UNIVERSITI PUTRA MALAYSIA

URBAN RESIDENTIAL DEMAND FOR WATER IN SUBANG JAYA, SELANGOR: A CROSS·SECTIONAL ANALYSIS

REMEE DASS ANNANIAH

FEP 1999 4

URBAN RESIDENTIAL DEMAND FOR WATER IN SUBANG JAYA, SELANGOR: A CROSS-SECTIONAL ANALYSIS

REMEE DASS ANNANIAH

MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA

1999

URBAN RESIDENTIAL DEMAND FOR WATER IN SUBANG JAYA, SELANGOR: A CROSS-SECTIONAL ANALYSIS

By

REMEE DASS ANNANIAH

A Thesis submitted in Partial Fulfilment of the Requirements of Master of Science in The Faculty of Economics and Management, Universiti Putra Malaysia

May, 1999

ACKNOWLEDGEMENTS

I am greatly indebted to my project supervisor Associate Professor Dr K. Kuperan Viswanathan for his very constructive comments and valuable guidance throughout my study. Much appreciation also goes to Professor Dr Nik Mustapha Raja Abdullah and Associate Professor Dr Zubaidi Baharumshah for their readership and conscientious comments.

I would like to thank all my lecturers at The Faculty of Economics and Management, Universiti Putra Malaysia for their help and guidance throughout my study.

Special thanks also go to the Directors of the Petaling Water Department in Selangor for providing the water consumption figures from their archieves. I also extend my sincere gratitude to my friends and colleagues who have helped me throughout this study. I would also like to thank Puan Norizan for typing several versions of the additions and corrections cheerfully.

Finally, I would like to thank my father and my mother for their inspiring and thought provoking counsel.

TABLE OF CONTENTS

Page

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AP	Average Price
D	Inframarginal price/Difference
FIP	Full Information Price
HS	Household size
I	Income
ICC	Income Consumption Curve
K	Price Perception Parameter
LRAC	Long-run average cost
LRMC	Long-run marginal cost
M^3	Cubic Metre
MC	Marginal Cost
MP	Marginal Price
MPC	Marginal Price Consumption Curve
MU	Marginal Utility
OLS	Ordinary Least Square
P	Price
Q	Quantity
S	Supply
SF	Sprinkling Frequency
TR	Total Revenue
VS	Visitors' Staying Frequency

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in partial fulfilment of the requirements for the degree of Master of Science.

URBAN RESIDENTIAL DEMEND FOR WATER IN SUBANG JAYA,SELANGOR: A CROSS-SECTIONAL ANALYSIS

By

REMEE DASS ANNANIAH

May 1999

Chairman: Associate Professor K. Kuperan, Ph.D.

Faculty: Economics and Management

Water resource management and development has become a much discussed topic in the last three decades, engaging the attention of not only engineers, planners and decision makers, but also the general public. Malaysia's water resources are under great strain as a result of rapid population growth, agricultural, industrial and commercial development and reduced rainfall in some areas. It is expected that water consumption will increase at least three fold by the year 2000. Considerable evidence shows that water conservation as an alternative is often a more cost effective than investment in additional capacity. Water resource economists, in particular, have become interested in understanding the empirical nature of water demand for forecasting of water demand, pricing and in improving water resources planning and

management. Recent controversies have been on the appropriate price specification and the estimation of elasticities under block rate pricing. Many economists have come forward with many challenging models and have justified their choice with empirical evidence. In this study, price elasticity of demand for residential water is estimated for consumers in Subang Jaya, Selangor.

