under review (pre-grant opposition). The main issue of contention relates to a reasonable level of royalty payments because this is not defined (Corporate Law Group, 2008; Grace 2005).

The extent to which patents will affect access to affordable medicines is matter of ongoing debate. Some estimates show that medicines that account for 10-15% of value share will be affected; whereas as cardiovascular and pain relief drugs are less likely to be affected because there is a high level of therapeutic competition and substitution (Grace 2005). Diseases such as HIV/AIDS and resistant strains of TB and malaria will require new drugs and as a result patents will have

implications for their affordability in developing countries including India (Grace 2005).

6.4 PHARMACEUTICAL INDUSTRY

6.4.1 MARKET ENVIRONMENT

Patented drugs are more widely consumed in wealthy countries (about two thirds) and account for one third in low income countries (WHO 2004a). The WHO (2004) notes that generic sales accounted for 60% in low and middle income countries and branded generics were more widely sold than unbranded generics. This is the case in the Indian market where branded generics dominate the market.

The Indian pharmaceutical market experienced significant growth at the start of the 1990s as a major supplier to the global generics market. India's pharmaceutical market is characterised by branded generics, unbranded generics and patented originator products. The market consists of 20,000 companies which is higher than in the U.S (Kripalani 2008).

In 2006, the total market by value was US$ 13 billion (domestic was US$ 7.9 billion and exports were US$ 5.3 billion) (OPPI 2007). The government figure for exports was estimated to be a higher at US$ 6.3 billion (Department of Chemicals and Petrochemicals 2008). According to OPPI, in 2006, the industry registered a growth of about 18%, which was the first time in 5 years that the industry registered double digit growth (OPPI 2007).

The success of the Indian pharmaceutical industry is mainly due to the absence of product patent protection before 2005 when process patents were in place (Shah 2007). India had abolished product patents in 1971. This was prompted by the dominance of foreign companies that were charging very high prices and would not part with their technology or significantly lower prices for public health concerns (Shah 2007).

A policy of process patents came into effect in the 1970s when the government provided significant public sector support to establish government facilities for the production of APIs. Many of the known Indian pharmaceutical companies today were started by personnel that first worked in government facilities. The government pushed a cost-based price control system which encouraged firms to improve their efficiency (Shah, 2007). This system created conditions for the industry to develop strong skills in patenting processes (i.e. reverse-engineering) in pharmaceutical production.

These policies affected the speed at which the market developed. In the 1980s, the industry attracted a number of entrepreneurs. The industry was characterised as having little barriers to entry. Development financial institutions had special schemes for funding start up investments (Chaudhuri 2005).

Recent trends show Indian companies are becoming increasingly export oriented. The growth of the industry has followed from production for the domestic market to export production. Most firms export to markets with little regulation. Most of the Indian companies operate at the lower end of the market where products are at the later stages of the product cycle. Barriers are less and the number of competitors is more.

Almost half of the increase in exports between 1999-2000 and 2002-2003 was attributed to the exports of the top three exporters, Ranbaxy, Dr. Reddy's and Cipla. Indian companies export formulations in their own brands (branded generics) (Chaudhuri, 2005).

India's exports to Asia, Africa and Eastern Europe accounted for 50% in 2004-05 (Shah, 2007). The majority of exporters focus on these markets which have little regulation (i.e. with little registration and inspection requirements). The majority of exports comes from formulations 71% (Chaudhuri 2005). Exports to regulated markets (North America and West Europe) have grown and in 2004-05, they accounted for 40% of total exports. Please see table below.

Table 6.6 - Pharmaceutical exports by region, 2003-2005

Market	2003-2004 US$ (millions)	2004-2005 US$ (millions)	Share in % 2004-2005	Real annual growth%
Asia	1010.2	1062.6	28.7	5.2
West Europe	759.7	805.8	21.8	6.1
North America	594.3	681.7	18.4	14.7
Africa	405.6	443.6	12.0	9.4
East Europe	309.4	399.9	10.8	29.3
Latin America	294.4	303	8.2	2.9
Total	3373.4	3696.6	100.0	

Source: Shah (2007))

Note: Annual data expressed in constant dollars. (Ex. Rate $1=INR 45).

The top Indian companies have also developed partnerships with western pharmaceutical companies. Targeting regulated markets also resulted in opportunities for strategic alliances such as Ranbaxy-GlaxoSimthKline, Dr. Reddy's Laboratories-Novartis, Torrent-AstraZeneca (Shah, 2007).

Most Indian companies have opted for safer strategies which involve forming alliances and partnerships with the multinational companies (MNCs) (e.g. by being a supplier in the export market and a marketing partner in the domestic market).

6.4.2 PROMOTIONAL ACTIVITIES

The Drugs and Magic Remedies (Objectionable Advertisements) Act of 1954 lists disease categories for which advertisements cannot target consumers. The Act does not distinguish whether the drug is over-the-counter (OTC) or a prescription drug. Advertising to a registered medical practitioner is permitted if it is carried

out in a confidential manner according to the Act. The MOHFW is responsible for monitoring industry marketing activities but enforcement is weak.

There is intense competition to gain market share. A study on drug marketing found that firms sometimes engage in aggressive marketing tactics, including showering physicians, pharmacists, and wholesale distributors with expensive gifts (Roy N, Madhiwalla N et al. 2007). Gifts range from jewellery and consumer electronics goods to automobiles. Physicians in small towns are also targeted and receive more expensive gifts the more tablets they prescribe (e.g. 1,000 tablets per month will give the doctor a cell phone; 5,000 tablets are worth an air-conditioner; 10,000 tablets are worth a motorcycle). This implies that doctors may prescribe drugs based on company incentives rather than the needs of patients and are targeted very early in their careers (Kripalani 2008).

The industry recognises that more effective self-regulation is necessary. In January 2008, the OPPI published a Voluntary Code on Marketing Practices. The code calls for maintaining strict ethical standards. That is, no financial benefit or benefit-in-kind should have an inappropriate influence on the professional's prescribing practices (OPPI. 2007). OPPI received only two complaints about aggressive marketing practices in the past year—partly because doctors and patients were generally reluctant to speak out, but OPPI would like the code turned into law (Kripalani 2008).

6.5 SUMMARY

This chapter provided an overview of the Indian health system. A number of policy issues were raised to provide context for the empirical work. The policy issues are important because they have implications for patient access to medicines; these are discussed in more detail as they relate to this thesis in Chapter 9. We now turn to the empirical work carried out in outpatient and inpatient care settings in India to inform this area of analysis.

7 Chapter 7 Analysis of determinants of patient access to medicines in outpatient care in India

7.1 INTRODUCTION

The next two chapters now turn to the empirical work of the Indian country case study to better understand demand for medicines and health seeking behaviour. There is currently limited evidence on how and why individuals in India and more broadly in developing countries choose prescriptions drugs for treatment. The lack of data on this topic makes it difficult for empirical work to be carried out. Previous research typically comes from small datasets. The Indian country case study aims to contribute to the evidence base and is drawn from a large household survey for analysis.

Two modelling approaches are taken to study the decision to seek care in both outpatient and inpatient care. This chapter focuses on outpatient care and sets out the theoretical framework and presents the findings from this analysis. The theoretical specification uses the MNL and nested approach as already seen in Chapter 5. Chapter 8 takes draws on the theory of count models to study the decision to seek care in inpatient settings. While different modelling approaches are taken, the analysis in both chapters estimates prices responsiveness and examines whether price responsiveness in India follows a similar pattern to the findings from the previous chapters. We now turn to the analysis in this chapter which aims to address the following research questions:

Table 7.1 - Chapter 7 Research question and objective

Chapter 7 Research Objective	**Research questions for analysis using household level data**
Determine the factors which affect access to medicines and outpatient care in India	1) Is income a driver in India? 2) Does regulation affect access

to medicines in India?
3) What is the price elasticity in India?

In this chapter, the data did not contain volume information for direct computation of price elasticities. Therefore, price elasticities were imputed by using health expenditure data which contained medicine expenditure data. As medicine expenditure data account for the largest share of health expenditure in the data set, the price elasticity estimates have implications for patient access to medicines and health seeking behaviour. The findings from the empirical analysis are based on the MNL and nested approaches. The results indicate that determinants to seek outpatient care include health status, marital status, urban/rural setting, log household expenditure, log predicted expenditure and regional dummies. Price elasticities for outpatient care range from -0.17 to -0.16 (1% significance), and 0.16 (10% significance) with overall range from -0.17 to 0.43. The most significant results are intuitive with a negative sign but are at the lower of the range found in the literature.

This chapter is organised as follows. Section 7.2 presents existing evidence from India, sections 7.3 and 7.4 present the theoretical framework, and data sources, section 7.5 provides the results, and 7.6 presents the conclusion.

7.2 LITERATURE SUMMARY

While the findings from the literature review in Chapter 3 are relevant to the Indian context, this section extends this discussion by focussing on evidence from India. This discussion highlights that common themes relating to patient access to medicines such as financial barriers are present in the Indian setting as well.

7.2.1 ACCESS TO CARE

Evidence on patient access to medicines is limited. One study found that financial constraints in urban areas were a major determinant in the partial purchase of prescribed drugs (Dineshkumar, Raghuram et al. 1995). A study that surveyed a village in Northern India examined the patient's decision to seek medicine treatment for vaccination; it found that informational constraints played an important role and that learning about vaccinations through observation did not necessarily lead to seeking treatment (Das and Das 2003). In rural areas, expenditures on medicines increase with income and are higher than for other services (Garg CC and Karan AK 2005). Among the urban poor, however, the share spent on drugs is as much as their richer counterparts (Garg CC and Karan AK 2005).

Research more broadly on access to care shows that some of the main factors that affect utilisation are cost, and distance (Nair, Thankappan et al. 2004; Ranson, Sinha et al. 2006); while another found that the reputation/trust of the health provider was a determining factor (Ager and Pepper 2005).The literature also emphasises that the poor and uneducated are less likely to use services (Pallikadavath, Foss et al. 2004; Roy K and Howard DH 2007) and have a higher price elasticity of demand (Borah 2006). There are differences by sex and by region. One study found differences in utilisation according to sex: in a rural community in Bengal; boys were fives time more likely to be taken for early medical care compared with girls (Pandey, Sengupta et al. 2002). Studies also show that there are high levels of utilisation in the private sector but that this varies for the poor from state to state (Ager and Pepper 2005; Levesque, Haddad et al. 2006).

The WHO/HAI survey collected price information of medicines from selected India states. The study found that typically generics are exclusively available in the public sector and that procurement prices are efficient (Kotwani et al. 2007). The study found that availability of medicines, however, is poor in the public sector which implies that patients are forced to turn to the private sector (Kotwani A, Gurbani N et al. 2009a; Kotwani A 2009b; Kotwani A 2010).

Borah (2006) and Sarma (2009) studied household choice for rural India. This was discussed in more detail in Chapter 3. Both studies came to similar results and found that price, income, poor health, distance, education, household composition mattered. Borah (2006) found that social caste mattered while Sarma (2009) found that sex was also a determinant. Estimates ranged from 0.00 to -1.68. Previous studies from India found smaller sized elasticities (Gupta I and Dasgupta P 2000).

7.2.2 PRESCRIBING AND QUALITY OF CARE

This section now turns to more descriptive analysis of prescribing practices and more generally quality of care. A large number of studies on drug utilisation in India have focussed on prescribing trends and whether medicines are prescribed rationally. This information is important to understand the supply chain of medicine distribution, how it affects patient access and whether they receive appropriate medicine treatment.

Findings suggest that there are inappropriate levels of prescribing. Many studies show inappropriate prescribing in primary and secondary care (Bapna, Tekur et al. 1992; Dharnidharka and Kandoth 1999; Das, Sarkar et al. 2006; Kotwani A 2010). Furthermore, there are high levels of self-medication and inadequate compliance of over the counter (OTC) sale of antibiotics (Ray, Mukhopadhyay et al. 2003). Other studies have shown inappropriate use in the prescribing of antihyperintensives (Tiwari, Kumar et al. 2004) and for patients with unstable angina (Malhotra, Grover et al. 2000). One study showed higher levels of inappropriate prescribing in rural areas than in urban settings (Dineshkumar, Raghuram et al. 1995). Another study that used a random sample of private and public section practitioners found that there was over-prescription of drugs by private practitioners (Bhatia and Cleland 2004).

Studies suggest that improvements in provider education and regulation of unregistered medical practitioners could lead to reduced levels of inappropriate prescribing (Malhotra, Jain et al. 2001a; Rehan and Lal 2002). The Delhi Society

for Promotion of Rational Use of Drugs (DSPRUD) Special Committee has used a form of prequalification since 1995 and has achieved savings of approximately 30-35% in the purchases of essential drugs (Chaudhury RR, Parameswar R et al. 2005). Delhi was the first state to develop a comprehensive Drug Policy, an essential drugs list (EDL), a centralised pooled procurement system, and activities to promote the rational use of drugs (Roy Chaudhury, Parameswar et al. 2005). Training programmes of providers led to a positive change in prescribing behaviour. Other studies show that the use of guidelines lead to improved rational prescribing in the use of antihyperintensives (Malhotra, Karan et al. 2001b) and among sexually transmitted diseases (Rewari, Tekur et al. 2000).

Quality of provision varies and affects patient's decision to access care. One study found that utilisation tends to be higher in teaching hospitals (Sinhababu, Mahapatra et al. 2006). In a survey in two rural and urban populations, respondents were less likely to use a government facility because they cited poor quality of services (Griffiths and Stephenson 2001). Utilisation appeared to be higher if a health worker visited households during pregnancy and not necessarily higher by the mere presence of a private health care facility (Sunil, Rajaram et al. 2006).

The findings indicate that financial factors are an important determinant of utilisation. Furthermore, perceptions of quality of care, level of literacy/ability to communicate symptoms, and trust in the provider could encourage or undermine access to care.

7.2.3 LIMITATIONS OF CURRENT RESEARCH

The aim of the Indian case study is to contribute to the evidence base on determinants related to health seeking behaviour and price responsiveness to medicines because the evidence base is limited. To address these knowledge gaps, this chapter uses information on medicines because this is not usually available in developing country surveys. Second, existing studies from India rely on small sample sizes of a small district, region or city rather than using a national datasets

or confined to either specific settings (e.g. rural). This chapter aims to fill the knowledge gap by carrying out analysis using a national dataset across rural and urban settings. Third, this chapter also addresses endogeneity issues related to health expenditure and health seeking behaviour. Fourth this empirical work has implications for policy and contributes to this topic by considering the pharmaceutical policy making environment in India and implications for price setting.

7.3 THEORETICAL MODEL

The modelling approach taken in this chapter is a function of the data available for analysis. In the national household survey, data on outpatient care data was only collected for one visit in the past 15 days preceding the survey. Therefore the theoretical framework models the probability to seek care for one visit. This analysis applies choice models as those used in Chapter 5. Two types of choice models are used: first a MNL model is used and then the data are applied to a nested framework to model the decision to seek care.

It is useful to recall the equation for a multinomial logit model. The probabilities sum to one so this implies that *J* parameter vectors are needed to determine *J* = 1 probabilities. In this case, $\alpha_0 = 0$. The equation can be rewritten as

$$\Pr ob(Y_i = j \mid w_i) = P_{ij} = \frac{\exp(w'_i \alpha_j)}{1 + \sum_{k=1}^{J} \exp(w'_i \alpha_k)} \quad j = 0, 1, \ldots, J, \ \alpha_0 = 0 \qquad (5\text{-}6)$$

In this analysis the choice model had five possible outcomes: public facility, private facility, self-treatment, do nothing, not sick. The coefficients are estimated as follows: $\beta^{(1)}, \beta^{(2)}, \beta^{(3)}, \beta^{(4)}, \beta^{(5)}$ where y=1 is set as the base outcome and $\beta^{(1)}$ is set to 0.

$$\Pr ob(y = 1) = \frac{1}{1 + e^{X\beta^{(2)}} + e^{X\beta^{(3)}} + e^{X\beta^{(4)}} + e^{X\beta^{(5)}}}$$

$$\Pr ob(y=2)=\frac{e^{X\beta^{(2)}}}{1+e^{X\beta^{(2)}}+e^{X\beta^{(3)}}+e^{X\beta^{(4)}}+e^{X\beta^{(5)}}}$$

$$\Pr ob(y=3)=\frac{e^{X\beta^{(3)}}}{1+e^{X\beta^{(2)}}+e^{X\beta^{(3)}}+e^{X\beta^{(4)}}+e^{X\beta^{(5)}}}$$

$$\Pr ob(y=4)=\frac{e^{X\beta^{(4)}}}{1+e^{X\beta^{(2)}}+e^{X\beta^{(3)}}+e^{X\beta^{(4)}}+e^{X\beta^{(5)}}}$$

$$\Pr ob(y=5)=\frac{e^{X\beta^{(5)}}}{1+e^{X\beta^{(2)}}+e^{X\beta^{(3)}}+e^{X\beta^{(4)}}+e^{X\beta^{(5)}}}$$

The computed coefficients, $\beta^{(2)},\beta^{(3)},\beta^{(4)},\beta^{(5)}$ measure the change relative to y=1. Any of the five outcomes could be set to one. The difference is that the coefficients will have different interpretations but the predicted probabilities for y=1, 2, 3, 4, 5 will be the same.

It is important to recall that in the MNL model, two assumptions should hold: the error terms are independent and identically distributed (IID) and that the ratio of the choice probabilities is independent, referred to as independence of irrelevant alternatives (IIA). These properties are tested and relaxed and are further discussed in the nested estimation in section 7.5.3.

7.4 DATA AND METHODS

7.4.1 DATA SOURCES

Two waves (1995-96 and 2004) of data come from the National Sampling Survey Organisation of India dataset (NSSO). Both surveys included information on socio demographic information of the household. The decision to seek care for one outpatient visit had five possible responses: visit to a public facility, private facility, self-treatment, do nothing when sick or not sick. This was the dependent variable. Expenditure information on one outpatient visit collected the costs for public facility, private facility, and self-treatment.

Two years of cross section data were available for analysis because the households surveyed in 1995-96 were not the same households surveyed in 2004. The sample includes children and adults. In 1995-96, 32 states were surveyed and included in the sample for analysis. In the 2004, the geographical boundaries were altered and 35 states were surveyed. For purposes of analysis, only 23 out of the 35 states had complete observations. The list of the states is provided in the table below.

Table 7.2 - State sample for outpatient analysis

State	1995/96(Obs)	1995-96 (%)	2004 (Obs)	2004 (%)
Uttar Pradesh	79,827	12.65	55,925	14.65
Bihar	52,081	8.25	NA	NA
Maharashtra	50,370	7.98	26,526	6.95
Madhya Pradesh	46,649	7.39	19,932	5.22
West Bengal	41,647	6.6	NA	NA
Andra Pradesh	40,290	6.39	22,345	5.85
Tamil Nadu	38,508	6.1	21,279	5.57
Rajasthan	28,314	4.49	19,242	5.04
Gujarat	27,614	4.38	14,563	3.81
Karnataka	27,163	4.3	16,972	4.44
Kerala	24,384	3.86	16,502	4.32
Punjab	22,451	3.56	1,242	0.33
Orissa	21,770	3.45	NA	NA
Assam	21,646	3.43	NA	NA
Jammu Kashmir	15,824	2.51	101,778	26.65
Himachal	11,246	1.78	20,087	5.26
Haryana	10,246	1.62	7,763	2.03
Tripura	9,276	1.47	NA	NA
Manipur	8,419	1.33	NA	NA
Meghalaya	7,658	1.21	NA	NA
Mizoram	7,275	1.15	NA	NA
Nagaland	7,260	1.15	NA	NA

Sikkim		7,049		1.12	NA	NA
Delhi		6,556		1.04	5,206	1.36
Arunchal		6,010		0.95	NA	NA
Andaman Nicobar Islands		4,498		0.71	NA	NA
Goa		2,332		0.37	900	0.24
Chandigarh		1,154		0.18	1,803	0.47
Pondicherry		1,073		0.17	1,182	0.31
Lakshadweep		908		0.14	5,667	1.48
Dadra		747		0.12	783	0.21
Daman		738		0.12	728	0.19
Jharkhand	NA		NA		10,915	2.86
Chhattisgarh	NA		NA		7,885	2.06
Uttranachal	NA		NA		2,642	0.69

Note: Jharkhand, Chhattisgarh, Uttranchal only appear in the 2004 wave due to a change in geographical state boundaries.

The regressors used in the analysis include age, sex and marital status were used. Two measures of the patient's health status were collected. The patient was asked to report whether he/she had been unwell in the last 15 days and the number of days ill. A variable on the reason for the visit was included on whether it was for an infectious condition or a non-infectious condition. The number of days ill was found to have more predictive power relative to the other measure of health status and was included in the model regression. The reason for visit was used in the regression to correct for endogeneity.

Socioeconomic information included whether the patient had education, was employed, whether the patient lived in a rural or urban setting, whether the patient had private health insurance and the number of members living in the household. An indicator for wealth or income was drawn from the households' expenditure as no direct income information was collected.

OOP costs were collected for public and private facilities and for patients who self-treated. In public and private facilities, medical expenditure included doctor's fees, medicines, diagnostic tests, attendant charges, physiotherapy, personal

medical appliances. Non-medical related expenditure was collected and included transport and lodging charges for the patient and escorts. Medical and non-medical related expenditure were summed together for the outpatient visit. For patients who self-treated, they consulted themselves/family member/friend, a medicine shop or other. Only the total cost paid was collected. This expenditure information was transformed into logs to account for non linearities in the data. All expenditure and income variables were converted to US$PPP. The 1995-96 expenditure data was converted into 2004 US$PPP.

The same approach used in Chapter 5 was employed to address potential endogeneity issues concerning health expenditure data and the decision to seek care. The log predicted expenditure was used as a regressor. The variable was calculated by regressing the log outpatient expenditure against age, sex, employed, education, urban or rural setting, insurance, log household expenditure, state dummy and the reason for the visit. The reason for the visit was divided into whether it concerned a chronic condition or related to an infectious condition.

7.4.2 EMPIRICAL SPECIFICATION

The empirical specification models the probability of seeking care. There are five potential responses: visit public facility, visit private facility, self-treatment, do nothing, not sick. A multinomial logit model is used to model the choice to seek care. The regression model is defined as follows for individual *i*:

$$\mathrm{Prob}(Y_i = j \mid w_i) = P_{ij} = \frac{\exp(w'_i \alpha_j)}{1 + \sum_{k=1}^{5} \exp(w'_i \alpha_k)} \quad j = 1, 2, 3, 4, 5 \quad \alpha_5 = 0 \qquad (5\text{-}0)$$

$\mathrm{Prob}(Y_i = 5)$ where the individual was not sick was set as the base outcome. The following regression model was run for the *i*th individual across *j* alternatives where j= 1, 2, 3, 4, 5. The variables that were chosen were based on health economic theory, findings from the literature and variables available in the

dataset. The regressors were chosen to capture information on the patient's health status, utilisation, and socioeconomic information.

$$Y_{ij} = \beta_{ij} + X age_{ij} + X age^2_{ij} + X sex_{ij} + X daysill_{ij} + X education_{ij} + X employed_{ij} + X marital status_{ij} + X household size_{ij} + X urban_{ij} + X health insurance_{ij} + X \log household expenditure_{ij} + X \log predic + X regiondummy_{ij} + X yeardummy_{ij}$$

The expected relationships of the regressors are set out in the table below and consistent with Chapter 5.

Table 7.3 - Expected signs of regressors

Variable	Expected Sign
Age	+
Sex	+/-
Days ill	+
Education	+
Employed	+
Marital status	+/-
Insurance	+
Urban	+/-
Household size	+/-
Household expenditure	+
Predicted expenditure	-
Regional dummy	+/-
Year dummy	+/-

The decision to seek care should increase with age. The age term was squared to address potential non linearities in the data. Those with poor health as measured by the number of days ill should be more likely to seek care.

