Microcredit from Delaying Bill Payments

William Violette*

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Abstract

Delaying bill payments to public utilities may provide an important strategy for households with volatile incomes to smooth their consumption. At the same time, tolerating late payments may reduce net revenues for utilities, which often leads to higher prices to cover costs. Using billing records from a large water utility in Manila, this paper estimates a household consumption and savings model to evaluate counterfactual payment policies. A popular proposal to ensure upfront payments — prepaid metering — recoups less revenue than is needed to compensate households for their loss of consumption smoothing. Alternatively, a revenue-neutral policy allowing more late payments increases welfare by encouraging greater consumption smoothing.

Keywords: credit constraints; consumption smoothing; water utilities.
JEL Codes: O13; E21; L95.

*Federal Trade Commission, Washington, DC. E-mail: william.j.violette@gmail.com Many thanks to Matthew Panhans, Miriam Larson-Koester, Adrian Rubli-Ornelas, and Stefano Polloni.

1. Introduction

Key notes to fill in later: - Ignore externalities of booster pumps - No quantity margin because of splitting of taps and because census data indicates really high coverage - Reweight by household number - Also measure by closest pipe for robustness

Section: Data

- only households connected earlier (explain) (what share are those?!) - consumption per HH - reweight data for household level?!

- Put in a table describing pipe-replacement; describe staggered approach; predict pipe-replacement?

Section: Descriptives and defending model and approach

2. Descriptives

Descriptive evidence indicates that fixing pipes improves water pressure, quality, and reliability, which may each affect consumer welfare. Table 1 tracks water service improvements by comparing average household survey responses before and after pipe replacement. [summarize the findings]

Consumers also invest in products and behaviors to compensate for low piped water service quality. These investments help reveal which aspects of piped water service are most valuable to consumers as well as most affected by pipe replacement.

Large investments in booster pumps suggest that households strongly value water pressure. Before pipe replacement, 40% of households invest in booster pumps that increase water pressure. Booster pumps are both expensive to purchase (PhP 6,000) and operate (benchmark with electricity costs). After pipe replacement, the share of households using booster pumps drops to 15%. This finding is consistent with booster pumps providing an important substitute to pressure from new water pipes.

Small investments in water filters combined with frequent purchases of filtered water both before and as well as after pipe replacement indicate that households may not derive large benefits from improvements in piped water quality. Only 12% of households use water filters both before and after pipe replacements. Averaging ([cost of filters]), filters are also much less expensive than booster pumps. Low filter usage may stem from the fact that less than half of households report drinking from the tap while over 70% of households report purchasing filtered water from local water-refilling stations. These behaviors remain constant after pipe replacements. Taken together, these

findings indicate that water quality improvements from pipe replacements may not be primary drivers of changes in household welfare.

Households cope with unreliable water supply by investing in water storage tanks. Before pipe replacement, 43% of households report using water storage tanks. This percentage only drops to 36% following pipe replacement, which is consistent with households continuing to report frequent water outages even after pipe replacement. While households seems to value reliable service, small changes in storage tank use suggest that reliability improvements are unlikely to account for a large share of the welfare gains from pipe replacements.

Increases in water pressure from pipe replacements may lead households to increase their monthly water consumption. Rapid water flow allows households to complete a greater number of water-using activities (like cleaning and bathing) in the same amount of time. Greater water pressure may also allow households to engage in new activities that require minimum pressure levels such as showering.[1] Figure 1 plots average monthly water usage per household in the 4 years before and 6 after pipe replacement. Usage increases from an average of 20.9 m3 before pipe replacement to 24.7 m3 after pipe replacement, which represents an 18% increase. The increase in usage occurs abruptly at the year of pipe replacement and remains at roughly the same level in the following 6 years. This sustained increase in consumption suggests that pipe replacement may provide sustained impacts on household welfare.

The absence of strong pre-trends in usage suggests that replacement projects are not targeted to areas with particular trends in local water demand. Instead, this pattern is consistent with the company's stated goal of sequentially replacing old pipes according to engineering specifications. Table 1 further supports this theory by indicating few demographic differences between households that receive pipe replacement projects (columns (1) and (2)) and all households (column (3)). Also, demographic characteristics appear relatively similar before and after pipe replacement, which suggests that pipe replacements were not coupled with other policies that may have also affected demand for water.

