Namibia IPP and Investment Market Framework Technical Assistance

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COST ALLOCATION, CROSS SUBSIDIES, AND RATE DESIGN ISSUES

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Namibia IPP and Investment Market Framework Technical Assistance Under a Grant by the U.S. Trade and Development Agency

ANNEX 7: COST ALLOCATION

CROSS-SUBSIDIES IN RATE DESIGN: WHY MULTI-PART TARIFFS AND SUBSIDIES THROUGH FIXED CHARGES MINIMIZE ELECTRICITY CONSUMPTION DISTORTIONS

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The Social Problem

- It is the case that many countries wish to subsidize certain groups to advance social goals such as equity or universal access.
- Given that governments are budget constrained, this means cross-subsidies must be used to achieve these social objectives.
  - Balanced against cost-reflective tariff rebalancing and pricing efficiency.
- Access/connection charges are prohibitive for the poor.
- On a per kWh basis, the cost of service to smaller residential customers may be more than larger commercial and industrial customers.

Political Economy of Prices and the Social Problem

- It is always politically desirable to have prices as low as possible...especially for politically sensitive customer classes.
  - In some cases, this means industrial customers pay low prices at the expense of residential customers under the guise of economic development.
  - In other cases, residential customers pay low prices at the expense of industrial customers who are seen as having the ability to pay.
  - Maybe all customers pay low prices.
- But if prices/rates are not revenue sufficient, then service provision is not sustainable without direct subsidies...
- And drains government/company coffers leading to other problems...
- Or leads to the bankruptcy of the service provider.
- So, revenue sufficiency is highly desirable.

The Technical Problem

- Traditionally, electricity rates have been set on a per kWh basis, and ideally based upon average costs or something akin to that.
  - Linear or non-linear tariffs
- Given the structure of electricity production, most of the costs are fixed in generation, transmission, and distribution facilities.
- Consequently, multi-part pricing with a fixed charge and a variable charge makes sense and can be efficient when compared to per kWh charges that are linear or non-linear.
  - Charges=monthly fixed charge + per kWh charge based on variable costs

Cross-Subsidy Idea

- Implement efficient multi-part pricing as a baseline, and cross-subsidize small, poorer customers through fixed charges which are non-distortionary.
- The per kWh charge would be based on the marginal cost of producing power.
- The fixed charge would have a link to the fixed cost of service to each customer type.
- **The cross-subsidy in the fixed charge acts like a lump-sum transfer which is known to be a non-distortionary way to redistribute wealth.**

Why Cross-Subsidies?

- Government can no longer easily subsidize infrastructure industries from tax revenues due to inefficient tax systems, corruption.
- Administratively should be easier to handle as the money stays within the utility (less of a "leaky bucket problem".
- According to Estache (2004), the problem with direct cross-subsidies is not as large as first suspected.
  - Especially when the subsidy is done through the connection charge rather than a usage charge.

Why Fixed Charges?

- Cross-subsidy schemes on consumption charges have been shown to benefit the non-poor more than the poor.
  - Honduras, Guatemala for example
- It has been discovered that the barriers are in access, not affordability.
- Subsidies on fixed, connection/access charges are less distorting than for consumption charges.

Why This Idea Now?

- For at least 5 years, many practitioners and analysts have danced around the idea, and either never got there, or got there, but never formalized the thinking.
- The demand-side (subsidy to customer part) is well understood and there seems to be agreement.
  - Subsidize fixed charges
- It was the source of funding side that had not been formally analyzed.

Defining the Baseline: Cost Causation, Cross-Subsidy, and Average Cost Pricing

Cost Causality and Cross-Subsidy

- Many would agree that if a customer causes a cost to be incurred, it seems reasonable that they be responsible for covering that cost.
- If cost causality is taken to be a reasonable basis for allocating costs, and thereby setting prices, then how does one determine cost causality in energy, for example?
  - Time of use
  - Location of use
  - Power flow studies
- **When prices are not based on cost-causality, cross-subsidies may be present.**
  - **Cross-subsidy occurs when at the current price, revenue collected from the customer class exceeds the cost of providing the service to that customer class, while for other customer classes the revenue collected is less than the cost of providing the service.**

Issues with Uniform Average Cost Prices

- If prices are set to average costs, P=Total Cost/Total kWh, then revenue sufficiency is satisfied.
- Prices can be perceived as fair (same price for all)
  - But can also result in the poor subsidizing the rich, for example or cross-subsidies in general that may be undesirable.
- However, average cost prices likely do not satisfy cost causality in the short-run or long-run.
  - Those who consume power at peak are not paying for all of the costs they cause because, implicitly, all kWh are assumed to have the same impact on cost
  - Thos who consume power at a location that has transmission/distribution constraints are not paying for the congestion, losses, or investment they cause.