Education and employment should have a positive effect on the probability of seeking care. The insurance variable is treated as exogenous given the characteristics of the health care market as discussed in Chapter 2 and so we

would expect insurance to have a positive effect. The literature suggests that high OOP expenditures have a negative effect on the probability to seek care while household expenditures (e.g. a measure of household wealth) have a positive effect on the probability to seek care

Women should be more likely seek care due to their health needs in particular relating to child health and child delivery, however the literature points to mixed evidence suggesting that men are more likely to seek care. Similarly, the effect of marital status is ambiguous on the probability of seeking care. Household size is ambiguous and may be a proxy for capturing wealth of a household. Larger households may have lower wealth and are more likely to seek care. Alternatively, smaller households could reflect greater wealth and suggest that the wealthy are more likely to seek care because they can afford it. The effect of the urban dummy variable is ambiguous as well. Patients living in urban settings may be more likely to seek care because there are likely to be more facilities available in urban settings. Alternatively, rural patients may be more likely to seek care if this variable is also a proxy for need: poor rural patients may struggle with health conditions and could be more likely to seek care.

The state dummies were grouped together by region: north, south, east, west and union territories because the initial model run found very large standard errors so to improve model specification, the state dummies were grouped together by regions. This allowed the two waves to be pooled together. The regional dummies aim to account for the heterogeneity in the cross sectional dataset so the direction of the sign of these dummies *a priori* is ambiguous. The regional dummies reflect regulatory differences as well as the average level of wealth. North and eastern states tend to have less developed regulation while, the west, south and some of the union territories are on average wealthier and have stronger regulatory practices. The model requires one regional dummy to be its reference base which is assigned arbitrarily. The year dummy is inserted in the model to account for the two waves of cross section data and its effect *a priori* is also ambiguous. Estimations were run with and without sampling weights but the results were consistent. Estimates without sampling weights are presented below.

7.5 RESULTS

7.5.1 DESCRIPTIVE STATISTICS

The dataset for the 1995-96 wave contained 630,590 observations and the 2004 wave contained 385,607 observations. The proportion of patients reporting being sick in each wave is as follows 5.6% (35,341 observations) in the first wave and 8.7% in the second wave (33,175 observations). The regressions were run using STATA software.

Table 7.4 - Summary of data sample

	1995	2004
Sick	35,341 (5.6%)	33,175 (8.7%)
Not sick	630,983	381,867

Of those who reported being sick, about two thirds visited a private facility for treatment as shown in the table below.

Table 7.5 - Distribution of patients reported sick

Reported Sick	1995		2004	
	Number sick (% Sick)	% Sample	Number sick (% Sick)	% Sample
Public visit	6,037 (17%)	0.9%	8,103 (24.4%)	2.1%
Private visit	22,192 (63%)	3.5%	20,663 (62.2%)	5.4%
Self-treatment	787 (2.2%)	0.1%	2,381 (7.1%)	0.6%
Do nothing	6,325 (18%)	1%	2,028 (6.1%)	0.5%

The average cost of treatment was lower in public facility than in a private facility by a small amount in both waves. Only a small proportion (roughly 3 to 4%) had expenditure that was greater than US$PPP 100. For about two thirds of patients, expenditure was less than US$PPP 20 which explains for a low average amount of around US$PPP 1.00 in each wave. The average cost of treatment was around

$USPPP 1 in the 1995-96 wave and ranged from $USPPP 1.00 to US$PPP 3.00 for the 2004 wave.

Table 7.6 - Summary of average OOP expenditure for outpatient care

	1995 (US$PPP 2004)	2004 (US$PPP)
Public	$19.60	$22.68
Private	$23.24	$25.64
Self-treatment	$12.65	$5.55
Average OOP	$1.05	$1.90

The table below provides a descriptive summary of the variables used.

Table 7.7 - Descriptive statistics

Variable	Description	1995 (Mean)	2004 (Mean)
Age	Age of adult patient	24.7	27.3
Sex	1 if patient is female and 0 otherwise	0.51	0.51
Marital status	1 if married or cohabitating and 0 otherwise	0.49	0.51
Reason for visit	1 if non-infectious ailment, 0 if for infectious ailment	0.41	0.66
Days ill	Number of days ill	8.9	10.4
Education	1 if patient has primary education or a higher and 0 otherwise	0.39	0.45
Employed	1 if patient is working and 0 otherwise	0.35	0.35
Urban setting	1 if patient lives in an urban or semi urban setting and 0 otherwise	0.40	0.35
Health insurance	1 if patient has health insurance and 0 otherwise	0.009	0.004
Household size	Number of members living in the household	6.6	6.5
Household expenditure	Previous month's household expenditure (US$PPP)	$270.61	$270.67
OOP	OOP expenditure (US$PPP)	$1.05	$1.90

expenditure

The descriptive statistics suggest that the adult population average age is around 25 years for the 1995 wave and 27 years for the 2004 wave. The sample has relatively even split between men and women and between married and non-married individuals. Among those reported being sick, the average number of days ill is around 10 days. In the 1995-96 wave, the majority reported the reason for the visit was related to an infectious ailment (59%) while in the 2004 wave the majority (66%) reported the ailment was related to a chronic condition. Between 35 to 45% of individuals in the sample are employed, live in urban settings and have at least primary education. A very small proportion of the population has insurance. The OOP expenditure averaged about US$PPP 1.0. Data on medicine expenditure was disaggregated only for the 2004 wave and accounted for 55% of total expenditure.

7.5.2 MULTINOMIAL LOGIT MODEL

The two waves were run together and after incomplete and missing observations were dropped, a total of 61,225 observations were available for analysis. The results from the MNL model to determine the probability to seek care are presented below. The coefficients are presented relative to not being sick which is the base outcome.

The coefficients of the logit model are not easily interpretable. The signs of the coefficients indicate whether the variable of interest has a positive or negative effect on the choice probabilities (Hensher et al. 2005).

Table 7.8 - Multinomial regression results of outpatient care

Regressor	Public	Private	Self-treatment	Do Nothing
Age	0.005	-0.0222***	0.003	0.004
Age^2	-0.0001*	0.0001*	-0.000	0.000
Sex	-0.006	-0.0787	-0.120*	-0.228***
Marital status	0.317**	0.613***	0.174	-0.137
Days ill	0.051***	0.039***	-0.065***	0.020***
Education	0.317***	0.430***	0.289***	0.062
Employed	0.041	0.088	0.092	-0.092
Urban setting	0.007	0.115*	-0.128*	-0.220***
Health insurance	0.007	0.337	0.157	0.192
Household size	0.007	-0.011	0.008	0.064***
Log house expenditure	0.545***	0.940***	0.292***	-0.291***
Log predicted expenditure	-1.27***	-1.27***	-0.934***	-0.360**
Region dummy1	0.467***	0.318***	0.167**	0.899***
Region dummy2	0.916***	0.461***	0.356***	1.686***
Region dummy3	0.422***	0.337**	-0.279*	0.153
Region dummy4	1.33**	-0.069	-0.195	0.866
Year dummy	-1.50***	-1.86***	-0.765***	-3.177***
Constant	1.74***	1.546***	1.698***	4.168***
N	61,225			
Pseudo R^2	0.0741			
Chi-sq.	9969.20***			
Log likelihood	-62290.45			

The marginal effects are used to better understand the impact of each regressor. The marginal effect reflects the change in probability for one of the choice alternatives given a unit change of the regressor on that choice alternative. These effects were estimated using post estimation techniques and are presented below.

Table 7.9 - Marginal effects of multinomial model of outpatient care

Regressor	Public	Private	Self-treatment	Do Nothing
Age	0.0007***	-0.002***	0.0002***	0.001***
Age^2				
Sex	0.014***	0.001	-0.001	-0.015***
Marital status	-0.019**	0.104***	-0.010**	-0.064***
Days ill	0.003***	0.002***	-0.004***	-0.001***
Education	-0.006	0.048***	-0.002	-0.029***
Employed	-0.002	0.017***	0.001	-0.015***
Urban setting	-0.006*	0.042***	-0.007***	-0.028***
Health insurance	-0.042**	0.054**	-0.003	-0.005
Household size	0.0008	-0.008***	0.0002	0.006
Log house			-0.015***	
expenditure	-0.024***	0.162***		-0.103***
Log predicted			0.007*	
expenditure	-0.025***	-0.100***		0.082***
Region dummy1	0.013***	-0.056***	-0.010***	0.052***
Region dummy2	0.0417***	-0.145***	-0.014***	0.125***
Region dummy3	0.023***	0.015*	-0.022***	-0.011**
Region dummy4	0.254***	-0.266***	-0.024**	0.041***
Year dummy	0.071***	-0.002	0.044***	-0.135***
N	61,225			
Pseudo R^2	0.0741			
Chi-sq.	9969.20***			
Log likelihood	-62290.45			

The results suggest that marital status, ill health, urban/rural setting, log household expenditure, log predicted expenditure and regional dummies have an effect (positive or negative) on the decision to seek care relative to those who are not sick. Those who are married are more likely to seek care at a public facility, self-treat or do nothing while those who are not married are more likely to seek private care. Those who are ill are more likely to seek care in public or private facilities.

Those who live in urban settings are more likely to seek private care. A proxy measure for a family's wealth, the log of household expenditure indicates that this variable reduces the probability of seeking care in a public facility, self-treat or doing nothing while it increases the chances of seeking care in a private facility. The log predicted expenditure increases the probability of seeking care in a public or private facility while having the opposite effect for self-treatment or doing nothing.

The regional dummies also affect the decision to seek care. All dummies have a positive effect to seek care in a public setting while their impact in the other settings is mixed. The year dummy is also significant which account for differences across the two waves of cross sectional data.

Own price elasticities and cross price elasticities were computed for the log predicted expenditure variable. The elasticities were calculated using post estimation techniques. This variable had mixed significance in the results. The elasticities for public and private facility are inelastic and significant: -0.16 and -0.17 respectively, while self-treatment is 0.16 and significant only at the 10% level. The results indicate that a 1% increase in expenditure is associated with a drop in the probability of seeking care in a public facility and private facility by 0.16% and 0.17% respectively but a 0.16% increase in the probability for self-treatment. The probability of using both public and private facility is negatively associated with an 1% increase in expenditure. The elasticity for self-treatment is positive but is only significant at the 10% level.

Cross price elasticities suggest that a public facility, private facility and self-treatment are substitutes. These numbers range from 0.24 for public facility, 0.76 for private and 0.05 for self-treatment. The results indicate that for a 1% increase in expenditure for public facility results in a 0.24% increase in the probability of visiting a private facility or self-treatment. Similarly, an increase in expenditure in a private facility results in a 0.74% increase in probability of visiting a public facility or self-treatment, while an increase in self-treatment has small effect on the probability of visiting a public or private facility (0.05%). Even though these

cross price elasticities make intuitive sense, the estimates are not statistically significant.

Table 7.10 - Elasticity calculation MNL model

	Own price elasticity	Cross price elasticity
Public facility	-0.16***	0.24
Private facility	-0.17***	0.76
Self treatment	0.16*	0.05

Note: 1%***; 5%**, 10%*

The MNL model assumes that the error terms are independently distributed and that the ratio of probabilities is independent of other choices. These two conditions refer to the IID property and the IIA property respectively.

A generalised Hausman test was run to test whether these properties were violated. The results indicate that they were with a Chi-square statistic of 209.75 and a p-value of 0.000. The nested model is developed and tested in the following section. The computer code is shown in Appendix E.

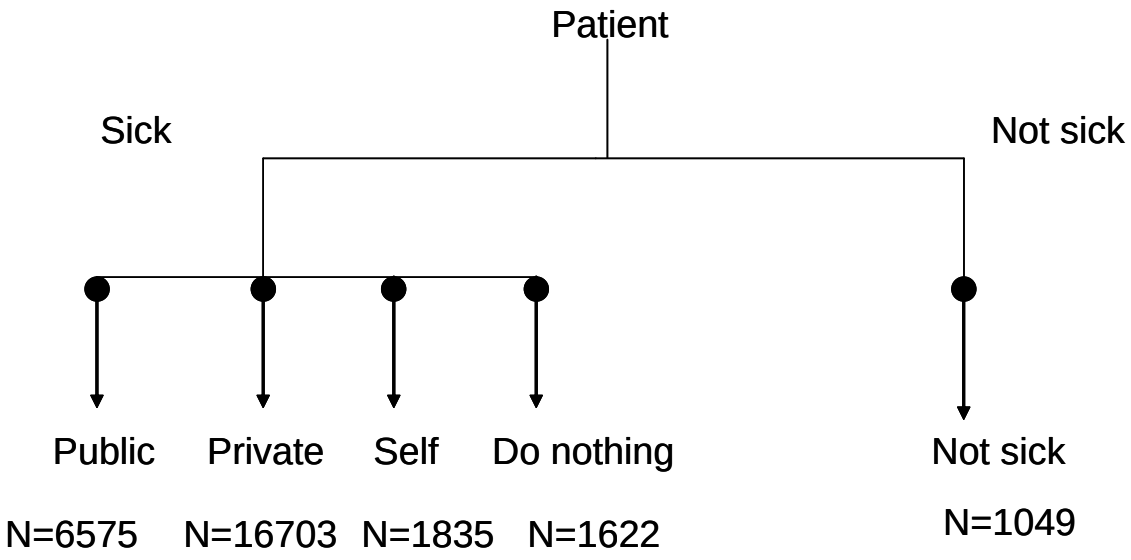
7.5.3 NESTED MODEL

We now turn to the nested logit model analysis of outpatient care. The same five choices are modelled. Four choices were nested together: public facility, private facility, self-treatment and do nothing. Nesting aims to control for the potential correlation between these choices not being strictly independent of not being sick. Once these four choices are nested together, the theoretical framework of the model assumes that the IID and IIA properties hold among the four alternatives: that is between public visit, private visit, self-treatment and doing nothing. The tree is shown below along with the sample size in each of the categories. The computer code is shown in Appendix E.

Table 7.11 - Sample size and choice categories

Choices	N	k	%
Branch 1 - Sick			
Public	27,784	6,575	23.66
Private	27,784	16,703	60.11
Self-treatment	27,784	1,835	6.6
Do Nothing	27,784	1,622	5.8
Branch 2 -Not sick			
Not sick	27,784	1,049	3.7
Total	138,920	27,784	100

Figure 7.1 - Nested tree structure



The important distinction with the nested approach is that variables common to all choices were computed. The one variable which varied across the elemental alternatives was the log predicted expenditure and was computed separately for each. The choice of doing nothing was used as the base case.

The nested logit results are somewhat consistent with the results under the MNL model but not as many variables are significant in the nested approach. The coefficients are shown below. The standard error computation was adjusted for

possible intra-correlation across regions. As a result regional dummies were not included as a separate regressor. The year dummy was not included either.

The results show that those more likely to seek care include those who are married, educated, come from small households, high household expenditure and OOP expenditure. The marginal effects of the regressors, however are not significant. Overall the results under the nested model are not as strong in statistical significance as those found under the MNL model. The computer code is shown in Appendix E.

Figure 7.2 - Nested logit results

Regressor	Coefficient
Age	-0.009
Age^2	-0.000
Sex	-0.111
Marital status	0.419**
Days ill	0.006
Education	0.269***
Employed	-0.020
Urban setting	0.102
Health insurance	0.256
Household size	-0.055***
Log house expenditure	0.749***
Log predicted expenditure public	0.411***
Log predicted expenditure private	0.677***
Log predicted expenditure self	0.020*

treatment	
Constant	
N	138,920
Chi-sq.	30194***
Log likelihood	-30876
Ratio scale parameter	0.707***
LR test IIA	3.81*

Note: 1%888, 5%**, 10%*

Table 7.12 - Elasticity results nested model

	Own price elasticity	Cross price elasticity
Public facility	0.26	-0.21
Private facility	0.43	-0.34
Self treatment	0.01	-0.01

Note: 1%***; 5%**, 10%*

Table 7.13 - Marginal effects nested model

Regressor	Coefficient
Age	-0.000
Age^2	-0.000
Sex	-0.012
Marital status	0.041
Days ill	0.000
Education	0.030
Employed	-0.001
Urban setting	0.015
Health insurance	0.033
Household size	-0.005
Log house expenditure	0.069
Log predicted	0.046

expenditure public	
Log predicted expenditure private	0.076
Log predicted expenditure self treatment	0.002
Constant	

Price elasticities and cross price elasticities were calculated. The elasticities for public facility is 0.26, private is 0.43 and self-treatment is 0.01. These numbers give suggest that a 1% increase in expenditure for each of these alternatives increases the probability of seeking treatment by 0.26% for public facility, 0.43% for private and 0.01% for self-treatment. These results are not intuitive to the previous model's findings but are also not statistically significant. The cross price elasticities are -0.21 for public facility, -0.34 for private and -0.01 for self-treatment, which suggest that these alternatives are complements rather than substitutes as found in the MNL model. These numbers suggest that for 1% increase in expenditure for public facility reduces the probability of visiting a private facility or self-treatment by 0.21%, 0.34% for private facility and 0.01% for self-treatment. These numbers suggest the opposite relationship as that found in the MNL model of each alternative being a substitute but these numbers are also not statistically significant. A summary of the estimates computed thus far in the empirical chapters are shown below.

Table 7.14 - Summary of elasticity results

Model	Key Assumptions	Sample	Description	Elasticity
MNL	IIA and IID hold	Cross country (Chapter 5)	Patient expenditure	-0.19 (hospital) 0.11** (clinic)
MNL	IIA IID hold	India (outpatient) (Chapter 7)	Patient expenditure	-0.16*** (public) -0.17***(private) 0.16* (self)
Nested	IIA and IID do not hold within nests. IIA and IID hold across nests	Cross country (Chapter 5)	Patient expenditure	0.03 (hospital) 0.63 (clinic)
Nested	IIA and IID do not hold within nests. IIA and IID hold across nests	India (outpatient) (Chapter 7)	Patient expenditure	0.26 (public) 0.43(private) 0.01(self)

Note: *** p<0.01, ** p<0.05, * p<0.1

The sensitivity tests of the model indicate that the IIA property and IID property in the MNL model do not hold. The likelihood ratio test rejects the null that the IIA property holds with a Chi-sq of 3.81 at the 10% level (0.0509). This may in part explain the lack of robust findings in the nested model. The parameter which measures the independence between choices is 0.707 and is the ratio of the scale parameter. This parameter lies between 0 and 1 and satisfies utility maximisation rules. Even though the limitation with this test is that it is specific to the tree structure which means that different specifications could give different results, the results from the generalised Hausman test found that the null hypothesis of the IIA property does not hold as was discussed in chapter 5.

7.5.4 LIMITATIONS

There are limitations with the analysis that should be highlighted. First, the same technique to estimate price elasticities in chapter 5 was used in this chapter: the estimation of price elasticities was based on health expenditure information. This information was limited in the survey to include information only on one episode and in one health setting which was either in a public or private facility. An important estimation issue involves a distinction between utilisation and health expenditure. The endogenous relationship between these two variables requires some method to correct for the bias in the estimated coefficients. The method used in this chapter was to estimate predicted health expenditure rather than using actual health expenditure. This approach aimed to purge the disease and socioeconomic effects in the generated price variable. While this technique is a common method used in the literature not all of the potentially endogeneity could be accounted for. Furthermore, the expenditure information related to only direct health care costs. Indirect costs of seeking care were not collected such as due to ill health, travel, waiting at health care facilities or providing care to family members (McIntyre D et al. 2006). The estimates of predicted health expenditure are therefore lower than the true costs of health care.

Despite using a large dataset, the analysis is based on two waves of cross sectional data. The data do not permit a time series analysis, which would shed light on the factors that would affect demand for health care over time or the cumulative effects of illness, access to care and health care spending over time.
This information is important because understanding the dynamic effects between these and other factors (e.g. the loss of income from illness) is particularly important as chronic illness prevalence increases globally (Wagner et al. 2011).

The household survey does not adequately capture those with unmet need including those who needed care but did not avail themselves of services and those who sought care but did not find their needs were properly met. The data are also not able to adequately capture information on adherence which would give a more complete picture on access. The data do not collect information on all

members of the household and thus may misclassify households with respect to need and access (Wagner et al. 2011).

The data did not allow for further analysis of individuals who chose to do nothing or for those who opted for self-treatment. Among those who chose not to take treatment based on medical advice (about 15% in both waves) the majority cited the ailment was not very serious (52% in 1995-96; 41% in 2004). Furthermore about half of the 15% sought alternate care (e.g. medicine shop). Information on their circumstances and the factors that affected this sub-sample of patients would provide useful information on those who chose not to present themselves to the health care system, which is of important policy relevance in these settings where alternate treatment practices (e.g. Ayurveda) are widely followed.

Information on traditional medicine practices and their relationship with the uptake of western medicines would have provided a more nuanced discussion on medicine consumption in these settings. For instance, it would have been useful to have information on whether western medicines are viewed more as complements than substitutes, and whether that varies depending on the patient's health condition, socioeconomic circumstances, etc.

While household surveys provide important information for analysis from the patient's perspective, data on supply side information is limited for analysis. Even though outpatient care was able to distinguish whether the visit was in a private or public setting, more information on supply/provider characteristics would better control the supply factors on demand for medicines. At a disaggregated level, these could include density measures of health professionals, number of hospital beds, number of health facilities per capita, and number of traditional healers per capita.

Quality information was partly available for government facilities but not collected for the other choice settings and therefore could not be used in the analysis. Quality information is potentially an important determinant of health seeking behaviour but its effect could be partly masked in other variables then this

will affect the estimation of the decision to seek care and the relationship between price and quality.

Finally, while the importance of the regulatory environment is tested using dummies, this approach is limited as it cannot account for states differences in greater detail. State information was grouped together on a regional basis because the log likelihood model could not be estimated due to large standard errors in the state coefficients. This approach is limited as it cannot account for state differences in greater detail such as procurement efficiency. State level dummies could have provided better estimates.

Furthermore, non-governmental actors play an important role in procurement in these settings which are not explicitly accounted for in the model and could confound the findings. There could be differences for diseases areas or due to differences in private sector providers or international organisations which could affect the price elasticity of demand. The role of the regulatory environment in these settings would have to be supplemented with more qualitative information so clearer links could be made with the quantitative findings and the policy setting environment. More information on the regulatory environment would shed light on the policy context to better understand patient access to medicines and health care.

7.6 DISCUSSION AND CONCLUSION

This chapter used household level data from India to better understand the demand structure for health care at the patient level in outpatient care. The household level data from India contained cross sectional data from two waves which draws information from a larger dataset than previous empirical work. The additional feature of this dataset is that it included expenditure information on medicines.

The findings from the MNL model indicate that determinants of health seeking behaviour include poor ill, marital status, urban/rural setting, log household

expenditure, log predicted expenditure and regional dummies. Those who are ill are more likely to seek care in public or private facilities. Those who live in urban settings are more likely to seek private care. A proxy measure for a family's wealth, indicates that this variable reduces the probability of seeking care in a public facility, self-treat or doing nothing while it increases the chances of seeking care in a private facility.

The elasticities for public and private facility are inelastic and significant: -0.16 and -0.17, respectively. These measures are within the range of elasticities found in the literature. Own price elasticity for self-treatment is 0.16 but it is only significant at the 10% level. The findings also suggest that the choice between public, private and self-treatment are substitutes with estimates consistent with literature findings ranging from 0.05 to 0.76 but were not statistically significant.

While the MNL results are more intuitive and significant the nested model is a more robust technique since the IID and IIA properties do not hold. The nested results, however, are not as strong in statistical significance and the marginal effects are smaller in magnitude. This may in part explain the lower level of significance of the likelihood ratio test that that IIA property is violated (10% significance level). The model finds that less regressors are significant but these are consistent with the MNL and include marital status, education, household and OOP expenditure except for household size which was only an important determinant in the nested model. In magnitude, price effects ranged from 0.01 to 0.43 and cross price effects suggest that the health choices are complements rather than substitutes but these none of these were significant.

