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Rent Seeking in Water Supply

by

Laszlo Lovei and Dale Whittington

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Executive Summary

Donor agencies involved with water projects in cities in developing countries typically assume that the objective of municipal water authorities is to serve the public interest. It is commonly acknowledged that such utilities suffer from a variety of financial and managerial problems, and in many cities the majority of the population does not receive its water from the municipal system. The poor often end up paying high prices to water vendors for small quantities of water, while middle and upper-income groups receive subsidized water from the municipal water distribution system.

Such evidence of water utilities' failure to provide high-quality service to the public is usually attributed to staff incompetence or lack of motivation, or perhaps to the political system's unwillingness to provide adequate resources to the water utility. Donors rarely acknowledge that water utilities may simply be pursuing objectives other than the delivery of water supply. It is widely alleged that graft and corruption occur in contracting procedures and that billing and meter reading are susceptible to manipulation for personal financial gain. However, it is not often admitted that rent seeking can possibly have important and pervasive implications for how an urban water delivery system is actually designed and operated. Based on public taps, distributing vendors, and relatively few house connections, a water delivery system could potentially generate substantial economic rent. The analytical approach used in this paper suggests the need for a careful rethinking of the assumptions that shape policies in the water sector.

This paper presents a framework for the analysis of rent seeking in water supply and a case study of water vending in a large metropolitan area in a developing country--Jakarta, Indonesia. Rent seeking can dramatically affect the terms and conditions under which service is offered to the public. No doubt, households pay very high prices to distributing vendors in Jakarta. It is possible that these high prices could generate substantial surpluses that could be absorbed as economic rents. Such a situation incurs high costs through inefficiency, and it poses problems of equity. The current arrangement results in too few water taps. Thus, too many resources are expended hauling water inefficiently by cart. The analysis here suggests that deregulation of water sales coupled with the easing of supply constraints could substantially lower both hauling costs and the price of water and could reduce the ability of the water utility staff and neighborhood officials to capture economic rents.

The actors in the water delivery system may have actual and stated objectives that are quite different. Water delivery systems have the potential to generate large economic rents. Proposals to change the technical, engineering aspects of the water distribution system may threaten the interests of powerful groups. To ignore the political aspects of technical proposals when projects are designed and evaluated is simply to invite failure. Effective public policy and donor involvement in the water sector must be based on an understanding of the structure of water markets and the political power supporting institutional arrangements.

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I. INTRODUCTION

1.1 Donor agencies involved with municipal water projects in developing countries typically assume that the authorities' objective is to serve the public interest. It is commonly acknowledged that such utilities suffer from a variety of financial and managerial problems, and in many cities the majority of the population does not receive water from the municipal system. The poor often pay high prices to water vendors for small quantities of water, while middle- and upper-income groups receive subsidized water from the municipal system.[1]

1.2 Such evidence of water utilities' failure to provide high-quality service to the public is usually attributed to staff incompetence, lack of motivation, or perhaps to the political system's unwillingness to provide adequate resources to the water utility. Donors rarely acknowledge that water utilities may simply be pursuing objectives other than the delivery of water supply. It is widely alleged that graft and corruption occur in contracting procedures and that billing and meter reading are susceptible to manipulation for personal financial gain. However, it is not admitted that the possibility for rent seeking can have important and pervasive implications for how an urban water delivery system is actually designed and operated.

1.3 Assuming a water utility seeks to extract rents from households, it could exercise leverage for that purpose in a number of ways. For example, the water supply can be restricted. Expansion of the system capacity can be delayed. Water lines may not be extended into certain neighborhoods. Certain households can be denied connections. The number of public taps in a neighborhood can be limited. Public tap operators can be required to be licensed. Households with private connections can be prohibited from reselling water to their neighbors.

1.4 This paper presents a framework for the analysis of rent seeking in water supply and a case study of water vending in a large metropolitan area in a developing country -- Jakarta, Indonesia. The

1. See Whittington, Lauria, and Mu, 1989; Fass, 1988; Lauria, 1989; Zaroff and Okun, 1984.

next two sections of the paper present background information on Jakarta's existing public water distribution system, the water vending system and how the informal water markets appear to work. The fourth section contrasts the stated objectives with the possible unstated, informal objectives of the main groups of actors in the water delivery system and proposes potential strategies that these groups might use to achieve these informal objectives. This contrast between stated and unstated objectives is expressed in a model of rent-seeking behavior with three principal groups of actors. Its implications are illustrated with numerical examples using data that closely approximate the situation in parts of Jakarta. The fifth and sixth sections discuss the policy implications of this analytical framework and offer some concluding observations.

II. BACKGROUND

2.1 The city of Jakarta was estimated to have 7.9 million people in 1985 and a population growth rate of more than 4 percent per year. This rapid growth has created intense pressures on city services and led to a number of environmental problems. Water supply is a prime example. As of 1988, only 14 percent of households received water through direct connections to the municipal water system. Another 32 percent bought drinking water from street vendors.[2] The rest of the population--54 percent--relied on private wells, a cheap but increasingly contaminated water source. Intensive withdrawal of groundwater has depleted the freshwater aquifers, and now much of the water in the wells in north and west Jakarta (along the coastline) is saline. Because the rivers are all extremely polluted, households in north and west Jakarta that have no connection to the piped water supply system must rely on vendors as their only source of drinking water. (Collection of rainwater for drinking is not widely practiced in Jakarta; rainwater is used for bathing and washing.)

2.2 As in many large cities in developing countries, numerous problems plague the municipal water supply system in Jakarta. Large water losses, intermittent supply (in the dry season), and

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2. See Urban Institute and Hasfarm, 1988.

contaminated water in the pipes are the main physical troubles. Institutional and financial difficulties include (1) capital tied up in underutilized water treatment plants, (2) large accounts receivable, (3) sudden unexplained changes in billed water quantities, (4) residential connections and tertiary distribution pipes that are officially nonexistent, and (5) lack of skilled staff.[3] In 1988, the reported gross revenue of the municipal water company from water sales to connected households was only $12 million, or about $10 per capita per year for the small percentage of the population connected to the system.

2.3 Households connected to the municipal system pay $0.10 per cubic meter for the first 15 m^3 of water they use in each month, $0.20 per cubic meter between 15 and 30 m^3/month, $0.30 per cubic meter between 30 and 50 m^3/month and $0.50 per cubic meter above that.[4] In 1988, the official household connection fee varied from $100 to $200, depending on the characteristics of the property.[5] The water tariff is determined by the city council of Jakarta, and the governor appoints the general manager of the water company, which is owned by the city of Jakarta.