The AP and FIP specification regression models using both linear and semilog functional forms are run for a cross-sectional sample of 173 households. The results showed that the price, income and household size elasticities are in the range of -0.56 to -0.97, 0.12 to 0.29 and 0.37 to 0.99 respectively. Compared to AP, the FIP specification which incorporates MP and D, was found to be a better choice for the price variable in the residential water demand models. In all cases except price, the AP model overestimated the change in consumption of water when there is a change in one of the explanatory variables (income, household size). Social, cultural and religious practices were not found to affect the consumption patterns of three different ethnic groups in Subang Jaya. This only shows that many city dwellers have adopted life style common for all ethnic groups living in Malaysia. Price, income and household size elasticities estimated for 5 different income groups using FIP specification were in the range of -1.18 to 1.98, negligible, and 0.48 to 1.11 respectively. The price elasticities obtained for some of the income groups however were inconsistent and had positive signs. Results of Shin's Price Perception Model showed that consumers were not

responsive to either average price or marginal price in all cases except the very high income group responsiveness declines with increases in the income level of households.

Results of this study showed that elasticities of explanatory variables can be used as an effective policy instrument by water utilities in the planning and allocation of water supplies. Water conserved through pricing and management policies would be more cost effective than financing storage capacity expansion. Future research work should look at the exact relationship between price change and storage capacity reduction. In particular, the price elasticity estimates and supply management by using appropriate pricing policy for urban consumers, would help policymakers to manage water resource efficiently.

Abstrak tesis yang dikemukan kepada Senat Universiti Putra Malaysia
sebagai memenuhi sebahagian dari keperluan untuk ijazah Master Sains

PERMINTAAN AIR OLEH PENDUDUK DI KAWASAN SUBANG JAYA, SELANGOR : SATU KAJIAN KERATAN RENTAS

Oleh

REMEE DASS ANNANIAH

Mei, 1999

Pengerusi: **Profesor Madya K. Kuperan, Ph.D.**

Fakulti: **Ekonomi dan Pengurusan**

Pengurusan dan perkembangan bekalan air telah menjadi suatu topik yang hangat dibincangkan sejak tiga dekad kebelakangan ini. Ia telah menarik perhatian bukan sahaja di kalangan jurutera-jurutera dan ahli perancang, tetapi juga masyarakat Malaysia pada umumnya. Bekalan air di negara ini telah berkurangan akibat dari pertumbuhan penduduk yang pesat, bertambahan kegunaannya di sektor pertanian industri dan perdagangan. Adalah dijangkakan bahawa pengunaan air akan bertambah sekurang-kurangnya 3 kali ganda pada tahun 2000. Banyak bukti yang menunjukkan bahawa pemulihan air adalah suatu alternatif yang kos efektif daripada mengadakan tambahan air simpanan. Ahli-ahli ekonomi dalam bidang bekalan air semakin berminat dalam pengajian empirikal permintaan air untuk peramalan permintaan air, penilaian

harga dan juga untuk membaiki pengurusan dan perancangan bekalan air. Sejak kebelakangan ini, controversi telah berlaku pada spesifikasi harga dan perjangkaan keanjalannya dibawah kadar blok harga. Banyak ahli ekonomi telah mengemukakan model-model harga mereka dengan bukti-bukti empirikalnya sekali gus.

Dalam kajian ini, keanajalan harga, pendapatan dan saiz keluarga untuk serumah telah diperolehi di kawasan Subang Jaya, Selangor dengan menggunakan beberapa spesifikasi harga dalam model-model permintaan. Fungsi linear dan semilog yang digunakan dalam model regressi AP (Harga Purata) dan FIP (Harga Marginal dan Inframarginal) telah dijalankan untuk rentasan 173 sampel perumahan. Hasilnya telah menunjukkan bahawa harga, pendapatan dan saiz keanjalan perumahan adalah masing-masing berada didalam jangkauan -0.56 ke -0.97, 0.12 ke 0.29 dan 0.37 ke 0.99. Berbanding kepada spesifikasi AP dan FIP, spesifikasi FIP yang mengandungi MP (Harga Marginal) dan D (Harga Inframarginal) telah didapati lebih sesuai untuk angkubah model permintaan air perumahan. Dalam semua kes, purata model harga telah berlebih anggar penggunaan air bila angkubah pendapatan atau saiz perumahan digunakan. Faktor sosial, budaya dan agama didapati tidak mempengaruhi penggunaan air untuk tiga kumpulan etnik di kawasan bandar Subang Jaya. Ini menunjukkan bahawa penduduk bandar telah menerima ciri-ciri corak budaya hidup yang sama di antara bangsa-bangsa Malaysia. Keanjalan harga dan saiz rumahtangga untuk lima kumpulan pendapatan adalah berada dalam jangkauan -1.18 ke 1.98 dan 0.48 ke 1.11. Keanjalan pendapatan adalah didapati hampir ke sifar dan dengan itu boleh diabaikan.

