BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

Docket Nos. UE-060256

WUTC v. CASCADE

RESPONSE OF PUBLIC COUNSEL TO STAFF DATA REQUESTS

Request No:	43
Directed to:	Judith Krebs
Date Received:	August 21, 2006
Date Produced:	September 6, 2006
Prepared by:	Jim Lazar
Witnesses:	Jim Lazar

WUTC STAFF DATA REQUEST NO. 43

Re: Witness Jim Lazar

Referring to page 33, line 15 through page 35, line 18 of Mr. Lazar's direct testimony, please provide all multiple regression price elasticity studies that Mr. Lazar has done on the inverted block rate design that he has proposed. Please provide a working electronic copy of the response and all supporting data.

RESPONSE:

Mr. Lazar has not done multiple regression price elasticity studies in association with this proposal. He has computed the estimated effect based on an arc elasticity of -0.3. A World Bank presentation on elasticity, that contributed to Mr. Lazar's selection of this arc elasticity is provided as WUTC 43 World Bank elasticity.ppt.

Session 3 & 6

Introduction to the Use of Economic and Financial Regulatory Models

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Topics

- The regulation problem
- Examples
  - Tariff rebalance to achieve social objectives
  - Devaluation and tariff pesification
- The model as a tool

The Regulation Problem

- Technological features of infrastructure sectors
  - Long life of assets
  - Investment irreversibility
  - High share of fixed costs
  - Natural monopoly
- Need to regulate

Regulatory Objectives

- **Sustainability:** adequate return on capital; attraction of capital to the industry
- **Allocative Efficiency** (prices = cost)
- **Productive Efficiency** (cost minimization)
- **Fairness:** to avoid unfair discrimination and ensure participation (universal service)

Trade-offs between Objectives (1)

- Allocative Efficiency vs. Sustainability
  - Under a natural monopoly, marginal costs are lower than average costs
- Allocative Efficiency vs. Productive Efficiency
  - The leveling of tariffs and costs can reduce incentives to minimize costs

Trade-offs between Objectives (2)

- Efficiency vs. Fairness
  - Price discrimination is efficient but can be unfair
- Sustainability vs. Fairness
  - Social tariffs or subsidies to certain services can challenge service sustainability

Economic-Financial Model

- It enables the analysis of alternative scenarios thus:
  - Providing a consistency framework among instruments, variables, parameters and functional relations
  - Quantifying the impact on the different actors (users, firm, government, creditors)
  - Contributing to the transparency and equanimity of the regulatory process

Features

- The model has been designed taking into consideration:
  - Sustainability objectives
  - Economic behavior
  - Social objectives
  - Conflicts among objectives

Sustainability

- To find a suitable combination of variables to reach the equilibrium:
  - i.e., the internal rate of return equals the opportunity cost of capital
- Also, to verify the financial viability of the project
  - Forecasted financial statements
  - Analysis of financial indicators

Economic Behavior

- It internalizes the behavior functions of economic agents:
  - Demand function
    - As a function of elasticity
  - Production function
    - Investments as a function of quality
    - Investments as a function of expansion
    - Efficiency gains

Demand Function - Elasticities

- The model includes price and income elasticity as parameters
  - Electricity
  - Water
- Elasticity:
  - Percentage variation in quantity demanded after a change of 1% in the price (income) of the good (consumer)
- Quantification of users' reaction after changes in prices and/or income

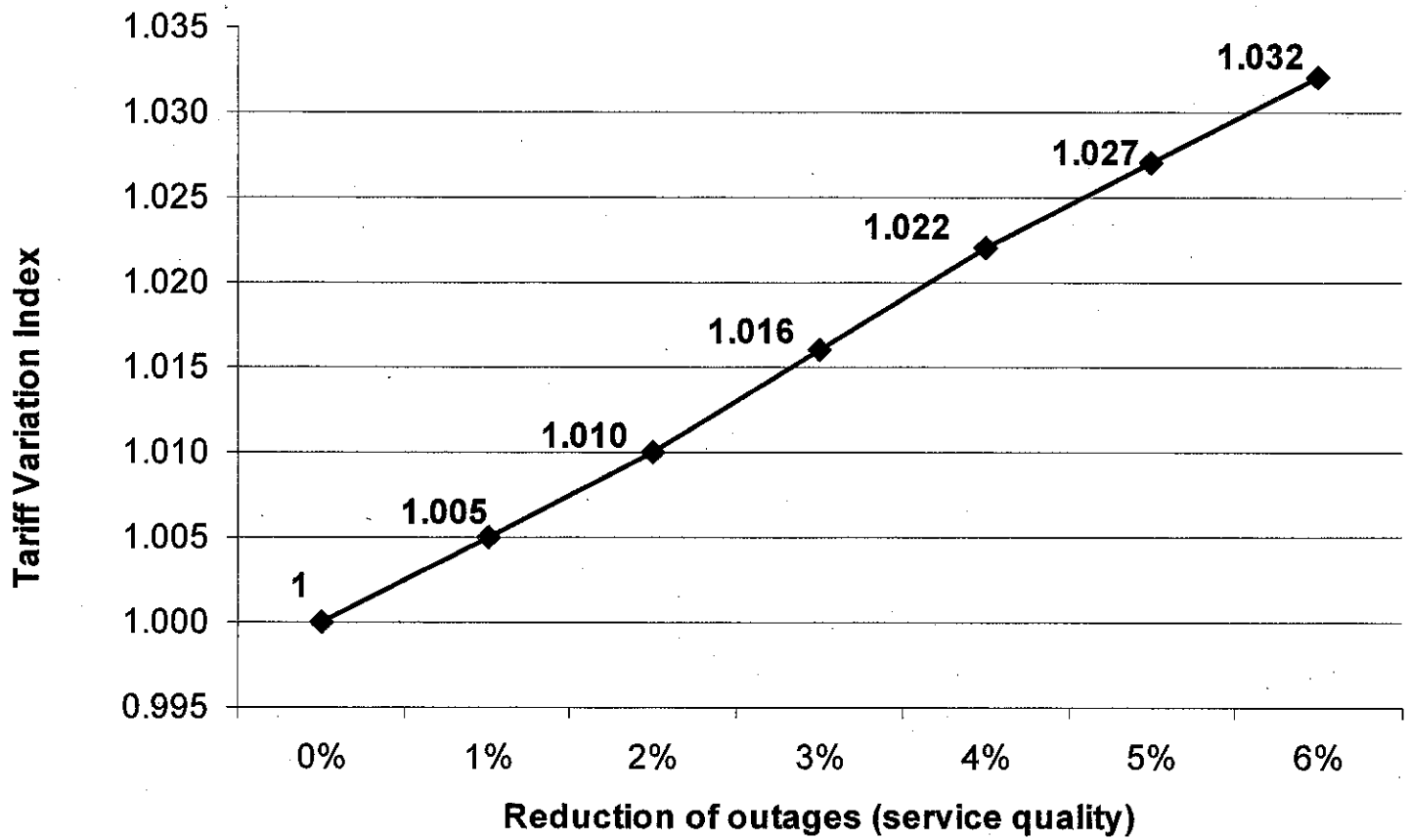
Price Elasticity: Numerical Example 20% Improvement in Service Quality =>Tariff Increase

Electricity	Pe	Required Increase Variable Charge Block 1
No Elasticity	-	10.2%
Minimum	-0.1	10.6%
Maximum	-0.8	14.7%
Average	-0.4	12.0%

Production Function - Investments

- Exogenous investments
  - The amount of the investment scheme is included in the model as a parameter
- Endogenous investments
  - The model determines the required investment amount on the basis of its parameters and forecasts
  - Treating investments endogenously implies a broad knowledge of the sector under analysis

Investments as a Function of Quality – Electricity Sector



Production Function – Efficiency Gains

- Efficiency factor applicable to O&M costs
  - Introduced as a parameter
    - In accordance with benchmarking studies
  - Used as an instrument
    - What is the efficiency gain consistent with a given scenario?