2.4 The municipal government of Jakarta is a complex, hierarchical institution. At the top presides the governor of Jakarta, who is appointed by the president of Indonesia. Jakarta is divided into five *wilayahs* (administrative divisions), each headed by a *walikota*, who is appointed by the governor. Each wilayah is divided into four to seven *kecamatans* (districts) headed by *camats*, who are appointed by the walikota. The kecamatans are divided into 5-10 *kelurahans* (subdistricts) headed by *lurahs*, who are appointed by the walikota and camat. The kelurahan is the lowest administrative subdivision of government, and the *lurah* is the lowest-level area head who is still paid by the government. Below each lurah, there are 5-15 *rukun wargas* (RW) or zone leaders, who function in the mixed role of petty

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3. For a more detailed description see World Bank, 1990.

4. All dollar figures are 1988 US$. $1 = Rp 1,700.

5. One householder reported that several years ago, he paid $300 for his metered connection, which does not deliver water to his house in the dry season (hence he has to resort to vendors). About 200 meters from his house is a public tap that supplies water to vendors. When pressure in the pipes is low the water company simply shuts down the pipe connections to private homes and directs the water to public taps operating in the area. In early 1989 there were rumors that the "full [unofficial] price" of a house connection had reached $600 in certain parts of Jakarta.

government official/community leader and assist the work of the lurah. Finally, below each RW there are 5-12 *rukun tetanggas* (RT) or neighborhood leaders, who are selected by and represent 70-150 families. Their selection is subject to the endorsement of the RW and the lurah. The RTs and RWs do not go without remuneration. Households make regular payments to the community leaders. These payments are informal and depend on the income and wealth of the respective household. The payments cover the services of the RT and/or RW and also the costs of solid waste collection, neighborhood security service, and community events.

III. THE WATER-VENDING SYSTEM IN JAKARTA [6]

A. Sources and Delivery of Water

3.1 With the exception of the very poor, practically every household in Jakarta owns a private well.[7] But because many wells in the northern part of the city are saline, well water can often only be used for washing and cleaning. People in north and west Jakarta generally purchase their drinking and bathing water from peddlers or street vendors, who deliver the water to the house.[8] These distributing vendors carry water in plastic jerricans, transported by single-axle handcarts. Each jerrican has a capacity of 17-30 liters. When full, the carts carry 12-18 jerricans and weigh 300-350 kg. When a household purchases water, the vendor hand-carries the jerricans to the house from the street or lane.

3.2 Another mode of home delivery, tanker trucks serve only a relatively few wealthy families. Tanker trucks are generally privately owned and operated. They have a capacity of 5-10 m^3 and deliver

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6. The description here is based on the field observations of a World Bank mission that visited Jakarta six times during 1988-89 while preparing a water supply project. Interviews were conducted with vendors, public tap operators, and households. Most interviews took place in the dry season (in North and West Jakarta), but certain areas were visited in the rainy season as well. During the first year of the implementation of the World Bank project (1990-91), the water-vending system changed significantly. We mention some of these changes below, but this paper primarily describes conditions in Jakarta prior to the implementation of the World Bank water supply project.

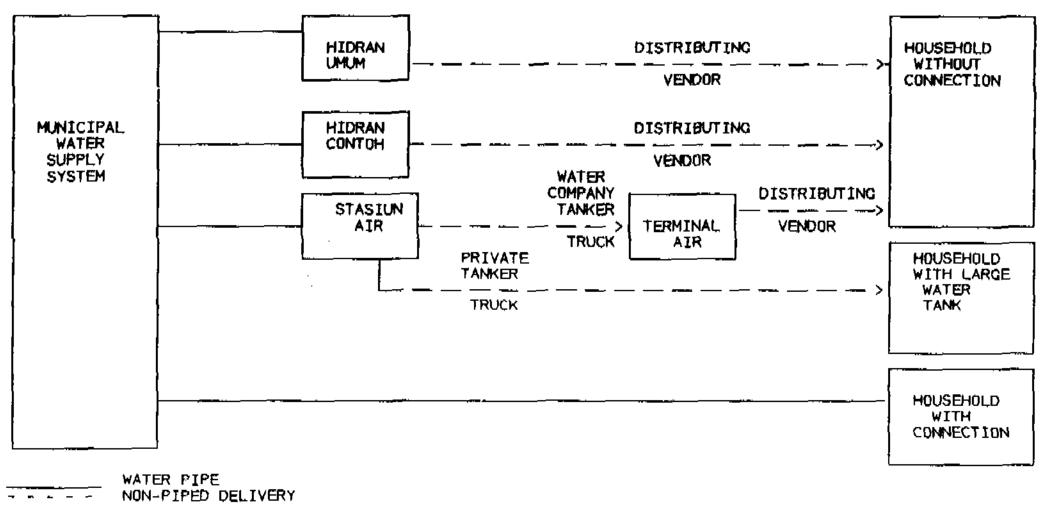
7. According to a 1988 housing survey (see Urban Institute and Hasfarm, 1988), 87 percent of households without a piped water connection had access to a well. Construction of a well equipped with a hand pump costs from $60 to $80.

8. We term these street peddlers, "distributing vendors" (see Whittington, Lauria, Okun, and Mu, 1989).

water through a hose to a household's private water tank. As these trucks can operate only on wider streets some fairly wealthy families that live in high-density *kampungs* (low-income neighborhoods) may still have to rely on street vendors. This situation is not uncommon in Jakarta.

3.3 The main sources of water for the distributing vendors are the "hydrants" (public taps) provided by the municipal water company. There are three types of hydrants (see Figure 1). A *hidran umum* is a public tap owned by an individual who purchased the facility from the water company. This is the traditional arrangement and represents the overwhelming majority of public taps (88 percent); there were 1,115 hidran umums in Jakarta at the end of 1988.

Figure 1: MEANS OF WATER DISTRIBUTION



3.4 A *hidran contoh* is a public tap constructed without charge by the public utility and managed for the utility by an individual operator. The operator and site of a hidran contoh are selected on recommendation of the lurah and the tap is usually located in the yard of the home of the operator. There were 134 hidran contohs in Jakarta in December 1988.

3.5 The third type is the *terminal air*, a multitap facility with a large water tank (10-20 m^3 capacity) that is regularly filled from tanker trucks operated by the water company. The manager of the facility is appointed by the water company on the lurah's recommendation. There were 19 terminal airs in Jakarta in December 1988.[9]

3.6 The commercial tanker trucks that sell water must obtain it from eight *stasiun airs*, facilities constructed especially for trucks by the water company. Because queuing is common at the stasiun airs, some truckers prefer to refill at illegal connections to the water system. Other truckers are rumored to obtain water outside the city.