Untuk setengah kumpulan pendapatan, keanjalan pendapatan didapati tidak konsisten dan mempunyai nilai positif. Keputusan dari model persepsi harga Shin menunjukkan pengguna tidak bertindak-balas dengan AP atau MP dalam semua kes kecuali kumpulan yang berpendapatannya sangat tinggi. Ini menunjukkan keputusan yang tidak konsisten kerana responsifnya berkurangan dengan peningkatan dalam pendapatan.

Keanjalan harga, pendapatan dan lain-lain angkubah dari kajian ini dapat digunakan sebagai alat polisi yang berkesan dalam pengagihan dan perancangan penawaran air. Penjimatan air dengan pengurusan yang cekap dan dengan polisi harga mengikut kadar tambahan blok (*increasing block pricing*) adalah lebih efektif daripada perkembangan keupayaan simpanan. Penyelidikan selanjutnya mengenai hubungan perubahan harga dan perubahan keupayaan simpanan adalah berguna untuk polisi pembekalan air.

CHAPTER I

INTRODUCTION

General Introduction

In the last three decades, water resource management and development has become a much discussed topic not only in Malaysia but also throughout the world. This has attracted the attention of engineers, planners, decision makers and the general public. The World Water Council pointed out that the demand for fresh-water doubles every 20 years. In 1950, only 12 countries, with 20 milion people faced water shortages. By 1990, the problem afflicted 26 countries with 300 million people, and by 2050 it is projected that 65 countries, with 7 billion people, or 60% of the world's population will be affected. Some political analysts have already predicted that the next world war may be fought over competing claims for water resources shared among countries.

Industrialisation, urbanisation, tourism and commercial agriculture are among the biggest users and competitors for water. Since these activities and processes have continued to expand, greater stress has been put on the availability and quality of water.

Awareness of scarcity and pollution has given rise to proposed market based solutions,including raising the price to discourage wastage of water.

Demand for Water

Total water demand is an aggregate of the demands originating from domestic, commercial, industrial and agricultural sectors of an economy. Domestic users of water include that for personal consumption and for household uses, such as lawn watering and car washing. Nearly 60% of per capita distribution of water in the last two decades can be attributed to higher incomes, better standards of living and technological changes associated with domestic uses. Sprinkling demands have created instantaneous and hourly peaks four to eight times than that of the average demand.

Commercial demand for water includes water requirements of stores, offices, theatres, hotels, motels, garages, restaurants and other business services which duplicate domestic functions, such as drinking, sanitary waste, disposal and air conditioning.

Industries can be grouped into light and heavy users of water. Light industries duplicate the water-use patterns of commercial establishments and homes. Heavy industries, on the other hand, require substantial amounts of public potable water in their products or in their processing methods.

In the agricultural sector, water demand is very much related to irrigation. The rate of increase in irrigation water demand in Malaysia over the next decades is expected to slow down. Consequently, the percentage contributed by the agricultural sector to Malaysia's Gross National Product (GNP) will slowly decline as industrialisation proceeds.

Water Demand in Malaysia

Population growth, agricultural and industrial development are placing strong demands on Malaysia's water resources. Water stress has already occurred in a number of places in the states of Perak and Kedah where water was abundant before. The trend will worsen as the country's present population of 18 million doubles in the next 20 years. The rationing of water supply to houseowners in parts of Selangor introduced in April 1998 is a testimony to the impending shortage of supply in meeting demand of the urban consumers. An expanding programme of water resource development need to be undertaken to keep pace with the socio-economic development of the country. Per capita water availability of 24.6 m^3 of water in 1990 will be halved by 2020 unless major schemes for expanding capacity are undertaken. In addition, land and industrial development and urbanisation will reduce the quantity and quality of available water resource.