Efficiency Gains - Electricity Distribution Sector

- Fixing an X factor = 3% annually results in a decrease of electricity tariffs of about 6.6%
- A 10% tariff reduction requires an X factor = 4.4% annually

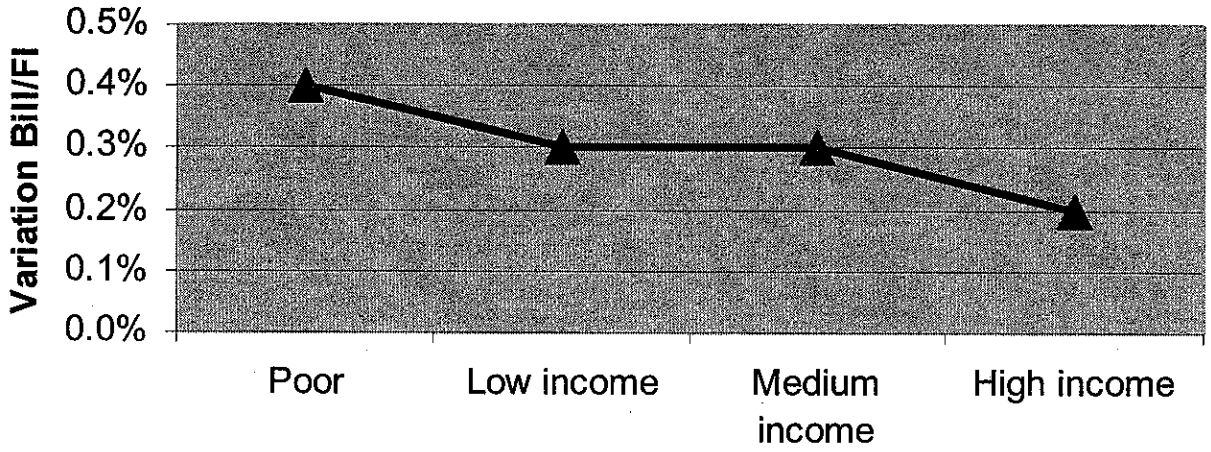
Social Objectives

- The model provides for different tariff structures for each income level
- It enables the analysis of the effect of a measure on different types of users

Social Impact Indicator: Bill / Income

- Increase of 20% in Water tariffs

Bill / Family Income	Present	New	Difference
Poor	1.9%	2.3%	0.4%
Low income	1.3%	1.6%	0.3%
Medium income	1.1%	1.4%	0.3%
High income	0.9%	1.1%	0.2%



Example using EFM

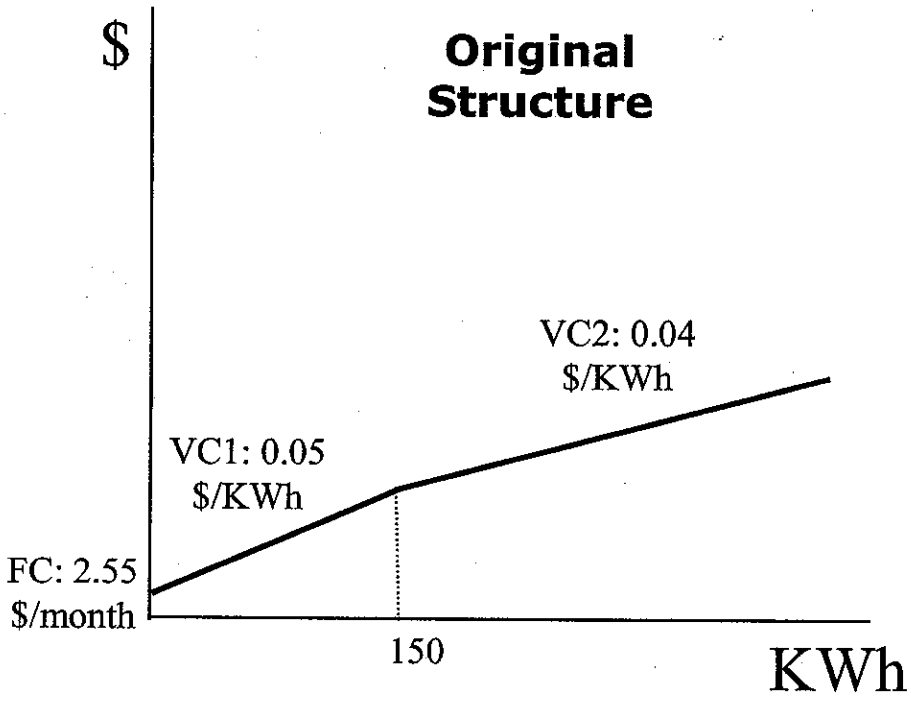
- Electricity
- Water

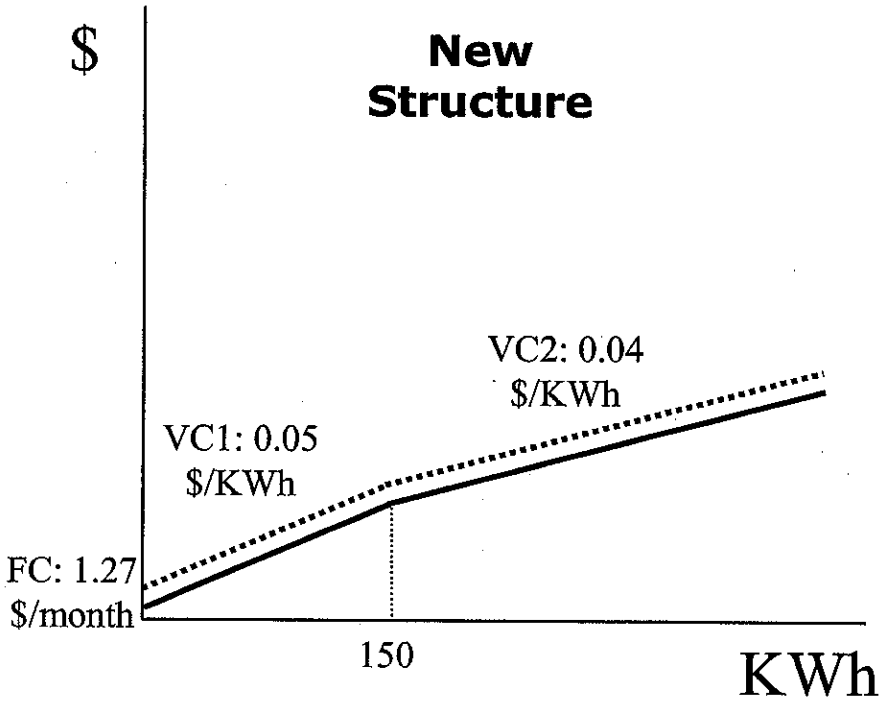
Access Subsidy New Users

- Elimination of connection charge can be compensated for with
  - 6.5% increase of the fixed charge to all users
  - 23% increase of fixed charge for the 30% of users with highest income
  - Annual treasury contribution of 0.3M$

Access Subsidy Existing Users

- 50% decrease of fixed charge for the 20% of users with lowest income





What does the Model Provide in these Scenarios?