There are similar implications for the counterintuitive price elasticity estimates found in this chapter as raised in chapter 5. These results could in part be due to model misspecification such as the missing indirect expenditure information or bias in the recall period. The recall period, however, specifies the past 15 days so this variable should be subject to less bias. Other reasons could relate to factors that affect the patient's decision to spend money once they decide to visit a health facility. These could be due to cultural factors relating to the relationship between health professionals and patients (e.g. expression of gratitude), the potential

demand for additional fees once the patient is at the facility by the health professional, or perceptions of improved quality of care if the patient pays more money once they are at the facility.

While perceived health status is an important factor, there could be elements of perceived health status that this variable failed to capture in the sense that for a given perceived health status, those with lower incomes (proxy using household expenditures) are less likely to seek care. Direct price and volume information would have provided a clearer picture on the determinants of health seeking behaviour.

Furthermore, while household expenditures are the common proxy for income in these settings, this variable may not appropriately capture true income differences between households. This variable will also be biased by the data sample for those with unmet need that were not included in the analysis. Such factors could therefore be masking the true relationship between price and the health visit.

Another approach would be to estimate price elasticities for each wave separately and to include interaction effects rather than computing one overall estimate. The approach taken in this chapter and in this thesis was to draw on larger datasets for analysis as previous studies have typically relied on smaller data samples for analysis. The large dataset potentially provides a more robust estimate but the limitation with this approach is that it takes data from two cross-sections which are 9 years apart. While a year dummy was included in the analysis, the gap between these two waves may not account for differences in the variables across both waves. One potential confounding factor could be greater error in estimating an 'average elasticity' across the two waves given that many contextual and other factors could have changed.

Some of the econometric results are consistent with the survey findings that income is an important determinant. In both waves households reported a loss to household income with an average loss of US$PPP 25.00 (US$PPP 28.00 in 1995-96 and US$PPP 20.00 in 2004). In both waves, about 15% did not seek treatment based on medical advice and about one fifth of these respondents cited

financial reasons (18% in 1995-96; 26% in 2004). The significance of visiting a private facility is also consistent with survey findings which suggest that patients prefer a private facility because it was closer and because from past experience were not satisfied with treatment in a public facility.

The results of the regional dummies indicated that the regulatory environment is an important factor. The data do not provide more disaggregate information which would better explain state differences. There could be differences in how well states procure medicines as found among some Indian states in the WHO/HAI (2006) survey. Thus, there could be differences within states and across states which are masked with an aggregate dummy measure.

Another key issue in these settings is that governments are not the only procurers of medicines in low and middle-income settings because the private sector is also an active procurer. For instance, some states could have very high procurement prices and therefore it would be useful to understand the factors which underpin high procurement prices. Procurement efficiency could be an important predictor in the model but since this information was not available at a more disaggregate measure, the dummy variable could confound the results. The regional dummy results are therefore limited in their interpretation and would have to be supplemented with more state-level analysis. The subsequent chapter partly address this issue by creating state dummies in the study of inpatient care in India.

The method used in this chapter was to first understand the determinants that affect the likelihood of seeking care and the implication for price responsiveness for price elasticities related to OOP for treatment. Unlike the 2004 wave, medicine expenditure was not separated from total expenditure reported in the 1995-96 wave but evidence from the literature suggests that medicines account for the largest share of household medical expenditure in India. The price elasticity information is useful in capturing patient price responsiveness to their OOP medicine costs. This is useful to inform price setting. For policy purposes, inelastic demand should not imply that an increase in prices would result in potential increase in revenues. This has found to be counterproductive as the literature shows that the demand for care drops and vulnerable groups are more

likely to be adversely affected. The policy response should consider low price setting to improve and increase welfare on patient access to care and to medicines. The next section further extends this analysis to understand health seeking behaviour in inpatient care in India.

8 Chapter 8 Analysis of determinants of patient access to medicines in inpatient care in India

8.1 INTRODUCTION

This chapter continues with the Indian case study analysis and now moves to inpatient care. The analysis in this chapter is useful as it complements the research on outpatient care. A key difference in this chapter's analysis is that the modelling approach is different from the choice models used in both Chapter 5 and 7 (MNL and nested). While these models are used when data on one health care visit are available, this chapter employs models applied to count data. Even though the models used in chapter 5 and 7 provide useful results, the data are limited for analysis because they are based on one visit. In contrast, in this chapter, data on inpatient care captured information for the numbers of visits over a 1 year period. This larger dataset of information on utilisation should in principle, provide more robust estimates of determinants of health seek behaviour and price elasticities. This chapter's research objective and questions are presented below.

Table 8.1- Chapter 8 Research question and objective

Chapter 8 Research Objective	**Research questions for analysis using household level data**
Determine the factors which affect access to medicines and inpatient care in India	4) Is income a driver in India? 5) Does regulation affect access to medicines in India? 6) What is the price elasticity in India?

It is important to note that because of large data constraints, there is limited information on patient's decisions to choose prescription drugs in developing country settings. In this chapter, volume information on medicines was not

available. Health expenditure data, which includes expenditure on medicines was used to impute price elasticities. As medicine expenditure data account for a large share of health expenditure in the data set, the price elasticity estimates have implications for patient access to medicines and health seeking behaviour.

The results indicate that for the inpatient setting, households with high expenditure have a positive effect on the probability of having a hospitalisation. This indicates that income is an important determinant. Being male, married, and also in poor health are more likely to have a hospitalisation. Insurance is an important predictor of hospitalisation. Those with education, the employed, living in urban areas and from small households have a negative effect on visiting the hospital.

Conditional on having a hospitalisation, the expected number of hospitalisations increases with high household expenditure, poor health, and being male, while the urban setting has a negative effect. Regulation also plays an important role on hospitalisations. States can have a positive or negative effect on the number of hospitalisations. Price elasticities range from -0.13 to -0.10 (1% significance), -0.11 (5% significance) and 0.03 (10% significance) with an overall range of -0.13 to 0.03 for inpatient care. The significant results are intuitive with a negative sign but are at the lower of the range found in the literature. While the results are inelastic and negative, the results should not be interpreted to mean there is revenue raising opportunity. The policy implications of these results are discussed at the end of this chapter.

This chapter is organised as follows. Section 8.2 presents the theoretical framework; sections 8.3 and 8.4 presents the analysis and discussion of inpatient care followed by the conclusion in 8.5.

8.2 THEORETICAL MODEL

8.2.1 SIMPLE COUNT MODELS

The data used in this section on inpatient care are count data, unlike the previous chapters where information on only one health care visit was recorded. In the literature, count data can be drawn from the number of visits, hospitalisations and these data are regressed in two stages. Examples include visits to GP, visits to specialists (Pohlmeier and Ulrich 1995; Hakkinen, Rosenqvist et al. 1996; Santos Silva and Windmeijer 2001), weeks in hospital (Gerdtham 1997), emergency room visits, hospital stays, number of drug prescriptions (Deb and Trivedi 1997) and number of outpatient visits (Deb and Trivedi 2002).

Count data on health care use typically contain a large proportion of zeros because the majority do not consume health care services while generally a small number of individuals tend to be high users of health care services, resulting in a skewed distribution of utilisation (Jones et al. 2007).

The nature of health utilisation data has given rise to applying the Poisson distribution to model health utilisation. The starting point for a standard count data model uses a Poisson distribution. The count dependent variable $y_{i,}$ follows a Poisson distribution with mean λ_i and covariates $\mathbf{x}_i$ as shown below (Jones et al., 2007):

$$P(y_i) = e^{-\lambda i} \lambda_i^{yi} / y_i \qquad (8\text{-}1)$$

The conditional mean λ_i is defined as

$$\lambda_i = E(y_i|\mathbf{x}_i) = exp(\mathbf{x}_i \beta) \qquad (8\text{-}2)$$

The literature, however, has shown that the Poisson model is too restrictive. Cameron and Trivedi (1998) note that one of the problems with a Poisson model is that of unobserved heterogeneity. This can lead to over dispersion and excess of zeros (Cameron and Trivedi, 1998). Cameron and Trivedi (1998) list the most common departures from the assumptions of the Poisson model. These include the equidispersion property, higher observed zeros than is consistent with Poisson and multimodality where observations are drawn from different populations (Cameron and Trivedi 1998).

Techniques have employed the negative binomial model, and zero inflated models to overcome the limitations with the Poisson model. A negative binomial (NB) model is proposed as an alternative because the heterogeneity can be modelled. In the Poisson model, the dependent variable is assumed to have the following distribution ($y_i|\mathbf{x}_i$).

In the NB, the distribution is ($y_i|\mathbf{x_i}, \eta_i$) where η_i follows a gamma distribution and E(y) = λ and Var(y) = $\lambda + \alpha^{2-k}$ (Jones et al., 2007). The NB nests the Poisson model which occurs when $\alpha = 0$ (please see Cameron and Trivedi 1998 for the derivation).

Even though the NB accounts for over dispersion, Gurmu (1997) notes that regression estimation does not adequately capture long-tailed distributions with excess zeros. The zero-inflated Poisson model ZIP is proposed to give more weight to the probability that the count variable equals zero. This estimation approach divides the population into users and non-users.

The probability of non-users is $q(\mathbf{x_{1i}}\beta_1)$ and the probability of users is 1-$q(\mathbf{x_{1i}}\beta_1)$ (Jones et al. 2007). The probability function for the zero-inflated Poisson (ZIP) model is a mixture of the standard Poisson model and a degenerate distribution concentrated at zero (Jones et al. 2007) as shown below:

$$P^{ZIP}(y|\boldsymbol{x}) = 1\ (y=0)q + (1-q)P^{P}(y|\boldsymbol{x}) \qquad (8\text{-}3)$$

The zero-inflated model can be estimated using the Poisson or for a more general specification the NB is applied (Jones et al. 2007).

8.2.2 TWO STAGE MODELLING

A further extension to model health utilisation has drawn on improved empirical specification using a technique referred to as the Hurdle model. This approach

models the decision to seek care in two stages. Mullahy (1986) developed the Hurdle model as a response to improving the empirical specification of count data models.

In the application to health care utilisation, the two stage approach aims to capture the principal-agent relationship used to commonly characterise the physician-patient relationship. In the two stage approach, the first part specifies the decision to seek care which is taken by the patient (principal). The second part models the positive values of the variable for those individuals who receive some care (Jones et al 2007). The second part aims to capture the role of the physician (agent) who determines the level of utilisation once initial contact is made (Jones et al 2007). This modelling approach aims to account for supply factors that affect the level of care.

Mullahy addresses the issue of whether the binary outcome of the count being either zero or positive might differ from that determining the magnitude of the positive counts (Mullahy 1986). He shows that two processes should not be constrained to be identical thus giving rise to estimation in two stages. The participation decision is determined by $P_1(.)$ and the positive counts are determined by $P_2(.)$. The log-likelihood is given by (Jones et al. 2007):

$$\begin{aligned} LogL &= \sum_{y=0} \log[1 - P_1(y > 0|x)] + \sum_{y>0} \{\log[P_1(y > 0|x)] + \log[P_2(y|x, y > 0)]\} \\ &= \{\sum_{y=0} \log[1 - P_1(y > 0|x)] + \sum_{y>0} \log[P_1(y > 0|x)]\} + \{\sum_{y>0} \log[P_2(y|x, y > 0)]\} \\ &= LogL_1 + LogL_2 \end{aligned} \quad (8\text{-}4)$$

In the application to health care utilisation, the first stage, the decision to seek care (participation decision) is usually modelled as a logit, probit, Poisson or negative binomial (NB). The most common approaches for the second stage include Poisson or NB. The literature has shown that the Hurdle approach is a better starting point to model count data when there is a high proportion of zeros (Grootendorst 1995; Pohlmeier and Ulrich 1995; Gerdtham 1997). Limitation with household data is that supply information is not well captured.

Further extensions to modelling health care utilisation include finite mixture/latent class model develop by Deb and Trivedi (1997) and the latent class Hurdle model (Bago d'Uva 2006). Both these approaches assume some sort of count data but require panel data for analysis which was not available in the Indian dataset.

The following sections apply the techniques of Poisson, NB, ZIP, ZINB and two stage modelling to the household data from India to study price responsiveness of patients and the implications for access to inpatient care.

8.3 DATA AND METHODS

This chapter aims to further refine the analysis on price responsiveness using household survey from India as a case study. This section presents the data and methods used to estimate the factors that affect health care utilisation, and the empirical estimation of patient's price responsiveness to the price of health care services consumed.

8.3.1 DATA SOURCES

The data used for analysis come from two waves of household survey data from India. The data source is the National Sampling Survey Organisation of India (NSSO). Two waves of household surveys that focussed on health care use were conducted for 1995-96 and 2004. The survey included socio demographic information of the household, health care utilisation of hospital visits, and expenditure incurred for using health services. All states in India were surveyed. Two years of cross section data were available for analysis because the households surveyed in 1995-96 were not the same households surveyed in 2004. The 1995-95 wave contained 32 states for analysis. The 2004 wave contained a total of 35 states due to a change in geographical boundaries. The table is below.

Table 8.2 - State sample for inpatient analysis

State	1995-96 (Obs)	1995-96 (%)	2004 (Obs)	2004 (%)

Andaman NicobarIslands		4,514		0.71	1,263	0.33
Andra Pradesh		40,337		6.37	22,651	5.85
Arunchal		6,032		0.95	5,599	1.45
Assam		21,646		3.42	14,121	3.65
Bihar		52,135		8.23	23,945	6.19
Chandigarh		1,164		0.18	1,829	0.47
Chhattisgarh	NA		NA		7,956	2.06
Dadra		753		0.12	791	0.2
Daman		741		0.12	737	0.19
Delhi		6,584		1.04	5,212	1.35
Goa		2,344		0.37	917	0.24
Gujarat		27,764		4.38	14,760	3.81
Haryana		10,351		1.63	7,881	2.04
Himachal		11,193		1.77	7,231	1.87
Jharkhand	NA		NA		6,816	1.76
Jammu Kashmir		15,877		2.51	11,005	2.84
Karnataka		27,276		4.31	17,114	4.42
Kerala		24,600		3.88	13,719	3.55
Lakshadweep		921		0.15	978	0.25
Madhya Pradesh		46,824		7.39	20,158	5.21
Maharashtra		50,771		8.01	26,959	6.97
Manipur		8,424		1.33	8,644	2.23
Meghalaya		7,669		1.21	4,074	1.05
Mizoram		7,284		1.15	5,384	1.39
Nagaland		7,313		1.15	1,813	0.47
Orissa		21,839		3.45	13,135	3.39
Pondicherry		1,072		0.17	1,208	0.31
Punjab		22,537		3.56	8,107	2.1
Rajasthan		28,445		4.49	19,467	5.03
Sikkim		7,066		1.12	2,570	0.66

Tamil Nadu	38,749	6.12	21,568	5.57
Tripura	9,304	1.47	4,840	1.25
Uttar Pradesh	80,224	12.66	56,613	14.63
Uttranachal	NA	NA	2,661	0.69
West Bengal	41,821	6.6	25,169	6.51

Note: Jharkhand, Chhattisgarh, Uttranchal only appear in the 2004 wave due to a change in geographical state boundaries. In the 2004 wave, Andaman Nicobar Islands, Jammu Kashmir, Pondicherry did not have complete observations for analysis.

The data available for this chapter's analysis recorded the total number of hospital visits for each household member over a one-year period. The 1995-96 wave collected total expenditure incurred for hospitalisation while the 2004 wave collected a breakdown of expenditure information which included doctor's fees, diagnostic tests, medicine costs, other hospital expenditure, transport and lodging costs.

The sample selection included all states in both waves. The household respondent was asked to report all hospitalisations that took place in the past year and to provide health care utilisation information related to each visit. The sample included adults and children. The dependent variable was total number of hospitalisations for each member of the household.

The following variables were used in the analysis. The age, sex and marital status were used. Two measures of the patient's health status were used. The patient was asked to report whether he/she had been unwell in the last 15 days as a proxy measure of the patient's health status and a variable on the reason for the visit was included. The measure on whether the patient had been unwell had relatively stronger predictive power in the model runs and was used for the regression analysis. The reason for visit variable was used in the regression to correct for endogeneity.

Socioeconomic information included whether the patient had education, was employed, whether the patient lived in a rural or urban setting, whether the patient had private health insurance and the number of members living in the household.

An indicator for wealth or income was drawn from the households' expenditure as no direct income information was collected.

Patients reported on their OOP costs related to the hospitalisation. All non-hospital related expenditure was also collected and included transport (other than ambulance) and lodging charges of escorts. Hospital and non-hospital related expenditure were summed together for each hospital visit. This expenditure information was transformed into logs to account for non linearities in the data. Data on whether the patient was treated in a public or private setting was incomplete and was excluded from the analysis. All expenditure and income variables were converted to US$PPP. The 1995-96 expenditure data was converted into 2004 US$PPP.

To address potential endogeneity issues the predicted hospital expenditure per visit was averaged across each state in India. This measure was used because it was the most robust to the model specification. The predicted hospital expenditure was calculated by regressing log hospital expenditure against age, sex, employed, education, urban or rural setting, insurance, log household expenditure and the reason for the visit. The reason for the visit was divided into whether it concerned a chronic condition or related to an infectious condition.

8.3.2 EMPIRICAL SPECIFICATION

The first stage of analysis involved running the regressions of total hospitalisations against the following regressors using the count data models.

The regression model is defined as follows for individual *i*:

$$Y_i = \beta_i + X age_i + X age^2{}_i + X sex_i + X ailinglast15days_i + X education_i + X employed_i + X maritalstatus_i + X householdsize_i + X urban_i + X healthinsurance_i + X \log household\exp enditure_i + X \log predicted\exp enditure_i + X statedummy_i$$

The variables chosen for analysis had two aims. First, the selection was intended to be consistent with the previous chapter's analysis for comparative purposes. Second the variables identified were in part based on health economic theory and in part based on determinants found to be significant from the literature. Empirical analysis was also dependent on variables available in the data set and included information on the patient's health status, utilisation and socioeconomic information.

The expected relationship between the dependent variable of total hospitalisations and the regressors draws from literature findings. These are also set out in the table below.

Table 8.3 - Expected signs of regressors

Variable	Expected Sign
Age	+
Sex	+/-
Ailing in the past 15 days	+
Education	+
Employed	+
Marital status	+/-
Insurance	+
Urban	+/-
Household expenditure	+
Predicted expenditure	-
State dummy	+/-
Reason for visit	+/-

Utilisation of hospital care should increase with age. The age term was also squared to address potential non-linearities in the data. Those with poor health status (variable of those ailing) would suggest that those patients would be more likely to be hospitalised. The effect of education and employed is expected to be positive on the probability of seeking care. Health insurance should have a

positive effect on the probability of seeking care. The effect of household expenditures should have a positive effect while high OOP should have a negative effect.

Women are more likely to seek care due to child related health needs but the evidence in the literature is mixed. Similarly the effect of marital status is ambiguous on the probability of seeking care. Household size is ambiguous and may be a proxy for capturing wealth of a household. The effect of the urban dummy variable is ambiguous as well.

In the inpatient data set the state dummies were not grouped together because their standard errors were reasonable. This did not allow for the waves to be pooled together because the geographical boundaries changed in the 2004 wave, resulting in three newly created states. For this reason, the regressions were run separately for each wave. The state dummies aim to account for the heterogeneity in the cross sectional dataset so the direction of the sign of these dummies *a priori* is ambiguous. The dummy that captures the reason for visit (chronic or infectious) was included but the direction of the sign of this dummy *a priori* is ambiguous. Estimations were run with and without sampling weights but the results were consistent. Estimates without sampling weights are presented below.

8.4 RESULTS

8.4.1 DESCRIPTIVE STATISTICS

The data set for the 1995-96 wave consisted of 630,590 observations and the 2004 wave consisted of 385,607 observations. The regressions were run using STATA software.

The table below provides the descriptive summaries of the variables used.

Table 8.4 - Descriptive Statistics

Variable	Description	1995-96 Mean	2004 Mean
Age	Age of adult patient	24.8	27.4
Sex	1 if patient is male and 0 otherwise	0.51	0.51
Marital status	1 if married or cohabitating and 0 otherwise	0.49	0.51
Ailing15days	1 if ailing in the last 15 days leading up to survey and 0 otherwise	0.06	0.09
Reason for visit	1 if non-infectious ailment, 0 if infectious ailment	0.68	0.65
Hospital stay	Number of days in hospital	1.28	1.23
Education	1 if patient has primary education or a higher and 0 otherwise	0.39	0.45
Employed	1 if patient is working and 0 otherwise	0.35	0.35
Urban setting	1 if patient lives in an urban setting and 0 otherwise	0.40	0.35
Health insurance	1 if patient has health insurance and 0 otherwise	0.01	0.004
Household size	Number of members living in the household	6.55	6.52
Household expenditure	Previous month's household expenditure (US$PPP)	213.48	270.28
Predicted OOP expenditure	Predicted hospital expenditure (US$PPP)	16.62	57.47

The descriptive statistics suggest that the adult population average age is around 25 years. The sample has relatively even split between men and women and between married and non-married individuals. Between 35 to 45% of individuals in the sample are employed, live in urban settings and have at least primary

education. A small proportion have insurance and were unwell in the past 15 days before the survey was taken. About two thirds sought care due to a non-infectious condition. Patients averaged around a 1 day stay in the hospital to a maximum of 11 days (1995-96 wave) and 9 days in the 2004 wave. Information on medicine expenditure was available only for the 2004 wave which shows that the average cost related to medicines was greater than all other medical expenditure incurred in the hospital.

Average expenditure in 1995-6 was around US$PPP 16.00 and around US$PPP 57.00 in 2004. Across states average inpatient expenditure varied from US$PPP 15.71 (Arunchal) to US$PPP 148.21 in Chandigarh in 2004; and from US$PPP 2.00 (Andaman Nicobar Islands) to US$PPP 32.00 (Delhi) in 1995-96 as shown below.

Figure 8.1 - Average inpatient expenditure (US$PPP), 2004

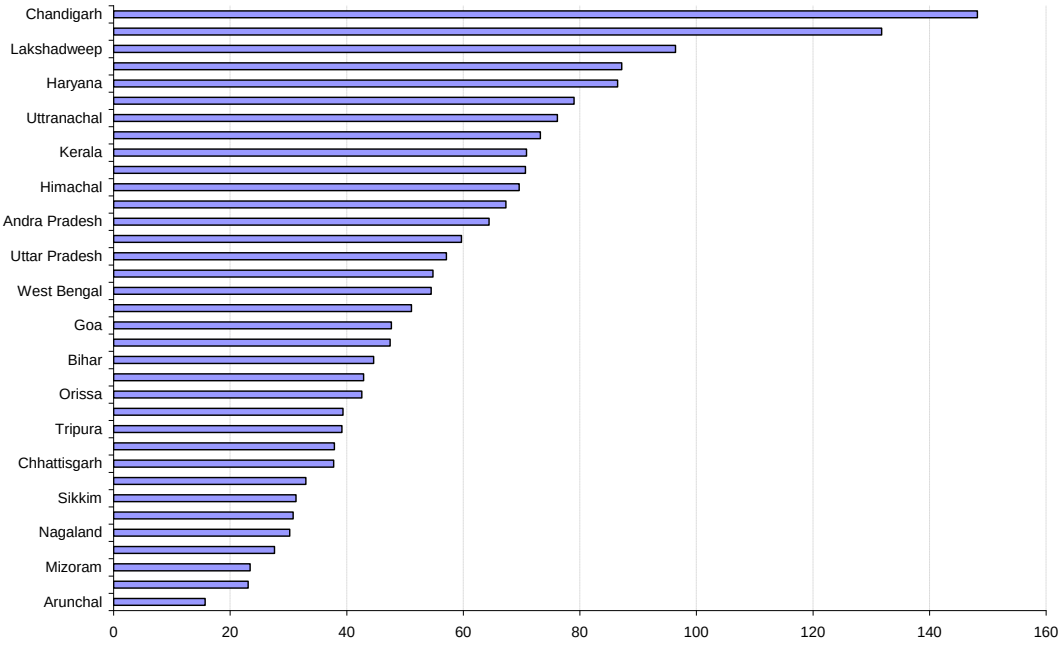
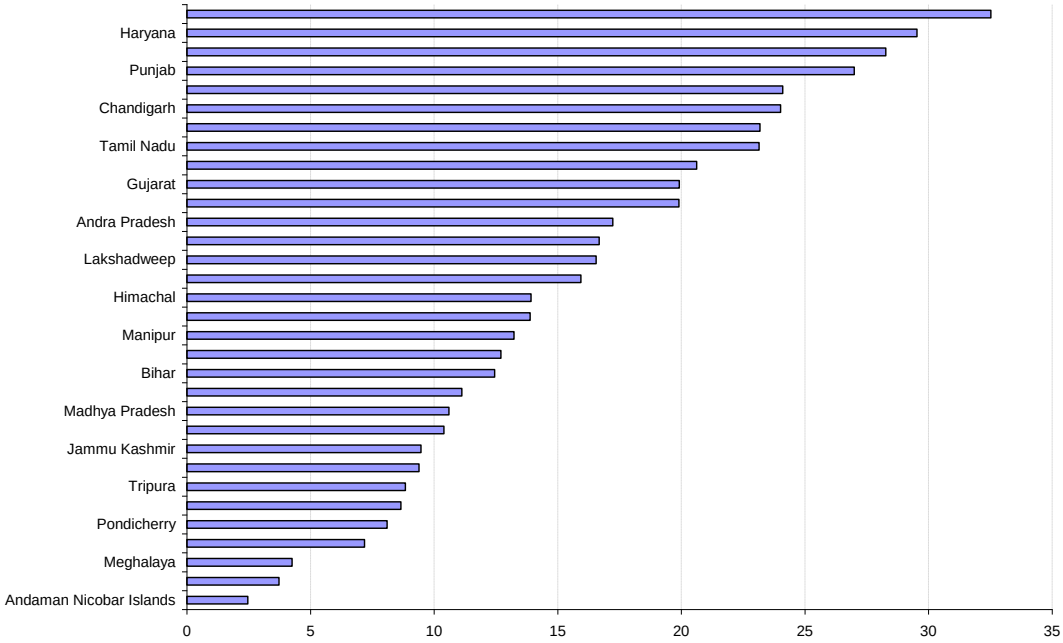


Figure 8.2 - Average inpatient expenditure (US$PPP in 2004 dollars), 1995-96



8.4.2 COUNT DATA MODELS

Count data models are a useful starting point for this analysis. Regression results from four types of count models are presented: Poisson, negative binomial (NB), zero-inflated Poisson (ZIP) and zero-inflated negative binomial (ZINB). The results from the count data models are presented below.