The demand for water is a function of both population and Gross Domestic Product (GDP) growth. The population of Malaysia is about 18 million and is projected

to be 23 million in 2000, growing at an average rate of 2.3% per annum (Table 1.1). The urban population in the country is expected to increase from 45.5% in 1990 to 53.3% in 2000. Based on the growth in population and GDP (Table 1.2), domestic and commercial demand for water is expected to increase from 2.1 billion cubic metres in 1995 to 2.2 billion cubic metres in 2000 (Table 1.3). This is a moderate estimate of demand for domestic and commercial water as population is only one of the factors affecting demand.

Water Resource Development and Management

The main objective of water resource development and management in Malaysia is to provide for the increasing domestic, industrial and irrigation demands for water. Providing for these demands will contribute to national and regional development, improvement of environmental quality and social well being. Water resource development and management in Malaysia is currently undertaken by various Federal and State departments or agencies.

By adopting an integrated or resource orientated management, optimum use of water can be achieved. Water resource development is a decreasing cost industry subject to economies of scale and therefore is subsidized by federal and state governments. This will necessitate the formulation and implementation of national water policy which is consistent with the overall national policies and programmes. The national electricity company, the national telephone company and the national postal services were privatised within the last seven years. Efforts are on the way to privatise

Table 1.1: Population by State, 1980, 1991, 1995 and 2000

Number ('000)

State	1980	1991	1995	2000
Johor	1,644.9	2,188.1	2,443.8	2,731.5
Kedah	1,120.6	1,371.3	1,482.1	1,605.2
Kelantan	897.8	1,227.0	1,376.1	1,561.5
Melaka	466.6	540.2	571.0	598.9
Negeri Sembilan	575.9	726.2	785.6	849.8
Pahang	802.2	1,079.6	1,189.6	1,319.1
Perak	1,812.3	1,995.3	2,072.0	2,130.0
Perlis	148.8	190.7	209.1	230.7
Pulau Pinang	958.2	1,133.6	1,197.8	1,259.4
Sabah	1,055.1	1,867.4	2,389.0	3,136.8
Sarawak	1,351.1	1,723.8	1,885.2	2,064.9
Selangor	1,521.6	2,431.2	2,822.4	3,287.8
Terengganu	543.1	810.7	922.1	1,064.1
Wilayah Persekutuan	981.0	1,262.1	1,343.5	1,423.9
Malaysia	**13,879.2**	**13,547.2**	**20,689.3**	**23,263.6**

Source : Seventh Malaysian Plan

Notes :1 Population data refer to mid-year population.

2 Includes Wilayah Persekutuan Labuan

Table 1.2: Gross Domestic Product by State, 1990 - 2000
(in 1978 prices)

	GDP at Purchasers' Value (RM million)			Average Annual Growth Rate (%)	
	1990	1995	2000	6MP	7MP
Johor	8,576	13,818	21,390	10.0	9.1
Kedah	3,511	5,618	8,705	9.9	9.2
Kelantan	2,025	2,736	3,765	6.2	6.6
Melaka	1,960	3,106	4,751	9.6	8.9
Negeri Sembilan	2,646	4,031	6,216	8.8	9.0
Pahang	3,823	5,484	8,003	7.5	7.9
Perak	6,927	9,961	14,776	7.5	8.2
Perlis	544	787	1,160	7.7	8.1
Pulau Pinang	5,789	9,330	13,686	10.0	8.0
Sabah	6,550	8,496	11,669	5.0	6.6
Sarawak	6,550	8,778	12,287	6.0	7.0
Selangor	14,639	24,518	36,473	10.9	8.3
Terengganu	5,471	8,055	11,927	8.0	8.2
Wilayah Persekutuan Kuala Lumpur	10,219	15,598	21,827	8.8	7.0
Malaysia	**79,329**	**120,316**	**176,635**	**8.7**	**8.0**