- An instrument which
  - guaranties the consistency between the different instruments and objectives
  - quantifies the economic and financial impacts on the various actors
  - values the sensitivities of the analysis in relation to different variables and parameters assumptions
  - assures the transparency of the analysis and the justification for the decisions
- A list that verifies the information necessary to take decisions

Model Basis

- Information:
  - Internal: related to the firm

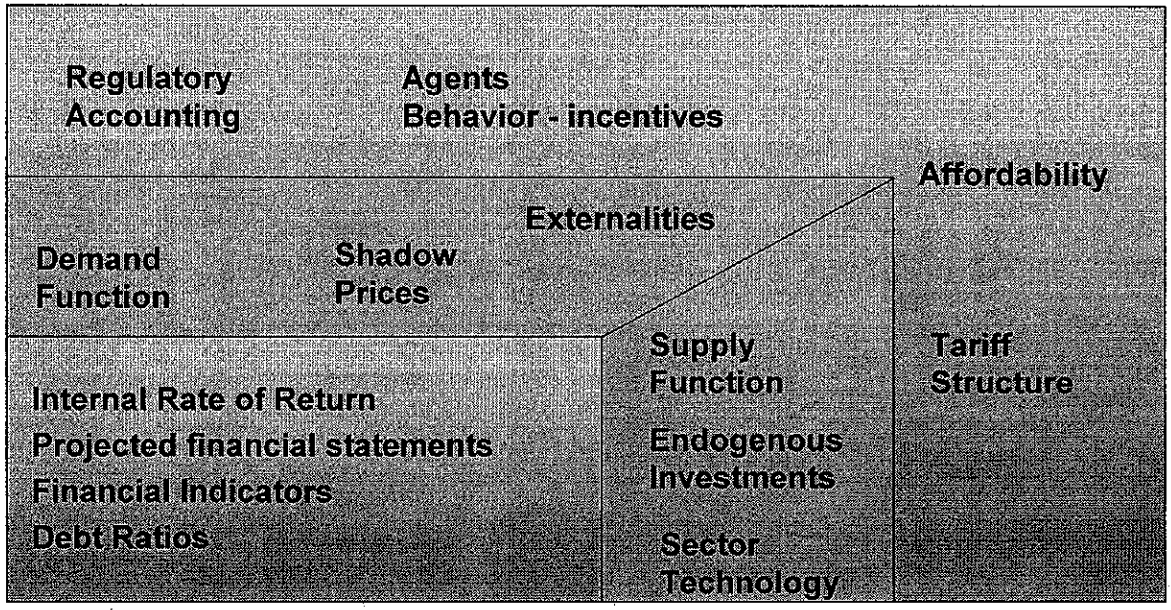
    Regulatory Accounting
  - External: related to comparable efficient costs and demand. Market studies and benchmarking

Structure of an EFM for Regulation

Regulatory Models

Economic Models

Financial Models



Engineering Models

Economic Financial Model for Regulation

Conclusions

- Need for an integrated view of all objectives and instruments
- Importance of data availability and quality
- Model as a checklist

Annexes

Annex

Session 1

Introduction to the Use of Economic and Financial Regulatory Models

Price and Income Elasticities – Electricity Distribution for Residential Users

Author	Ey	Ep
Raphael Branch (1993)	0.23	-0.2
Hsiao and Mountain (1985)	0.17	
Shin (1985)	0.17	-0.14
Barnes et al (1981)	0.2	-0.55
houthakker (1980)	0.14	-0.11
Acton et al (1976)	0.4	-0.35
Nan & Murray (1991)		-0.611
Tiwari (2000)		-0.7
filippini (1995)		-0.6 (peak) -0.79 (no peak)
Herriges & King (1994)		-0.2 (summer) -0.4 (winter)
Archibald et al (1982)		-0.4 (summer) -0.48 (winter)
Barnes et al (1981)		-0.55
Dubin (1985(		-0.16
Dubin & Mc Fadden (1984)		-0.25
Goett & Mc Fadden (1982)		-0.17
Houston (1982)		-0.28
Mc Fadden et al (1977)		-0.37
Chang & Hsing (1991)		-0.33
Silk & Joutz (1997)		-0.62

Bibliography

- "Short Run Income Elasticity of Demand for Residential Electricity Using Consumer Expenditure Survey Data". Raphael Branch. Energy Journal vol. 14 Issue 4, 1993
- "Electricity Prices and Cost Factors", C. Sayers & D. Shields, Productivity, Commission Staff Research Paper, AusInfo, Canberra, August 2001

Price and Income Elasticities – Water Distribution

Author	Ey	Ep
Neiswiadimy & Molina (1989)	0.14	-0.55
Neiswiadimy & Molina (1993)	0.63	-0.63
Chi-Keung Woo (1992)	0.28	-0.38
Neiswiadomy (1992)	0.44	-0.11
	0.25*	-0.28
IWACO (1989)	0.4, 0.5	-0.29, -0.33
IWACO (1992)	0.37	-0.68
Martin (1992)	0.18, 0.27	-0.7, -0.6
	0.04, 0.17	-0.49,-0.32
Rizaiza (1991)	0.11	-0.48
Hubbell (1977)	0.36	-0.48
Nauges & Thomas (2000)	0.09	-0.22
Renwick & Archibald (1998)	0.36	-.53, -0.11
Renwick (1996)		-0.33
Corral et al. (1998)		-0.30

* not significant

Bibliography

- "Water & Wastewater utilities", Guillermo Yepes & Augusta Dianderas, TWUWS, 1996
- "Price and Income Elasticities of Residential Water Demand", J. Dalhuisen, R. Florax, H. De Grut & P. Nijkamp, Tinbergen Institute Discussion Paper

Electricity Distribution Example

Base Case: Electricity Distribution

- Characteristics
  - Service concessions granted in 1992 for 95 years divided into ten-year management periods
  - Price cap regulation with reviews every five years
  - Tariffs in dollars indexed in accordance with US inflation
  - Minimum quality requirements