Table 8.5 - Count data regression results for 2004 wave

Regressor	Poisson	NB	ZIP	ZINB
Age	0.02188***	0.01872***	0.01807***	0.02629***
Age^2	-0.00021***	-0.00016***	-0.00016***	-0.00031***
Sex	0.29887***	0.28156***	0.26140***	0.38794***
Marital status	0.49478***	0.50342***	0.48508***	0.38047***
Ailment past			1.52163***	
15 days	1.57002***	1.56167***		1.07421***
Education	-0.04743***	-0.04316***	-0.04253***	0.04008**

Employed	-0.30098***	-0.29854***	-0.28203***	-0.27300***
Urban setting	-0.06043***	-0.04612***	-0.04580***	-0.04949***
Health insurance	0.29671***	0.35904***	0.29091***	0.15703**
Household size	-0.06108***	-0.06272***	-0.05998***	-0.03930***
Log house expenditure	0.19910***	0.17365***	0.17541***	0.28662***
Log predicted expenditure	-0.13044***	-0.13852***	-0.12984***	-0.10676***
Constant	-3.31622***	-3.09877***	-2.46496***	-3.49796***
N	385607	385607	385607	385607
Pseudo R^2	0.1094	0.0840		
Chi-sq.	29608.00	21625.25	21698.65	3828.20
Log likelihood	-120484.62	-117955.54	-118774.8	-117087.9
Alpha		1.47494		
LR test alpha		5058.15***		
Vuong test			22.52***	20.24***

Note: *** p<0.01, ** p<0.05, * p<0.1

Overall, most of the coefficients are generally consistent across the various models. Those who have insurance are more likely to seek inpatient care which implies that income is an important determinant. Other factors include gender, those who are married, and unwell. Those who are educated, employed, living in urban areas and come from small households are less likely to seek inpatient care. The age variable was close to zero and positive but the age square term was negative. These results do not give a clear pattern of the effect of age when controlling for other factors and appear to be specific to the sample.

The price elasticity estimates are roughly similar in magnitude and range from -0.13 to -0.10. These findings are consistent with results found in the literature and suggest that demand for inpatient care is inelastic.

The specification of the Poisson model is assessed using the RESET command in STATA with the following calculation: chi-sq of 43.94 with a p-value of 0.00. The result shows strong evidence of rejecting the null hypothesis of the Poisson model. Overall the standard Poisson model is rejected for a more robust modelling approach.

The negative binomial (NB) regression assumes a Poisson-like process but this model allows for greater variation than found in a Poisson model, which is referred to as over dispersion. The likelihood-ratio test of the over dispersion parameter, alpha, rejects the null hypothesis of the Poisson model with a chi-sq of 5058.15 and a p-value of 0.00.

The zero-inflated poisson (ZIP) regression aims to adjust for the zero observations in the data by giving more weight to the probability that the count variable equals zero. This estimation approach divides the population into users and non-users. In this model, the ZIP is preferred over the standard Poisson. The Vuong test shows a z score of 22.52 with a p-value of 0.00.

The zero-inflated negative binomial (ZINB) model combines the features of the negative binomial with the zero-inflated model. The Vuong test prefers the ZINB over the NB with a z score of 20.24 on all the regressors. Similar results are shown for 1995-96 in appendix F.

These regressions are a useful starting to point to assess model specification of count data. The results suggest that a more developed model should be applied to the data. The next section uses the two part hurdle model to model the decision to seek inpatient care.

8.4.3 TWO PART HURDLE MODEL

In a two stage model for analysing health care use, the first stage of the Hurdle model regression determines the probability of hospitalisation occurring. The

dependent variable is 1 if the patient had a hospitalisation and 0 otherwise. The same regressors were used in both stages of the model.

The first stage regression was run and these results are presented in the first column. The second stage regression truncates the data for those with only positive values for hospitalisations. The dependent variable is the total number of hospitalisations, the same variable as that used in the count data models in the previous section. These results are shown in the second column.

The elasticity results are shown in the third column. The results are presented in the table below for the 2004. Appendix F contains results for the 1995-96 wave.

Table 8.6 - Results Two Part Hurdle Model 2004

Regressor	First stage Y=1,0 hospitalisation 2004	Second stage Y= number of hospitalisations 2004	Elasticities 2004
Age	0.02335***	0.00265**	0.00265**
Age^2	-0.00021***	-0.00002*	-0.00002*
Sex	0.32148***	0.03512***	0.03512**
Marital status	0.4475***	0.00453	0.00453
Ailment past 15 days	1.61468***	0.18364***	0.18364***
Education	-0.06321***	-0.00988	-0.00988
Employed	-0.33745***	-0.05312***	-0.05312***
Urban setting	-0.07538***	-0.00852	-0.00852
Health insurance	0.36386***	0.00594	0.00594
Household size	-0.06323***	-0.00369*	-0.00369*
Log house expenditure	0.16374***	0.05416***	0.05416***
Log predicted	-0.15057***	-0.11461**	-0.11461**

expenditure			
Himalchal	0.23435**	0.13107**	0.13107**
Punjab	0.03283	0.12056	0.12056
Chandigarh	0.14846	0.05319	0.05319
Uttranachal	0.26707*	0.10512	0.10512
Haryana	0.18274**	0.21061***	0.21061***
Delhi	-0.38681***	-0.05593	-0.05593
Rajasthan	0.15262**	0.15643**	0.15643**
Uttar Pradesh	0.02294	0.09825*	0.09825*
Bihar	0.05600	0.02130	0.02130
Sikkim	0.15328*	0.00208	0.00208
Arunchal	-0.09262	-0.12629*	-0.12629*
Nagaland	0.21987**	-0.06966	-0.06966
Manipur	0.12680*	-0.00979	-0.00979
Mizoram	0.10327	-0.11567*	-0.11567*
Tripura	0.02398	-0.17314**	-0.17314**
Meghalaya	-0.11265	0.01150	0.01150
Assam	-0.17452***	-0.10559**	-0.10559**
West Bengal	0.07806	0.03950	0.03950
Jharkhand	-0.13015**	-0.00629	-0.00629
Orissa	0.22229***	0.07071	0.07071
Chhattisgarh	0.06979	0.12478**	0.12478**
Madhya Pradesh	0.17967***	0.09511**	0.09511**
Gujarat	0.20293***	0.11528**	0.11528**
Daman	0.40709***	0.24809**	0.24809**
Dadra	0.33269**	0.03062	0.03062
Maharashtra	0.25404***	0.13920***	0.13920***
Andra Pradesh	0.22013***	0.10843**	0.10843**
Karnataka	0.19306***	-0.00836	-0.00836
Goa	0.23299*	0.11742	0.11742
Lakshadweep	0.08981	0.09096	0.09065
Kerala	0.20700***	0.21271***	0.21271***
Tamil Nadu	0.30075***	0.02277	0.02277

Andaman			-0.09777
Nicobar	0.22911*	-0.09777	
Constant	-3.23445***	0.37558	
N	385607	31860	
Pseudo R^2	0.0974	0.0092	
Chi-sq.	21421.55	686.26	
Log likelihood	-99237.087	-37054.45	

Note: *** p<0.01, ** p<0.05, * p<0.1
Note: State dummies are relative to the state of Jammu Kashmir
Note: STATA dropped observations from the state of Pondicherry (1,208 observations) due to collinearity.
Note: Three new states were created when the 2004 wave was conducted. In the 1995-96 wave these states belonged to the following: Chhattisgarh was part of Madhya Pradesh, Jharkhand part of Bihar, Uttranchal was part of Uttar Pradesh.

Column two shows a positive effect of being male, married, poor health, having insurance and household expenditure on the probability of having a hospitalisation. Those with education, the employed, living in urban areas and from small households have a negative effect on the probability of visiting the hospital. Column three shows that conditional on having at least one hospitalisation, the expected number of hospitalisations increases with being male and household expenditure, while the effect of being employed and small household size has a negative effect. The effect of age is unclear as the coefficient is positive but quite close to zero while the age squared term is negative and close to zero. The predicted hospital expenditure is negative in both regressions. The elasticity result is presented in the fourth column and shows the elasticity is –0.11, which is negative and inelastic.

The regulation dummies for the states show mixed results. The dummy effects should be interpreted with caution. The majority of the states (21 out of 35) have a positive effect on seeking inpatient care, 6 out of 35 have a negative effect and the remaining were not significant as shown below. The states with a positive effect on hospitalisation consist of (but not exclusively) wealthier states such as Kerala, Karnataka, Maharashtra, Rajasthan, Tamil Nadu while some of the smaller states were negative or not significant.

Table 8.7 - State regulation dummy effects of two part hurdle model

Positive	Negative	Not significant
Himalchal, Uttranchal, Haryana, Rajasthan, Uttar Pradesh, Sikkim, Nagaland, Manipur, Orissa, Chhattisgarh, Madhya Pradesh, Gujarat, Daman, Dadra, Maharashtra, Andra Pradesh, Karnataka, Goa, Kerala, Tamil Nadu, Adaman Nicobar Islands	Delhi, Arunchal, Mizoram, Tripura, Assam, Jharkhand	Punjab, Chandigarh, Bihar, Meghalaya, West Bengal, Lakshadweep

The results for 1995-96 are similar to 2004 wave (Appendix F). The results show that in column two, being male, married, poor health, and household expenditure have a positive effect on the probability of having a hospitalisation. Those with education, employed, living in urban settings, having insurance and small households have a negative effect on hospitalisation.

Conditional on having at least one hospitalisation, as shown in column three, the expected number of hospitalisations increases with poor health and household expenditure, while the effect of living in an urban setting has a negative effect. The effect of age is unclear as the coefficient is positive but quite close to zero while the age squared term is negative and close to zero in the first stage regression and insignificant in the second state. The predicted hospital expenditure is negative in the first regression and positive in the second regression. The elasticity result is presented in the third column and shows the elasticity is 0.03 which is positive and inelastic (significant at the 10% level).

The elasticity results from the simple count and two part models are broadly consistent with literature findings (-0.13 to 0.03). The results from the MNL and nested model are mixed (-0.19 to 0.63). In particular the results for clinic and self-treatment are counterintuitive which could be due to misspecification or other

factors not captured in the model. A review of the computed elasticities from the empirical analysis in this thesis is presented below.

Table 8.8 – Summary of elasticity results

Model	Key Assumptions	Sample	Description	Elasticity
MNL	IIA and IID hold	Cross country (Chapter 5)	Patient expenditure	-0.19 (hospital) 0.11** (clinic)
MNL	IIA IID hold	India (outpatient) (Chapter 7)	Patient expenditure	-0.16*** (public) -0.17***(private) 0.16* (self)
Nested	IIA and IID do not hold within nests. IIA and IID hold across nests	Cross country (Chapter 5)	Patient expenditure	0.03 (hospital) 0.63 (clinic)
Nested	IIA and IID do not hold within nests. IIA and IID hold across nests	India (outpatient) (Chapter 7)	Patient expenditure	0.26 (public) 0.43(private) 0.01(self)
Simple count models	Unobserved heterogeneity due to over dispersion of excess of zeros	India (inpatient) (Chapter 8)	Patient expenditure	-0.13*** to -0.10***
Two part hurdle	Address some of the heterogeneity	India (inpatient) (Chapter 8)	Patient expenditure	-0.11** (2004) 0.03* (1995-96)

	with two part estimation using count models			

Note: *** p<0.01, ** p<0.05, * p<0.1

8.4.4 LIMITATIONS

There are limitations with the analysis that should be highlighted. First, there could be a problem with causal ordering. The empirical specification used health status based on the previous 15 days while inpatient service use refers to the past year. The measure of health which is used as a predictor post-dates the measure used for the dependent variable. While the use of predicted health expenditure variable aimed to correct part of the endogeneity, not all of the endogeneity could be accounted for. The two-part hurdle model results aimed to partly address this issue by separating the decision to seek care with the frequency of visit. The coefficient sizes of the health status variable, while significant were smaller in magnitude in this model than under the count models presented earlier in this chapter.

Second, the same technique to estimate price elasticities as done in chapter 5 and chapter 7 was used in this chapter: the estimation of price elasticities was based on health expenditure information. Unlike the two earlier chapters which were based on one health visit, the health expenditure information related to all hospitalisations in the past year. An important estimation issue involves a distinction between utilisation and health expenditure. The endogenous relationship between these two variables requires some method to correct for the bias in the estimated coefficients. The method used in this chapter was to estimate predicted health expenditure rather than using actual health expenditure. This approach aimed to purge the disease and socioeconomic effects in the generated price variable. Chapter 7 studied outpatient care and chapter 8 studied inpatient care. Health seeking behaviour in these two settings could be inter-correlated

which cannot be properly captured in the models employed with the predicted health expenditure variable.

While the predicted health expenditure variable is commonly used to eliminate some of the potential bias, not all of the potentially endogeneity could be accounted for. Furthermore, the expenditure information related to only direct health care costs. Indirect costs of seeking care were not collected such as due to ill health, travel, waiting at health care facilities or providing care to family members (McIntyre D et al. 2006). The estimates of predicted health expenditure are therefore lower than the true costs of health care.

Despite using a large dataset, the analysis is based on two waves of cross sectional data which were run separately. The data do not permit a time series analysis, which would shed light on the factors that would affect demand for health care over time or the cumulative effects of illness, access to care and health care spending over time. Panel data, which collects information over time, would have complemented this analysis. This information is important because understanding the dynamic effects between these and other factors (e.g. the loss of income from illness) is particularly important as chronic illness prevalence increases globally (Wagner et al. 2011).

There was incomplete information on whether the patient was treated in a public or private setting due to a large number of missing observations in the inpatient dataset so this information could not be included in the analysis. This information would have provided useful information on health seeking behaviour and how the relative importance of factors varies between provider settings.

The household survey does not adequately capture those with unmet need including those who needed care but did not avail themselves of services and those who sought care but did not find their needs were properly met. The data are also not able to adequately capture information on adherence which would give a more complete picture on access. The data do not collect information on all members of the household and thus may misclassify households with respect to need and access (Wagner et al. 2011).

The data only capture those who presented themselves to the hospital for treatment. Information on the reasons why those who sought care but did not get it or those who chose not to visit a hospital was not collected. Therefore these aspects of unmet need were not captured. Information on their circumstances and the factors that affected this sub-sample of patients would provide useful information on those who chose not to present themselves to the health care system, which is of important policy relevance in these settings where alternate treatment practices (e.g. Ayurveda) are widely followed. Information on traditional medicine practices and their relationship with the uptake of western medicines would have provided a more nuanced discussion on medicine consumption in these settings. For instance, it would have been useful to have information on whether western medicines are viewed more as complements than substitutes, and whether that varies depending on the patient's health condition, socioeconomic circumstances, etc.

The nature of household data provides information from the patient's perspective. This captures useful demand information, but these surveys are limited to capture supply information so these effects cannot be appropriately modelled without the use of administrative data. More information on supply/provider information would better control the supply factors on demand for medicines. At a disaggregated level, these could include density measures of health professionals, number of hospital beds per capita, and number of traditional healers per capita.

The analysis could not capture quality effects because this information was not collected. Quality information is potentially an important determinant of health seeking behaviour but its effect could be partly masked in other variables then this will affect the estimation of the decision to seek care and the relationship between price and quality.

Finally, while the importance of the regulatory environment is tested using dummies, this approach is limited as it cannot account for states differences in greater detail. Even though regulation is accounted for as a dummy variable, discrete policy changes at the state level cannot be adequately captured in the data

such as there are differences in how well states procure medicines according to the WHO/HAI survey (2006). This could potentially mask important information within and across states. Furthermore, non-governmental actors play an important role in procurement in these settings which are not explicitly accounted for in the model and could confound the findings. There could be differences for diseases areas or due to differences in private sector providers or international organisations which could affect the price elasticity of demand. The role of the regulatory environment in these settings would have to be supplemented with more qualitative information so clearer links could be made with the quantitative findings and the policy setting environment. More information on the regulatory environment would shed light on the policy context to better understand patient access to medicines and health care within and across Indian states.

8.5 DISCUSSION AND CONCLUSION

In summary, findings from inpatient care show that gender, marital status, poor health, education, employment, urban setting, and household size are determinants of seeking inpatient care. The expected number of hospitalisations increases with being male and high household expenditure, while the effect of being employed and small household size has a negative effect. As medicine expenditure accounts for a proportion of total health expenditure, these results have implications for patient access to medicines. OOP expenditure has a negative relationship with the probability of seeking inpatient care. The elasticity result is –0.11, which is negative and inelastic. Income is an important determinant for those who sought inpatient care. This is borne out in the survey findings which indicate households experience a loss of income due to inpatient treatment (US$PPP 113 in 1995-6 and US$PPP 72.00 in 2004). The role of regulation at the state level show that state dummies are significant and that state regulation plays an important role in accessing inpatient care.

These findings identify similar determinants for outpatient care from the previous chapter but the significance and size of these coefficients are less when a nested model specification was used. Estimates of price responsiveness in both settings

are inelastic and negative but the findings for inpatient care are more robust than the findings from outpatient care.

It is important to note that two different modelling approaches were used in the Indian case study. This will in part explain the different level of robustness in the results. The modelling approach in this chapter is preferred over the MNL and nested approach in Chapters 5 and 7. This is because a key limitation with these results is that they are based on only one visit. The approach taken in this chapter was to capture multiple visits in inpatient care over the 1 year period and as a result permitted more robust analysis.

This chapter aimed to study the determinants of inpatient care and to measure price responsiveness. Across larger datasets, determinants of demand are consistent with literature findings. The case study on India indicates that patient's demand for care is inelastic and the estimates are within the range of results found in recent literature from India (Borah 2006; Sarma 2009).

While the elasticity estimate for the 2004 was negative and inelastic, there are similar implications for the counterintuitive price elasticity estimate of 0.03 found for the 1995-96 wave as raised in the earlier chapters. This result could in part be due to model misspecification such as the missing indirect expenditure information or bias in the recall period. The recall period, is over a year and could be subject to greater bias than in the earlier chapters. Other reasons could relate to factors that affect the patient's decision to spend money once they decide to visit a health facility. These could be due to cultural factors relating to the relationship between health professionals and patients (e.g. expression of gratitude), the potential demand for additional fees once the patient is at the facility by the health professional, or perceptions of improved quality of care if the patient pays more money once they are at the facility.

While perceived health status is an important factor, there could be elements of perceived health status that this variable failed to capture in the sense that for a given perceived health status, those with lower incomes (proxy using household expenditures) are less likely to seek care. The use of the predicted expenditure

variable may not have corrected for the endogeneity between hospitalisations and the health status measure which post-dates the dependent variable. Another approach would be to examine the effect of hospitalisations over a one-year period on health at the end of the year (a form of health production function).

Furthermore, while household expenditures are the common proxy for income in these settings, this variable may not appropriately capture differences in true income between households. This variable will also be biased by the data sample for those with unmet need that were not included in the analysis which could bias this proxy of the income variable. Such factors could therefore mask the true relationship between price and the health visit.

Another approach would be to estimate price elasticities for each state separately and include interaction effects rather than computing one overall estimate for each wave. The approach taken in this chapter and in this thesis was to draw on larger datasets for analysis as previous studies have typically relied on smaller data samples for analysis.

The results of the state dummies indicated that the regulatory environment is an important factor with the majority of dummies having a positive effect on the decision to seek inpatient care. The WHO/HAI dataset indicated that Haryana, Karnataka, Maharashtra, Rajasthan, Tamil Nadu, West Bengal were efficient procurers by international standards. There were variations across states with Tamil Nadu typically being the most efficient. Compared with the regression results, the dummy for West Bengal was insignificant while are others had positive significance. The data do not provide more disaggregate information which would better explain state differences. There could be differences within states and across states which are masked with an aggregate dummy measure.

For instance, another key issue in these settings is that governments are not the only procurers of medicines in low and middle-income settings because the private sector is also an active procurer. Some states could have very high procurement prices and therefore it would be useful to understand the factors which underpin high procurement prices. Procurement efficiency could be an

important predictor in the model but since this information was not available at a more disaggregate measure, the dummy variable could confound the results. While the descriptive information on procurement efficiency provides some contextual information, the state-level dummy results are therefore limited in their interpretation and would have to be supplemented with more state-level analysis.

The discussion on the policy context in India shows that states vary in their budgets and in capacity to provide health services and to subsidise the cost of medicines. Examples of improving access to medicines indicate that a multipronged policy such as efficient procurement, and training providers reduced the cost of the drugs budget while improving access to medicines.

These findings suggest that government policies could be play an important role such as government drug procurement and price setting in increasing access to medicines. The key challenge for state governments is to address the role and impact of the private sector on access. The private sector is not regulated and patients experience high levels of OOP expenditure in this setting. These issues are further explored in the policy discussion in Chapter 9.

9 Chapter 9 Conclusion, policy discussion, thesis limitations and future research

9.1 INTRODUCTION

This thesis explored the issue of access to medicines in developing countries. The analytical approach studied the determinants of health seeking behaviour and price responsiveness. The aim of this thesis was to contribute to the evidence base by drawing on larger and new data sources for empirical estimation. The empirical work set out in this thesis met the thesis research objectives. The thesis findings and contribution are summarised below.

The first stage of analysis considered price responsiveness of government procurement across a cross section of low and middle income countries. The next stage of analysis estimated the determinants of health seeking behaviour and price responsiveness across a sample of households in developing countries. The final stage of empirical work explored the same issues using India as a case study. This thesis hypothesised income is an important determinant of access to medicines and health care at the individual level which suggests that the poor will have access problems relative to the wealthy. Furthermore, the expectation of a high level of expenditure reduces the propensity to consume (which implies a negative price elasticity). The findings confirm this hypothesis. There are three key findings from the analysis to highlight: income is a determinant of health seeking behaviour at the patient level; patient demand for health care gives a mixed picture and is inelastic in some cases and suggests that other factors affect health seeking behaviour due to the counter-intuitive results; and that regulation could have a positive effect on access. A summary of the computed elasticities is presented below and discussed in the subsequent sections.