3.7 All retail water outlets are required to obtain sales permits, renewable annually, that are issued by the municipal government via the water company.[10] Households connected to the piped public water system are not permitted to sell water. Apparently this regulation is well enforced; neither vendor activity nor connections through a hose to neighbors can be observed around residential connections in Jakarta.[11]

B. Prices and Costs

3.8 Distributing vendors. The minimum amount of water sold by a distributing vendor in a single transaction is one *pikul* (two jerricans), about 35-55 liters depending on the size of the jerricans. That is the amount low-income households usually buy every day or every other day. Medium- and higher-income households might buy two to four pikuls (70-150 liters) daily. Larger jerricans (30 liters) are used in more affluent neighborhoods or where the prices tend to be lower. Prices run as high as

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9. The construction costs of hidran contohs and terminal airs were financed from central government grants under a recently launched national poverty alleviation program. The program was still under implementation in 1989 and 1990 and the number of hidran contohs and terminal airs is still increasing. This program is one of the reasons that the water vending system in Jakarta is changing.

10. Whether any retail operations are based on wells is not known, but certainly there would not be many. Where fresh water is available in one well, other wells nearby will also provide fresh water and demand for water from vendors would be low. Where the groundwater is saline or very polluted, good wells will be some distance away and thus unattractive to vendors as an alternative source to public taps.

11. This does not apply generally to all Indonesian cities; see Suleiman 1977. The possibility of connected households selling water was eventually introduced--on a trial basis--in Jakarta in early 1990.

Rp 350 ($0.21) per pikul, or about $5.20/m^3, in neighborhoods very distant from the nearest public tap. Households in the immediate vicinity of a public tap are charged Rp 100-150 per pikul ($1.50-2.20/m^3) and those 1-2 km away, Rp 200-250 per pikul ($3-3.70/m^3; see Table 1).[12]

Table 1: PRICES CHARGED FOR WATER IN JAKARTA ($/m^3)

Municipal water company:	
to public taps	0.09
to water terminals	0.35
to connected households	0.10-0.50
Public tap operators/owners:	
to distributing vendors/tanker trucks	0.35-0.65
Water terminal operators:	
to vendors	0.70-1.00
Tanker truck operators:	
to households	1.80
Distributing vendors:	
to households	1.50-5.20

3.9 A low-income household that purchased one pikul per day for Rp 200 ($0.12) would spend about $3.50 per month for vended water. Mean household income in Jakarta was estimated at $133 per month in 1988; 21 percent of households had less than $60 per month, and 11 percent had more than $240.[13] A household with an income of $50 per month might thus spend 7 percent of its income on vended water in the dry season. Even in the rainy season, prices never fall below Rp 100/pikul, and the average price charged (about Rp 150/pikul) is only 20-30 percent lower than in the dry season. (Households do buy less water in the rainy season, because the water in their wells and collected rainwater can then be used for bathing, whereas in the dry season they use water purchased from vendors for both drinking and bathing.)

12. A short note analyzing the relationship between water prices and distance from a public tap along a road in Surabaya, Indonesia, reports that 1km generally added $0.35/m3 to the price (see Shugart, 1989).

13. See Urban Institute and Hasfarm 1988.

3.10 According to the vendors, a cart with jerricans costs \$30-75 to buy or \$0.30/day to rent. A vendor sells five to ten carts of water (1.5-3 m^3) per day, depending on the season and the area.[14]

3.11 Tanker trucks. Tanker trucks charge their customers Rp 3,000/m^3 (\$1.80/m^3). Information was not available on daily sales, number of trucks operating, or average operating expenses.

3.12 Public taps. Public taps receive water from the municipal water authority for \$0.09/m^3 and sell it to distributing vendors for \$0.35-0.60/m^3, depending on the season and the area. A tap serves six to ten vendors and sells 10-15 m^3 of water per day. If the tap is owned by the operator (hidran umum), the official installation/connection fee is about \$300.[15] When the facility is publicly owned (hidran contoh), officially the operator pays no license fee. However, several operators mentioned that they had paid a "reasonable amount" for a license. Although there are apparently no formal restrictions that would prevent customers from coming directly to the taps to collect their own water, sales of this kind were not observed at hidran umums. At one hidran contoh consumers did come directly to the tap, but this was in a small kampung where the tap was located on public property and was managed by the neighborhood. Other hidran contohs are operated similarly to the hidran umums and serve only vendors.

3.13 One typical terminal air, a large facility with nine water taps and a 20 m^3 storage tank, was constructed by the water company at a cost of \$25,000. Since that cost was covered from a government grant, the water company did not charge the operators for the license. The operator of the facility buys

14. Interestingly, this delivery system has hardly changed since the mid-1970s, except that water prices have doubled (in real terms). In their *Masterplan for the Jakarta Water Supply System*, Nihon Suido Consultants (1977) reported, "there is an established system of water selling by water vendors in Jakarta. The price of water sold to the consumer is Rp 15-20 per pair of cans which contain 18 liters each. . . . The average consumption of the consumer who buys from the vendor is around 11 l/c/d [liters per capita per day] and they [*sic*] can afford to use such water only for drinking and cooking purposes" (section 2.3.6, p. 30). The exchange rate was \$1 = Rp 415.

15. Although one operator reported that he paid \$6,000 to the water company for the license and the installation in 1975.

the water at a price of \$0.35/m3 from tanker trucks operated by the water company and sells it to vendors at a price of $\$0.70/m^3$. He sells 35 m^3/day in the dry season.[16]

3.14 Summary. If we assume that the approximately 500,000 families relying on vendors for drinking water purchased 40 liters daily at an average price of $\$2.50/m^3$, the annual gross revenue of the vendors would be about \$20 million. This is almost twice the amount the water company collects from households connected to the piped system. In some cases, households purchasing from vendors pay as much as 50 times more per unit of water than households connected to to the municipal system.

IV. EXAMINATION OF POSSIBLE RENT-SEEKING BEHAVIOR

4.1 Hauling water by carts and with tanker trucks is a costly, inefficient operation. How has the water-vending industry been able to survive for such a long time and compete on such a broad scale with the technically superior municipal water supply system? Does the explanation simply lie in public sector inefficiency and a shortage of capital for expansion of the distribution system?

4.2 There are indications that this cannot be the full story. If unofficial surcharges have to be paid to obtain any kind of water outlet, it suggests that some actors involved in the water delivery system may potentially use their position for private gains. Table 2 presents the classification of principal actors involved in a piped water-based vending system and lists their formal tasks and their stated objectives; it also proposes hypothetically a set of possible informal, unstated objectives for each group of actors and suggests strategies that they might use to achieve these informal objectives.