Base Case: Electricity Distribution

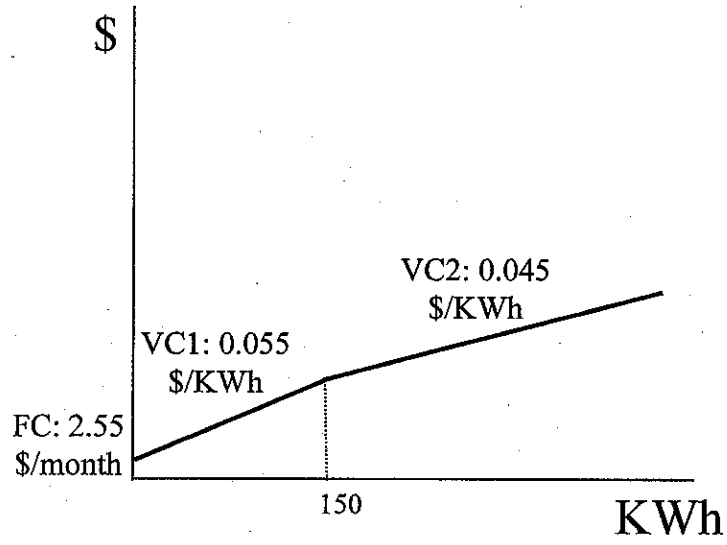
- Coverage
  - 100% coverage in the metropolitan area
- Quality
  - Substantial improvements of service quality
- Tariffs
  - Two-part (fixed charge and variable charge) and decreasing blocks (the higher the consumption, the lower the unit price)

Residential Users: Base Case

	Low Income	Medium Income	High Income	Total
Number of Users	46,286	115,715	69,429	231,430
Average Tariff per Category - $/month	6.98	9.43	11.77	9.51
% metered users	85%	100%	100%	97%
Billing for energy sales (M$)	3.50	13.09	9.81	26.40

Residential Tariffs Decreasing Blocks

Base Case Structure		
Category / Charge	T1 R1 (< 150 KWh)	T1 R2 (>= 150 KWh)
Fixed ($/month)	2.55	2.55
Variable ($/KWh)	0.055	0.045



Electricity: Examples

- Example 1: Social objectives
- Example 2: Macroeconomic crisis

Example 1: Improvement of Social Objectives

- Objective:
  - Improvement of social objectives related to coverage and affordability while
  - Ensuring economic and financial sustainability in the long run and
  - Minimizing allocative distortions in the economy

Social Objectives: Instruments

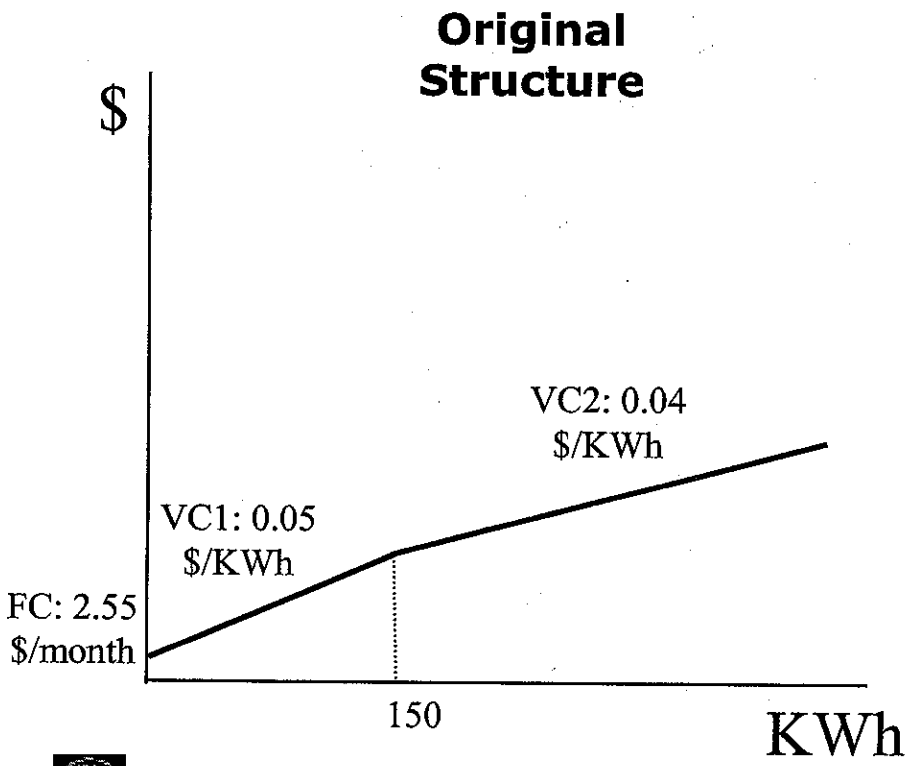
Instruments	Electricity	
	Access	Consumption
Fiscal		
Subsidy	NO	NO
ΔTax	NO	?
Tariff Level	YES	YES
Tariff Structure	YES	YES
Quality Standard	NO	YES
Concession Term	NO	NO

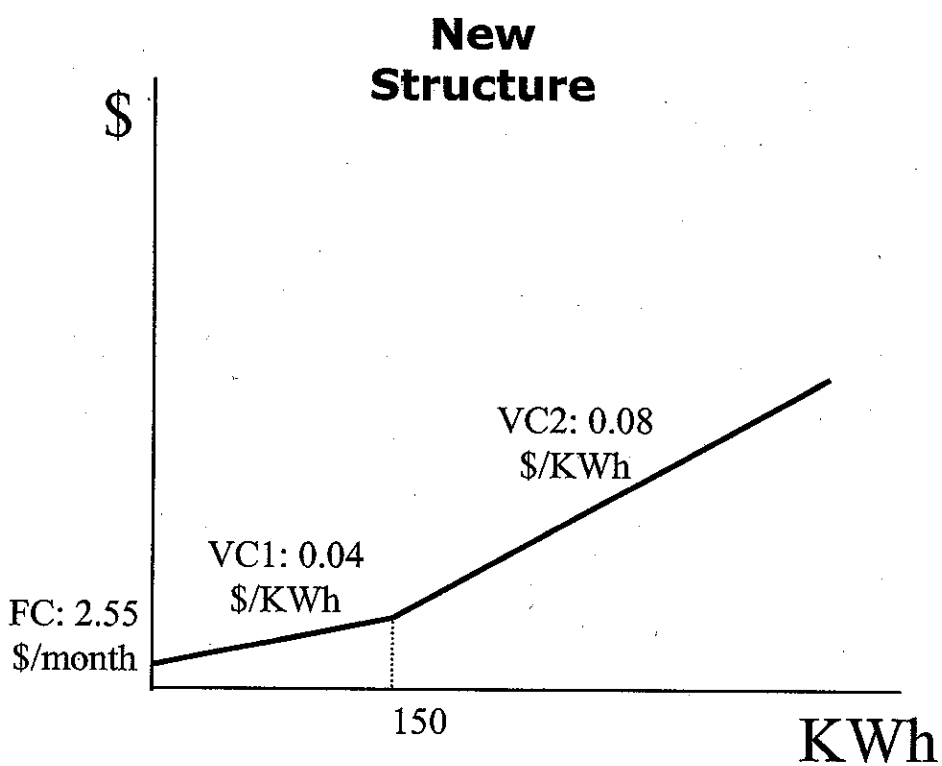
Alternatives

- Improvement of Social Conditions
- Change in tariff structure
  - Access subsidy
    - New users
    - Existing users
  - Consumption Subsidy
  - Investments
    - Quality changes