Table 9.1 - Summary of elasticity results

Model	Key Assumptions	Sample	Description	Elasticity
MNL	IIA and IID hold	Cross country (Chapter 5)	Patient expenditure	-0.19 (hospital) 0.11** (clinic)
MNL	IIA IID hold	India (outpatient) (Chapter 7)	Patient expenditure	-0.16*** (public) -0.17***(private) 0.16* (self)
Nested	IIA and IID do not hold within nests. IIA and IID hold across nests	Cross country (Chapter 5)	Patient expenditure	0.03 (hospital) 0.63 (clinic)
Nested	IIA and IID do not hold within nests. IIA and IID hold across nests	India (outpatient) (Chapter 7)	Patient expenditure	0.26 (public) 0.43(private) 0.01(self)
Simple count models	Unobserved heterogeneity due to over dispersion of excess of zeros	India (inpatient) (Chapter 8)	Patient expenditure	-0.13*** to -0.10***
Two part hurdle	Address some of the heterogeneity with two part estimation using count	India (inpatient) (Chapter 8)	Patient expenditure	-0.11** (2004) 0.03* (1995-96)

	models			

Note: *** p<0.01, ** p<0.05, * p<0.1

Before moving onto the summary of the empirical findings, it is useful to provide a summary of the contribution of this thesis. First, this thesis used information on medicine expenditure in its analysis of health seeking behaviour because empirical work on medicine related information is limited. Second, existing studies are largely drawn from small sample sizes of regions or districts, confined to either specific rural or urban areas. This thesis carried out analysis over country level data sets to understand health seeking behaviour and price responsiveness across rural and urban settings. Third, this thesis contributes to the evidence base to address endogeneity issues related to health expenditure and health seeking behaviour. The findings provide empirical estimates of price elasticities and identify the main determinants of health seeking behaviour.

We now turn to a summary of the thesis findings from each of the analytical chapters in sections 9.2 to 9.4. Section 9.5 moves to a discussion on the policy implications and recommendations of each of the analytical chapters and finally section 9.6 provides a discussion on the limitations of the analysis in this thesis and implications for future research.

9.2 CONCLUSION OF CHAPTER 4 – ANALYSIS OF PRICES PAID BY DEVELOPING COUNTRIES

Chapter 4 took a first step to study prices of medicines in low and middle-income countries. This was an exploratory exercise and so the results should be viewed as suggestive. More robust data on prices and volume would be required to carry out sophisticate analysis of price elasticities based on government procurement data. Due to data constraints, a different approach was used for measuring elasticities than the common approach in the literature drawing on the Ramsey pricing rule because volume information was not available. The dataset was the first of its

kind to provide comparable pricing information on medicines across a sample of developing countries.

Estimates on price elasticities suggest that governments in developing countries are responsive to the prices of medicines. Price elasticities range from -1 to -2 across therapeutic products and countries. This implies that if the procurement price increases by 1%, demand for the drug could drop by 1% to 2%. This implies that developing countries are fairly responsive to changes in the price of medicines and if these estimates represent a good first approximation, as expected, certainly more so than high income countries (Dzator and Asafu-Adjaye 2004; Goldman, Joyce et al. 2007). There is weak evidence, however, that price elasticities are correlated with income (GDP as a proxy).

9.3 CONCLUSION OF CHAPTER 5 – CROSS COUNTRY ANALYSIS OF PATIENT ACCESS TO MEDICINES AND HEALTH CARE

Chapter 5 began the analysis at the patient level to study determinants of access to medicines and health care. This chapter used household level data from the World Health Organization World Health Survey. The dataset contained one wave of household information from 35 developing countries. This dataset provides a more comprehensive picture of demand for care than previous studies, which relied on smaller data set samples from specific countries or regions within a country. Expenditure data contained useful information about the costs individuals incurred for inpatient or outpatient care. Typically, costs of medicine expenditure accounted for the majority of costs incurred so the estimate of price elasticity also captures the effect of medicine expenditure on the demand for seeking care. The endogenous nature of expenditure data was first regressed against socio-economic variables and the reason for visit. The predicted expenditure estimates were then averaged over rural and urban settings within each country and then this variable was used in the regression analysis.

Two econometric approaches were applied to the data. First the MNL model was applied. The results suggest that households with high expenditure (i.e. a proxy

for income) and insurance are more likely to seek care. These results suggest that the poor will have greater access problems relative to the wealthy. Furthermore, women, married adults, poor health status, those in urban settings, and the educated are more likely to seek care if they are ill. Those with better health and living in smaller households are less likely to seek care. These results seem intuitive and highlight that the poor and the sick will have greater access problems than the wealthy.

Hospital visits attracted those with asthma, heart disease, bodily injury, minor surgery, for child birth or other reason not specified. Those visiting clinics were for antenatal or dental care reasons. These results seem to capture the main types of services that hospitals and clinics provide. Price elasticity's ranged from –0.19 (hospitals) to 0.11 (clinic, 5% significance). The price elasticity estimate for hospitals, however, had an insignificant p-value.

The second modeling approach used a nested logit analysis. This approach was used to address the IID (error terms are independent) assumption and the IIA (ratio of probabilities are independent of other choices) property, both of which were violated in the MNL model. The regression results were consistent with the MNL, which indicated similar determinants for seeking health care demand. Price elasticities were 0.03 (hospital) and 0.63 (clinic) but were statistically insignificant.

The price elasticity estimates provide some evidence of inelastic demand. The price elasticity result for hospitals in both modeling approaches is inelastic and within the range found in the literature (-0.11 to 0.03). The estimate from the MNL model, however, does not have a significant p-value. The estimates for clinic are counterintuitive as they are positive (which suggests that patients increase use of services as costs increase). These results are not conclusive. Two possible reasons for this result are either due to estimation problems with the data used or patients are not sensitive to price but face other access problems that are not captured in the model due to a variety of other factors not captured in the model such as informational constraints and cultural factors.

The country dummies which aimed to capture the effect of regulation had an effect on the likelihood of seeking care for those that are ill. Results of the following countries showed positive effects on seeking care: Bangladesh, Bosnia and Herzegovina, Côte d'Ivoire, Congo, Dominican Republic, Ghana, Guatemala, India, Mauritania, Malawi, Namibia, Pakistan, Paraguay, Sri Lanka, and Zambia. Research into understanding the regulatory environment in these countries is a potential area of future research to provide evidence on best practices. Furthermore the countries which had negative or non-significant effects offer other potential areas of future research as they would provide insight into their policy challenges and potential areas for reform.

9.4 CONCLUSION OF CHAPTER 7 AND CHAPTER 8 – ANALYSIS OF PATIENT ACCESS TO MEDICINES AND HEALTH CARE IN INDIA

The Indian country case study extended the analysis at the patient level. India provided a useful case study for four mean reasons. First India procures medicines relatively efficiently according to international procurement prices which may imply that medicine prices are affordable to patients. Second households incur high OOP health care costs which could create problems for patient access to medicines and health care. Third, analysis from Chapter 5 indicated that the Indian dummy for regulation had a positive effect on access. Finally data for India come from a well-developed national household survey questionnaire consisting of two waves of data from 1995-96 and 2004. Separate analysis was carried out for outpatient care and inpatient care.

In Chapter 7, the analysis on outpatient care consisted of utilisation data for one visit. The first stage of analysis applied a MNL model. The findings from the MNL model indicate that determinants of health seeking behaviour include poor ill, marital status, urban/rural setting, log household expenditure, log predicted expenditure and regional dummies. Next a nested model was run. The model found that fewer regressors are significant but these are consistent with the MNL and include marital status, education, household and OOP expenditure except for

household size which was only an important determinant in the nested model. Price elasticity estimates ranged from -0.17 to -0.16 (1% significance), and 0.16 (10% significance) with overall range from -0.17 to 0.43.

In chapter 8, the analysis on inpatient care consisted of count data. The nature of count data resulted in two different modelling approaches from the previous empirical chapters. As a first stage of analysis, simple count models were used and included the Poisson, negative binomial (NB), zero-inflated Poisson (ZIP) and zero-inflated negative binomial (ZINB). The second approach applied the Hurdle model, which separately models the decision to seek care from the frequency of care.

The regression results from the simple count models indicated that those who have insurance are more likely to be hospitalised. The educated, employed, and those from small households are less likely to be hospitalised. These finding suggests that the poor will have access problems relative to the wealthy. Individuals who already have an existing ailment, married individuals, men and those living in urban areas are more likely to be hospitalised. State level dummies indicate that regulation has an effect on the demand for inpatient care. Elasticity estimates range from -0.13 to -0.10 (1% significance). These estimates are consistent with literature findings and indicate that demand is inelastic.

The two-part model showed similar results. The determinants for inpatient care indicate that, those with insurance and high household expenditure are more likely to have a hospitalisation. The educated, the employed, those in urban areas and from small households are less likely to have a hospitalisation. Similar to the previous models, these findings suggest that the poor will have access problems to inpatient care. Those who already have an existing ailment, men, and those who are married, are more likely to have a hospitalisation. Conditional on having a hospitalisation, the expected number of hospitalisations increases with high household expenditure and being male, while the effect of being employed and coming from a small household has a negative effect. The price elasticity estimates range from –0.11, at 5% significance (2004 wave) to 0.03 at 10% significance (1995-96 wave) which are similar to the results found in the

literature. The most significant results are intuitive with a negative sign but are at the lower of the range found in the literature. The results indicate that demand for inpatient care in India is inelastic. The state dummies aim to account for heterogeneity and in part reflect the regulatory environment. The results indicate that regulation plays a role on the decision to seek inpatient care.

Most states showed positive effects on seeking care. Some of these states in particular have shown strong regulatory practices (Kerala, Karnataka, Maharashtra, Rajasthan, and Tamil Nadu). The WHO/HAI survey found that the state of Tamil Nadu in particular have very efficient procurement practices relative to the others (WHO/HAI 2006). Qualitative research into understanding the regulatory environment in these states is a potential area of future research to provide evidence on best practices. Furthermore the states which had negative or non-significant effects offer other potential areas of future research to identify areas for policy reform.

The Indian case study was an important aspect of the empirical work of this thesis because these findings provide implications for the policy context in India. While India has very high OOP relative to other developing countries, some elements of its pharmaceutical environment are developed (e.g. procure medicines at relatively low prices). The findings from this analysis identify policy recommendations which could be relevant to other developing countries because they all face similar pharmaceutical policy challenges. These issues are further explored in section 9.5.

9.5 POLICY IMPLICATIONS OF ANALYTICAL CHAPTERS

The policy implications that arise from the analysis are now discussed. First the discussion considers the high level macro and micro level issues in 9.5.1, then a discussion of pharmaceutical regulation from the demand and supply side is presented in 9.5.2 and 9.5.3 and then specific policy proposals for the Indian case study are presented in 9.5.4.

9.5.1 HIGH LEVEL ISSUES

The empirical findings have important policy implications. The most significant price elasticity results are intuitive with a negative sign but are relatively inelastic and are at the lower range of the literature. These inelastic estimates do not suggest that high user fees could be a policy response for revenue generation. Rather, they suggest that the already high level of OOP indicate that any policies to increase OOP are regressive for households as demand for health care is a necessity. The implication for government is that policies to lessen the burden on households should be pursued.

In this section we first turn to address the high level issues relating to patient access to medicines and the design of pharmaceutical polices. The empirical work of this thesis helps to identify three principles that should underpin the policy design.

First, from a policy perspective, the design of pharmaceutical regulation should be done within the context of overall health system goals. There are always trade-offs with cross-cutting policy goals such as efficiency and equity.

Second, a key challenge with pharmaceutical regulation is to balance health policy objectives with industry goals. A government's main pharmaceutical policy objectives include obtaining a reasonable price for medicines, or maximising static-efficiency, which in the health context means minimising costs for a given level of health outcomes, ensuring their availability to their citizens and offering an environment to the pharmaceutical industry that provides incentives for R&D and investment in drugs that their populations may require. Equity in this context involves fairness with respect to patient access to medicines. As already discussed, access to medicines is a multidimensional concept and many factors influence it.

A firm's main objective is profitability. Two key constraints that affect a firm's profitability are the range of demand side measures in place which include pricing

and reimbursement policies by the public buyer and the threat of international leakages which include reference pricing constraints and the threat of parallel trade.

Third, pricing policies are an integral part of overall pharmaceutical regulation. The value of the medicine with respect to the health benefits they bring to patients should inform pricing decisions. Cost effectiveness analysis (CEA) is an important policy lever in this respect. CEA determines value for money of the new treatment relative to an appropriate comparator. This method aims to capture the health benefits of a new treatment that is the value they bring to patients, relative to an appropriate comparator. Value-based pricing (VBP) sends the right signals to firms to invest in areas of patient need and unmet need (OFTb, 2007). VBP rewards firms with socially efficient dynamic incentives. Furthermore, correct price signals would target areas of unmet need addressing equity and fairness concerns. It has recently been announced that the UK aims to use VBP to reward innovation by sending price signals to firms based on therapeutic value (Boseley 2010).

9.5.2 DEMAND SIDE PHARMACEUTICAL REGULATION

There are a number of demand side policy levers relating to pharmaceutical regulation which will have an impact on access to medicines. Furthermore there are also cultural factors including use of traditional forms of medicines. This section, however, discusses the main government policies as they relate to the findings of this thesis: pricing and reimbursement, procurement by the public buyer, and prescribing in primary and secondary care.

The findings indicate that government demand for medicines is elastic and that governments are responsive to the prices of medicines. Evidence suggests that developing countries show varied levels of efficiency with respect to procurement based on international reference prices (WHO/HAI 2006). Pricing and reimbursement decisions are integral to pharmaceutical regulation. There is

currently insufficient information on how developing countries procure and the factors that inform their pricing decisions.

While a number of regulatory hurdles exist, low and middle-income country settings lack the resources to control their markets and enforce their laws, which results in regulatory failure to varying degrees. These include the following: inconsistent enforcement of good manufacturing practices, and good distribution practices could lead to quality problems with drugs that are legally in circulation; and the presence of counterfeit or substandard drugs. There could also be delays in licensing and potential corruption of officials (e.g. officials may ask for a bribe to provide a license); easy purchase of drugs without a prescription; non-existent or insufficient reporting practices creating an inability to recall a faulty product through the distribution system. Informational constraints could result in no easily accessible source for validated information on drugs for professionals, no translation for imported drugs into local languages; and no monitoring or sanctions for unethical practices and clinical trials performed in violation of standards (e.g. without obtaining informed consent from patients) (Seiter 2010).

Furthermore, there could be the issue of corruption around the misuse of funds. In countries with weak public sector governance, funds could be diverted for private gain or used in inefficient ways such as the funds may be spent on overpriced drugs because of rigged procurement processes (Seiter 2010). Low salaries in the public sector may increase vulnerability of the presence of corruption. Weak points include officials who make decisions on registration, licensing, pricing, procurement, and inclusion of drugs on reimbursement lists. For instance corrupt officials could try to leverage their decision-making power for personal gain and as a result, more drug shortages could occur, and quality problems are possible if the procurement process is rigged (Seiter 2010).

Two important regulatory hurdles for governments are the system of pricing and reimbursement (P&R) and procurement practices. Explicit pricing policies are not common place in developing countries. Such policies are involved and incur administration costs (WHO 2004b). The WHO report noted that such costs contribute to the low uptake of adopting pricing policies with only half of all

developing countries have any pricing policy in place (WHO 2004b). Pricing policies, however, affect how well governments procure affordable and quality medicines for their population.

Policy options exist to improve buying power of countries. The short term solution involves the emergence of more international bodies to procure on behalf of countries via bulk purchasing arrangements for a number of countries. In the past, organisations such as UNICEF were a large player in drug procurement particularly in the area of medicines for maternal and child health (WTO WHO 2001). Now there is the emergence of organisations such as the Clinton Foundation which aim to aggressively negotiate drug purchases for HIV/AIDS and malaria on behalf of countries (Clinton Foundation 2010).

Analysis of global antiretroviral prices between 2005 and 2008 found that whether a drug is generic, the socioeconomic status of the country and whether the country is a member of the Clinton HIV/AIDS Initiative influenced the country's ARV prices (Wirtz, Forsythe et al. 2009). Factors which did not influence procurement were HIV prevalence, procurement volume, whether the country is a least developed country or a focus of the United States President's Emergency Plan for AIDS relief (PEPFAR). The authors conclude that a useful strategy to improve procurement efficiency is to benchmark prices (Wirtz et al. 2009). These efforts may go some way to improving procurement practices and are an important aspect of pharmaceutical policy design.

There are long term implications of global procurement efforts. A study which looked at multiple data sources of antiretroviral price transactions found that global initiatives have created efficient markets for older antiretroviral therapies but newer products are less competitive (Waning, Kyle et al. 2010). These authors find that large scale initiatives for procurement may decrease the number of buyers and sellers rendering the market less competitive in the long run.

Therefore an important policy question is whether such short term solutions are sustainable in the long run. The short term solution for in house country procurement is to have adequate knowledge of price information. Developing

countries could benefit from improving their knowledge on price information. Presently a variety of sources of price data exist for countries to draw on this knowledge such as WHO, UNICEF, MSH, IDA Foundation. Formalised agreements with these institutions could assist developing countries to improve their knowledge on prices. Developing countries could benefit from using this information as they improve their skills in demand forecasting for medicines for their populations.

In the long run, it is argued that countries should improve their institutional arrangements so that they exert their own buying power rather than solely relying on international organisations (Danzon 2003; Tetteh 2009). Price discounts can result in low prices but not all countries realise this potential saving (Grace 2003). One policy response is regional buying to secure low prices (Quick JD, Boohene NA et al. 2005). Such an approach calls for aggressive purchasing to maximise price discounts. Policy options include the implementation of confidential tenders so that countries do not know the outcome of other countries' price negotiations for the same drug (Danzon and Towse 2003; Tetteh 2009). Some suggest keeping prices confidential, publishing relative prices, lagged prices or aggregate prices to balance transparency and accountability concerns (Tetteh 2009; Danzon and Towse 2003) rather than publicly disclosing prices which could undermine active industry participation for threat of leakage and parallel trade. These proposals aim to encourage developing countries to exert their own influence on pricing decisions.

An important aspect which is absent in these policy proposals is to include the value of the drug in pricing decisions. This thesis found weak evidence that price elasticities were correlated with income as shown in the exploratory exercise in Chapter 4. This policy proposal is a blunt instrument and furthermore it does not consider the therapeutic effectiveness of a drug. The purpose of VBP is for drugs to incorporate the relative effectiveness of the drug in its price. In the long run, VBP sends correct prices signals to target areas of unmet need addressing equity and fairness concerns while at the same time addressing dynamic efficiency concern (OFT 2007b).

VBP could also inform price negotiations where drugs have no comparator which would particularly be useful for drugs to treat conditions that exclusively afflict low income countries. In this instance, a price premium could be offered to firms (OFT, 2007b). This price premium could use current measures to evaluate the treatment effectiveness of drugs such as Quality Adjusted Life Years (QALYs) to reflect the therapeutic advantage of the drug (OFT, 2007b). Furthermore, in cases where there was insufficient clinical data on the drug's clinical effectiveness, risk sharing agreements could be negotiated between the country and the firm (OFT, 2007b). Once the drug entered the market, pharmacovigilance (phase IV) data could be used to better inform pricing decisions drawing on CEA. Risk sharing agreements are emerging as an appropriate policy response particularly to split the risk between the government and the industry. International organisations could draw on such tools to inform their pricing decisions in the short run. The long term solution is for countries to develop this capacity, as they become more skilled in their negotiations.

This is a regulatory challenge for developing countries as many do not have well developed drug price sources. In the short run, international organisations can draw upon cost effectiveness data from high-income countries. This information would be useful particularly as some drugs are common in both high and low-income settings due to the prevalence of chronic diseases. A variety of pricing approaches are used in high income settings and increasingly CEA is seen as an important element not only in market authorisation but in pricing and reimbursement (OFT, 2007b). CEA could be appropriately adjusted to reflect developing country settings where other factors such as morbidity, mortality, and prevalence could inform such discussions.

Even though pharmacoeconomic analysis currently does not play an important role in policy development in developing countries, external pressures could potentially encourage its uptake (Babar 2010). In particular, the increasing presence of international organisations that work on behalf of developing countries to purchase medicines, assist with procurement, provide donations in the form of freely available medicines are required to follow appropriate accountability and transparency policies. As more multinational firms move into

countries which recognise their IPRs, such firms recognise that rationing will require a prioritisation of health spending and pharmacoeconomic analysis is one policy tool that could demonstrate the clinical effectiveness of their drugs relative to therapeutic equivalents.

Another area that policies could be pursued to lessen the burden of OOP on households is to improve provider incentives. At the provider level, the literature notes that there is mixed evidence on the implementation of guidelines (Homedes, Ugalde et al. 2001b). An important area of policy development is the improvement of national formularies and that they are implemented. The right incentives are required for pharmacies and hospitals to procure medicines such as financial incentives to encourage cost effective prescribing (e.g. flat payment to prescribe the cost effective drug).

Incentives for rational prescribing practices play a key role in securing patient access to cost effective medicines. Pharmaceutical firms employ a variety of techniques to promote their medicines in developing country settings which take the form of gifts (e.g. mobile phone, cars, down payment on property) (Consumer International 2007). For instance, the same medical experts may be used by both pharmaceutical companies and ministries of health in advisory roles that affect drug policy (Seiter 2010). A system which does not have sufficient checks and balances could undermine policies to promote rational prescribing because the information is not balanced but biased towards the firm's drug. Furthermore, the absence and lack of enforcement of clinical guidelines is a barrier to encourage rational prescribing practices. Targeted interventions at GPs can encourage an improvement in this area (Homedes et al. 2001b).

Interventions targeted at health professionals should be multi-pronged beginning during their professional and educational training and continuing in the form of well-developed continuing education practices. Such approaches are typically used in high-income settings. The challenge in developing country settings is to design interventions widely to target not only GPs, but nurses and pharmacists who also play a key role in prescribing. Financial and non-financial incentives should complement one another. Financial incentives could be designed to reward

cost effective prescribing or through pay for performance activities. Evidence from Rwanda shows that pay for performance incentives led to cost efficiencies (Soeters R, Habineza C et al. 2006; Meessen B, Kashala JP et al. 2007). Financial policies have the risk of leading to gaming behaviour and should not be the only policy tool. Non-financial incentives such as continuing education activities, clinical guidelines, licensure and accreditation and revalidation should reward clinical behaviour. Evidence shows that such multi-pronged approaches achieved an improvement in rational prescribing practices (Pagnoni F, Convelbo N et al. 1997; Chaudhury RR, Parameswar R et al. 2005).

9.5.3 SUPPLY SIDE PHARMACEUTICAL REGULATION

There are a number of supply related policies that are important elements of pharmaceutical regulation. While policies related to IP issues and R&D (DiMasi, Hansen et al. 2003; Love and Hubbard 2007) play a very important role, this section discusses issues that are relevant to the thesis findings which include regulation of mark-ups and the system of taxation.

The recent WHO/HAI survey provided an important first step in data collection to analyse the medicine supply chain in the countries sampled. Of particular importance was that mark-ups typically are not regulated and in some countries can vary from 20% to 150% (WHO/HAI 2006), contributing to a larger share of medicine's overall price than the manufacturer's price. For example in Malaysia, mark-ups were higher for generics (46% to 150%) versus branded drugs (27% to 80%) and greater mark-ups were noted for dispensing doctors (129% for originator and 234% for generic) (WHO/HAI 2006). Furthermore, mark-ups in the private sector exceeded those in the public sector. These findings suggest that better regulation and enforcement of mark-ups could reduce the overall retail price of medicines to patients thereby improving access to medicines.

