

Paul Schrimpf

Incentive
regulation

Examples

Cable
television
regulation and
quality

Gregory S. Crawford
and Matthew Shum
(2007)

Crawford,
Shcherbakov, and
Shum (2015)

References

Paul Schrimpf

UBC
Economics 567

March 8, 2018

Paul Schrimpf

Incentive
regulation

Examples

Cable
television
regulation and
quality

Gregory S. Crawford
and Matthew Shum
(2007)

Crawford,
Shcherbakov, and
Shum (2015)

References

1 Incentive regulation Examples

- 2 Cable television regulation and quality
Gregory S. Crawford and Matthew Shum (2007)
Crawford, Shcherbakov, and Shum (2015)

Paul Schrimpf

Incentive
regulation

Examples

Cable
television
regulation and
quality

Gregory S. Crawford
and Matthew Shum
(2007)

Crawford,
Shcherbakov, and
Shum (2015)

References

Section 1

Incentive regulation

Incentive
regulation

Examples

Cable
television
regulation and
quality

Gregory S. Crawford
and Matthew Shum
(2007)

Crawford,
Shcherbakov, and
Shum (2015)

References

- This section is based largely on [Joskow \(2014\)](#)

Downsides of rate of return regulation

- Gives no incentive to control costs
 - Overinvestment
 - Too little managerial effort
- Gives no incentive for high quality
 - In transportation networks, quality \approx lack of congestion
 - Uniformly applied rate of return does not give incentive about where to invest in network, e.g. <http://faculty.arts.ubc.ca/pschrimpf/565/gasSlides.pdf>

Incentive regulation 1

- Incentive regulation : regulate prices such that regulated firm is the residual claimant on cost reductions and/or quality improvements
- If regulator knows the costs of an efficiently run firm, set prices such that revenues of any firm equals the costs of an efficient one

Theoretical framework

- Allow revenues, $R = a + (1 - b)C$, where $C =$ realized costs
 - Rate of return / cost of service : $a = 0, b = 0$, so $R = C$.
 - Fixed price / price cap : $a = C^*, b = 1$
 - Sliding scale : $0 < a < C^*, 0 < b < 1$
- C depends on type of firm and managerial effort
 - Rate of return pricing gives no incentive for cost reducing effort
 - Fixed price fully incentives effort, but for all firms to be viable, C^* must be set to cost of the highest cost type firm
 - Faced with distribution of cost types, optimal for regulator to offer menu of contract such that lowest cost firm chooses fixed price, others sliding scale getting closer to rate of return as cost type increases

Practical issues

- How does regulator know C^* ?
 - C from cost accounting data like in FERC Form 2 for natural gas pipelines
 - C^* typically based on either historical performance + expected improvements, and/or performance of similar firms
 - C^* usually reset periodically (“ratchet”) as regulator gains information
- Should a menu be used?
 - Explicit menus rarely offered, but negotiations between firms and regulator could be serving a similar purpose

Examples 1

- England 1855-1930ish gas distribution : sliding scale mechanism, see [Hammond, Johnes, and Robinson \(2002\)](#)
- US electric power : some states adopted rate freezes and price caps since mid-1990s
- Price cap mechanisms : since mid 1980s UK, New Zealand, Australia, and Latin America electric, gas, water, and telecom ; US telecom
 - Initial price cap chosen, then each year changes by inflation minus target productivity growth

$$p_{t+1} = p_t(1 + RPI - x)$$

- Periodic ratchets tradeoff incentives, rent extraction, and firm viability constraints

UK electric distribution

- OFGEM - Office of Gas and Electricity Markets
- Operating costs - price cap with 5 year ratchet – measure of C^* relatively easy and well-understood
- Capital costs - at price review, next price cap depends on future capital costs
 - Difficult to have efficient benchmark for capital costs because of variation in time and space
 - OFGEM offers menu of sliding scale contracts
 - Lower capital allowance with higher powered incentive and higher expected return on investment
- Price also affected by reaching quality of service targets