Tariff Structure Change

- Change of structure blocks from decreasing to increasing





Change in Tariff Structure

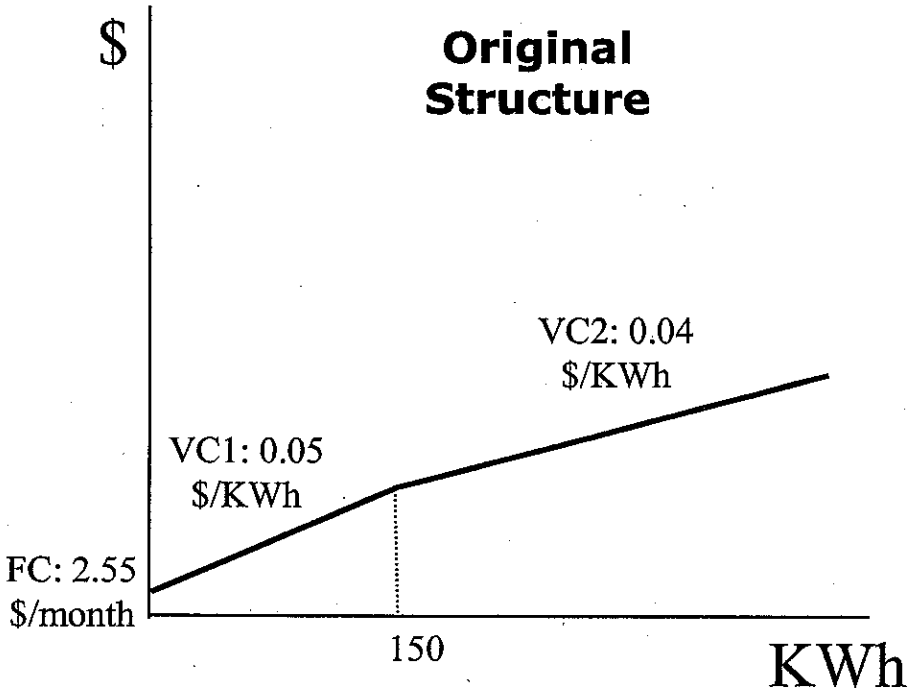
- Equilibrium is reached and the following positive social effects are caused:
  - The poorest 20% pays an average of 7.50% less than in the base case representing 3.15% of their monthly income
  - The richest 30% pays an average of 1.20% more than in the base case representing 0.71% of their monthly income

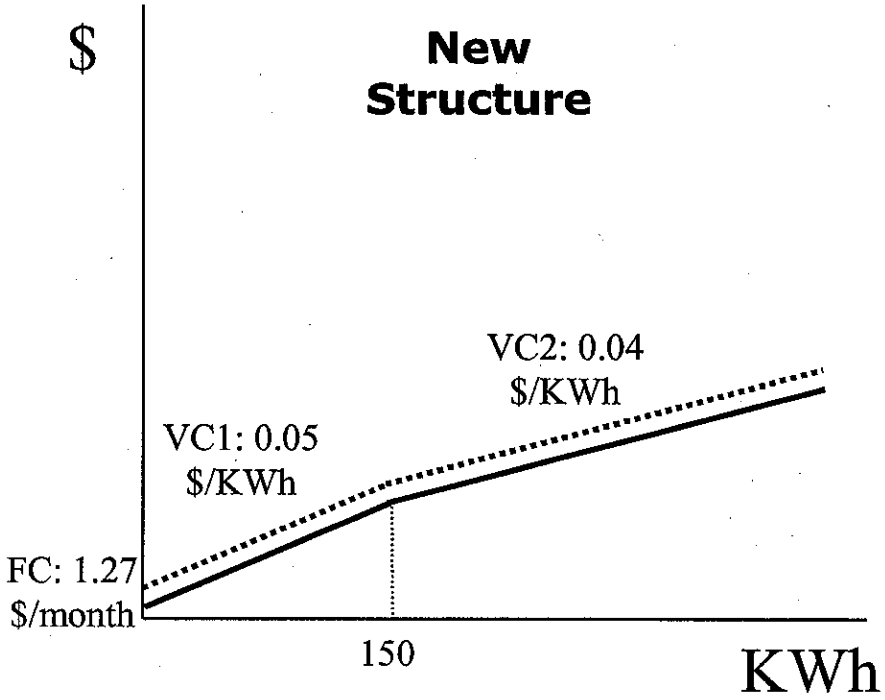
Access Subsidy New Users

- Elimination of connection charge can be compensated for with
  - 6.5% increase of the fixed charge to all users
  - 23% increase of fixed charge for the 30% of users with highest income
  - Annual treasury contribution of 0.3M$