Another key challenge in these settings is that governments are not the only procurers of medicines. The private sector plays a key role as well. Furthermore, a key policy challenge for governments relates to corruption. While most large

pharmaceutical firms have explicit policies against corruption and unethical business practices based on the international codes for ethical marketing, these are less likely to be enforced in countries with weak overall governance (Seiter 2010). This is a particular problem where activities take place on a local level, where smaller firms are less exposed to oversight and more likely to resort to unethical practices. Some examples include using cheaper, lower-quality raw materials, eliminating labour-intensive in-process controls; switching off electricity-consuming air-handling systems and reducing other activities that are part of GMP requirements (Seiter 2010).

There is also evidence that importers collude with foreign suppliers to misreport procurement prices, and with retailers not to apply statutory margins. Pharmacists are reported to adjust prices according to market demand (Russo and McPake 2010; Seiter 2010). These findings are consistent with the body of economic literature which maintains that price controls are not effective policy tools, especially in developing countries (Hongoro and Kumaranayake 2000; Kumaranayake et al. 2003).

An important policy issue that affects mark-ups is taxation (e.g. consumption taxes) and tariffs applied to imported drugs. Levison and Laing (2003) showed that for a select number of developing countries such wholesale and retail margins, taxes and tariffs ranged from 48% to 88%. These authors found that taxes and tariffs alone ranged from about 3% to 39%. In some countries these measures are a significant portion of the mark-ups while in others wholesale and retail mark-ups dominate the contribution to a medicine's final retail price. Therefore, cash strapped developing countries have to balance their fiscal goals with health policy goals and the intended and unintended consequences of such fiscal policies on access to medicines. . A more comprehensive policy making approach is required which considers both demand and supply related factors to address such policy challenges.

9.5.4 POLICY RECOMMENDATIONS FOR THE INDIAN CONTEXT

The findings from the Indian case study highlight that patient demand for outpatient and inpatient care is inelastic. This implies that individuals are not particularly responsive to changes in price. This section discusses the implications of these findings on access to medicines. One reason for the inelastic response could be due to the necessity of medications and also the potential lack of appropriate therapeutic alternatives.

A number of issues arise from the Indian context in light of the finding of inelastic demand. First, households account for the largest share of total health expenditure and medicines account for a large share of household expenditure (55% on average in outpatient care, 38% to 66% in inpatient care). The literature from developing countries notes that the implementation of user charge policies in the face of inelastic demand led to inequities in access to care as utilisation dropped for low income groups. Evidence shows that this generally results with mixed or low effects on quality. Revenue generated from cost sharing does not offset the administration costs, which may or may not have exemptions.

Second, the WHO/HAI (2006) survey indicates that India procures medicines efficiently relative to other low and middle-income countries. The survey also noted that within India, states vary in their relative efficiency of procuring medicines. Government procurement of medicines is an important element to secure affordable prices for their population.

Third, evidence from the WHO/HAI survey suggests that stock availability is poorer in government (public) facilities than in private facilities. Medicines are typically free of charge in public facilities. This should promote access to medicines but public facilities tend to have low stock, which forces individuals to go to the private sector where they must pay for medicines.

Fourth, the private sector is large and unregulated. Retail prices are high due to unregulated mark-ups, which could undermine access to medicines. Distribution networks in the private sector, however, resulted in greater availability of medicines despite high prices.

Fifth, prescribers are aggressively targeted by the industry to promote their medicines. The range of incentives prescribers receive makes it difficult to encourage rational prescribing practices.

Sixth, the current institutional arrangement involves the federal government and states. The highly developed pharmaceutical market in India requires a balance of health policy with industrial policy goals. The current institutional arrangement lacks well-coordinated health policy-making between the federal government and the states. In particular there is a lack of coordination for licensing, and quality control of medicines.

There are many considerations in the design of an effective pharmaceutical policy. These issues highlight the complex and multi-dimensional issue of access of medicines, and that it remains a pressing issue. The following sections explore the policy recommendations in more detail.

Demand side policies

On the demand side, the key policy areas include procurement, licensing and quality control, pricing of medicines, and prescribing practices. These policy areas would benefit from better coordination within government to strengthen information sharing.

In India, government procurement of medicines according to international procurement practices is relatively efficient. This is an important finding but evidence suggests that not all states are efficient in their procurement practices. For instance, the state of Tamil Nadu is reported to have implemented a variety of procedures to improve procurement and quality control such as a two-part tender system, regular reviews of their stock levels to ensure availability of medicines, and quality control checks (World Bank 2000). At the state level, there is scope for state drug authorities to share best practices to improve procurement methods.

The findings of inelastic demand for health care supports the argument that price setting should aim to keep prices low, which will increase expenditure on

medicines and possibly have a positive effect on access to medicines. The health benefits medicines bring to patients could inform the price of the drug. The current pricing policy does not capture this information. The concept of pharmacoeconomics has not come to India because competition has mainly been between generics. As more patented medicines enter the market there could be an increase in pressure to establish value. There may be scope for the NPPA to consider such information to inform its pricing policies.

These approaches are widely used in developed country settings where there is a trend to use information on the benefits that drugs bring to patients to inform pricing decisions (OFT 2007b; Mossialos and Srivastava 2008). Levels of price setting, however, need to consider necessary incentives of the actors involved in the distribution and supply of medicines such as the pharmaceutical sector, pharmacies and health professionals.

Rational prescribing practices can play an important role in improving access to medicines. As the findings from the measures implemented in Delhi indicate, a multi-targeted approach improved access to medicines (Chaudhury et al. 2005). This approach focussed on improved procurement and measures to educate health encourage rational prescribing. Continued efforts are underway by the Delhi Society for Promotion of Rational Use of Drugs (DSPRUD) to educate health professionals which is a welcome step. India has a highly developed generics market so appropriate financial incentives for prescribers should be to distinguish between the cost effective generic versus the more expensive alternatives. Furthermore, the large numbers of health professionals in the private sector should be included in such education efforts. There is scope for state drug authorities to share best practices to improve prescribing practices.

Supply side policies

Policy levers on the supply side could improve access to medicines and include regulation of mark-ups, licensing and quality control. These measures would encourage better coordination, and harmonisation of practices.

A key area which requires regulation enforcement relates to the mark-ups in the supply chain. Mark-ups are unregulated for drugs outside of price control but evidence suggests that even mark-ups under price control also exceeded the regulated levels. Therefore, this sector requires greater government attention to regulate markups and put monitoring systems in place. The WHO/HAI (2006) price surveys found that the private sector had better distribution systems. Given the small size of public budgets, programmes will need to better target the poor and where necessary, collaboration with the private sector may require subsidisation schemes to help the poor to have access to medicines in both public and private sectors. A potential area for policy development would be for the government to increase its collaboration with the private sector and to take advantage of its distribution networks of medicine supply.

Licensing and quality control at the federal level is an important feature of pharmaceutical policy. Even though there are reforms underway at the federal level such as establishing a new central drug authority that would fall under the DCGI to look after standards of medicines and cosmetics, the government will need to continue to be proactive in the development of policy that strengthens key institutions—namely the MOHFW, and the DCGI. Steps for a central drug authority are welcome but the government should aim to secure the support and interest among state level controllers to assist in greater coordination between the centre and the states to improve quality control. Measures to improve transparency in the licensing of manufacturers are necessary.

There is a need for greater coordination between government bodies, such as MOHFW, the DCGI and the Department of Chemicals and Petrochemicals to meet on a regular basis to coordinate their efforts. This could be achieved through joint budgeting arrangements so each institution has a greater incentive in implementation. Such measures should be supported by law with a clear accountability framework.

The implications for India joining the TRIPS agreement are too early to tell the full impact of this policy move (Grace 2005). The pharmaceutical industry is very proactive with the government and it has proposed measures to improve

regulation of quality control. This reason for this approach is likely to remove many of the small scale generic manufacturers which currently pass lax quality control standards.

The growing industry will bring much benefit to the Indian economy but the implications for the poor are less clear. A segment of the industry will be outward looking to penetrate western markets. Clear incentives and fiscal instruments will require that the government improve its regulation of quality control for domestic consumption (i.e. issue licenses that follow GMP and prove quality) and for the exportation of medicines to developing countries as well.

Only 3% of medicines in the Indian market do not have substitutes (ORG-IMS 2007).[33] A McKinsey study projects that in 2015, the market will be worth $20 billion; 10% of the market will consist of patented drugs and 90% will be generic (McKinsey 2007). The high number of competitors may encourage price competition.

Overall, the discussion on pharmaceutical regulation in India indicates that the institutional framework could be improved to better regulate and implement pharmaceutical policies. A number of policy challenges exist, including corruption. A broader approach to pharmaceutical policy making is necessary that considers reform measures from a health systems perspective. This implies a different approach to existing institutional arrangements.

Policy measures should improve regulation and monitoring of the pharmaceutical supply chain distribution, monitor pharmaceutical marketing practices, and incentivise physicians and pharmacists to dispense rationally. Certain policy efforts at the state level have led to encouraging greater access to medicines. There is scope for greater policy exchange with states to share best practices in a variety of policy areas.

[33] The level of substitution could not be confirmed. It is likely that this refers to substitutes at the chemical level.

9.6 LIMITATIONS AND FUTURE RESEARCH

9.6.1 THESIS LIMITATIONS

Limitations of the analytical approach used in this thesis were discussed in the respective chapters. In summary, data constraints did not allow for direct computation of price elasticities as price and volume data were not available and necessitated the imputation of elasticities. This limitation influenced the analytical approaches taken in this thesis. The analysis in the empirical chapters use different data sources which are not exactly comparable but the main issues in each chapter are highlighted.

The analysis in Chapter 4 imputed price elasticities using upstream prices (government procurement prices). While the technique was not based on a sophisticated approach, it was a first attempt based on data availability and was strictly an exploratory exercise. The data were cross sectional so did not allow for time series analysis. This analysis assumes that generic prices are reasonable proxies of marginal cost to apply the Ramsey rule. The lack of volume data required the imputation of price elasticities using the Ramsey pricing rule. The approach taken in this chapter could not model the interaction between government procurement and firm behaviour.

The main limitation in chapter 5, 7and 8 was that detailed medicine information was lacking to measure downstream prices (i.e. patient level). The surveys did not properly capture those who could not seek care to better understand the implications for unmet need. Furthermore, supply information on health providers, settings, quality, appropriateness of care; context was limited because the analysis was from the patient's perspective. Some evidence suggests that individuals may seek care from more than one provider simultaneously (Sepheri and Chernomas 2001) which undermines the choice models used in this thesis. The quantitative approach was limited in measuring the significance of regulation. These chapters drew on cross sectional information as panel data did not exist for analysis.

The analysis could not pick disaggregate difference within and across countries. There could be differences for diseases areas or due to differences in private sector providers or international organisations which could affect the price elasticity of demand. While data are not drawn from very recent waves of data, the findings do have policy relevance for these country settings. More recent data from these countries could fill an important area of analysis.

Despite the thesis limitations, the research objectives were met in each of the empirical chapters. The data were adjusted to meet the modelling assumptions set out in the models used. The implication for the thesis results is that these limitations provide a conservative estimate of price elasticities and are therefore at the lower bound of the range found in the literature. Due to the data constraints, the empirical price elasticity estimates are imputations and it is important to note that they are proxies for the true price elasticities.

9.6.2 FUTURE RESEARCH

The literature on access to medicines in developing countries has been largely devoted to IP issues and patents. These issues are pressing but there are many actors in the pharmaceutical systems and each play an important role in improving access. The recent WHO/HAI data collection efforts, the establishment of organisations such as the Clinton Foundation, the launch of the Medicines Transparency Alliance (MeTA) signal a shift in pharmaceutical policy analysis to include this wider set of actors in policy making.

There are three key areas where further research would expand the evidence and knowledge base on issues related to access to medicines in developing countries. These are regulatory analysis, supply side analysis and accessing existing and expanding data sources.

Qualitative analysis of the regulatory environment of countries would fill an important gap in understanding the main challenges of pharmaceutical policy making in developing countries. Such analysis should in the first instance look at

P&R, and procurement. Countries which had a positive effect on access as identified from this analysis include Bangladesh, Bosnia and Herzegovina, Côte d'Ivoire, Congo, Dominican Republic, Ghana, Guatemala, India, Mauritania, Malawi, Namibia, Pakistan, Paraguay, Sri Lanka, and Zambia. Similarly within India, certain states were identified as having relatively efficient procurement practices (Kerala, Karnataka, Maharashtra, Rajasthan, and Tamil Nadu). Research into the regulatory environment would provide the opportunity of sharing of best practices which would be relevant for policy makers.

The next key areas include licensing, rational prescribing practices, and insurance mechanisms to protect low income families. Current efforts such as MeTA aim to study such aspects of pharmaceutical policy. These initiatives are an important first step in this policy area. Typically, access to health care in developing country settings has studied issues concerning maternal/child health, malaria, TB and in the past two decades, HIV/AIDS. These are important health policy areas but research has not had enough focus on the impact of developing appropriate pharmaceutical policy responses within overall health policy planning.

A second key area should be to study supply side issues. There is a significant gap in analysing policies concerning wholesalers, retailers, pharmacies, and overall industrial policy. Supply side information would provide a more comprehensive picture of pharmaceutical policy issues and the challenge to balance health policy goals with industrial policy objectives. Information on public and private sector providers would provide valuable information on the role of the private sector and implications for the public sector providers.

The third important area concerns accessing existing data sources for analysis and for expanding data sources to study implications of P&R and licensing decisions. Data collection relating to volume, regulatory and supply issues would provide important information in understanding medicine issues in developing country settings. Such efforts would allow for strengthening information relating to data analysis. For instance, in India, the NPPA has price data which has potential for more research and analysis. Its industry data largely comes from ORG-IMS, which has its limitations but it is a source of information. The government should

encourage greater use of its data sources from the various bodies, and strengthen its data collection systems. Furthermore, there are many activities at the international level to improve access to medicines. Many of these institutions are in a position to collect and provide information which could strengthen data sources. Recent efforts by the WHIO/HAI, Access to Medicines index, signal an important priority shift in this area.

Reliable data from pharmaceutical markets in the world's most populous countries, China and India are in short supply (WHO 2004a).[34] Inpatient data records are available but outpatient data are lacking. Surrogate surveillance is how current research and analysis are carried out. There will be health system pressures from an increase in consumption and sales among the middle class, and expansion of the private health insurance market, which will require a greater system of tracking information and coordination between various bodies that collect data.

There is scope to improve the quality of academic research in this topic area as confirmed by a review of studies on user charges/cost sharing based on the Effective Practice and Organisation of Care (EPOC) group of the Cochrane Collaboration (Lagarde M and Palmer N 2008). Main issues with the studies related to presence of confounding factors, small sample sizes, unreliable data, and policy changes not accounted for during the study period. Similarly, Homedes et al (2001b) reviewed community and patient level interventions to improve medicine uptake. The authors conclude that to carry out comparative analysis, there is a need for a minimum set of standards for evaluating interventions, some agreement on definitions of measurements, and outcome indicators.

Future research in these areas, combined with international efforts and a concerted effort to improve the quality of academic research would significantly contribute to understanding the issue of access to medicines. As this thesis has shown, access

[34] Data on trade, production, expenditure and consumption come from different sources. Monetary value are reported rather than volume which does not reflect the scale of consumption (traditional, low-priced generics, branded and non-branded).

to medicines is a pressing yet complex public health issue. Research in this area is needed in order to continue to build evidence to inform the design of effective pharmaceutical policy and to contribute to improving access to medicines for people in the developing world.

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Appendix A: Appendix to Chapter 3

Table A. 1 Estimates of the elasticity of demand for medicare[a]

Reference	Total price elasticity
Feldstein (1964)	-0.19
Feldstein (1970)	1.67
Rosenthal (1970)	0.19 to -0.70
Feldstein (1971)	-0.49 for total bed days
Davis and Russell (1972)	-0.32
Fuchs and Kramer (1972)	-0.10 to -0.36
Phelps and Newhouse (1972a)	-0.14[b] (OLS), -0.118 (Tobit)
Scitovsky and Snyder (1972)	-0.060[b]
Phelps (1973)	Not significantly different from zero
Rosett and Huang (1973)	-0.35 to -1.5
Beck (1974)	-0.065[b]
Newhouse and Phelps (1974)	-0.1 (length of stay)
Phelps and Newhouse (1974)	-0.10
Newhouse and Phelps (1976)	-0.24 (hospital), -0.42 (physician)
Scitovsky and McCall (1977)	-2.56 ancillary
Colle and Grossman (1978)	-0.11
McAvinchey and Yannopoulos (1993)	-1.2
Newhouse and the Insurance Experiment Group (1993)	-0.17 to -0.31 (hospital); 0.17 to -0.22 (outpatient)
Bhattacharya, Vogt, et al. (1996)	-0.22
Cherkin, Grothaus et al. (1989)	-0.035[b] (all visits); -0.15b to -0.075[b] (preventive)
Eichner (1998)	-0.32
Summary	-0.20 (visits price elasticity -0.05 to -0.15)

[a]See Cutler and Zeckhauser (2000) for details

[b]Elasticities computed according to appendix of Phelps and Newhouse (1972b)

Appendix B: Appendix to Chapter 4

Table B. 1 Standard error calculations of medicine prices by molecule name

Molecule name	Therapeutic category	Brand pack	Generic pack	Brand per pill	Generic per pill	Sample
Aciclovir	Antiviral	6.4	1.3	2.6	1.1	4
Amitriptyline	Antidepressant	1.3	0.06	1.7	0.0	3
Amlodipine	Calcium channel blocker	NA	NA	NA	NA	1
Atenolol	Antihypertensive	1.1	0.9	11.4	2.5	2
Beclometasone	Asthma	0.8	0.6	0.2	0.5	2
Benzathine benzylpenicillin	Antibiotic	NA	NA	NA	NA	1
Captopril	Antihypertensive	29.1	8.3	15.0	5.7	5
Carbamazepine	Epilepsy	38.3	4.2	2.8	1.6	7
Ceftriaxone	Antibiotic	2.1	1.1	2.1	1.0	6
Ciprofloxacin	Antibiotic	49.2	1.4	22.8	10.9	5
Co-trimoxazole	Antibiotic	0.8	0	3.3	0.08	2
Diazepam	Anxiolytic	1.4	0.5	4.7	2.2	4
Diclofenac	Anti-inflammatory	7.7	1.4	14.6	3.3	5
Digoxin	Cardio therapy	NA	NA	NA	NA	1
Fluconazole	Antifungal	166.0	6.3	49.0	0.2	3
Fluoxetine	Antidepressant	9.3	6.8	13.4	10.6	4
Fluphenazine	Antipsychotic	0.6	0	1.2	0	2
Furosemide	Diueretic	2.3	0	17.0	0	2
Glibenclamide	Diabetes	NA	NA	NA	NA	1
Indinavir	Antiviral	NA	NA	NA	NA	1
Loratadine	Antihistamine	1.3	0.6	7.3	0.5	2
Mebendazole	Antiparasitic	0.1	0	4.7	0	2
Medroxyprogesterone	Contraceptive	NA	NA	NA	NA	1
Metformin	Diabetes	5.8	0.9	3.3	0.7	4
Metronidazole	Antiparasitic	16.8	0	38.3	1.4	2
Nevirapine	Antiviral	88.7	12.0	0.9	0.2	2
Nifedipine Retard	Anti hypertensive	20.7	0.1	10.0	0.0	2
Omeprazole	Antacid	0.1	3.5	10.9	2.9	2
Paracetamol	Anti-inflammatory	NA	NA	NA	NA	

						1
Phenytoin	Epilepsy	0.6	0	0.9	0.0	4
Ranitidine	Antacid	7.2	0.6	8.3	0.3	3
Simvastatin	Lipid lowering	NA	NA	NA	NA	1
Streptomycin	Antibiotic	NA	NA	NA	NA	1
Zidovudine	Antiviral	153.6	13.4	8.2	1.3	2

Note: Cells with NA are due to only one observation

Table B. 2 Table of elasticity results by molecule name

Molecule name	Therapeutic category	Country	Elasticity	Brand pack price ($US)	Generic pack price ($US)	Pack size
Aciclovir	Antiviral	Kazakhstan	-1.3	17.5	3.9	25
Aciclovir	Antiviral	Tunisia	-1.1	25.0	2.4	25
Aciclovir	Antiviral	Philippines	-1.1	32.8	2.4	25
Aciclovir	Antiviral	Syria	-1.3	21.8	5.0	25
Amitriptyline	Antidepressant	Jordan	-1.4	2.6	0.8	100
Amitriptyline	Antidepressant	Morocco	-1.2	5.1	0.8	100
Amitriptyline	Antidepressant	Lebanon	-1.3	3.4	0.7	100
Amlodipine	Calcium channel blocker	Malaysia	-1.1	8.8	0.4	30
Atenolol	Antihypertensive	Syria	-1.4	5.9	1.7	60
Atenolol	Antihypertensive	Philippines	-1.0	7.4	0.3	28
Beclometasone	Asthma	Peru	-2.0	6.8	3.4	200
Beclometasone	Asthma	Morocco	-1.5	7.9	2.5	200
Benzathine benzylpenicillin	Antibiotic	Morocco	-1.4	2.2	0.6	4
Captopril	Antihypertensive	Morocco	-1.5	59.6	20.3	60
Captopril	Antihypertensive	Malaysia	-1.7	3.9	1.6	60
Captopril	Antihypertensive	Kazakhstan	-1.4	5.1	1.6	60

Captopril	Antihypertensive	Pakistan	-1.1	5.6	0.5	60
Captopril	Antihypertensive	Philippines	-1.1	56.2	4.0	150
Carbamazepine	Epilepsy	Kazakhstan	-1.8	26.9	12.2	150
Carbamazepine	Epilepsy	Shanghai	-1.2	13.1	2.0	100
Carbamazepine	Epilepsy	Shandong	-1.2	12.5	2.0	100
Carbamazepine	Epilepsy	Philippines	-1.1	115.1	10.0	500
Carbamazepine	Epilepsy	Kuwait	-1.3	12.2	2.9	150
Carbamazepine	Epilepsy	Malaysia	-1.5	6.4	2.0	100
Carbamazepine	Epilepsy	Syria	-1.4	20.2	5.5	150
Ceftriaxone	Antibiotic	South Africa	-1.2	8.5	1.5	1
Ceftriaxone	Antibiotic	Malaysia	-1.7	6.1	2.6	1
Ceftriaxone	Antibiotic	Kazakhstan	-1.4	10.4	3.0	1
Ceftriaxone	Antibiotic	Philippines	-1.4	9.1	2.6	1
Ceftriaxone	Antibiotic	Shanghai	-1.1	10.2	0.7	1
Ceftriaxone	Antibiotic	Shandong	-1.0	12.5	0.4	1
Ciprofloxacin	Antibiotic	Kazakhstan	-1.2	0.2	0.0	1
Ciprofloxacin	Antibiotic	Nigeria	-1.3	0.9	0.2	1
Ciprofloxacin	Antibiotic	Morocco	-1.6	2.1	0.8	1
Ciprofloxacin	Antibiotic	Philippines	-1.0	111.0	3.2	100
Ciprofloxacin	Antibiotic	South Africa	-1.1	0.7	0.0	1
Co-trimoxazole	Antibiotic	Syria	-1.5	0.8	0.3	70
Co-trimoxazole	Antibiotic	Tunisia	-1.2	1.9	0.3	70
Diazepam	Anxiolytic	Tunisia	-1.8	2.8	1.3	100