Mapping these increases in consumption into household welfare requires measuring how households trade off water usage and price. Prices are determined by the government regulator who imposes an increasing tariff schedule according to monthly

[1] By contrast, water quality improvements may have an ambiguous effect on water consumption. On one hand, cleaner water may induce households to use more tap water for cooking and cleaning. On the other hand, cleaner water may increase the productivity of cleaning and bathing, which may lead households to use less piped water.

Figure 1. Average Consumption per Household with Years to Pipe Replacement

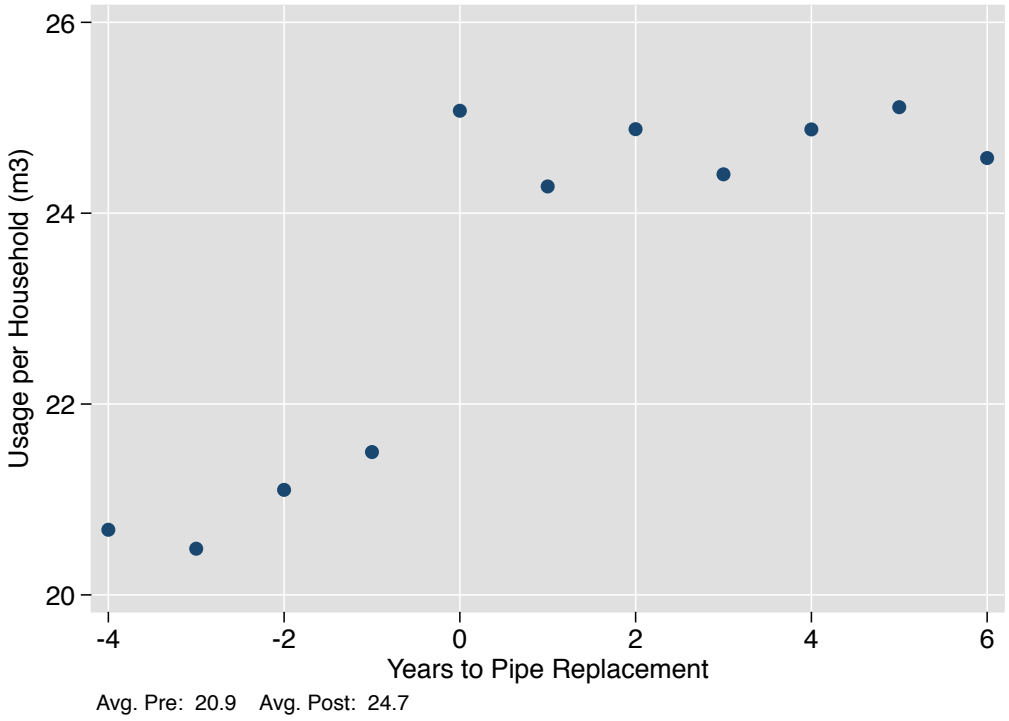

Table 1. Average Survey Responses Before and After Pipe Replacement

	Before	After	All
Piped Water Quality			
Water has strong pressure (6pm-12am)†	0.24	0.52	0.44
Water has no pressure (6pm-12am)†	0.30	0.06	0.11
Water interruptions in last 3 months	2.55	2.06	2.19
Water has foreign bodies	0.23	0.05	0.14
Water is discolored	0.09	0.04	0.05
Water has unusual taste/smell	0.14	0.04	0.07
Private Water Quality Investments			
Has booster pump	0.40	0.15	0.18
Hours booster pump is used per day	2.92	2.36	2.63
Has water storage tank	0.43	0.36	0.39
Has water filter	0.12	0.12	0.11
Purchases filtered water	0.70	0.76	0.70
Purchases from a deepwell	0.05	0.02	0.03
Spending on non-piped water (PhP)	94.75	91.59	90.71
Drinks from the tap	0.47	0.43	0.49
Demographics			
Household size	5.06	5.05	5.09
Employed members	1.62	1.49	1.57
High-skilled employment	0.11	0.09	0.10
Lives in duplex	0.17	0.20	0.18
Lives in single house	0.55	0.51	0.57
Other households sharing tap	0.40	0.42	0.43
Households	13,441	8,461	57,018

† when not using booster pump. Bill, Unpaid Balance, Payment, and Income are in PhP. Measures exclude months where households remain disconnected through the end of the sample period. Billing data include households for household-month observations. Income data include households for household-month observations. 45 PhP = 1 USD

usage, which is standard among public utilities (Hoque and Wichelns [2013]). Despite steep increases in marginal price at specific levels of usage, households do not appear to be sensitive to these price changes because households are not observed adjusting

their consumption strategically to avoid higher prices (cite appendix). The regulator also increases prices gradually over time to ensure that the company continues to cover operating costs. Since households also gradually increase their average usage over this interval, it is unclear whether households are responsive to these price increases (cite appendix).