Access Subsidy Existing Users

- 50% decrease of fixed charge for the 20% of users with lowest income



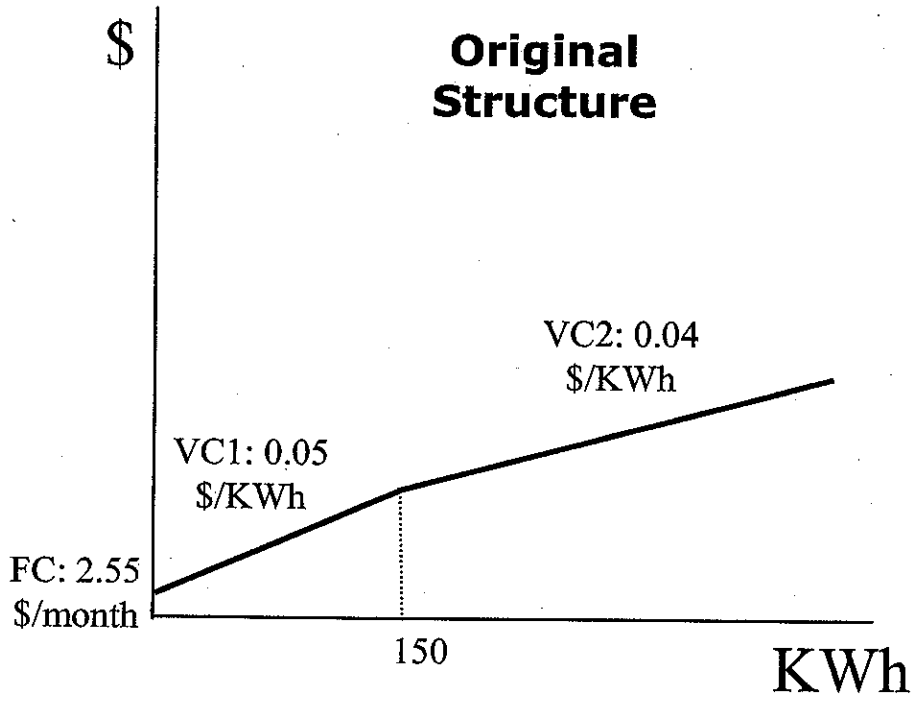


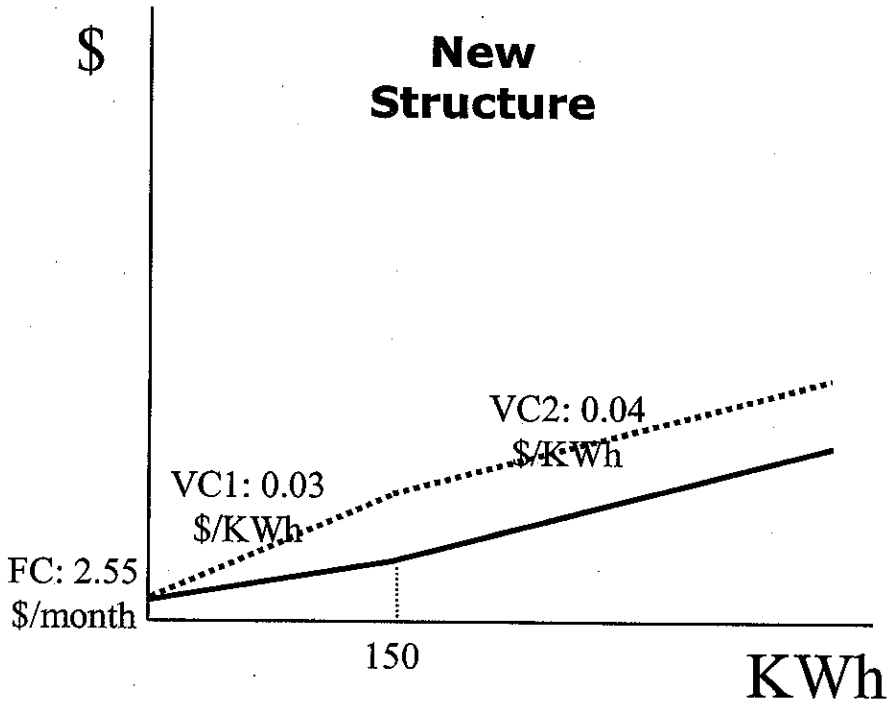
Access Subsidy Existing Users

- The subsidy can be compensated for with
  - 7.1% increase of variable charge of consumption block 1
  - 46% increase of fixed charge for the 30% of users with highest income
  - Annual treasury contribution of 0.6M$

Consumption Subsidy

- 20% decrease of the variable charge for the first 150 KWh





Consumption Subsidy

- The subsidy can be compensated for with
  - 36.3% increase of fixed charge
  - 130% increase of fixed charge for group with highest income
  - 55.7% increase of second variable charge
  - Annual treasury contribution of 1.7M$

Investments

- Decrease of quality standard requirements
  - 20% reduction of investments in High and Medium Voltage and Substations
    - 100% decrease of fixed charges for low income users and 47% for medium income users

Example 2
Macroeconomic crisis

- Background
  - Recession since 1997
  - Deterioration of fiscal situation
  - Increase of country risk
  - Capital leakage
- Outbreak
  - Capital flow constrains
  - Default on sovereign debt
  - Economic Emergency Law

Economic Emergency Law

- Pesification and no indexation of utility tariffs
- Renegotiation of contracts considering
  - 1) impact of tariffs on competitiveness of the economy and income distribution;
  - 2) service quality and investment schemes, when established by contract;
  - 3) users' interest and service affordability;
  - 4) security of systems involved; and
  - 5) firms' return

Hypothesis
Devaluation of Electricity Tariffs

Operating Cost	
ENERGY Purchases (% of devaluation impact)	100.0%
% of imported components affecting total costs	30.0%
Investment	
% of imported elements in investment	40.0%
% of Asset Base in US$	100%
Devaluation rate of initial exchange rate	40.0%
Pre-devaluation expected inflation	3.5%
Post-devaluation expected inflation	20.0%

Devaluation Scenario with Indexation

	PRE-DEVALUATION SCENARIO	DEVALUATION WITHOUT PASS-THROUGH	DEVALUATION WITH PASS-THROUGH	
Net Present Value (Millions $)	0	-140	0	
Internal Rate of Return (real)	7.26%	n/a	7.26%	
Average Tariff per Category ($/month/user)				TARIFF VARIATION
Low Income Users	7.03	7.03	8.60	22%
Medium Income Users	9.40	9.40	12.06	28%
High Income Users	11.89	11.89	14.44	21%
Non-residential Users	55	55	72	31%

Devaluation Scenario without Indexation

	PRE-DEVALUATION SCENARIO	DEVALUATION WITHOUT PASS-THROUGH	DEVALUATION WITH PASS-THROUGH	
Net Present Value (Millions $)	0	-159	0	
Internal Rate of Return (real)	7.26%	n/a	7.26%	
Internal Rate of Return (nominal)	11.00%		28.70%	
Average Tariff per Category ($/month/user)				TARIFF VARIATION
Low Income Users	7.03	7.03	14.25	103%
Medium Income Users	9.40	9.40	18.83	100%
High Income Users	11.89	11.89	19.90	67%
Non-residential Users	55	55	138	151%

Sewage and Water Distribution Service Example

Base Case: Water & Sewage

- Characteristics
  - Services concessions were granted in 1992 for 95 years divided into ten-year management periods
  - Served areas are divided into two different geographical areas
  - Price cap regulation with reviews every five years
  - Tariffs set in dollars are indexed in accordance with US inflation
  - Minimum coverage, metering, treatment and quality requirements

Water & Sewage: Coverage

	Region A		Region B	
	Present	Contract Goal	Present	Contract Goal
Water	68%	85%	45%	80%
Sewage	55%	80%	25%	75%
Year of "full" water micrometering	15		15	
Population	750,000		430,000	

Water: Tariff Structure

- Metered users
  - Fixed Charge
  - Two variable charges in increasing blocks
- Non-metered users
  - MAX(MinimumBill;CAC*K)
    - CAC: covered area charge
    - K: regional factor
- Infrastructure work charge
- Connection charge

Water: Tariff Chart

Metered users		
Fixed charge	($/month)	3.00
VCB1 (first 30 m3)	($/m3)	0.40
VCB2 (consumption over 30 m3)	($/m3)	0.50
Non-metered users		
Minimum bill	($/month)	3.80
Covered area charge	($/m²/month)	0.10
Connection charge	$	45.00
Infrastructure work charge	$	150.00

Water: Tariff Chart – Regional Coefficients (K)

Category of users	Regional coefficient
Poor	**0.55**
Low income	**0.75**
Medium Income	**1.00**
High Income	**1.40**

Sewage: Structure and Tariff Chart

Variable Charge	**Water bill* STF (Sewage Tariff Factor) STF = 0.45**
Connection Charge	**$ 80**
Infrastructure Work Charge	**$ 250**

Family Expenditure Composition

Category	Bill / Family Average Monthly Income
Poor	1.88%
Low income	1.35%
Medium income	1.18%
High income	0.93%

Family Expenditure Composition

Category	Water connection charge / FMI	Sewage connection charge/ FMI	Water work charge / FMI	Sewage work charge / FMI
Poor	18%	32%	59%	99%
Low income	9%	17%	31%	52%
Medium income	5%	8%	15%	25%
High income	3%	5%	9%	14%

Water: Examples

- Example 1: Social objectives
- Example 2: Macroeconomic crisis

Example 1: Improvement of Social Objectives

- Objective:
  - Improvement of social objectives regarding coverage and affordability by
  - Ensuring economic and financial sustainability in the long run and
  - Minimizing allocative distortions in the economy