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16. An example of an atypical terminal air is a small facility located in a fishing village separated from the rest of Jakarta by fishing ponds. Children and women purchase water at this facility for a price of \$1/m3; no vendors buy here at all. The operator of the facility (who lives in the village) buys water from the tanker trucks of the water company at a price of $\$0.50/m^3$ and usually sells 5 m^3/day. The facility was built in 1989 as part of a poverty alleviation effort. Before the facility was constructed, vendors came to the village by boat and sold water at a price of $\$7/m^3$.

Table 2. ACTORS, OBJECTIVES, AND STRATEGIES IN WATER SUPPLY

ACTOR	TASKS	OBJECTIVE: FORMAL	OBJECTIVE: INFORMAL	STRATEGY TO ACHIEVE INFORMAL OBJECTIVE
1. Government officials (municipal, district, neighborhood)	- Regulate public utility - Regulate use of alternative water sources (e.g. groundwater) - Regulate all commercial activities	- To ensure public needs (supply of clean water) are met with the least cost - To conserve water resources	- To achieve and maintain a position which "entitles" it to receive resources from parties seeking to obtain economic rents (to be a patron)	- To encourage rent-seeking behavior and to create and maintain monopolies as long as public dissent does not lead to action endangering the position of government officials (to practice patronage)
2. Water utility staff	- Construct public taps and house connections; - Produce and sell water; - Award licenses to operate public taps	- To satisfy public demand for piped water - To operate efficiently	- To extract payments (off-budget) from those who wish to obtain a house connection or a license to operate a public tap	- To motivate the regulating authority to limit competition from other water sources - To optimize the number of house connections and public taps so that the total (ex-budget) payments received as a result of the difference between market and official price of a public tap operator license and house connection are maximized - To restrict the resale of piped water by households in order to maximize revenue from public tap operator licenses
3. Public tap operators	- Buy water from utility and sell it to distributing vendors and consumers	- To maintain and operate the public tap so the neighborhood has access to water	- To maximize net revenue	- To form a cartel with other operators in the area in order to fix the price of water at a level which maximizes their net revenue - To maintain good relations with the public utility and the area leaders in order to ensure the flow of water, to preserve the license, and to limit competition (help maintain the cartel)
4. Distributing vendors	- Buy water from public tap operator or other source and distribute/sell water to consumers		- To maximize net revenue	- To form a cartel in order to set the sale prices to maximize net revenue and to limit entry into the occupation. - To maintain good relations with community leaders in order to be allowed to operate in the area and to get help to discourage consumers from obtaining water directly from public taps or other water sources

4.3 We have not conducted research to determine conclusively the actual motivations of each of the actors in Jakarta's water delivery system. Instead, we offer simple models of rent-seeking behavior for distributing vendors, public tap operators, and the water utility, and then use these models to construct numerical examples, using data that closely parallel conditions in Jakarta. By comparing the results of the numerical examples with what we know of the actual situation in Jakarta, we can see whether the analytical framework can provide any insight into the functioning of the city's water supply system.

A. Distributing Vendors

4.4 If the distributing vendors are serving the public interest, they should be delivering water to their customers at the lowest possible cost. Then they would act as independent agents, selling water in a competitive market. Free entry into the business would prevent the vendors' implicit wage rate from rising above the wage rate for unskilled labor (perhaps with a premium for the degree of hard work involved and a return to risk and entrepreneurship).

4.5 However, distributing vendors charge substantially higher prices for water than would be necessary for them, on the average, to earn that wage. For example, a distributing vendor who sells 2 m^3 of water daily at an average price of $2.50/$m^3$ has a daily revenue of $5.00. His daily costs would be about $1.00 for water from public taps and $0.30 for equipment rental, for a total of $1.30. His net revenue would thus be $3.70 per day. His implicit hourly wage is $0.37-0.46, depending on the number of hours worked. This is 2.5-3 times the average wage for men who have not completed primary school (and about twice the average wage of men who completed primary school).[17] Distributing vendors thus appear to have lucrative occupation; however, it is unclear how much of these profits they are able to keep and how much is absorbed by their rent-seeking costs.

17. See Government of Indonesia/UNICEF, 1989, Table 5.4.

4.6 These apparently high profits suggest that distributing vendors may not be operating in a competitive business environment. One possible rent-seeking strategy would be for a cartel of distributing vendors to attempt to maximize their collective net revenues, NR_v:

$$NR_v = \sum_{i=1}^{N} \{q_i * [p_i - (P_o + t_o * w + d_i * t * w)]\} - (N * C_g) - (L * C_{dv}), \qquad (1)$$

where

N = number of customers relying on distributing vendors
L = number of distributing vendors
q_i = quantity of water sold to the ith customer
d_i = distance to the ith consumer from the nearest public tap (km)
p_i = price charged to the ith customer, where $p_i = f(d_i)$
P_o = price of water paid by distributing vendors to the public tap operator (assumed to be the same for all vendors)
w = opportunity cost of distributing vendors' labor (assumed to be constant per hour and the same for all vendors)
t_o = time (in hours) required to purchase 1 m^3 of water and to sell it to customers (excluding hauling time)
t = time required to haul 1 m^3 of water over a distance of 1 km and return to water source
C_{dv} = cost per vendor for rental of cart and jerricans
C_g = cost per customer of any payments by the distributing vendors' cartel to government officials, neighborhood leaders.

This objective would be advanced by raising prices, limiting supply, and restricting entry into business. The successful creation of a cartel might require participants to maintain good relations with community leaders to be allowed to operate in a neighborhood and to obtain assistance in discouraging households from obtaining water directly from public taps or other water sources.

4.7 This statement of the distributing vendors' net revenue objective involves many simplifications. For example, the time required to carry 1 m^3 of water from a public tap to the home of customer i (d_i*t) actually depends on q_j, the quantity of water purchased by other customers and their location. Also, it would be a function of the total quantity of water delivered, because there may be economies of scale in hauling. However, we ignore these effects to focus on the main characteristics of the water market.

4.8 In the absence of alternative water sources, the demand for water from vendors (within the range of consumption levels observed in Jakarta) is inelastic. As long as the absolute value of the elasticity of demand remains less than 1, price increases would continue to generate revenue for the cartel. In practice, however, political constraints may prohibit price increases above a certain level, even though the demand for water is inelastic. Also, at very high prices, demand may become more elastic as households will find it worthwhile to spend money to improve the quality of well water, or potential suppliers from other sources (e.g., connected households) will find it worthwhile to enter the market in spite of restrictive regulations. In this analysis, we denote the upper bound on the price the distributing vendors can charge by P_{max}.