Table 5.2 Sliding scale matrix for capital expenditure allowance

	100	105	110	115	120	125	130	135	140
DNO: PB Power ratio	100	105	110	115	120	125	130	135	140
Efficiency incentive	40%	38%	35%	33%	30%	28%	25%	23%	20%
Additional income	2.5	2.1	1.6	1.1	0.6	-0.1	-0.8	-1.6	-2.4
As pretax rate of return	0.200%	0.168%	0.130%	0.090%	0.046%	-0.004%	-0.062%	-0.124%	-0.192%
<i>Rewards and penalties</i>									
Allowed expenditure	105	106.25	107.5	108.75	110	111.25	112.5	113.75	115
Actual exp.									
70	16.5	15.7	14.8	13.7	12.6	11.3	9.9	8.3	6.6
80	12.5	11.9	11.3	10.5	9.6	8.5	7.4	6.0	4.6
90	8.5	8.2	7.8	7.2	6.6	5.8	4.9	3.8	2.6
100	4.5	4.4	4.3	4.0	3.6	3.0	2.4	1.5	0.6
105	2.5	2.6	2.5	2.3	2.1	1.7	1.1	0.4	-0.4
110	0.5	0.7	0.8	0.7	0.6	0.3	-0.1	-0.7	-1.4
115	-1.5	-1.2	-1.0	-0.9	-0.9	-1.1	-1.4	-1.8	-2.4
120	-3.5	-3.1	-2.7	-2.5	-2.4	-2.5	-2.6	-3.0	-3.4
125	-5.5	-4.9	-4.5	-4.2	-3.9	-3.8	-3.9	-4.1	-4.4
130	-7.5	-6.8	-6.2	-5.8	-5.4	-5.2	-5.1	-5.2	-5.4
135	-9.5	-8.7	-8.0	-7.4	-6.9	-6.6	-6.4	-6.3	-6.4
140	-11.5	-10.6	-9.7	-9.0	-8.4	-8.0	-7.6	-7.5	-7.4
Where, for example:	(top-left corner)	$16.5 = (105 - 70) \times 40\% + 2.5$							
	(bottom-right)	$-7.4 = (115 - 140) \times 20\% - 2.4$							

Source: OFGEM (2004d, 87).

National Grid Company

- Electricity transmission in England and Wales
- Price cap with 5 year ratchets
- There is only one firm, so C^* determined by historical data and engineering studies

“ there are many similarities here with the way cost-of-service regulation works in practice in the United States. Indeed, perhaps the greatest difference is philosophical. OFGEM takes a view that recognizes that by providing performance based incentives for regulated utilities to reduce costs, it can yield consumer benefits in the long run by making it profitable for the firm to make efficiency improvements. If the firm overperforms against the target, consumers eventually benefit at the next price review. It has generally (though not always) been willing to allow the regulated firms to earn significantly higher returns than their cost of capital when these returns are achieved from cost savings beyond the benchmark, knowing that the next “ratchet” will convey these benefits to consumers. Under traditional US regulation, the provision of incentives through regulatory lag is more a consequence of the impracticality of frequent price reviews and changing economic conditions than by design.”

Empirical work

- Far more theory than empirical work
- Little to no structural empirical work about impact of incentive regulation
- Mostly case studies and some reduced form
- See [Joskow \(2014\)](#) for references

Paul Schrimpf

Incentive
regulation

Examples

Cable
television
regulation and
quality

Gregory S. Crawford
and Matthew Shum
(2007)

Crawford,
Shcherbakov, and
Shum (2015)

References

Section 2

Cable television regulation and quality

“Monopoly Quality Degradation and Regulation in Cable Television” Gregory S. Crawford and Matthew Shum (2007)

Introduction

- Firms with market power
 - Charge higher prices
 - If quality endogenous, provide lower quality
- Usual approach to measuring market power wrt prices : BLP - estimate demand and use optimality condition for prices to recover marginal costs
- This paper : optimality conditions for quality choice to measure quality degradation
- Relate variation in quality degradation to variation in local regulatory oversight

Quality choice model 1

- Mussa and Rosen (1978)
- Consumer types $t_0 < t_1 < t_2$, probabilities f_j
- Firm chooses two qualities and prices:

$$\max_{p,q} \sum_{i=1}^2 f_i [P(q_i) - C(q_i)]$$

s.t.

$$q_i = \arg \max_{q \in \{q_1, q_2\}} v(q, t_i) - P(q)$$

$$v(q_i, t_i) - P(q_i) \geq 0$$

$$q_i \geq \underline{q}$$

- FOC:

$$v_q(q_1, t_1) - C_q(q_1) + \lambda = \frac{1 - F_1}{f_1} [v_q(q_1, t_2) - v_q(q_1, t_1)] \text{ and } v_q(q_2, t_2)$$