Social Objectives: Instruments

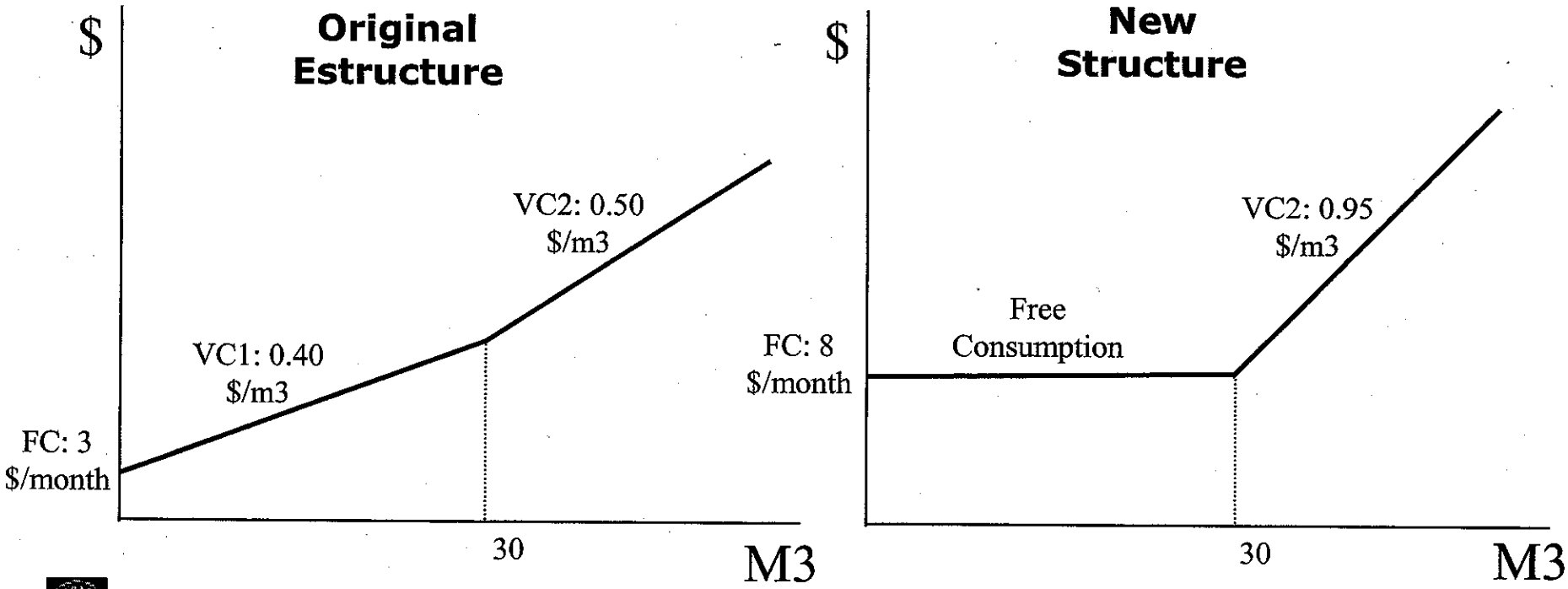
Instruments	Water	
	Access	Consumption
Fiscal		
Subsidy	NO	NO
ΔTax	?	NO
Tariff Level	YES	YES
Tariff Structure	Limited	Limited
Quality Standard	?	NO
Concession Term	?	?

Alternatives

- Improvement of social conditions
  - Change in tariff structure
  - Access subsidy
    - New users
    - Existing users
  - Consumption subsidy
  - Investment – Quality changes
    - Safety Margin
    - Sewage Secondary Treatment

Tariff Structure Change

- Change of current structure from increasing blocks to free consumption in the first block



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Tariff Structure Change

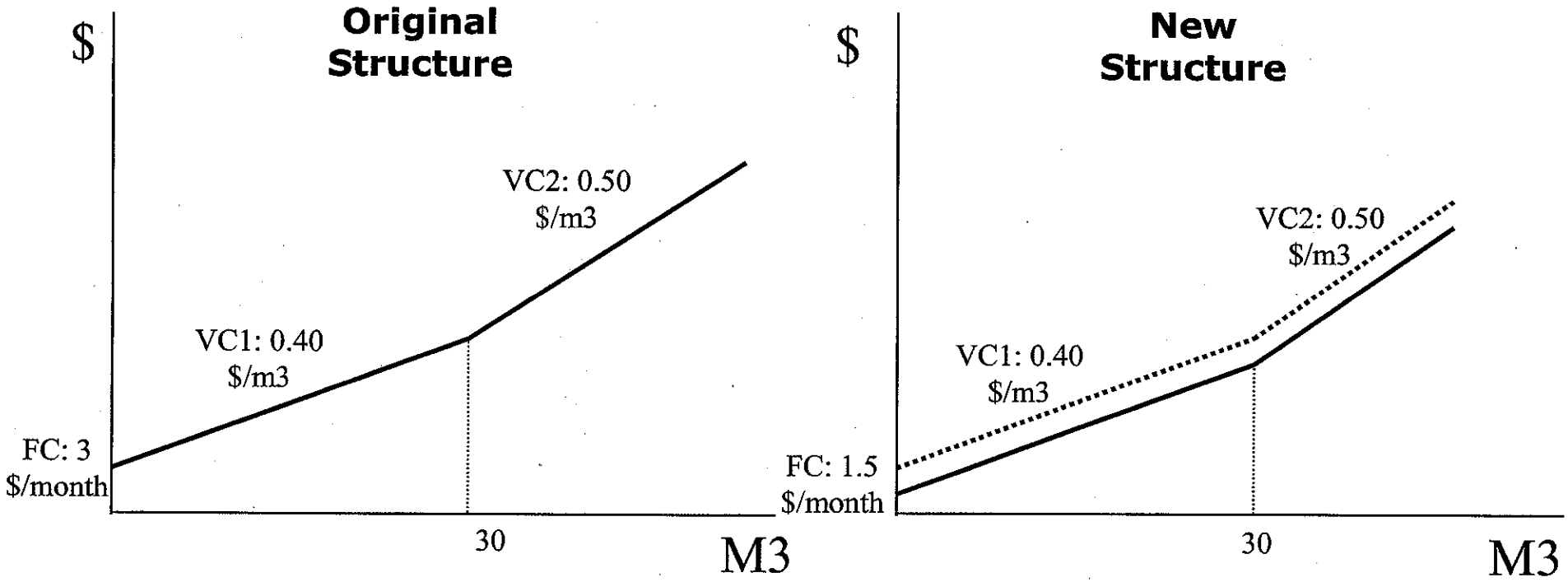
- The equilibrium is reached and the following positive social effects are caused
  - The situation of poor users does not change since they are not metered
  - Low income users pay an average of 9% less than in the base case, which represents 1.23% of their monthly income
  - High income users pay an average of 9% more than in the base case, which represents 1.02% of their monthly income

Access Subsidy New Users

- Elimination of connection charge can be compensated for with
  - General tariff increase by 6.3% in the fourth five-year period
  - General tariff increase by 3.1% for high income users
  - Annual treasury contribution of 0.5M$