Average Cost Prices By Customer Class

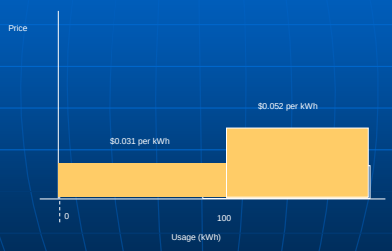
- Prices can be averaged by customer class to reflect some cost causality as determined by cost of service studies and/or FDC.
  - Now there are different prices by customer class.
  - Price equals the average cost a serving a customer in that class.
- These prices, while reflecting some general cost causality trends, are still not economically efficient.
  - They likely do not address the location and time factors in cost causation.
- These prices are discriminatory by their very design.
- This may be more of a problem than a solution cost causation by class may not be socially desired if uniform average costs implicitly subsidize the poor.

Inclining Block Tariffs as the Traditional Pro-Poor Tariff:

Non-Linear Prices: Inclining Blocks

- Non-linear – prices per unit increase as consumption increases.
- Prices are not economically efficient.
- Used as a pro-poor tariff with the first block having a low price (or no price in some cases), and successive blocks higher prices for larger, more wealthy customers.
  - Takes away burden of fixed cost recovery from poor who are connected…but in practice the wealthy are the ones who benefit most from this tariff.
- Encourages conservation and energy efficiency for large users through increasing prices for extra consumption.
  - A variant was used in Brazil during their hydro crisis in 2001.

Inclining Block Tariff



Telescoping Inclining Block Tariff

- Pay the low price for the first block and higher prices for successive block.
- Small consumers (in terms of total consumption) pay lower prices.
- Smooth price transition to consuming larger quantities for poorer consumers if they consume more than the first block.
- For example, if 101 kWh is consumed, the bill is 100 x 0.031 + 1 x 0.052 = 3.152
- **But larger consumers also benefit as they also benefit from the lower prices in the first block!**
- **Only those who are connected benefit! In many countries, electricity access is quite low.**

Non-Telescoping Inclining Block Tariff

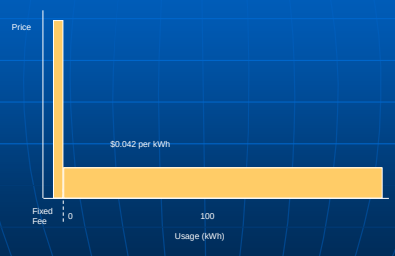
- Pay the low price for the first block and higher prices for successive block.
- But once consumption goes into the second block, all power is charged the higher price!!!
- Small, poor consumers face risk of consuming 1 kWh too much!!
- But larger customers do not receive any benefits of lower prices in the first block
- The marginal cost to small consumers of consuming into the second block is large…leading to incentives to "cheat" on the meter.
- For example, if 101 kWh is consumed, the bill is 101 x 0.052 = 5.252 but consuming only 100 kWh is 3.10. The last kWh costs over $2!

Multi-Part Tariffs as a Pro-Poor Tariff: Basics

Multi-Part Prices Defined

- Customers pay access fee (fixed charge) plus usage
  - The access fee covers the "fixed" cost and the usage fee marginal cost.
  - This fee does not change with consumption.
  - The fixed charge can be based on the cost of service (cost causality)
  - This can be an efficient pricing scheme with economies of scale.
  - Another variant is usage fee is lower than average cost, and above marginal cost with lower fixed fee.

Multi-Part Price Example

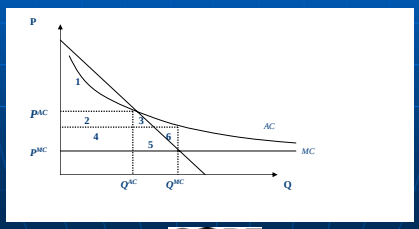


Multi-Part Prices: Determining the Fixed Charge

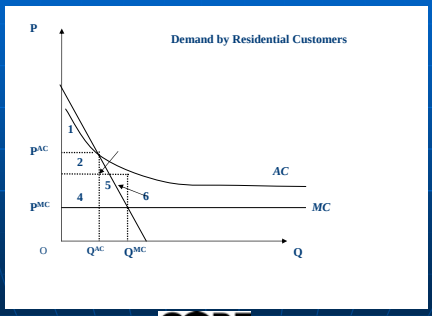
- Components:
  - Overheads such as metering, billing, and customer service.
    - Can be levied as a per customer charge.
  - Monetary value of fixed assets such as generation, transmission, distribution.
    - Can levied based on maximum contract demand as a per kW charge.
    - Can be levied based on coincident or non-coincident peak demand as a per kW charge.
    - For T&D can be determined by load flow models to determine cost causality at peak.
    - Some have suggested these charges also be time differentiated.
  - Connection Charge amortized over time may be included.