- US cable systems in 1995
- Quality = basic vs expanded basic service
- Regulation : 1992 cable act required price per channel reduction by 17% if local franchise authority or consumers complained to FCC

Table 1

Sample Statistics: Selected Characteristics

Variable	All Markets	Three-Good Markets	Two-Good Markets	One-Good Markets
Expanded basic services:				
Any	.30	1.00	1.00	.00
One	.23	.00	1.00	.00
Two	.07	1.00	.00	.00
Market shares:				
w_3	.66	.47	.61	.70
w_2	.06 ^a	.12	.04	. . .
w_1	.04 ^a	.04	. . .	. . .
Prices:				
p_3	20.40	25.64	22.69	19.13
p_2	14.32 ^a	21.86	12.05	. . .
p_1	16.78 ^a	16.78	. . .	. . .
Programming:				
Top 40 cable networks:				
On service 3	16.55	22.29	20.85	14.57
On service 2	9.14 ^a	18.15	6.44	. . .
On service 1	11.94 ^a	11.94	. . .	. . .
Broadcast networks:				
Over the air	2.54	3.19	2.85	2.37
On cable	5.74	6.57	6.51	5.40
Other networks on basic	14.36	10.85	13.18	15.09
System characteristics:				
Homes passed (1,000s)	5.11	9.54	12.19	2.34
Channel capacity	38.87	43.21	43.55	36.91
Market characteristics:				
Income:				
Mean	28.83	28.27	30.11	30.15
Standard deviation	24.61	24.15	25.52	26.21
Skew	2.69	2.70	2.64	2.68
Age:				
Mean	36.22	36.36	35.75	36.34
Standard deviation	23.20	23.36	22.74	23.03
Skew	.16	.15	.18	.15
Household size:				

Table 2
Top 15 Cable Programming Networks

Rank	Network	Subscribers (millions)	Programming Format
1	TBS Superstation	77.0	General interest
2	Discovery Channel	76.4	Nature
3	ESPN	76.2	Sports
4	USA Network	75.8	General interest
5	C-SPAN	75.7	Public affairs
6	TNT	75.6	General interest
7	FOX Family Channel	74.0	General interest/kids
8	TNN (The Nashville Network)	74.0	General interest/country
9	Lifetime Television	73.4	Women's
10	CNN (Cable News Network)	73.0	News
11	A&E	73.0	General interest
12	The Weather Channel	72.0	Weather
13	QVC	70.1	Home shopping
14	The Learning Channel (TLC)	70.0	Science
15	MTV: Music Television	69.4	Music

Note. Data on network subscribers are from National Cable and Telecommunications Association, Top 20 Cable Programming Networks—as of December 2006 (<http://www.ncta.com/ContentView.aspx?contentID=74>). Data on programming formats from individual network promotional material are from National Cable and Telecommunications Association, Cable Networks (<http://www.ncta.com/Organizations.aspx?type=orgtyp2&contentID=2907>) or industry sources.

Table 3
Preliminary Evidence of Quality Degradation

Total Prices/Channels	Three-Good Markets		Two-Good Markets	
	Mean	Difference	Mean	Difference
$p_3/\text{channel}$	1.06 (.03)	-.04 (.01)	1.10 (.03)	-.61 (.06)
$p_2/\text{channel}$	1.10 (.03)	-.13 (.02)	1.72 (.07)	. . .
$p_1/\text{channel}$	1.23 (.04)		. . .	
N	72		239	

Note. Reported are the average price per channel for each offered cable service. Channels include all top 40 satellite channels and, for the lowest quality service, all major broadcast networks. Ratios are formed with total price and total channels. Values in the Difference columns are the difference in price per channel in that row and the row that follows. The cable system in one two-good market included no satellite or broadcast networks in its lowest quality service. Standard errors are in parentheses.