B. Public Tap Operators

4.9 The objective of the public tap operators might likewise be to maximize collective net revenue, NR_{pto}, defined as

$$NR_{pto} = \sum_{i=1}^{N}[q_i * (P_o - P_u)] - M * (C_l + C_o) \qquad (2)$$

where

M = the number of public taps
P_u = price of water the utility charges the public tap operators
C_l = a public tap operator's monthly cost of a license (including all payments, both formal and partial payments with no receipt)
C_o = other monthly costs of operating the public tap (such as maintenance, management, and labor cost).

If the price that distributing vendors charge their customers is constrained to P_{max}, P_o is also constrained for the tap operators by the requirement that $NR_v \geq 0$, that is,

$$P_o \leq [\sum_{i=1}^{N} q_i (P_{max} - w*d_i*t - w*t_o) - (N * C_g) - (L * C_{dv})] / \sum_{i=1}^{N} q_i \qquad (3)$$

C. The Water Utility

4.10 The number of public taps in Jakarta is very low, about 1,200. (The city of Surabaya, with only one quarter of the population of Jakarta, has 2,300 taps.) Five to ten thousand public taps could be constructed in Jakarta for the price of one of the city's underutilized water treatment plants. Let us examine how water utility staff could potentially benefit when the number of public taps is low.

4.11 First, assume that there are no house connections. In this case the net informal revenue of utility staff, NR_u, is given by

$$NR_u = M * (C_l - C_r) \qquad (4)$$

where C_r = monthly equivalent cost of constructing the public tap. The maximum payment for the license from a public tap operator (C_l) is constrained by the requirement that $NR_{pto} \geq 0$, that is,

$$C_l \leq 1/M * [\sum_{i=1}^{N} q_i \, (P_o - P_u)] - C_o \qquad (5)$$

Since the distance from the taps to the customers (d) depends on the number of taps (M), the maximum value of P_o (because of equation 3 above) also depends on M. This implies, in turn, that the maximum value of C_l is also a function of M. Assuming P_u is exogenously determined (that is, by the municipal government), the water utility's problem is to set M such that NR_u is maximized.

D. A Numerical Example: No House Connections

4.12 Consider a neighborhood of 1,000 households, each with the same water demand function, served by distributing vendors. We make the following assumptions:

(a) For political reasons, the maximum end-user price allowed (P_{max}) is \$2.50 per m^3.

(b) The opportunity cost of vendors' time (w) is \$0.15 per hour (equal to the average wage in Jakarta for male workers with less than primary school education).

(c) All households are assumed to be the same distance (d) from the nearest public tap. If there is one tap in the neighborhood, this distance is assumed to be 2 km. If there are M taps, $d = 2/\sqrt{M}$.[18]

(d) Vendors are assumed to be able to haul 1 m^3 of water 1 km in 2 hours ($t = 2$), and 2 additional hours are required to purchase 1 m^3 of water at the public tap and sell it to customers ($t_o = 2$).

(e) There are 20 distributing vendors in the neighborhood, each of whom incurs a cost of $9 per month for equipment rental ($L = 20$; $C_{dv} = \$9.00$).

(f) The cost of side payments to neighborhood functionaries is $1.50 per month per customer ($C_g = \$1.50$).[19]

(g) The cost of operating a public tap is $60 per month ($C_o = \$60$), and the monthly equivalent cost of installing it is $5 ($C_r = \$5$).[20]

(h) The public tap operators pay the water utility $0.09 per m^3 ($P_u = \$0.09$).

(i) Each household's water demand function is given by $q = 2 * p^{-0.5}$, where q is measured in m^3 per month. This demand function implies a constant price elasticity of -0.5.

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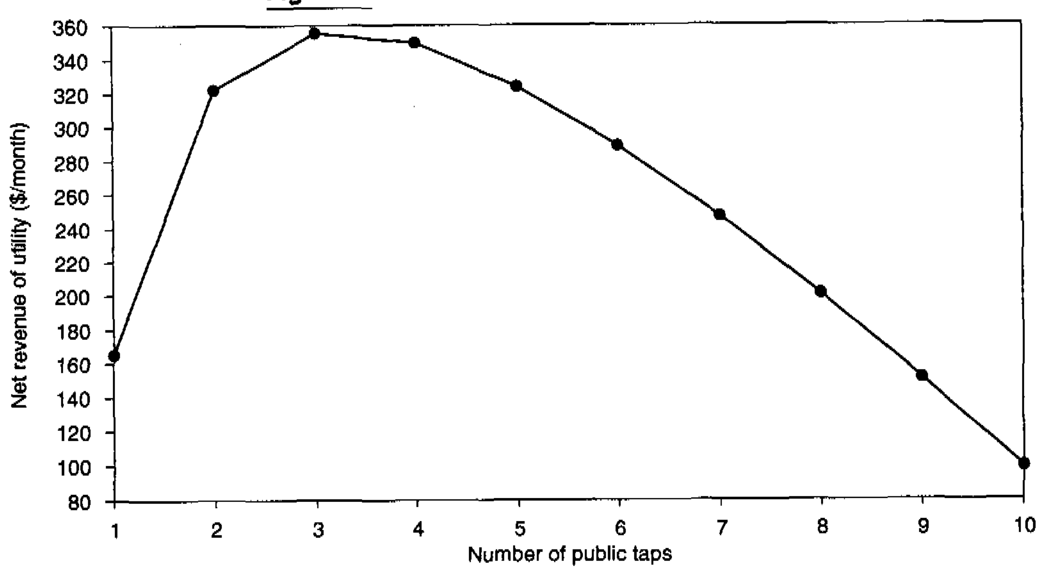
18. Admittedly, the spatial aspects are not given proper treatment here. But $d = 2/\sqrt{M}$ meets the most important requirement: it is a decreasing function of M with a decreasing return to scale. The numerator was simply set at a level that ensures that the vendors work nine hours per day with observed density of public taps and observed quantities delivered. B. J. L. Berry and K. Sierra provide a brief analysis of the spatial aspects of the Jakarta public tap-distributing vendor system in an unpublished paper, "Public Works Investment Strategy in a Developing Country: Urban Water Supply in Indonesia," Department of City and Regional Planning, Harvard University, 1978.

19. Because of a lack of direct information about C_g, we chose a value that (based on equation 3 above) leads to an upper bound for P_0 that complies with our observations. If $C_g = \$1.50$, then $P_0 \leq \$0.53/m3$.