Source : Seventh Malaysia Plan (7MP)
Note : Includes Wilayah Persekutuan Labuan

Table 1.3 : Domestic and Commercial Consumption of Water

(Unit : $10^6 m^3$)

	1993		1994		1995		2000+	
	Domestic	Commercial	Domestic	Commercial	Domestic	Commercial	Domestic	Commercial
Peninsular Malaysia	707.1	289.0	803.0	336.5	978.6	422.1	1096.4	472.9
Sabah	44.6	30.9	44.7	30.2	51.3	51.7	66.7	67.3
Sarawak	69.1	370.7	75.0	373.2	83.0	383.6	90.7	419.4
Total	820.8	690.6	922.7	739.9	1,112.9	857.4	1253.8	959.6

Source : Malaysia Water Industry Report 1995/1996
(+) - It is assumed that the domestic and commercial consumption of water will increase at the average annual growth of population. (The Seventh Malaysia Plan,1996 - 2000)
Peninsular Malaysia at 2.3%
Sabah at 5.4%
Sarawak at 1.8%

the water departments and agencies in line with the government drive to privatise many state bodies to become financially independent and to operate more efficiently. After a brief water crisis in early 1998, the National Water Resources Council was formed to enable better co-operation between the State governments and the Federal government on issues of water allocation between states, water tariffs and water supply developments.

The Problem Statement

The World Water Council has pointed out that the demand for water will continue to increase in line with the growth of world population. It projected that at least 65 countries will be affected by water shortage by the middle of next century. In Malaysia, population growth, agricultural, commercial and industrial development are creating strong demands for water. The Klang Valley, for example, experienced water shortage in April, 1998 showing that water supply could not meet the increasing demand by consumers. This led to the setting up of National Water Council (NCW) which would act as a regulatory body to manage interstate transfers of water and to manage and develop water resources effectively.

To overcome water shortage problem, water utility managers could either increase water storage capacities and treatment facilities or implement effective pricing policies and conservation measures. The choice of investing in additonal capacity depends on the availability of valuable financial resources and capital. For a developing country

such as Malaysia, investing in water resource projects could drain valuable capital which could otherwise be invested in more productive sectors of the economy that could yield higher returns in a short term.

Effective pricing policies not only generate income for the water utilities but also in itself act as a water conservation measure. Knowledge of demand elasticities helps utility managers to formulate effective pricing policies for different income and consumer groups. In this study, different price specifications will be used to estimate price elasticities for consumers facing a block rate pricing structure. Further discussions on the price specifications are given in Chapter two and three.

The Objectives of Study

Price is an important explanatory variable in many water demand studies. Indeed, in almost all studies cited in the literature, price is the only variable that is inversely related to the demand for water which is useful for management in allocating water for competing uses. In this study, cross-sectional regressions are used to determine the demand for residential water. Emphasis is given to the price and income elasticities. Knowledge of these elasticities and other relevant variable elasticities is helpful to the water utility managers and other governing bodies of water utilities in forecasting the change in consumption in water when there is a change in one of the explanatory

variables. Effective demand management policies, (effective pricing, conservation measures) can be implemented with the knowledge of differing consumer responses to water demand.

The objectives of this study are as follows:

(1) to study the impact of price, (e.g. average price (AP), marginal price (MP) and inframarginal price (D)), income and other variables on the demand for urban residential water.

(2) to evaluate consumer responsiveness to AP or MP using Shin's(1985) price perception model.

(3) to determine the price and income elasticities and other relevant variable elasticities of demand for urban residential water using linear and semi-log functional forms for the entire sample and for the different income groups.

(4) to examine the impact of socio-cultural factors on household water consumption among the ethnic groups of Malaysia.