The government regulator also gives the water company discretion to assign households to a high-price tariff schedule if they have any business activity at their residence, which provides a novel source of price variation in the context of public utilities. In the vast majority of cases, the high price tariff is applied to households that operate small food stands (or "Sari-Sari" stores). For a household with average monthly usage, the high-price tariff results in an average price of 25.3 PhP/m3 while the regular tariff results in an average price of 20.5 PhP/m3 (cite appendix for tariff). The water company periodically visits consumers and updates prices according to the activities observed at each consumer's residence. In some cases, consumers request price changes, which prompts the company to investigate the household and determine the appropriate price. Table 2 provides average characteristics of households that are always observed with the regular price (in column (1)), that are always observed with the high price (in column (2)), and that are observed changing prices during the sample (in column (3)). While the 2,442 households that experience price changes use more water than other households, they share similar demographic characteristics, which suggests that they may also share similar price-sensitivities.

Figure 2 plots average usage 4 years before and after households are switched from the regular price to the high price (in red) as well as before and after households are switched from the high price to the regular price (in blue). Before the price change, average usage for both groups follows relatively constant trends. The price change is associated with a usage jump for households switched to the regular price and a corresponding usage slide for households switched to the high price. The changes in consumption appear relatively persistent up to 4 four years after the price changes. These patterns indicate that household water usage is sensitive to large, discrete price changes.

Section Model: - What are the key model choices? - Satiation in water consumption - Linear term in quality - need to include expectation? - Booster error independence ! (keep assumption!) and sorting - Booster externality assumption

Section Estimation: - show what happens when boosters are turned off

Section Welfare: - Welfare benefits with 10 yr 5% loans (assume discount rates) or