20. We assumed that the cost of installing the tap is $300. Using a 20 percent opportunity cost of capital, this is equivalent to a monthly cost of $5.

Since the assumed demand function implies that water demand is inelastic, the optimal pricing strategy for the distributing vendors is to charge the maximum price permissible, \$2.50. At the maximum price, this demand function implies a household water consumption level of 1.26 m^3 per month, which is about the average water use in Jakarta by households that rely on distributing vendors. The informal net income of the water utility, NR_u, is maximized when there are three public taps (Figure 2).

Figure 2: INFORMAL REVENUE OF UTILITY STAFF



4.13 This result closely resembles the situation in Jakarta. In 1988, the city had about 1.7 million households, 32 percent of which relied on vendors. Assuming that the public taps (hidran umums and hidran contohs) served 500,000 households, there were approximately 2.5 taps per 1,000 households served.

4.14 Based on this numerical example, Figures 3 and 4 summarize our estimates (on a per cubic meter basis) of the rents potentially available for appropriators from households. As illustrated in Figure 3, almost one half of the price paid by households to distributing vendors appears to be surplus, potentially available for rent-seeking agents. About 20 percent of the price received by distributing vendors is used to pay public tap operators for water. More than half of this payment could be available to public tap operators for distribution to other rent-seeking agents, such as neighborhood officials and

Figure 3: ALLOCATION OF PRICE PAID BY HOUSEHOLD TO DISTRIBUTING VENDORS

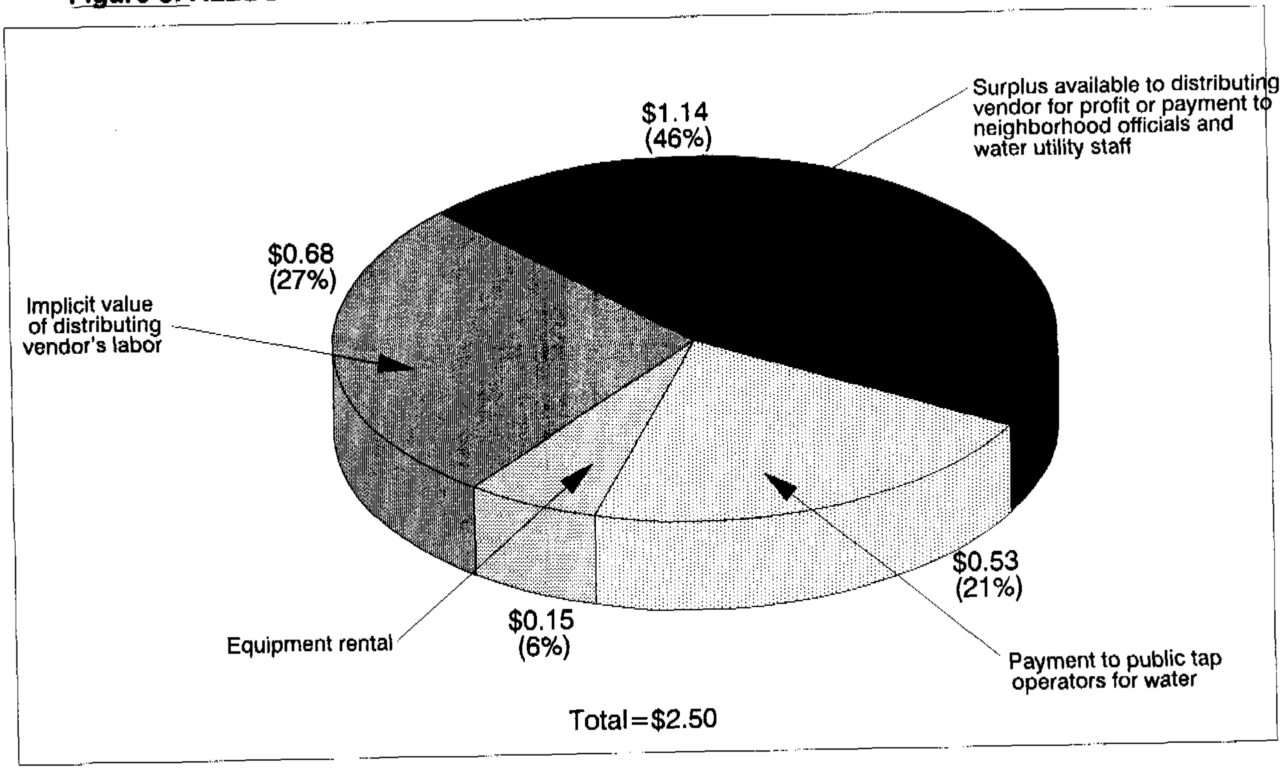
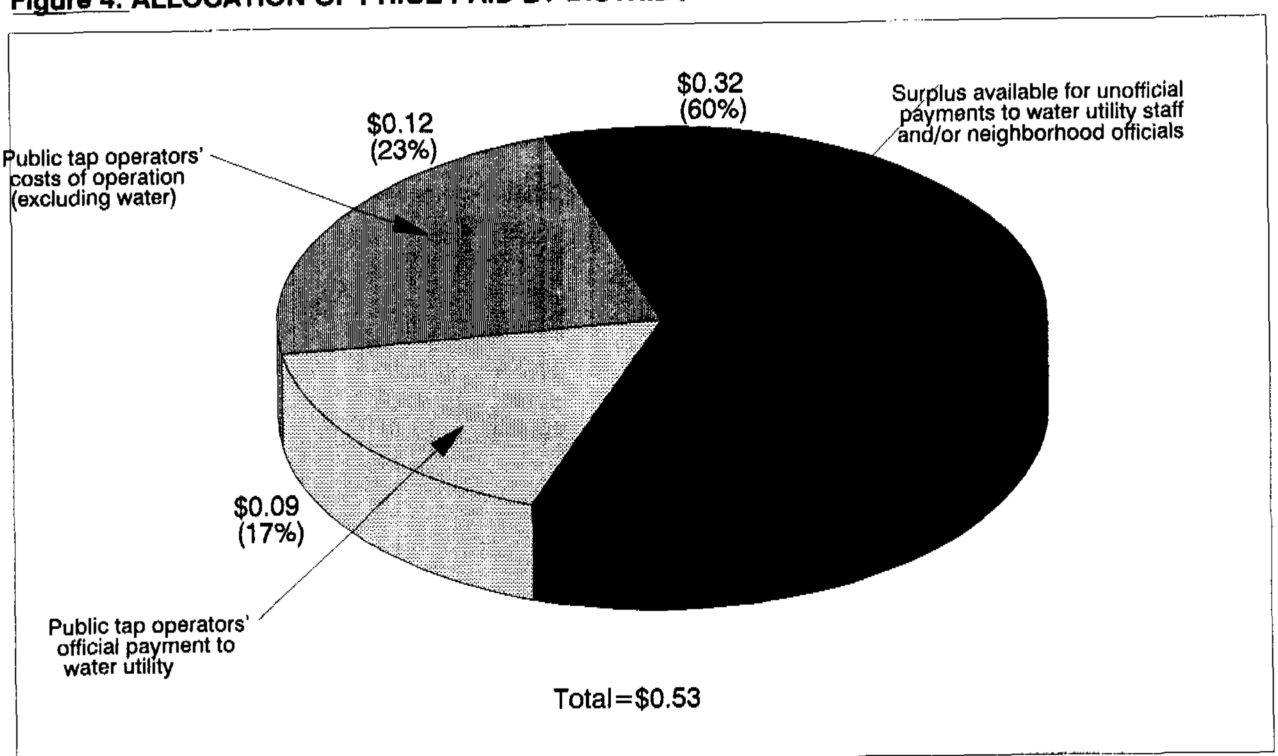