- Functional forms $u(q, t) = tq - p$, $C(q) = q^2/2$
 - Implies socially optimal $q_i^{**} = t_i$
- Market shares $= \hat{f}_i$
- Prices $p_i = t_i q_i - u_i(q_i)$
- Quality $q_i = \begin{cases} t_n & \text{if } i = n \\ t_i = \frac{1-F_i}{f_i} (t_{i+1} - t_i) & \text{otherwise} \end{cases}$
- Utilities $u_i = \sum_{i'=1}^{i-1} (t_{i'+1} - t_{i'}) q_{i'}$, $u_1 = 0$

Table 5
Recovered Parameter Values and Implied Qualities

Variable	Three-Good Markets	Two-Good Markets	One-Good Markets
Net type distribution:			
\bar{f}_3	.47	.61	.70
\bar{f}_2	.12	.04	. . .
\bar{f}_1	.04	. . .	. . .
\bar{f}_0	.37	.35	.30
\bar{t}_3	5.15	4.77	4.35
\bar{t}_2	4.99	4.65	. . .
\bar{t}_1	4.90	. . .	. . .
Qualities:			
q_3	5.15	4.77	4.35
q_2	4.43	2.57	. . .
q_1	3.42	. . .	. . .
% Degradation:			
$(\bar{t}_3 - q_3)/\bar{t}_3$	.00	.00	.00
$(\bar{t}_2 - q_2)/\bar{t}_2$	.11	.45	. . .
$(\bar{t}_1 - q_1)/\bar{t}_1$	.30	. . .	. . .
Price/quality ratio			
q_3/p_3	.20	.21	.23
q_2/p_2	.21	.21	. . .
q_1/p_1	.21	. . .	. . .
N	72	240	730

Note. Parameters of net type distribution are obtained using the procedure in Section 4.2. Quality measures are calculated using equation (12). Percentage of degradation evaluated at cut types is defined as the marginal type just inclined to purchase that quality.

Table 6
Interpreting Quality Measures

Variable	Estimate	Implied Mean WTP (\$)
WTBS	.53 (.03)	2.39
Discovery	.16 (.04)	.73
ESPN	.94 (.04)	4.22
USA	.33 (.03)	1.49
CSPAN	.08 (.03)	.34
TNT	-.13 (.04)	-.59
Family	.47 (.03)	2.13
Nashville	.31 (.03)	1.38
Lifetime	.02 (.03)	.09
CNN	.21 (.03)	.94
A&E	.22 (.03)	1.01
Weather	.02 (.03)	.10
QVC	.57 (.04)	2.57
Learning	.15 (.04)	.67
MTV	.08 (.03)	.37
Other networks	.04 (.00)	.18

Note. Coefficient estimates from regression of recovered quality levels on broadcast and cable programming variables. Reported are results for the top 15 cable networks listed in Table 2. The results are pooled across all markets and across all bundles within a market. Standard errors are in parentheses. The second column is from the authors' calculations; the estimated willingness