Figure 2. Usage and Price Changes

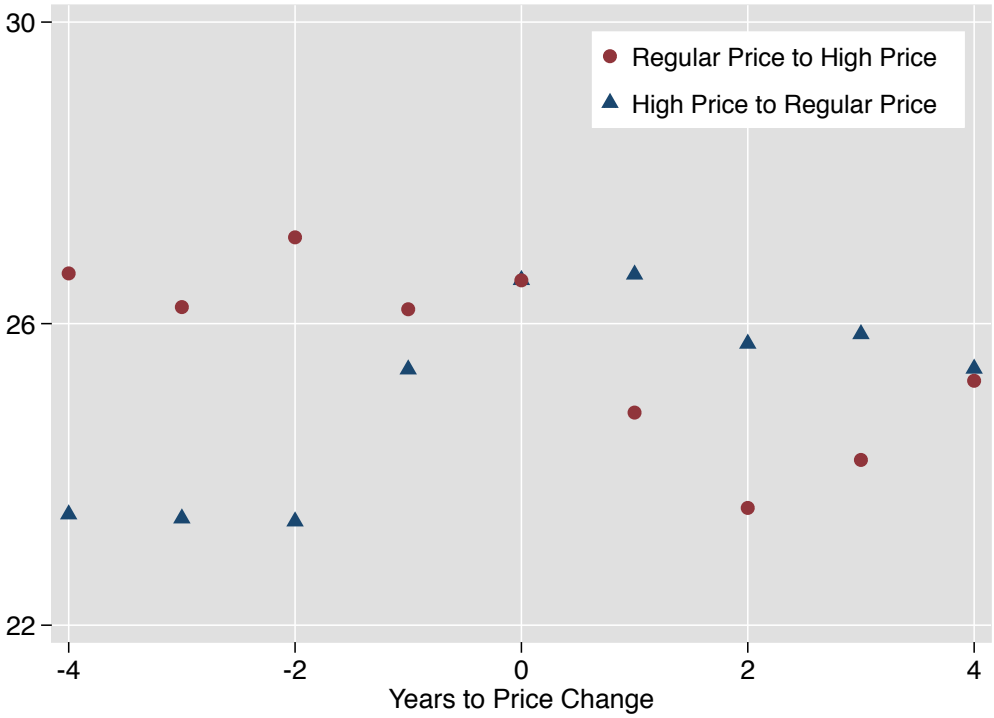

Table 2. Average Household Characteristics by Prices Charged

	Always Reg. Price	Always High Price	Change Price
Usage per Household (m3)	22.67	22.18	25.97
Household size	5.12	4.82	5.17
Employed members	1.56	1.45	1.50
High-skilled employment	0.15	0.08	0.10
Lives in duplex	0.19	0.18	0.17
Lives in single house	0.54	0.66	0.63
Other households sharing tap	0.43	0.44	0.46
Households	43,442	3,823	2,442

Reg. refers to regular price.
Pressure is 6 to midnight! Bill, Unpaid Balance, Payment, and Income are in PhP. Measures exclude months where households remain disconnected through the end of the sample period. Billing data include households for household-month observations. Income data include households for household-month observations. 45 PhP = 1 USD

50 yr 5% loan? - Welfare benefits with cash - Are households willing to pay for pipe improvements?

Robustness: - Use nearest pipe replacement definition (selection into meter identification)