Figure 4: ALLOCATION OF PRICE PAID BY DISTRIBUTING VENDOR TO PUBLIC TAP OPERATOR



water utility staff (Figure 4). Altogether, it appears that almost 60 percent of the price paid by a household to a distributing vendor comprises the potential surplus available to rent-seeking agents.

E. The Provision of Private House Connections

4.15 Let us now consider the conditions under which a rent-seeking water utility would provide private house connections. The value of a private water connection to a household is equal to the household's welfare gain from being able to purchase water at a lower price (we assume that the perceived quality of the water obtained from vendors and from the private connection is the same and that resale of water from private connections is not permitted). This value consists of two components. The first is the welfare gain associated with the cost savings on the initial quantity of water that the household purchased from distributing vendors. The second is the consumer surplus on the increased quantity of water that the household uses as a result of the lower price. If $q_j = f_j(p)$ is the ordinary demand function for household j, and p_j is the price of water that distributing vendors charge household j, while p_h is the price that the utility charges for water obtained through a residential connection, then the value of the connection to household j, B_j, is given by[21]

$$B_j = \int_{P_h}^{P_j} f(p)\, dp \qquad (6)$$

If the monthly equivalent of the construction cost of the house connection is C_h and that is equal to the official connection fee, the maximum amount of net informal revenue that the water utility can obtain from "selling" the connection to household j is $(B_j - C_h)$. If $(B_j - C_h)$ is negative, the household is not willing to purchase a connection even if the water utility staff is prepared to sell it at cost.

4.16 If $(B_j - C_h)$ is positive, rent-seeking water utility staff must consider whether more rents will accrue from providing the house connection, or from "serving" the household through the public taps via distributing vendors. If perfect price discrimination were possible (that is, if water utility staff could determine the value of a connection to each household and assign differential connection prices

21. This is only an approximation. For a review of the literature on the valuation of economic gains, see Johansson 1987.

accordingly), the optimal strategy would be to set connection prices at levels such that only households yielding more informal revenue by paying the "full" connection charge (rather than continuing to purchase water from distributing vendors supplied by public taps) would find it worthwhile to connect.[22] The "full" connection charge would be set equal to B_j.

4.17 If price discrimination is not possible, the water utility should set the "full" connection charge (C_f) and the number of public taps (M) such that the sum of net revenues from households and public tap operators is maximized. In a situation in which the supply in the public water distribution system is limited (as is actually the case in Jakarta), the problem for the water utility is to determine the mix of house connections and public taps that maximizes informal revenue subject to a constraint on the maximum amount of water that can be provided. Because households that rely on distributing vendors use substantially less water than households with a private connection, a water availability constraint will in general penalize house connections. Similarly, in the dry season it is typically more profitable to sell the marginal unit of water through distributing vendors (via public taps) than through house connections, because connected households place a much lower value on the marginal unit of water than do households that rely on distributing vendors. This may explain why during times of shortage the water company in Jakarta shuts off water to house connections, while still supplying water to the public taps. (Note that this practice is quite consistent with both an allocative efficiency objective and an equity objective.)

F. A Numerical Example with House Connections

4.18 Let us assume that the price of water sold to connected households, p_h, is determined exogenously (that is, by the Jakarta City Council) and is equal to \$0.10 per m^3 (this is the actual water tariff in Jakarta for households consuming 0 to 15 m^3 per month). The other parameter values are the same as in the previous example. Using the same household demand function, B_j is equal to \$5.06 per month. If we assume that the official connection fee for the household is \$150 and that the household's real rate of time preference is 20 percent annually, the monthly cost of the official connection fee is

22. Some price discrimination may in fact occur. Because even the official connection fee (CH) depends on property characteristics, it is quite possible that the "full" price of the connection is also differentiated.

$2.50. This implies that the household would be willing to pay $2.56 per month for a connection in addition to the connection fee. The maximum informal revenue the water utility staff can obtain from a household using distributing vendors and public taps may be estimated as $0.36 per month.[23] Thus, the water utility can collect more economic rent from selling a private home connection.[24] By selling a private connection, the water utility effectively captures any rents that the public tap operator and distributing vendor may have obtained from the household.

4.19 If the water supply is limited (for example, because of capacity constraints in the system), the optimal strategy for a rent-seeking water utility is still to provide a mix of house connections and public taps. In practice, household willingness to pay for a private connection varies significantly, and households with the highest willingness to pay are likely to obtain connections first because they can offer the water utility the largest rents. As water becomes more available (for example, through increases in the capacity of the water supply system), more and more households will receive connections.

V. POLICY IMPLICATIONS

5.1 An understanding of the possibility and consequences of rent-seeking behavior in water delivery systems is essential for formulation of government policy and successful donor involvement in the water sector. In early 1990, "deregulation" of water sales was proposed in Jakarta. Specifically, all households with a metered connection were to be permitted to sell water to their neighbors and to water vendors. Three arguments were made in support of this policy:

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23. As shown in Figure 2, NRu = $356 per month with 1,000 households.

24. This result is not very robust with respect to the assumed parameter values. For example, if the household's real rate of time preference is 30 percent, then Bj - Ch = $1.31. If neighborhood officials also have a say in which households are permitted to have a private connection, and thus are able to capture a portion of the household's surplus, the utility may be able to obtain more money from selling water to the household through public taps.