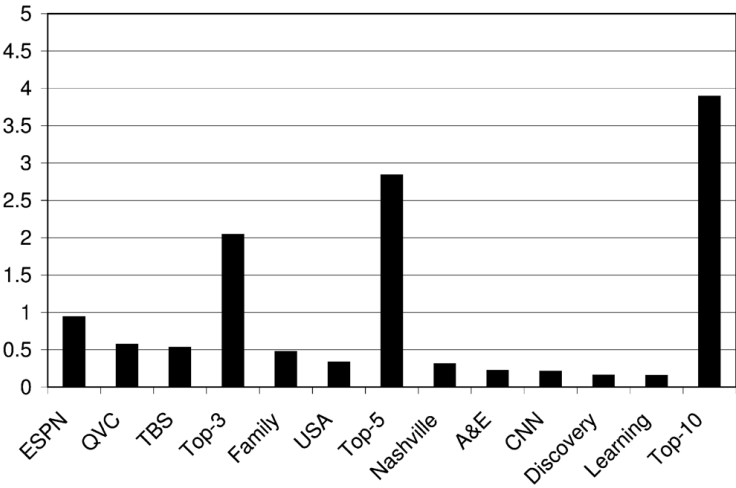


Figure 3. Recovered quality levels for top-networks results from Table 6

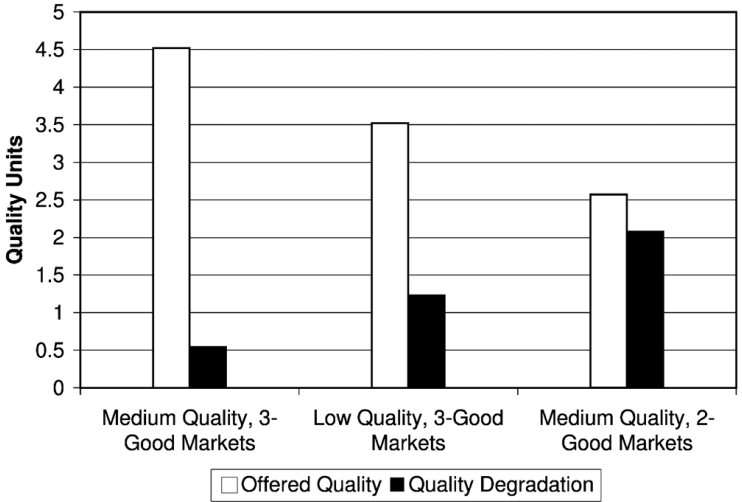


Figure 4. Quality and quality degradation by market results from Table 5

Table 7
Determinants of Cable Service Quality

Variable	Ordinary Least Squares			Instrumental Variables		
	All Qualities	High Quality	Low and Medium Qualities	All Qualities	High Quality	Low and Medium Qualities
System characteristics:						
Homes passed	2.600 (1.080)	1.790 (.853)	3.010 (1.560)	-3.020 (5.470)	1.810 (2.400)	-5.430 (9.450)
Channel capacity	.007 (.001)	.010 (.001)	.005 (.002)	.000 (.007)	.010 (.003)	-.005 (.011)
Market characteristics:						
Mean income	.002 (.004)	-.003 (.003)	.004 (.006)	.021 (.019)	-.003 (.008)	.034 (.033)
Skew of income	-.088 (.041)	-.018 (.032)	-.123 (.058)	-.164 (.101)	-.017 (.044)	-.237 (.174)
Mean age	.068 (.017)	.030 (.013)	.087 (.024)	.092 (.037)	.030 (.016)	.123 (.065)
Standard deviation of age	-.165 (.030)	-.080 (.024)	-.208 (.044)	-.085 (.091)	-.080 (.040)	-.088 (.157)
Mean household size	.275 (.128)	.143 (.101)	.341 (.184)	.449 (.279)	.143 (.123)	.602 (.482)
Skew of household size	.410 (.073)	.144 (.058)	.543 (.105)	.180 (.247)	.145 (.109)	.198 (.426)
Regulatory characteristic: certification	.522 (.057)	.147 (.045)	.710 (.082)	5.271 (4.327)	.127 (1.901)	7.843 (7.469)
N	1,426	1,042	384	1,426	1,042	384

Note. Instrumental variables regressions use share of primary county population living in rural areas to instrument for regulatory certification. Standard errors are in parentheses.

Table 8
Further Effects of Certification

Variable	Quality Degradation, Low and Medium Qualities	Number of Services, All Qualities	Total Price		Quality/Price Ratio	
			High Quality	Low and Medium Qualities	High Quality	Low and Medium Qualities
System characteristics:						
Homes passed	.808 (.394)	3,700 (1,060)	15,200 (7,460)	14,700 (7,630)	-.032 (.046)	.391 (.099)
Channel capacity	.003 (.001)	.004 (.001)	.082 (.010)	.025 (.010)	-.001 (.000)	.000 (.000)
Market characteristics:						
Mean income	-.002 (.002)	.001 (.004)	-.011 (.028)	.027 (.029)	.000 (.000)	.000 (.000)
Skew of income	.038 (.030)	-.059 (.040)	-.179 (.280)	-.632 (.286)	.000 (.002)	-.006 (.004)
Mean age	-.007 (.010)	.049 (.016)	.289 (.116)	.429 (.118)	-.001 (.001)	.005 (.002)
Variance of age	.001 (.019)	-.129 (.030)	-.741 (.209)	-1.018 (.214)	.003 (.001)	-.014 (.003)
Mean household size	-.088 (.086)	.155 (.125)	1.383 (.882)	1.732 (.902)	-.006 (.005)	.016 (.012)
Skew of household size	-.118 (.047)	.286 (.071)	1.077 (.503)	2.597 (.515)	-.005 (.003)	.031 (.007)
Regulatory characteristic: certification	-.093 (.026)	.344 (.056)	1.177 (.394)	3.547 (.403)	-.006 (.002)	.035 (.005)
<i>N</i>	384	1,042	1,042	384	1,042	384

Note. Reported are coefficient estimates from ordinary least squares regressions. Parameters are pooled across services given in the column headings, with the dependent variables. Standard errors are in parentheses.