3. Appendix

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Figure 3. Price Time-Series

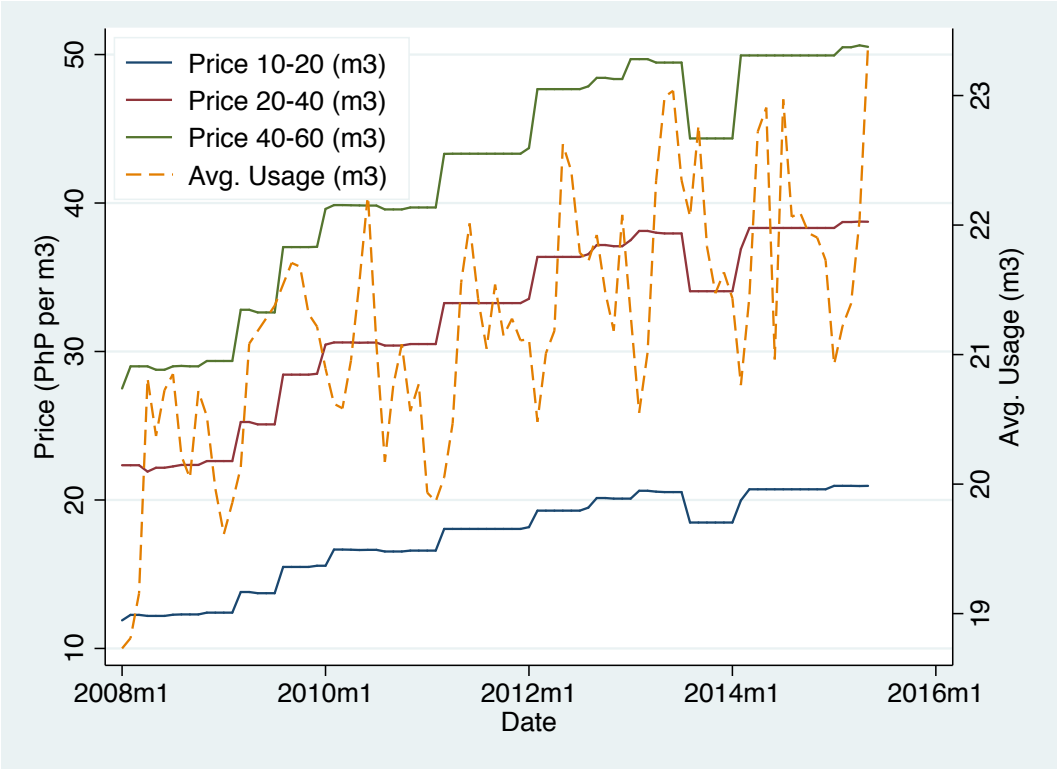


Figure 4. Tariff Schedule

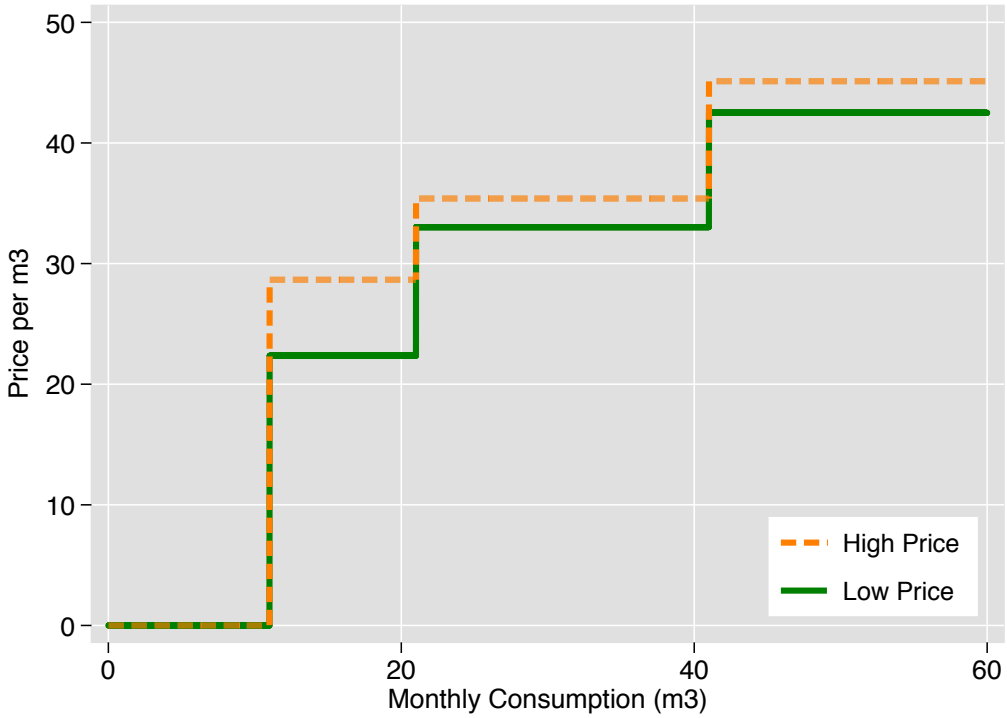
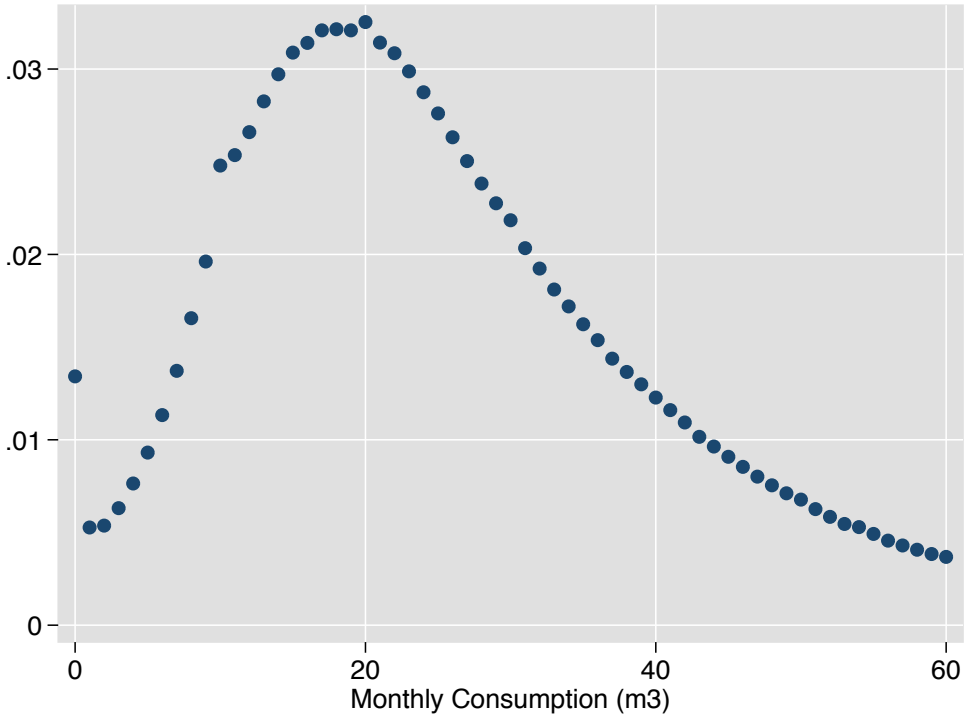


Figure 5. Consumption Histogram



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