(a) The upcoming investment project would substantially increase the capacity of the piped system to deliver water. With more water in the pipes, connected households could obtain enough water to meet their own demand and sell to others. With more outlets selling water, the average distance from water outlets to customers would be shortened, thus lowering delivery costs.

(b) Households would be able to buy directly from neighbors, thus introducing an element of competition into water pricing. Households would no longer have only the option of buying from vendors.

(c) Since an increasing block water tariff structure is used, the revenue of the water company would be increased, thus enabling the utility to improve its financial situation.[25]

5.2 We can use the analytical framework developed above to analyze the effects of the proposed policy change. It is possible that the connected households might join the cartel of public tap operators. In this case the cartel would determine the new optimal price (P_o) and would only serve distributing vendors. Consider again the same 1,000 households relying on three public taps, and assume that there are also 100 connected households in the neighborhood (all other parameter values are the same as in our numerical examples). Without the "deregulation" of water sales, the water utility can extract $356 from the three public tap operators (see Figure 2) and $256 from the 100 connected households, for a total of $612 per month. Assuming that 10 out of the 100 connected households decide to sell water, there would be 13 sources of water with deregulation. If we assume that they divide the market equally, using the relationship $d = 2/\sqrt{M}$, we can calculate that the constraint on the maximum price of water at the public taps (see equation 3) would increase to $\$0.71/m^3$. However, since the three public taps sell less water, no informal revenue would accrue to utility staff; the operators themselves would just about break even. It is not clear whether the 10 connected households would make much profit selling water.

25. The increasing-block tariff structure would, however, likely result in a higher price of water sold by households to their neighbors. See Whittington 1990.

Given the existing tariff structure, they could make a profit only if their operation and maintenance costs were less than $1.00 per day.

5.3 Altogether, utility staff would lose about 60 percent of the previously collected rent however, the price of water to households would remain high. Real resource costs would shift: the savings in the time the vendors spend delivering water would be somewhat counterbalanced by the operation and maintenance costs the 10 connected households incur in reselling water.

5.4 A more interesting possibility is that the households might not join the cartel but may simply begin selling water to both vendors and neighbors at the same price public taps have been charging (P_o = $0.53/m^3; see footnote 15). This would allow people to choose between buying water from vendors or carrying the water themselves from one of the 10 connected households to their own homes. Assume that (a) households attach the same value to time spent hauling water that distributing vendors do; and (b) hauling water home takes households k times longer ($k > 1$) than distributing vendors.[26] Given these assumptions, household i will haul water unless

$$P_o + (d_i * k * t * w) + (t_o * w) \geq p_i \tag{7}$$

If $k = 3$ and $M = 13$, then $p_i \leq$ \$1.33 per m^3. Because the final price is lower than previously, nonconnected households would want to buy more water. (We are assuming that the piped system can deliver that additional amount of water; this is probably not true in Jakarta in the short run, but will be after the World Bank water project is implemented.) If we assume that the distributing vendors have to pay $1.50 per month per customer to neighborhood officials in order to work in the neighborhood, their revenue after payments for water ($0.80/m^3) will be too low to cover their other operating costs. In this situation, there is no assured market for the distributing vendors, because households have the option to collect water themselves. Although the demand for their services will not disappear, distributing vendors will find that they cannot afford side payments to neighborhood officials. Similarly,

26. The purpose of k is to reflect the disadvantage of hauling small quantities of water to only one destination point. Householders might conceivably gain an advantage in time if they could work out arrangements to purchase water from neighbors through individual hose connections.

neither the three public tap operators nor the households selling water can afford informal payments. Since the price of water sold by vendors is substantially lower than before, the consumer surplus that determines the value of house connections is also lower. As a result, the 100 connected households will be ready to pay only $85/month to utility staff. That means the informal revenue of water utility staff after the policy change is only 14 percent of the amount possible before the deregulation of water sales.

5.5 When households are free to carry water themselves, neighborhood officials lose even more from deregulation than the water utility staff. The gains from the policy change accrue to unconnected households that are able to obtain water at a substantially reduced real cost. These households also benefit from cost savings on the original quantity of water purchased from distributing vendors and from the increased water consumption that results from lower real costs. This outcome is desirable from both an efficiency and an equity perspective.

5.6 The new policy for Jakarta allowing connected households to sell water was publicly announced in April 1990. Certain restrictions still apply; the policy was only introduced on a trial basis and sales to tanker trucks are not permitted. Very little information about the actual impact of this deregulation is as yet available. The capacity of the piped system to supply water-stressed areas was projected to increase substantially only after one or two years. Preliminary observations suggest that in areas where the pipes can deliver more water, the hidran contoh program and the deregulation have pushed down the price to $\$1.50/m^3$. In other parts of the city, where connections do not deliver enough water, households have no surplus to sell and the price the vendors charge is still in the range of $2.20 to $4.50/m^3$.

5.7 In our view, some understanding of the political economy of water supply, such as presented in this paper, is essential for the development of effective projects and policies. Specifically, knowledge of the workings of the water-vending system appears to be a necessary condition of good project design. Relatively simple field investigations, covering quantities, prices, costs, and delivery methods, should be sufficient to assess whether excessive profits are accruing to some participants.

VI. CONCLUDING REMARKS

6.1 The model presented in this paper has demonstrated that a water delivery system based on public taps, distributing vendors, and relatively few house connections can generate a substantial amount of economic rent for the actors involved. The analytical approach used here does not, of course, prove that the high price of water sold by vendors in Jakarta is the result of rent-seeking behavior; alternative explanations of the existing situation cannot be ruled out. It does, however, suggest the need for a careful rethinking of the assumptions that shape the policies of governments and most donors working in the water sector.

6.2 There can be no doubt that the prices households pay for water from distributing vendors in Jakarta are very high, and it appears to us that these high prices are generating substantial surpluses that could be absorbed as economic rents. Such market distortions are neither efficient nor equitable. The current arrangement results in too few water taps, and too many resources are thus expended hauling water inefficiently by cart. Our analysis suggests that deregulation of water sales coupled with the easing of the supply constraint may substantially lower both hauling costs and the price of water and reduce the potential for water utility staff and neighborhood functionaries to capture economic rents.

6.3 In the past, attention was focused on the technical and financial aspects of water projects without adequately appreciating the importance of the political and economic characteristics of water delivery systems. Actors in the water delivery system may have unstated objectives that are different from their stated objectives. Moreover, water delivery systems have the potential of generating large economic rents. To ignore the political aspects of technical proposals when projects are being designed and evaluated is simply to invite failure. An understanding of the structure of water markets and the political power supporting existing institutional arrangements is essential for effective public policy and donor involvement in the water sector.

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