Access Subsidy Existing Users

- Reduction of 50% of fixed charge

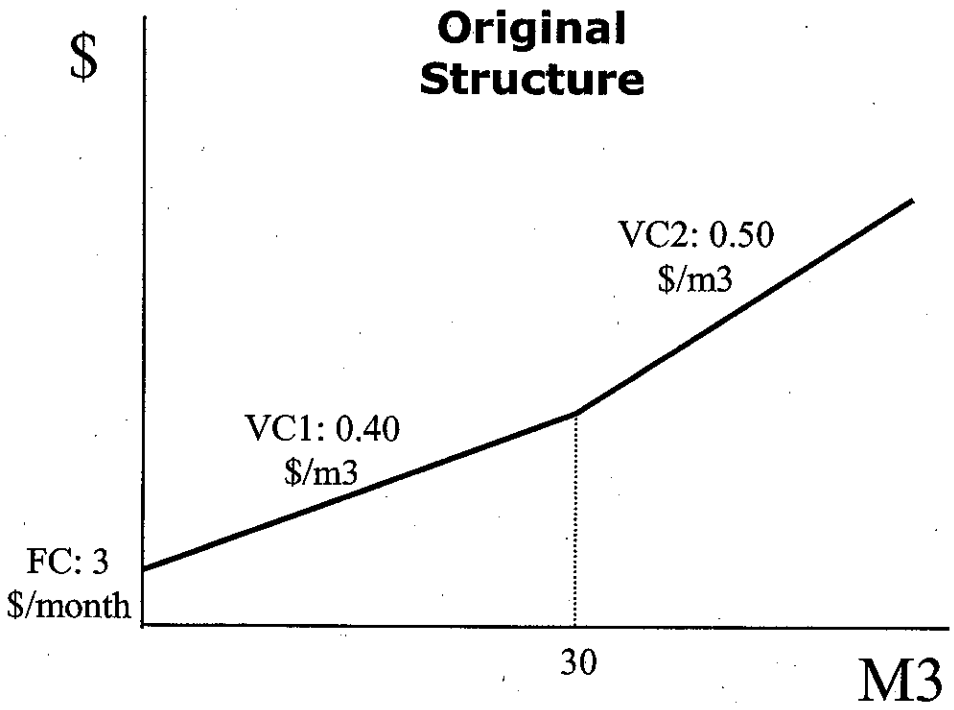


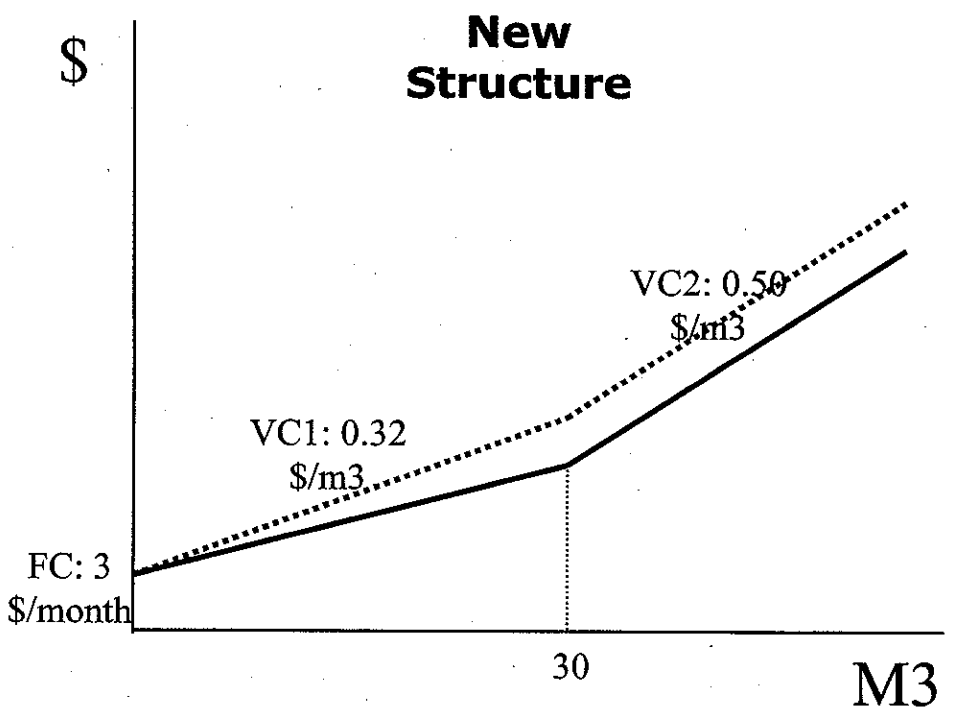
Access Subsidy Existing Users

- The subsidy can be compensated for with
  - 17% increase of variable charge block 1
  - 35% increase of variable charge block 2
  - Annual treasury contribution of 2.5M$

Consumption Subsidy

- Reduction of 20% of variable charge for the first 30 m3





Consumption Subsidy

- The subsidy can be compensated for with
  - 59% increase of fixed charge
  - 41% increase of variable charge for high consumption group
  - Annual treasury contribution of 3M$

Safety Margin

- System's minimum safety margin can be increased (from 10% to 20%) through
  - General tariff increase of 4.1% in the first five-year period
  - Tariff increase of 8.1% for high income users
  - Annual treasury contribution of 1.3M$

Sewage Secondary Treatment

- Sewage secondary treatment can be incorporated for both regions in the 7th year through
  - General tariff increase of 11.3% in the first five-year period
  - General tariff increase of 15.9% in the second five-year period
  - Annual treasury contribution of 3.5M$

Example 2
Macroeconomic Crisis

- Background
  - Recession since 1997
  - Deterioration of fiscal situation
  - Increase of country risk
  - Capital leakage
- Outbreak
  - Capital flow constrains
  - Default on sovereign debt
  - Economic Emergency Law

Economic Emergency Law

- Pesification and no indexation of utility tariffs
- Renegotiation of contracts considering
  - 1) impact of tariffs on competitiveness of the economy and income distribution;
  - 2) service quality and investment schemes, when established by contract;
  - 3) users' interest and service affordability;
  - 4) security of systems involved; and
  - 5) firms' return

Hypothesis Summary
Devaluation in Water Tariffs

Devaluation	40%
Imported components in CAPEX	40%
Imported components in OPEX	30%
Impact of devaluation on index price	50%
Pre-devaluation expected inflation rate	3%
Post-devaluation expected inflation rate	20%

Devaluation Scenario with Indexation

	PRE-DEVALUATION SCENARIO	DEVALUATION WITHOUT PASS-THROUGH	DEVALUATION WITH PASS-THROUGH
NET PRESENT VALUE(in millions of $)	0	-30.25	0
INTERNAL RATE OF RETURN (real)	8.17%	6.38%	8.17%

Average monthly bill / Family Income	Present	New
Poor	1.88%	2.05%
Low income	1.34%	1.47%
Medium income	1.16%	1.27%
High Income	0.92%	1.00%

Devaluation Scenario without Indexation

	PRE-DEVALUATION SCENARIO	DEVALUATION WITHOUT PASS-THROUGH	DEVALUATION WITH PASS-THROUGH
NET PRESENT VALUE(in millions of $)	0	-89.16	0
INTERNAL RATE OF RETURN (real)	8.17%	n/d	8.17%

Average monthly bill / Family Income	Present	New
Poor	1.88%	4.48%
Low income	1.23%	2.94%
Medium income	0.92%	2.19%
High Income	0.64%	1.46%