“The Welfare Effects of Endogenous Quality Choice in Cable Television Markets” Crawford, Shcherbakov, and Shum (2015)

Introduction

- Firms with market power
 - Charge higher prices
 - If quality endogenous, provide non-optimal quality
- Compared with [Gregory S. Crawford and Matthew Shum \(2007\)](#)
 - More flexible preferences
 - Marginal social benefit of quality can be higher or lower than marginal cost
 - Find quality is distorted upward
- Decompose welfare loss from monopoly into price distortion and quality distortion

Quality markups

- Inverse demand $P(\underbrace{s}_{\text{quantity}}, \underbrace{q}_{\text{quality}})$
- Cost $c(q)s$
- Social planner

$$\max_{s,q} \int_0^s P(s', q) ds' - c(q)s$$

$$[s] : \quad P(s^{SP}, q^{SP}) = c(q^{SP})$$

$$[q] : \quad \int_0^{s^{SP}} P_q(s', q^{SP}) ds' = s^{SP} c_q(q^{SP})$$

- Price markup $PM(s, q) = P(s, q) - c(q)$
- Quality markup $QM(s, q) = \int_0^s P_q(s', q^{SP}) ds' - s c_q(q)$

Welfare effect decomposition

- Total surplus $TS(s, q) = \int_0^s P(s', q) ds' - c(q)s$
- Total welfare loss $\Delta TS(s, q) = TS(s^{SP}, q^{SP}) - TS(s, q)$
- Given quality, p and s one-to-one, so let $TS(p, q) = TS(s(p, q), q)$
- Welfare loss from market power over quality

$$MPQ = TS(p, q^{SP}(p)) - TS(p, q)$$

- Welfare loss from market power over price

$$MPP = TS(p^{SP}, q^{SP}) - TS(p, q^{SP}(p))$$

- $\Delta TS(p, q) = MPP(p, q) + MPQ(p, q)$

Data

- Annual data on 3931 cable systems from 1997-2006
- Prices and market shares of cable and satellite tiers
- Quality = sum of average cost of channels offered

Table 2: Data summary statistics, 1997-2006

	Mean	StdDev	Min	Max
Periods and Products				
Time periods	2.1	1.2	1	9
Cable products	1.5	0.7	1	3
Satellite products	5.2	1.4	3	6
Market shares				
s^c	0.54	0.19	0.05	0.90
s^s	0.15	0.12	0.01	0.88
Prices				
Cable				
P_{Low}^c	\$20.44	\$7.71	\$2.68	\$81.86
P_{Med}^c	\$32.77	\$14.59	\$7.88	\$136.30
P_{High}^c	\$60.28	\$23.79	\$16.90	\$291.08
Satellite				
P_{Low}^s	\$21.69	\$9.33	\$14.44	\$39.24
P_{Med}^s	\$27.15	\$9.06	\$19.26	\$43.61
P_{High}^s	\$45.95	\$22.94	\$28.89	\$87.22
Quality				
Cable				
q_{Low}^c	3.09	1.81	0.30	13.13
q_{Med}^c	5.76	2.63	0.71	16.86
q_{High}^c	9.11	3.45	2.34	19.02
Satellite				
q_{Low}^s	5.12	3.49	1.78	11.73
q_{Med}^s	6.48	3.16	3.30	12.67
q_{High}^s	10.77	6.51	5.65	27.88
Other Vars				
Miles of plant	0.160	0.560	0.000	17.690
Channel capacity	44.9	20.2	5	542

Paul Schrimpf

Incentive
regulation

Examples

Cable
television
regulation and
qualityGregory S. Crawford
and Matthew Shum
(2007)Crawford,
Shcherbakov, and
Shum (2015)

References

Table 3: Exploratory evidence of quality degradation

	Three-Good Markets		Two-Good Markets	
	Mean	Diff	Mean	Diff
Prices-per-channel				
$p_2/channels_2$	1.28 (0.64)	0.46 (0.34)	1.38 (0.82)	-0.31 (1.50)
$p_1/channels_1$	0.81 (0.40)	-0.42 (0.87)	1.69 (1.50)	
$p_0/channels_0$	1.23 (1.04)			
Prices-per-weighted-channel				
p_2/q_2	7.27 (2.74)	2.03 (1.74)	6.60 (2.39)	-4.26 (10.02)
p_1/q_1	5.24 (2.21)	-5.11 (7.52)	10.86 (10.20)	
p_0/q_0	10.34 (8.21)			
Observations	1,360		3,727	