Diazepam	Anxiolytic	Jordan	-1.7	0.9	0.4	100
Diazepam	Anxiolytic	Syria	-1.4	3.9	1.2	100
Diazepam	Anxiolytic	Morocco	-1.1	3.8	0.4	100
Diclofenac	Anti-inflammatory	Shandong	-1.7	9.3	4.0	100
Diclofenac	Anti-inflammatory	Syria	-1.3	9.3	1.9	100
Diclofenac	Anti-inflammatory	Philippines	-1.0	15.6	0.5	100
Diclofenac	Anti-inflammatory	Kazakhstan	-1.1	27.1	2.1	100
Diclofenac	Anti-inflammatory	Morocco	-1.1	9.7	0.5	100
Digoxin	Cardio therapy	Philippines	-1.1	28.5	3.3	500
Fluconazole	Antifungal	South Africa	-1.1	107.7	12.3	30
Fluconazole	Antifungal	Tunisia	-1.0	325.9	3.6	30
Fluconazole	Antifungal	Jordan	-1.8	0.2	0.1	1
Fluoxetine	Antidepressant	Malaysia	-1.0	27.5	0.9	30
Fluoxetine	Antidepressant	Shandong	-1.4	34.6	10.5	30
Fluoxetine	Antidepressant	Shanghai	-1.7	35.1	14.3	30
Fluoxetine	Antidepressant	Philippines	-1.0	49.7	0.8	28
Fluphenazine	Antipsychotic	Morocco	-1.4	1.8	0.5	1
Fluphenazine	Antipsychotic	Jordan	-2.0	1.0	0.5	1
Furosemide	Diueretic	Philippines	-1.0	3.5	0.1	28
Furosemide	Diueretic	Jordan	-2.0	0.2	0.1	20
Glibenclamide	Diabetes	Philippines	-1.1	14.6	0.8	200
Indinavir	Antiviral	Morocco	-1.9	133.4	62.6	180
Loratadine	Antihistamine	Syria	-1.3	4.2	1.0	20

Loratadine	Antihistamine	Malaysia	-1.1	2.4	0.2	10
Mebendazole	Antiparasitic	Kazakhstan	-1.0	1.3	0.0	6
Mebendazole	Antiparasitic	Kyrgyzstan	-1.0	1.5	0.0	6
Medroxyprogesterone	Contraceptive	Kazakhstan	-1.2	7.4	1.0	1
Metformin	Diabetes	Nigeria	-1.2	7.1	1.4	100
Metformin	Diabetes	Pakistan	-1.6	1.7	0.7	100
Metformin	Diabetes	Shanghai	-1.2	15.3	2.8	100
Metformin	Diabetes	Philippines	-1.2	11.0	1.8	100
Metronidazole	Antiparasitic	Syria	-1.9	0.8	0.4	20
Metronidazole	Antiparasitic	Philippines	-1.0	24.5	0.4	100
Nevirapine	Antiviral	Lebanon	-1.2	197.8	31.0	60
Nevirapine	Antiviral	Morocco	-1.2	72.3	14.1	60
Nifedipine Retard	Anti hypertensive	Morocco	-1.1	41.2	2.2	100
Nifedipine Retard	Anti hypertensive	Kuwait	-1.3	11.9	2.4	100
Omeprazole	Antacid	Shandong	-1.1	39.1	3.6	30
Omeprazole	Antacid	Shanghai	-1.3	39.2	8.5	30
Paracetamol	Anti-inflammatory	Syria	-1.3	1.1	0.2	20
Phenytoin	Epilepsy	Lebanon	-1.2	4.1	0.7	100
Phenytoin	Epilepsy	Kuwait	-1.2	3.7	0.7	100
Phenytoin	Epilepsy	Jordan	-1.2	4.6	0.7	100
Phenytoin	Epilepsy	Tunisia	-1.3	3.2	0.7	100
Ranitidine	Antacid	Philippines	-1.1	23.0	1.2	50
Ranitidine	Antacid	Kazakhstan	-1.1	11.7	1.5	60

Ranitidine	Antacid	Syria	-1.3	9.5	2.4	60
Simvastatin	Lipid lowering	Malaysia	-1.1	104.2	10.0	120
Streptomycin	Antibiotic	Morocco	-1.4	0.4	0.1	1
Zidovudine	Antiviral	Lebanon	-1.1	296.0	18.6	150
Zidovudine	Antiviral	Malaysia	-1.9	78.8	37.5	100

Table B. 3 Table of drugs coded by number

Code	Molecule name	Therapeutic category	Observations	Countries
1	Carbamazepine	Epilepsy	8	China, Kazakhstan, Kuwait, Malaysia, Morocco, Philippines, Syria
2	Ceftriaxone	Antibiotic	7	China, Kazakhstan, Malaysia, Morocco, Philippines, South Africa
3	Salbutamol	Asthma	7	China, Kazakhstan, Kuwait, Morocco, Tunisia, Uganda
4	Fluoxetine	Antidepressant	6	China, Jordan, Malaysia, Philippines, Tunisia
5	Metformin	Diabetes	6	China, Morocco, Nigeria, Pakistan, Philippines
6	Aciclovir	Antiviral	5	Jordan, Kazakhstan, Philippines, Syria, Tunisia
7	Amitriptyline	Antidepressant	5	Jordan, Lebanon, Morocco, Syria, Tunisia
8	Captopril	Antihypertensive	5	Kazakhstan, Malaysia, Morocco, Pakistan, Philippines
9	Ciprofloxacin	Antibiotic	5	Kazakhstan, Morocco, Nigeria, Philippines, South Africa

10	Diclofenac	Anti-inflammatory	5	China, Kazakhstan, Morocco, Philippines, Syria
11	Phenytoin	Epilepsy	5	Jordan, Kuwait, Lebanon, Malaysia, Tunisia
12	Beclometasone	Asthma	4	China, Morocco, Peru
13	Diazepam	Anxiolytic	4	Jordan, Morocco, Syria, Tunisia
14	Losartan	Antihypertensive	4	China, Kazakhstan, Malaysia
15	Omeprazole	Antacid	4	China, Philippines, South Africa
16	Ranitidine	Antacid	4	Kazakhstan, Nigeria, Philippines,Syria
17	Fluconazole	Antifungal	3	South Africa, Tunisia, Uganda
18	Fluphenazine	Antipsychotic	3	Jordan, Morocco, Peru
19	Indinavir	Antiviral	3	Lebanon, Malaysia, Morocco
20	Loratadine	Antihistamine	3	China, Malaysia, Syria
21	Simvastatin	Lipid lowering	3	China, Jordan, Malaysia
22	Zidovudine	Antiviral	3	Lebanon, Malaysia, Morocco
23	Amlodipine	Calcium channel blocker	2	China, Malaysia
24	Atenolol	Antihypertensive	2	Philippines, Syria
25	Co-trimoxazole	Antibiotic	2	Syria, Tunisia
26	Fluconazole	Antifungal	2	Jordan, Kazakhstan

27	Furosemide	Diueretic	2	Jordan, Philippines
28	Mebendazole	Antiparasitic	2	Kazakhstan, Kyrgyzstan
29	Metronidazole	Antiparasitic	2	Philippines, Syria
30	Nevirapine	Antiviral	2	Lebanon, Morocco
31	Nifedipine Retard	Anti hypertensive	2	Kuwait, Morocco
32	Pyrazinamide	Antiinfectives	2	Morocco, Philippines
33	Valproic Acid	Epilepsy	2	Malaysia, Morocco
34	Acetylsalicylic acid	Anti-inflammatory	1	Morocco
35	Amoxicillin	Antibiotic	1	Jordan
36	Benzathine benzylpenicillin	Antibiotic	1	Morocco
37	Cefradine	Antibiotic	1	China
38	Chloroquine	Antimalarial	1	Tunisia
39	Cimetidine	Antacid	1	China
40	Digoxin	Cardio therapy	1	Philippines
41	Diltiazem	Calcium channel blocker	1	Jordan
42	Enalapril	Antihypertensive	1	Jordan

43	Glibenclamide	Diabetes	1	Philippines
44	Gliclazide	Diabetes	1	China
45	Insulin neutral	Diabetes	1	Kuwait
46	Isosorbide dinitrate	Cardio therapy	1	Philippines
47	Itraconazole	Antifungal	1	Malaysia
48	Lisinopril	Antihypertensive	1	Kuwait
49	Medroxyprogesterone	Contraceptive	1	Kazakhstan
50	Methyldopa	Antihypertensive	1	Jordan
51	Paracetamol	Anti-inflammatory	1	Syria
52	Prazosin	Antihypertensive	1	Malaysia
53	Streptomycin	Antibiotic	1	Morocco

Note: Due to lack of data, price elasticities could not be calculated for the following: Acetylsalicylic acid (34); Cefradine (37); Chloroquine (38); Cimetidine (39); and Glicazide (44).

Note: Data from China were sampled in two regions, which resulted in two observations for this country. The corresponding elasticities were calculated separately.

Appendix C: Appendix to Chapter 5

Table C. 1 - Multinomial model without dummies

Regressor	Hospital	Clinic	Do nothing
Age	-0.0310***	-0.0115***	-0.0310***
Age^2	0.000201**	5.42e-06	0.000221***
Sex	0.382***	0.272***	-0.00595
Marital status	0.377***	0.240***	0.110**
Self reported health	-0.567***	-0.406***	-0.585***
Chronic condition	0.527***	0.388***	0.254***
Education	0.272***	0.0170	-0.325***
Employed	-0.250***	-0.0654***	-0.00675
Urban setting	0.266***	0.145***	-0.124**
Health insurance	0.146**	-0.0116	-0.743***
Household size	-0.00990	0.00480	-0.0335***
Log house expenditure	-0.131***	0.0535***	0.0834***
Log predicted expenditure	-0.145***	0.0297*	-0.662***
Constant	-1.137***	0.294***	-0.698***
N	42,668		
Pseudo R^2	0.0262		
Chi-sq.	2152.86***		
Log likelihood	-40060.357		

Note: *** p<0.01, ** p<0.05, * p<0.1

Table C. 2 - Marginal effects of multinomial model without dummies

Regressor	Hospital	Clinic	Do nothing
Age	-0.000738***	-0.00155*	-0.000949***
Age^2	6.02e-06**	-7.51e-06	8.56e-06***

Sex	0.00723***	0.0604***	-0.00715***
Marital status	0.00735***	0.0503***	-0.00159
Self reported health	-0.00999***	- 0.0751***	-0.0136***
Chronic condition	0.00963***	0.0789***	0.000239
Education	0.00880***	0.00701	-0.0142***
Employed	-0.00688***	-0.0114**	0.00161
Urban setting	0.00612***	0.0337***	-0.00870***
Health insurance	0.00605**	0.00855	-0.0247***
Household size	-0.000358	0.00215**	-0.00146***
Log house expenditure	-0.00529***	0.0137***	0.00232**
Log predicted expenditure	-0.00424***	0.0255***	-0.0274***

Note: *** p<0.01, ** p<0.05, * p<0.1

Table C. 3 - Multinomial model with country dummies

Regressor	Hospital	Clinic	Do nothing
Age	-0.0418***	-0.0155***	-0.0227***
Age^2	0.000279***	6.11e-05	0.000147*
Sex	0.394***	0.344***	0.125**
Marital status	0.491***	0.257***	0.0789
Self reported health	-0.626***	-0.468***	-0.689***
Chronic condition	0.649***	0.471***	0.225***
Education	-0.0853	0.0800***	-0.193***
Employed	-0.181***	0.0329	0.0197
Urban setting	0.198***	0.144***	-0.211***
Health insurance	0.661***	0.404***	-0.218*
Household size	-0.0127	-0.0150***	-0.00124
Log house	0.0230	0.114***	-0.0577

expenditure			
Log predicted			
expenditure	0.188	0.326***	1.235***
Bangladesh	1.138***	2.546***	1.417***
Bosnia and			
Herzegovina	0.305	0.450***	-2.592**
China	-0.450	0.0213	-1.996***
Côte d'Ivoire	0.637**	0.645***	-0.349
Congo	1.708***	0.491***	0.280
Comoros	0.957**	-0.0752	-1.383***
Dominican			
Republic	1.355***	1.058***	-1.308***
Ecuador	0.171	0.0492	-1.865***
Ethiopia	-0.658	0.738***	1.435***
Georgia	-1.282***	-1.202***	-1.558***
Ghana	1.135***	0.792***	0.659**
Guatemala	0.131	0.673***	-2.902***
India	0.261	0.990***	-1.528***
Kazakhstan	0.260	0.457***	-0.651*
Kenya	-0.246	-0.258*	1.419***
Laos	1.143***	-0.684***	-1.153***
Sri Lanka	2.279***	1.462***	-1.674***
Morocco	0.309	0.286**	1.826***
Mali	-1.182*	0.0210	-1.209**
Myanmar	0.159	0.661***	0.0550
Mauritania	0.214	0.631***	-0.335
Malawi	1.176***	1.529***	1.893***
Namibia	1.923***	0.900***	-1.062***
Nepal	-0.359	0.618***	1.161***
Pakistan	0.530	1.524***	-0.902**
Philippines	0.205	-0.413***	-1.008***
Paraguay	0.0954	1.260***	2.374***
Russia	1.179***	0.319**	0.959**

Senegal	1.001***	0.501***	-0.00951
Chad	-0.0458	-0.112	0.544**
Tunisia	-1.139***	0.0400	-1.960***
Ukraine	0.465	-0.155	-0.691**
Vietnam	0.864***	0.406***	-1.514***
Zambia	1.802***	1.299***	0.908***
Constant	-2.445***	-0.967***	-1.535***
N	42,668		
Pseudo R^2	0.0902		
Chi-sq.	7424.98***		
Log likelihood	-37424.3		

Note: *** p<0.01, ** p<0.05, * p<0.1

Table C. 4 - Marginal effects of multinomial model with country dummies

Regressor	Hospital	Clinic	Do nothing
Age	0.000888***	-0.00270***	-0.000389
Age^2	6.62e-06**	7.73e-06	3.24e-06
Sex	0.00523***	0.0756***	-0.00277*
Marital status	0.00904***	0.0542***	-0.00266
Self reported health	-0.00918***	-0.0904***	-0.0126***
Chronic condition	0.0104***	0.0985***	-0.00244
Education	-0.00350*	0.0246***	-0.00753***
Employed	-0.00565***	0.0107*	0.000182
Urban setting	0.00336*	0.0358***	-0.00927***
Health insurance	0.0132***	0.0878***	-0.0133***
Household size	-0.000108	-0.00345***	0.000250
Log house expenditure	-0.00115	0.0285***	-0.00393***
Log predicted	-0.00122	0.0542**	0.0326***

expenditure			
Bangladesh	-0.0170***	0.378***	-0.0146***
Bosnia and Herzegovina	0.00120	0.116***	-0.0314***
China	-0.00993	0.0286	-0.0292***
Côte d'Ivoire	0.00676	0.140***	-0.0177***
Congo	0.0760***	0.0514	-0.00382
Comoros	0.0471	-0.0304	-0.0243***
Dominican Republic	0.0234*	0.206***	-0.0303***
Ecuador	0.00511	0.0253	-0.0284***
Ethiopia	-0.0202***	0.128***	0.0467**
Georgia	-0.0144**	-0.261***	-0.0203***
Ghana	0.0213	0.139***	0.00296
Guatemala	-0.00700	0.169***	-0.0358***
India	-0.00932	0.225***	-0.0330***
Kazakhstan	-0.000470	0.111***	-0.0205***
Kenya	-0.00541	-0.113***	0.105***
Laos	0.0888***	-0.189***	-0.0190***
Sri Lanka	0.0593***	0.232***	-0.0340***
Morocco	5.24e-05	-0.0120	0.111***
Mali	-0.0197***	0.0306	-0.0227***
Myanmar	-0.00679	0.148***	-0.0102
Mauritania	-0.00493	0.145***	-0.0171***
Malawi	-2.12e-05	0.234***	0.0326**
Namibia	0.0692***	0.142***	-0.0275***
Nepal	-0.0165***	0.116***	0.0330**
Pakistan	-0.0124**	0.300***	-0.0307***
Philippines	0.0154	-0.0938***	-0.0181***
Paraguay	-0.0176***	0.173***	0.0882***
Russia	0.0409**	0.0201	0.0310
Senegal	0.0261	0.0930***	-0.00980
Chad	-0.000192	-0.0401	0.0255**

Tunisia	-0.0200***	0.0396	-0.0299***
Ukraine	0.0207	-0.0385	-0.0149***
Vietnam	0.0234**	0.0894***	-0.0279***
Zambia	0.0350**	0.205***	-0.00247

Note: *** p<0.01, ** p<0.05, * p<0.1

Table C. 5 - Multinomial model with reason for visit and country dummies

Regressor	Hospital	Clinic	Do nothing
Age	-0.0296***	-0.0213***	-0.0304***
Age^2	0.000171*	0.000111***	0.000202**
Sex	0.281***	0.392***	0.194***
Marital status	0.349***	0.321***	0.157***
Self reported health	-0.633***	-0.461***	-0.670***
Chronic condition	0.596***	0.453***	0.159***
Education	-0.101	0.0819***	-0.198***
Employed	-0.120*	0.0112	-0.00659
Urban setting	0.189***	0.153***	-0.204***
Health insurance	0.658***	0.401***	-0.222*
Household size	-0.0179	-0.0132***	0.000331
Log house expenditure	0.0423	0.106***	-0.0630*
Log predicted expenditure	0.0633	0.371***	1.306***
Immunisation	-0.310	-0.261	-2.239***
Antenatal	0.268	0.441***	-1.538***
Family planning	0.342	0.153	-0.862**
Childbirth	1.420***	-1.945***	-1.721***
Dental care	-0.965***	0.680***	-0.0805
Arthritis	0.246	0.130**	0.413***
Asthma	1.173***	0.219**	0.00351
Heart disease	0.946***	0.0707	-0.364**

Bodily injury	0.855***	-0.172***	-0.761***
Minor surgery	0.902***	-1.302***	-1.724***
Other reason	0.370***	0.0680**	-0.171***
Bangladesh	1.243***	2.509***	1.324***
Bosnia and Herzegovina	0.168	0.522***	-2.479**
China	-0.162	-0.0887	-2.184***
Côte d'Ivoire	0.749***	0.636***	-0.382
Congo	1.742***	0.562***	0.272
Comoros	1.182**	-0.183	-1.495***
Dominican Republic	1.284***	1.057***	-1.233***
Ecuador	0.263	0.0136	-1.890***
Ethiopia	-0.556	0.679***	1.335***
Georgia	-1.256***	-1.278***	-1.534***
Ghana	1.069***	0.839***	0.703**
Guatemala	0.195	0.621***	-2.924***
India	0.482	0.937***	-1.662***
Kazakhstan	0.257	0.407***	-0.611
Kenya	-0.273	-0.255*	1.396***
Laos	1.240***	-0.726***	-1.168***
Sri Lanka	2.279***	1.465***	-1.727***
Morocco	0.267	0.258**	1.803***
Mali	-1.128*	0.0111	-1.156**
Myanmar	0.0493	0.722***	0.0611
Mauritania	0.272	0.620***	-0.382
Malawi	1.323***	1.489***	1.798***
Namibia	1.825***	0.973***	-0.974***
Nepal	-0.295	0.590***	1.128***
Pakistan	0.795**	1.464***	-1.099***
Philippines	0.225	-0.456***	-1.010***
Paraguay	0.0288	1.193***	2.466***
Russia	1.064***	0.265*	0.995**

Senegal	1.070***	0.458***	-0.0398
Chad	0.0255	-0.127	0.512**
Tunisia	-0.956**	-0.0155	-2.056***
Ukraine	0.620**	-0.285**	-0.720**
Vietnam	0.918***	0.339***	-1.554***
Zambia	1.906***	1.313***	0.822***
Constant	-3.082***	-0.860***	-1.160***
N	42,668		
Pseudo R^2	0.1155		
Chi-sq.	9499.3***		
Log likelihood	-36387.1		

Note: *** p<0.01, ** p<0.05, * p<0.1

Table C. 6 - Marginal effects of multinomial model with reason for visit and country dummies

Regressor	Hospital	Clinic	Do nothing
Age	-0.000386*	-0.00427***	-0.000522**
Age^2	2.39e-06	2.13e-05**	4.02e-06*
Sex	0.00112	0.0887***	-0.00130
Marital status	0.00373**	0.0716***	-0.00113
Self reported health	-0.00825***	-0.0907***	-0.0118***
Chronic condition	0.00799***	0.0978***	-0.00387**
Education	-0.00342**	0.0251***	-0.00750***
Employed	-0.00304*	0.00454	-0.000308
Urban setting	0.00253	0.0384***	-0.00894***
Health insurance	0.0113***	0.0887***	-0.0129***
Household size	-0.000243	-0.00298**	0.000260
Log house expenditure	-0.000424	0.0266***	-0.00386***
Log predicted expenditure	-0.00467	0.0666**	0.0332***

Immunisation	-0.00296	-0.0436	-0.0277***
Antenatal	0.000194	0.113***	-0.0271***
Family planning	0.00724	0.0418	-0.0194***
Childbirth	0.150***	-0.430***	-0.0215***
Dental care	-0.0202***	0.165***	-0.0128***
Arthritis	0.00392	0.0193	0.0115***
Asthma	0.0411***	0.0246	-0.00502
Heart disease	0.0335***	0.00200	-0.0112***
Bodily injury	0.0357***	-0.0504***	-0.0162***
Minor surgery	0.0752***	-0.310***	-0.0225***
Other reason	0.00825***	0.0144**	-0.00665***
Bangladesh	-0.0129***	0.376***	-0.0153***
Bosnia and Herzegovina	-0.00325	0.134***	-0.0304***
China	-0.00182	-0.00219	-0.0290***
Côte d'Ivoire	0.00952	0.137***	-0.0176***
Congo	0.0650***	0.0736**	-0.00488
Comoros	0.0606*	-0.0625	-0.0241***
Dominican Republic	0.0174	0.211***	-0.0290***
Ecuador	0.00774	0.0151	-0.0276***
Ethiopia	-0.0161***	0.120***	0.0415**
Georgia	-0.0117**	-0.280***	-0.0192***
Ghana	0.0145	0.153***	0.00344
Guatemala	-0.00403	0.157***	-0.0347***
India	-0.00297	0.213***	-0.0327***
Kazakhstan	0.000336	0.100***	-0.0188***
Kenya	-0.00510	-0.110***	0.0994***
Laos	0.0880***	-0.199***	-0.0184***
Sri Lanka	0.0514***	0.241***	-0.0332***
Morocco	-0.000407	-0.0142	0.108***
Mali	-0.0165***	0.0255	-0.0215***
Myanmar	-0.00853*	0.162***	-0.0107*

Mauritania	-0.00285	0.143***	-0.0172***
Malawi	0.00484	0.232***	0.0283**
Namibia	0.0490***	0.170***	-0.0264***
Nepal	-0.0130***	0.111***	0.0312**
Pakistan	-0.00537	0.289***	-0.0307***
Philippines	0.0147	-0.105***	-0.0173***
Paraguay	-0.0154***	0.155***	0.101***
Russia	0.0310*	0.0141	0.0352
Senegal	0.0272*	0.0847***	-0.00952
Chad	0.00185	-0.0435	0.0235**
Tunisia	-0.0150***	0.0232	-0.0294***
Ukraine	0.0279*	-0.0734**	-0.0139**
Vietnam	0.0246**	0.0750***	-0.0270***
Zambia	0.0354**	0.211***	-0.00499

Note: *** p<0.01, ** p<0.05, * p<0.1

Table C. 7 - Nested model code

```
* run nested model
expand 4
bysort id: gen alternatives = _n
gen choice = 0
replace choice = 1 if soughtcare==alternatives-1
bysort id: replace choice = 1 if illness==0 & _n==1

nlogitgen type = alternatives(sick:2|3|4, notsick:1), nolog
nlogittree alternatives type
constraint 1 [notsick_tau]_cons = 1
constraint 2 [alternatives1]log_pcost = 1
*constraint 3 [alternatives1]facilityquality = 1
*constraint 4 [alternatives1]traveltime = 1

nlogit choice || type: age female married srhgood chronicpresent
working primaryplus hsize urban insurance log_house, base(notsick)
|| alternatives: log_pcost, base(4) noconstant case(id)
constraints(1/2) vce(cluster country)
```