Average Cost Pricing vs. Multi-part Pricing

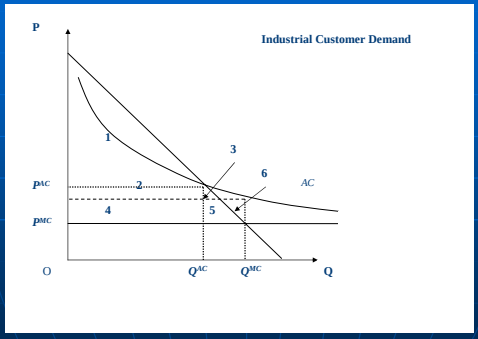
- Average cost pricing leads to a loss in welfare of 3+5.
- Multi-part pricing captures that lost welfare for consumers. Utility gets area 2+4.



Residential Customers Costs



Industrial Customers Costs



The Cross-Subsidy

Table 1

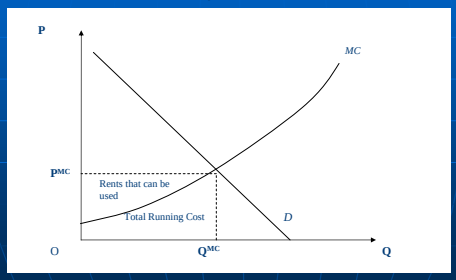
	Multi-Part Prices, No Cross Subsidy				Multi-Part Prices, Cross Subsidy		
Customer Class	Price and Quantity	Consumer Surplus	Fixed Charge		Price and Quantity	Consumer Surplus	Fixed Charge
Residential	P^{MC}, Q^{MC}	1+3+5	2+4		P^{MC}, Q^{MC}	1+3+5	2+4-(3 and 5 from industrial)
Industrial	P^{MC}, Q^{MC}	1+3+5	2+4		P^{MC}, Q^{MC}	1	2+3+4+5

Table 2

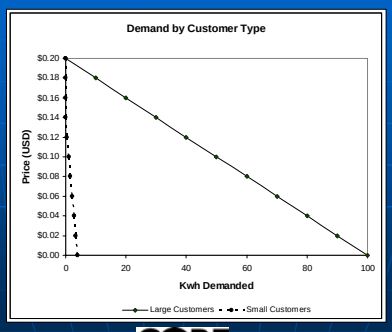
	Average Cost Pricing				Multi-Part Prices, Cross Subsidy		
Customer Class	Price and Quantity	Consumer Surplus	Producer Surplus		Price and Quantity	Consumer Surplus	Fixed Charge
Residential	P^{AC}, Q^{AC}	1	2+4 (3+5 is the deadweight loss)		P^{MC}, Q^{MC}	1+3+5	2+4-(3 and 5 from industrial)
Industrial	P^{AC}, Q^{AC}	1	2+4 (3+5 is the deadweight loss)		P^{MC}, Q^{MC}	1	2+3+4+5

Other Potential Funds

- The rents from charging marginal cost can also be used to implement the cross-subsidy.



Example Demands



Numerical Example of Multi-Part Tariff and Cross-Subsidy

		Tariff Proposals				
		Uniform Tariff	Multi-Part Tariff -1	Multi-Part Tariff - 2	Split Pro Poor Tariff	
					Large	Small
Tariff	Fixed Fee	None	$1,575.00	$75.00	$1,575.00	$ -
	Usage Fee	$ 0.062	$0.04	$0.06169	$0.04	$0.04
Results	Demand (kwh)	71,051,490	80,000,000	69,154,750	82800000	
	Marginal Cost	$ 0.040	$ 0.040	$ 0.040	$0.04	
	Fixed Cost	$ 1,575,000	$ 1,575,000	$ 1,575,000	1,575,000.00	
	Revenue	$ 4,417,058	$ 4,775,000	$ 4,341,191	$4,887,000.00	
	Total Cost	$ 4,417,060	$ 4,775,000	$ 4,341,190	$4,887,000.00	
	Profits	$ (2)	$ -	$ 1	$0.00	
Details	Number of Customers					
	Large	1000	1000	1000	1000	Doesn't Buy
	Small	20,000	Doesn't buy	Doesn't buy	Doesn't buy	20,000
	Demand (kwh)					
	Large	68,916,500	80,000,000	69,154,750	80000000	
	Small	2,134,990	Doesn't buy	Doesn't buy		2,800,000
	Net Consumer Surplus					
	Large	$ 4,749,484	$ 4,825,000	$ 4,707,379	$4,825,000.00	
	Small	$ 83,086	Doesn't buy	Doesn't buy		$ 140,000
	Total	$ 4,832,570	$ 4,825,000	$ 4,707,379	$4,965,000.00	