Notes: Reported are the average price per channel and price per weighted channel for each offered cable service in our estimation sample. Weights are given by the national average input cost for that channel in the relevant year. Values in the “Difference” columns are the difference in price per channel in that row and the row that follows. Standard errors are in parentheses.

Model

- Consumers : choose among cable, satellite, product

$$u_{ijgn} = \alpha_g + (a_{i0} + a_y I_n + a_h H_n + a_u U_n) p_{jgn} + \\ + (b_{i0} + b_y I_n + b_h H_n + b_u U_n) q_{jgn} + \xi_{gn} + \epsilon_{ijgn}$$

- Supply :
 - assume satellite price is fixed (wrt counterfactual prices and qualities of cable systems)
 - FOC for cable systems :

$$[p] : \quad s_{jcn} + \sum_r (p_{rcn} - mc_{rcn}) \frac{\partial s_{rcn}}{\partial p_{jcn}} = 0$$

$$[q] : \quad -\frac{\partial mc_{jcn}}{\partial q_{jcn}} s_{jcn} + \sum_r (p_{rcn} - mc_{rcn}) \frac{\partial s_{rcn}}{\partial q_{jcn}} = 0$$

- Functional form :

$$mc_{jcn} = \exp (z_{jn} \theta_{s0} + v_{0jn} + (z_{jn} \theta_{s1} + v_{1jn}))$$

Moment conditions and instruments

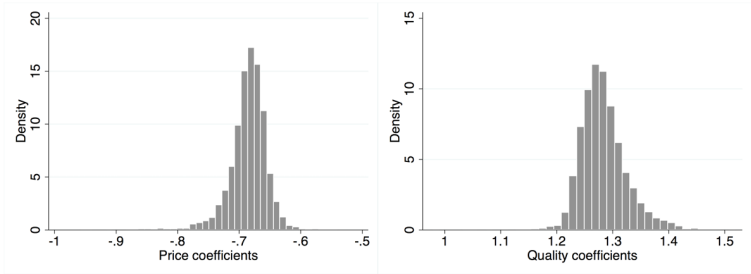
- $E[\xi_{gn} | Z_{gn}] = 0$
- Average price and quality of other local cable systems owned by same multi-system operator
- Total number of subscribers of multi-system operator (shifts bargaining power)
- Average channel capacity of multi-system
- Total length of coaxial lines

Table 4: Estimation results

parameter	(1)		(2)	
	coef.	s.e.	coef.	s.e.
<i>price coefficient, α_{ip}</i>				
mean	-0.673	(0.001)	-0.682	(0.023)
income			-0.418	(0.091)
h-size			0.396	(0.062)
urban			-0.173	(0.017)
sigma	0.102	(0.006)	0.122	(0.013)
<i>quality coefficient, α_{iq}</i>				
mean	1.108	(0.032)	1.225	(0.083)
income			-0.337	(0.413)
h-size			0.221	(0.144)
urban			0.331	(0.184)
sigma	0.310	(0.007)	0.266	(0.007)
<i>corr(a_{ip}, a_{iq})</i>	-0.545	(0.032)	-0.481	(0.090)
demand t-dummies	Yes		Yes	
supply t-dummies	Yes		Yes	

Notes: Reported are estimation results for key parameters from our structural model of demand, price, and quality choice. There are 12,214 observations, where an observation is a cable system-product-year. Full estimation results can be found in Appendix C. Specification (1) does not include market demographics in preferences, while specification (2) does. Instruments include all those described in Section 5.3; results using each variable as its own instrument (OLS-type) and a minimal set of instruments based on ownership (MSO) measures (min-IV) are presented in Appendix A. Standard errors are in parentheses.