Table C. 8 - Nested logit model

Regressor	No dummies	Country dummies	All dummies
Age	-0.0106***	-0.0265***	-0.0307***
Age^2	-5.74e-07	0.000166***	0.000200***
Sex	0.262***	0.315***	0.359***
Marital status	0.229***	0.268***	0.323***
Self reported health	-0.424***	-0.520***	-0.511***
Chronic condition	0.388***	0.458***	0.434***
Education	0.0215	0.0474*	0.0475*
Employed	-0.0722***	0.0227	0.00478
Urban setting	0.116***	0.161***	0.161***
Health insurance	-0.0776***	0.388***	0.386***
Household size	0.00309	-0.0149***	-0.0133***
Log house expenditure	0.0428***	0.0550***	0.0526***
Log predicted expenditure hospital	0.0605**	0.0699***	0.0768***
Log predicted expenditure clinic	1.355***	1.082***	1.186***
Bangladesh		1.774***	1.756***
Bosnia and Herzegovina		0.220*	0.284**
China		0.366**	0.188
Côte d'Ivoire		0.364***	0.374***
Congo		0.585***	0.670***
Comoros		0.226	0.0979
Dominican		0.366***	0.396***

Republic		
Ecuador	0.171	0.111
Ethiopia	0.154	0.118
Georgia	-1.084***	-1.171***
Ghana	0.155*	0.221**
Guatemala	0.666***	0.593***
India	1.014***	0.931***
Kazakhstan	-0.203**	-0.222**
Kenya	-0.545***	-0.529***
Laos	-0.557***	-0.563***
Sri Lanka	1.270***	1.287***
Morocco	-0.0865	-0.0905
Mali	-0.684***	-0.669***
Myanmar	-0.0530	0.00879
Mauritania	0.379***	0.375***
Malawi	0.877***	0.866***
Namibia	0.662***	0.765***
Nepal	0.0147	0.00926
Pakistan	1.607***	1.504***
Philippines	-0.317***	-0.359***
Paraguay	0.755***	0.718***
Russia	-0.212*	-0.228*
Senegal	0.0631	0.0526
Chad	-0.297***	-0.289***
Tunisia	0.208	0.0985
Ukraine	0.0284	-0.0911
Vietnam	0.141	0.0912
Zambia	0.627***	0.667***
Immunisation		-0.401**
Antenatal		0.298***
Family planning		0.0954
Childbirth		-1.249***
Dental care		0.577***

Arthritis			0.163***
Asthma			0.253***
Heart disease			0.0886
Bodily injury			-0.172***
Minor surgery			-1.064***
Other reason			0.0513*
Constant			
N	170,672	170,672	170,672
Chi-sq.	16087***	17242***	17487***
Log likelihood	-48196	-46709	-46271
Ratio scale parameter	0.533***	0.419***	0.459***
LR test IIA	553.74***	179.32***	149.88***

Note: *** p<0.01, ** p<0.05, * p<0.1

Table C. 9 - Generalised Hausman Test

Test for equal coefficients across alternatives	Chi square
Hospital and Clinic	180.62***
Hospital and do nothing	96.04**
Hospital and not sick	4582.83***

Note: *** p<0.01, ** p<0.05

Table C. 10 - STATA code for elasticity and marginal effect calculation in nested logit model

```
predict cprobchoice, hlevel(2) condp
*P(B|LR), the conditional probability of choosing a branch given
the choice of trunk and limb
egen meanchoice=mean(cprobchoice)

predict cprobtype, hlevel(1) condp
*P(L|R), the conditional probability of choosing a limb, given the
choice of trunk.
```

```
egen meantype=mean(cprobtype)

*generate iv values for hlevel2 this is IV(B|LR)
predict xb2, xb hlevel(2)
gen double tau = [sick_tau]_b[_cons] if type==1
replace tau = [notsick_tau]_b[_cons] if type==2
bysort id type: egen double totexpxb = total(exp(xb2/tau))
gen double iv = log(totexpxb)
egen meaniv=mean(iv)

gen trunk= 1*1*(1-meanchoice)
gen limb = 1* (1-meantype)*meanchoice * meaniv
*gen branch = (1-1)* cprobtype*cprobchoice * iv * 1
*branch effect is zero according to Greene

gen F=trunk+limb

egen meanh=mean(log_pcost) if soughtcare==1 & choice==1
egen meanc=mean(log_pcost) if soughtcare==2 & choice==1

*egen meanh=mean(log_averagecost2) if soughtcare==1 & choice==1
*egen meanc=mean(log_averagecost2) if soughtcare==2 & choice==1



*regression coefficients
mat list e(b)


gen coefficienth=[alternatives2]_b[log_pcost]
*gen coefficienth=[alternatives2]_b[log_averagecost2]
gen elasticityh=meanh*coefficienth*F

gen coefficientc= [alternatives3]_b[log_pcost]
*gen coefficientc= [alternatives3]_b[log_averagecost2]
gen elasticityc=meanc*coefficientc*F

*gen facilityh=[alternatives2]_b[facilityquality]
*gen facilityc=[alternatives3]_b[facilityquality]


*marginal effect calculation
gen marginalcosth=meanchoice*meantype*coefficienth*F if
soughtcare==1 & choice==1
gen marginalcostc=meanchoice*meantype*coefficientc*F if
soughtcare==2 & choice==1
sum  elasticityh elasticityc marginalcosth marginalcostc

*for other data
*gen marginalfacilityh=meanchoice*meantype*facilityh*F
*gen marginalfacilityc=meanchoice*meantype*facilityc*F
```

Appendix D: Appendix to Chapter 6

Table D. 1 List of price controlled medicines

List of Price Controlled Drugs (DPCO 1995)

[See Paragraphs 2 and 3]

BULK DRUGS

1. SULPHAMETHOXAZOLE
2. PENICILLINS
3. TETRACYCLINE
4. RIFAMPICIN
5. STREPTOMYCIN
6. RANITIDINE
7. VITAMIN C
8. BETAMETHASONE
9. METRONIDAZOLE
10. CHLOROQUINE
11. INSULIN
12. ERYTHROMYCIN
13. VITAMIN A
14. OXYTETRACYCLINE
15. PREDNISOLONE
16. CEPHAZOLIN
17. METHYLDOPA
18. ASPIRIN
19. TRIMETHOPRIM
20. CLOXACILLIN
21. SULPHADIMIDINE
22. SALBUTAMOL
23. FAMOTIDINE
24. IBUPROFEN
25. METAMIZOL (ANALGIN)
26. DOXYCYCLINE
27. CIPROFLOXACIN
28. CEFOTAXIME
29. DEXAMETHASONE
30. EPHEDRINE
31. VITAMIN B1 (THIAMINE)
32. CARBAMAZEPINE
33. VITAMIN B2 (RIBOFLAVIN)
34. THEOPHYLLINE
35. LEVODOPA
36. TOLNAFTATE
37. VITAMIN E
38. NALIDIXIC ACID
39. GRISEOFULVIN
40. GENTAMICIN
41. DEXTROPROPOXYPHENE
42. HALOGENATED HYDROXYQUINOLINE
43. PENTAZOCINE
44. CAPTOPRIL
45. NAPROXEN
46. PYRENTAL
47. SULPHADOXINE
48. NORFLOXACIN
49. CEFADROXYL
50. PANTHONATES & PANTHENOLS
51. FURAZOLIDONE
52. PYRITHIOXINE
53. SULPHADIAZINE
54. FRAMYCETIN
55. VERAPAMIL
56. AMIKACIN SULPHATE *
57. GLIPIZIDE
58. SPIRONOLACTONE
59. PENTOXYFYLLINE
60. AMODIAQUIN
61. SULPHAMOXOLE
62. FRUSEMIDE
63. PHENIRAMINE MALEATE
64. CHLOROXYLENOLS
65. BECAMPICILLIN
66. LINCOMYCIN
67. CHLORPROPAMIDE
68. MEBHYDROLINE
69. CHLORPROMAZINE
70. METHENDIENONE
71. PHENYL BUTAZONE
72. LYNESTRANOL
73. SALAZOSULPHAPYRINE
74. DIOSMINE
75. TRIMIPRAMINE

Source: (Ministry of Chemicals and Fertilizers 1995)

The retail price of a formulation shall be calculated by the Government in accordance with the following formula namely:

R.P. = (M.C. + C.C. + P.M. + P.C.) x (1 + MAPE/100) + ED. where

- "R.P." means retail price;
- "M.C." means material cost and includes the cost of drugs and other pharmaceutical aids used including overages, if any, plus process loss thereon specified as a norm from time to time by notification in the Official Gazette in this behalf;
- "C.C." means conversion cost worked out in accordance with established procedures of costing and shall be fixed as a norm every year by notification in the Official Gazette in this behalf;

"P.M." means cost of the packing material used in the packing of concerned formulation, including process loss, and shall be fixed as a norm every year by, notification in the Official Gazette in this behalf;

"P.C." means packing charges worked out in accordance with established procedures of costing and shall be fixed as a norm every year by notification in the Official Gazette in this behalf;

"MAPE" (Maximum Allowable Post-manufacturing Expenses) means all costs incurred by a manufacturer from the stage of ex-factory cost to retailing and includes trade margin and margin for the manufacturer and it shall not exceed one hundred per cent for indigenously manufactured Scheduled formulations;

"E.D." means excise duty:

Provided that in the case of an imported formulation, the landed cost shall form the basis for fixing its price along with such margin to cover selling and distribution expenses including interest and importer's profit which shall not exceed fifty percent of the landed cost.

Explanation - For the purpose of this proviso, "landed cost" means the cost of import of formulation inclusive of customs duty and clearing charges.

Source: (CDSCO 1995)

Appendix E: Appendix to Chapter 7

Table E. 1 - Multinomial model 2004 wave

Regressor	Public	Private	Self-treatment	Do Nothing
Age	-0.009	-0.296***	-0.001	-0.014*
Age^2	-0.00008	0.0001**	-0.00008	-0.00002
Sex	-0.072	-0.148**	-0.133*	-0.152**
Marital status	0.463***	0.641***	0.217	-0.507***
Days ill	0.069***	0.050***	-0.053***	0.120***
Education	-0.044	0.299***	0.363***	-0.423***
Employed	0.038	0.094	0.168*	-0.158*
Urban setting	0.150**	0.116**	-0.19**	-0.007
Health insurance	-0.609	0.620	0.293	0.394
Household size	0.002	-0.014	0.005	0.065***
Log house expenditure	-0.153	0.625***	0.475***	-0.519***
Log predicted expenditure	0.650***	-0.216	-1.088***	0.322
Region dummy1	1.06***	0.890***	0.231**	1.27***
Region dummy2	0.660***	0.659***	-0.307**	0.813***
Region dummy3	1.204***	0.321*	-0.714**	1.13***
Constant	-0.117	-1.12***	-0.014	-0.289
N	29,449			
Pseudo R^2	0.0540			
Chi-sq.	3731.68***			
Log likelihood	-32713.02			

Note: *** p<0.01, ** p<0.05, * p<0.1

Table E. 2 - Multinomial model 1995-96 wave

Regressor	Public	Private	Self-treatment	Do Nothing
Age	0.005	-0.025*	-0.112	-0.004
Age^2	-0.00005	0.0002	0.0001	0.0001
Sex	-0.067	-0.133	-0.298*	-0.330*
Marital status	-0.118	0.256	-0.064	-0.356
Days ill	-0.024***	-0.034***	-0.111***	-0.073***
Education	0.647***	0.768***	0.578**	0.497**
Employed	0.0911	0.1222	0.124	-0.128
Urban setting	2.59	1.200	-0.162	-0.695
Health insurance	-0.073	-0.1669	-0.003	-0.094
Household size	0.033	0.019	0.031	0.091***
Log house expenditure	0.681***	0.890***	-0.117	-0.306*
Log predicted expenditure	-2.49***	-2.291***	-0.768**	-1.252***
Region dummy1	-0.897***	-1.294***	-0.885***	-0.631***
Region dummy2	0.680**	-0.204	1.075***	1.406***
Region dummy3	-0.0084	-0.170	-0.254	-0.333*
Region dummy4	0.670	-0.780	-0.1266	0.440
Distance dummy1	3.33*	1.33	0.001	-0.214
Distance dummy2	1.897	-0.036	-0.892	-1.636
Distance dummy3	2.953	1.366	0.296	-0.172
Distance dummy4	2.382	0.878	-0.370	-0.689
Distance dummy5	2.592	1.097	-0.109	-0.243
Constant	2.613	4.66	4.732**	8.401***
N	32860			
Pseudo R^2	0.0718			
Chi-sq.	4867.69			
Log likelihood	-31448.63			

Note: *** p<0.01, ** p<0.05, * p<0.1

Table E. 3 - Elasticity results

Test for equal coefficients across alternatives	2004 Wave	1995-96 Wave
Public	0.67***	-0.40***
Cross price elasticity public	-0.14	0.41
Private	-0.18***	-0.206***
Cross price elasticity private	-0.37	1.55
Self-treatment	-1.05***	1.31***
Cross price elasticity self-treatment	-0.04	0.056

Note: *** p<0.01, ** p<0.05, * p<0.1

Table E. 4 – Generalised Hausman Test

Test for equal coefficients across alternatives	Chi square
Private	209.75***
Self treatment	157.95***
Do nothing	180.20***

Note: *** p<0.01, Public choice removed to test for equality across alternatives

Table E. 5 - Nested model computer code

```
expand 5
bysort memberid: gen alternatives = _n
gen choice = 0
replace choice = 1 if seek==alternatives-1
bysort memberid: replace choice = 1 if illness==0 & _n==1
*list memberid illness seek alternatives choice

nlogitgen type = alternatives(sick:2|3|4|5, notsick:1), nolog
nlogittree alternatives type
```

```
xi: nlogit choice || type: age agesq male married daysill working
primaryplus urban insurance hsize log_house i.regiondummy
i.yeardummy, base(notsick) || alternatives: log_predictedcost,
base(5) noconstant case(memberid) constraints(1/2)
*vce(cluster code60th) if include IIA not calculated
constraint 1 [notsick_tau]_cons = 1
constraint 2 [alternatives1]log_predicted cost = 1
nlogit choice || type: age agesq male married daysill working
primaryplus urban insurance log_house, base(notsick) ||
alternatives: log_visitcost, base(5) noconstant case(memberid)
constraints(1/2)
```

Table E. 6 - STATA code for elasticity and marginal effect calculation in nested logit model

```
*bug in STATA fixed so will compute IV values
*compute IV values
predict cprobchoice, hlevel(2) condp
*P(B|LR), the conditional probability of choosing a branch given the
choice of trunk and limb

predict cprobtype, hlevel(1) condp
*P(L|R), the conditional probability of choosing a limb, given the
choice of trunk.

*generate iv values for hlevel2 this is IV(B|LR)
predict double iv, hlevel(2)

gen trunk= 1*1*(1-cprobchoice)
gen limb = 1* (1-cprobtype)*cprobchoice * iv
*gen branch = (1-1)* cprobtype*cprobchoice * iv * 1
*branch effect is zero according to Greene

gen F=trunk+limb

*regression coefficients
mat list e(b)

*log predicted
gen coefficientpublic=[alternatives2]_b[log_predicted]
gen coefficientprivate=[alternatives3]_b[log_predicted]
```

```
gen coefficientself=[alternatives4]_b[log_predicted]

gen elasticitypublic=coefficientpublic*F
gen elasticityprivate=coefficientprivate*F
gen elasticityself=coefficientself*F

zscore elasticity*
gen pvepublic=2*(1-normal(abs( z_elasticitypublic)))
gen pveprivate=2*(1-normal(abs( z_elasticityprivate)))
gen pveself=2*(1-normal(abs( z_elasticityself)))

**cross price F value

gen cp_trunk= cprobchoice
gen cp_limb=cprobtype*(cprobchoice)*iv
gen cp_F= cp_trunk + cp_limb
gen crosselasticity_public=-cp_F*coefficientpublic if seek==1
gen crosselasticity_private=-cp_F*coefficientprivate if seek==2
gen crosselasticity_self=-cp_F*coefficientself if seek==3
zscore crosselasticity*
gen pvcppublic=2*(1-normal(abs( z_crosselasticity_public)))
gen pvcpprivate=2*(1-normal(abs( z_crosselasticity_private)))
gen pvcpself=2*(1-normal(abs( z_crosselasticity_self)))

*marginal effect
gen
marginalpublic=cprobchoice*cprobtype*[alternatives2]_b[log_predicted]*F
gen
marginalprivate=cprobchoice*cprobtype*[alternatives3]_b[log_predicted]*F
gen
marginalself=cprobchoice*cprobtype*[alternatives4]_b[log_predicted]*F

gen marginalage=cprobchoice*cprobtype*[sick]_b[age]*F
gen marginalagesq=cprobchoice*cprobtype*[sick]_b[agesq]*F
gen marginalmale=cprobchoice*cprobtype*[sick]_b[male]*F
gen marginalmarried=cprobchoice*cprobtype*[sick]_b[married]*F
gen marginaldaysill=cprobchoice*cprobtype*[sick]_b[daysill]*F
gen marginalworking=cprobchoice*cprobtype*[sick]_b[working]*F
gen marginalprimaryplus=cprobchoice*cprobtype*[sick]_b[primaryplus]*F
gen marginalurban=cprobchoice*cprobtype*[sick]_b[urban]*F
gen marginalinsurance=cprobchoice*cprobtype*[sick]_b[insurance]*F
```

```
gen marginallog_house=cprobchoice*cprobtype*[sick]_b[log_house]*F
gen marginalhsize=cprobchoice*cprobtype*[sick]_b[hsize]*F



zscore marginal*
gen pvmpublic=2*(1-normal(abs( z_marginalpublic)))
gen pvmprivate=2*(1-normal(abs( z_marginalprivate)))
gen pvmself=2*(1-normal(abs( z_marginalself)))
gen pvmage=2*(1-normal(abs( z_marginalage)))
gen pvmagesq=2*(1-normal(abs( z_marginalagesq)))
gen pvmmale=2*(1-normal(abs( z_marginalmale)))
gen pvmmarried=2*(1-normal(abs( z_marginalmarried)))
gen pvmdaysill=2*(1-normal(abs( z_marginaldaysill)))
gen pvmworking=2*(1-normal(abs( z_marginalworking)))
gen pvmprimaryplus=2*(1-normal(abs( z_marginalprimaryplus)))
gen pvmurban=2*(1-normal(abs( z_marginalurban)))
gen pvminsurance=2*(1-normal(abs( z_marginalinsurance)))
gen pvmlog_house=2*(1-normal(abs( z_marginallog_house)))
gen pvmhsize=2*(1-normal(abs( z_marginalhsize)))
```

Appendix F: Appendix to Chapter 8

Table F. 1 - Results for 1995-96 Wave

Regressor	Poisson	NB	ZIP	ZINB
Age	0.02238***	0.01620***	0.01850***	0.00234
Age^2	-0.00011***	-0.00002	-0.00008***	-0.00004
Sex	0.26552***	0.22016***	0.18849***	0.18444***
Marital status	0.32361***	0.33747***	0.29902***	0.04086
Ailment past 15 days	1.44736***	1.43427***	1.17227***	0.57400***
Education	-0.05787***	-0.02233	-0.02993**	0.01807
Employed	-0.27943***	-0.24935***	-0.20616***	-0.06891**
Urban setting	-0.05798***	-0.04162***	-0.03836**	-0.09552***
Health insurance	-0.07060	0.01407	0.01281	-0.10927
Household size	-0.12883***	-0.12973***	-0.11210***	-0.03053***
Log house expenditure	0.79751***	0.79651***	0.69551***	0.44831***
Log predicted expenditure	-0.27729***	-0.34174***	-0.30498***	0.07002**
Constant	-5.84675***	-5.46690***	-3.72506***	-3.93449***
N	630590	630590	630590	630590
Pseudo R^2	0.0950	0.0646		
Chi-sq.	27017.96	16835.50	14897.78	1232.94
Log likelihood	-128661.92	-121809.69	-123366.4	-120149.7
Alpha		4.85210		
LR test alpha		1.4e+04***		
Vuong test			32.35***	26.42***

Note: *** p<0.01, ** p<0.05, * p<0.1

Some of the coefficients are similar across the models. Men, those who are married, unwell are more likely to seek care. Those who are educated, employed, living in urban areas and come from small households are less likely to seek care. Unlike the data from 2004 survey, not all the coefficients are significant across the models from the 1995-96 wave.

Overall, a more robust count data model is preferred over the standard Poisson.The specification of the Poisson model is assessed using the RESET command in STATA with the following calculation: chi-sq of 6.18 with a p-value of 0.0130. The result shows some evidence of rejecting the null hypothesis of the Poisson model.

The negative binomial (NB) regression also shows evidence of rejecting the Poisson with the LR test of the overdispersion parameter, alpha , of 1.4e+04 with a p-value of 0.00.

The Vuong test in the zero-inflated model suggests that the ZIP is preferred over the standard Poisson with a z score of 32.35 and a p-value of 0.00.

The Vuong test zero-inflated negative binomial on all the regressors suggests that the ZINB is preferred over the NB with a Vuong z score of 26.42 and a p-value of 0.00.

Table F. 2 - Results Two Part Hurdle Model 1995-96

Regressor	First stage Y=1,0 hospitalisation 1995-96	Second stage Y= number of hospitalisations 1995-96	Elasticities 1995-96
Age	0.02518***	-0.00144	-0.00144
Age^2	-0.00011***	0.00001	0.00001
Sex	0.29261***	0.01421	0.01421
Marital status	0.34464***	0.01542	0.01542

Ailment past 15			0.13790***
days	1.48226***	0.13790***	
Education	-0.11210***	0.01018	0.01018
Employed	-0.33653***	0.00655	0.00655
Urban setting	-0.04676***	-0.03726***	-0.03726***
Health insurance	-0.09791*	-0.02358	-0.02358
Household size	-0.13707***	-0.00323	-0.00323
Log house			0.10621***
expenditure	0.79405***	0.10621***	
Log predicted			0.03791*
expenditure	-0.04389*	0.03791*	
Arunchal	0.23372***	0.08847	0.08847
Assam	-0.29085***	-0.05065	-0.05065
Bihar	-0.39234***	-0.05988*	-0.05988*
Goa	0.12752	0.03017	0.03017
Gujarat	-0.14914***	-0.00717	-0.00717
Haryana	-0.18666***	-0.00485	-0.00485
Himachal	-0.19745***	-0.00543	-0.00543
Jammu Kashmir	-0.52375***	-0.13032***	-0.13032***
Karnataka	-0.07066*	-0.04513	-0.04513
Kerala	0.19987***	0.09930***	0.09930***
Madhya Pradesh	-0.22884***	0.12032***	0.12032***
Maharashtra	0.01234	0.10228***	0.10228
Manipur	-0.14768**	-0.06045	-0.06045
Meghalaya	-0.18883***	-0.03126	-0.03126
Mizoram	0.04340	0.03321	0.03321
Nagaland	0.01592	0.19902***	0.19902***
Orissa	-0.19825***	0.01320	0.01320
Punjab	-0.36233***	-0.10789**	-0.10789**
Rajasthan	-0.28423***	0.02786	0.02786
Sikkim	-0.27251***	0.01383	0.01383
Tamil Nadu	0.12643***	0.03091	0.03091
Tripura	0.78251***	0.27348***	0.27348***

Uttar Pradesh	-0.32888***	0.03805	0.03805
West Bengal	-0.06129*	-0.00318	-0.00318
Chandigarh	-0.37390***	0.00240	0.00240
Dadra	-0.11298	0.02275	0.02275
Daman	0.16875	-0.11880	-0.11880
Delhi	-0.50722***	-0.01353	-0.01353
Lakshadweep	0.12166	0.22998**	0.22998**
Pondicherry	0.13920	-0.04215	-0.04215
Constant	-7.00663***	-0.52367***	
N	630590	27144	
Pseudo R^2	0.0923	0.0069	
Chi-sq.	20666.09	450.91	
Log likelihood	-101599.62	-32425.436	

Note: *** p<0.01, ** p<0.05, * p<0.1
Note: State dummies are relative to the state of Andra Pradesh
Note: STATA dropped observations from the state of Andaman Nicobar Islands (4,514 observations) due to collinearity.
Note: Three new states were created when the 2004 wave was conducted. In the 1995-96 wave these states belonged to the following: Chhattisgarh was part of Madya Pradesh, Jharkhand part of Bihar, Uttranchal was part of Uttar Pradesh.