Example Explained

- Under the Uniform Tariff:
  - Assumes all people are connected
  - This is our baseline
- Under Multi-part Tariffs with Fixed Charge of $1,575.00 and$75.00:
  - No small consumers are connected. Think of the $1,575 as the connection charge, if you wish.
  - The $75 fee is based on fixed costs averaged over all consumers if they were connected
  - Looks like the situation in many developing countries. In both cases small (poor) customers can afford the variable charge.

More on the Example

- Under Pro-poor Split:
  - Small consumers can pay no fixed charge and the marginal cost ($0.04). They are connected.
  - Large consumers can pay $1,575 fixed, and $0.04 marginal cost.
  - Both classes are better off than under uniform average cost pricing in terms of surplus.
- In this example, the largest fixed charge that could be levied on small customers is $7 as this is their consumer surplus at the marginal cost.
- There is also another issue at play here…how does a regulator or utility keep large customers from taking service as a small customer?

Menu of Tariff Options

Split Pro Poor Tariff		Menu of Tariffs		
Large	Small	Tariff 1	Tariff 2	
$1,575.00	$ -	$1,575.00	$ -	
$0.04	$0.04	$0.04	$0.04	< =300 kWh
			$0.20	> 300 kWh
82800000		80000000	2800000	
$0.04		$0.04		
1,575,000.00		1,575,000.00		
$4,887,000.00		$4,887,000.00		
$4,887,000.00		$4,887,000.00		
$0.00		$0.00		
1000	Doesn't Buy	1000		
Doesn't buy	20,000		20,000	
80000000		80000000		
	2,800,000		2,800,000	
$4,825,000.00		$4,825,000.00		
	$ 140,000		$ 140,000	
$4,965,000.00		$4,965,000.00		

Menu of Tariffs as an Implementation Strategy?

- Menu of options with different access + usage fee + inclining or declining block combinations.
  - Customers can select price option that benefits them most
- The menu should result in company profits increasing and customer benefit increasing due to the choice.
- Large users would select Tariff 1. For consumption above 300 kWh, it is cheaper to pay the fixed fee than pay $0.20 per kWh.
  - In fact, the large user would consume no more than 300kWh!!
- Small users pay no fixed charge and would not ever worry about the large price in the block above 300 kWh.
- An alternative to non-telescoping inclining block tariffs?

Implementation Considerations

- Estimates of Demand
  - It helps to have good estimates of demand by customer class.
  - Fortunately, the cross-subsidy is through fixed charges so there is a margin for error.
- Cost of Service Studies
  - The cost of service study will provide the baseline cost reflective rates by which the cross-subsidy is implemented.
- Regulatory Mechanism
  - A mechanism that will fix revenue, based on fixed costs would be most appropriate…a revenue cap.
  - Price caps or average cost pricing may lead to over-recovery of fixed costs.
- Uneconomic Bypass
  - This could still be a problem is the cross-subsidy goes too far, but as proposed here this should be easy to avoid.

Implementation Considerations

- Customer Base Configurations
  - It is assumed that large customers have more wealth, though this may not always be the case.
  - Moreover, some smaller customers may be quite wealthy and perhaps could receive a subsidy even though they may not need it.
  - Helps if the numbers of unconnected poor are outnumbered greatly by existing connections according to Estache, Foster, and Wodon (2002)
- Industry Configuration
  - This can be applied to a vertically integrated monopoly or to an unbundled competitive environment as long as fixed and variable costs are separated out.

Concluding Thoughts

- The proposed cross-subsidy uses optimal multi-part pricing as its basis.
- The cross-subsidy is non-distortionary to consumption decisions.
- The cross-subsidy proposed does not need to leave any customer class worse off in terms of welfare compared to average cost pricing.
- Implementing this scheme may be quite difficult and time consuming and must be done with care.