Marginal Cost Water Pricing: Welfare Effects and Policy Implications using Minimum Cost and Benchmarking Models, with Case Studies from Australia and Asia

Thesis

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by

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ABBREVIATIONS

2SLS	Two-Stage Least Squares
ADB	Asian Development Bank
ADERASA	Association of Water and Sanitation Regulatory Entities of the Americas
ADR	Appropriate Discount Rate (Phil.[1])
AEPA	Accelerated Extraordinary Price Adjustment (Phil.)
AWWA	American Water Works Association
AUD	Australian Dollar
BEA	Bureau of Economic Analysis (USA)
BOOT	Build Own Operate Transfer (Vic.[2])
CAPEX	Capital Expenditure
CERA	Currency Exchange Rate Adjustment (Phil.)
CES	Constant Elasticity of Substitution
CPI	Consumer Price Index
CRS	Constant Returns to Scale
DCRA	Debt Capital and Restructuring Agreement (Phil.)
DEA	Data Envelopment Analysis
EEPSEA	Economy and Environment Program for Southeast Asia (Canada)
ESC	Essential Services Commission (Vic.)
FCDA	Foreign Currency Devaluation Adjustment (Phil.)

[1]Philippines
[2]Victoria, Australia

FIES	Family Income and Expenditure Survey (Phil.)
FTE	Full Time Equivalent
HPE	Heterogeneous Preferences Error
IBRD	International Bank for Reconstruction and Development
IBRT	Increasing Block Rate Tariff
IDA	International Development Agency
IFC	International Finance Corporation
IPART	Independent Pricing and Regulatory Tribunal (NSW)
KL	Kilolitres
KLM	Kilolitres per Month
LIBOR	London Interbank Overnight Rate
ML	Megalitres
MLD	Megalitres per Day
MLE	Maximum Likelihood Estimation
MWCI	Manila Water Company Inc. (Phil.)
MWSI	Maynilad Water Supply Inc. (Phil.)
MWSS	Metropolitan Water and Sewerage Service (Phil.)
MWSS−RO	Metropolitan Water and Sewerage Service - Regulatory Office
NCR	National Capital Region (Phil.)
NGO	Non-Government Organisation
NRW	Non-Revenue Water
NSO	National Survey Office (Phil.)
NWC	National Water Commission (Australia)
OECD	Organisation for Economic Cooperation and Development
OFWAT	Office of Water Services (UK)
OLS	Ordinary Least Squares

PAWS	Public Assessment of Water Services (Phil.)
PhP	Philippine Peso
PPE	Property Plant and Equipment
RESET	Regression Specification Error Test
RTS	Returns to Scale
SEAWUN	Southeast Asian Water Utilities Network
SFA	Stochastic Cost Frontier
SPR	Service Performance Report (Phil.)
SUR	Seemingly Unrelated Regressions
UATP	Umiray Angat Transbasin Project (Phil.)
USD	US. Dollar
VAT	Value Added Tax (Phil.)
VRS	Variable Returns to Scale
WACC	Weighted Average Cost of Capital
WIRO	Water Industry Regulatory Order (Vic.)
WUP	Water Utility Partnership (Africa)

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ABSTRACT

Recent studies in water management policy point to insufficient recognition of water as a scarce commodity and the failure of pricing policies to account for the full economic costs of its production and supply. These costs include opportunity costs related to alternative uses of water; user costs associated with managing a scarce resource; and costs of externalities such as ground water depletion, pollution of waterways, and greenhouse gas emissions. Existing cost recovery based pricing policies may lead to inefficiencies such as excess consumption, under-investment in water infrastructure, and unnecessary subsidisation.

Water scarcity can be managed in several ways. We can increase supply by investment in additional harvesting capabilities or new technologies such as desalination; we can constrain consumption so that existing supplies last longer; or we can use water in more efficient ways. As a short term measure, most countries adopt water restrictions when supplies are at critical levels. In the future, as urban population growth continues, harvesting of storm water and reuse of grey water may become part of a sustainable water management strategy. Water trading can be used to move water to where the marginal benefits are highest. Considerable water savings are possible through the use of more efficient industrial and domestic appliances. There is evidence in some countries that higher water tariffs have reduced consumption and promoted awareness of conservation. If we accept that

water is an economic good, then we need to understand the costs related to its production, the patterns of its use, and the benefits received by different users.

This thesis is an examination of theoretical and applied aspects of urban water pricing based on analysis of cost, demand, and welfare. We present theoretical models of cost that include economies of scale as a parameter, and a model of water demand by households with heterogeneous preferences. We determine marginal cost at the efficient level of output based on a partial equilibrium of supply and demand. We also show that when water is produced with increasing returns to scale, the efficient price will be insufficient to recover all costs, and therefore a form of second best pricing is required. We contrast conventional notions about water suppliers being cost minimisers with an alternative frontier model of cost efficiency. Two case studies examine the provision of water services under different forms of ownership. The first case study examines the provision of water to domestic households in the state of Victoria, Australia. The second case study examines the supply of water to the residents of Manila, one of the world's largest cities that privatised its water service in 1997 under a form of concession agreement. A third case study derives an efficient cost frontier for a sample of water utilities from Asia and Australia and proposes a form of best practice pricing. The thesis concludes with a summary of the main results and policy conclusions, and ideas for future research.

THESIS DECLARATION

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being made available in all forms of media, now or hereafter known.

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