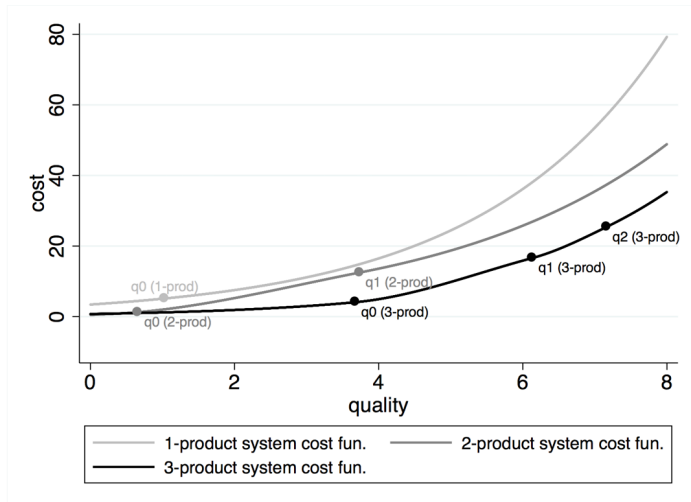
Figure 3: Distributions of mean price and quality parameters across markets.



Notes: Reported are the estimated distributions of mean price and quality parameters across markets implied by the parameter estimates reported in Table 4.

Table 5: Summary statistics for the supply side estimates.

system type	variable	mean	p50	min	max	sd
1-product	mc_0	16.81	17.15	0.03	46.79	5.79
	$\partial mc / \partial q_0$	1.90	1.90	1.03	2.96	0.13
2-product	mc_0	13.36	11.44	0.00	70.42	9.42
	mc_1	25.47	22.53	1.50	96.06	11.93
	$\partial mc / \partial q_0$	1.79	1.84	0.07	2.41	0.25
	$\partial mc / \partial q_1$	13.49	7.41	0.66	114.75	13.71
3-product	mc_0	12.88	12.16	0.06	60.46	8.58
	mc_1	28.61	26.31	2.20	99.36	12.97
	mc_2	47.80	45.12	11.46	119.67	17.43
	$\partial mc / \partial q_0$	1.77	1.83	0.12	2.40	0.26
	$\partial mc / \partial q_1$	4.03	3.64	0.27	14.31	1.89
	$\partial mc / \partial q_2$	20.79	16.73	2.04	129.47	14.74

Figure 4: Estimated marginal cost functions by system type*Notes:*

Reported are the estimated marginal cost functions by system type (1, 2, or 3-product) and by product within each system type implied by the parameter estimates reported in Table 5.

Table 6: Estimated Price and Quality Markups

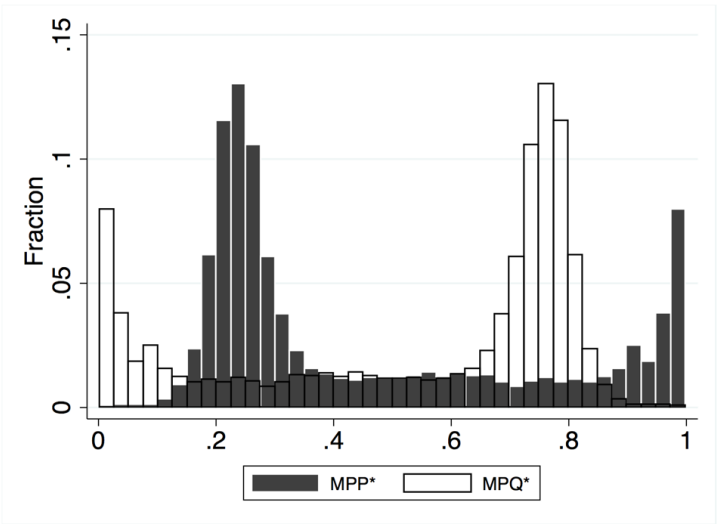
Market Type	Obs	Price Markups		Quality Markups	
		Mean	StdDev	Mean	StdDev
One-product markets	7,105	0.264	0.139	0.226	0.230
Two-product markets					
Low-quality products	3,615	0.320	0.202	0.426	0.541
High-quality products	3,615	0.226	0.100	0.014	0.049
Three-product markets					
Low-quality products	1,327	0.339	0.188	0.362	0.396
Medium-quality products	1,327	0.174	0.101	0.009	0.026
High-quality products	1,327	0.210	0.095	0.000	0.001

Notes: Reported are estimated price and quality markups from our baseline estimation results (Table 4, Column (2)). Price markups are reported as a percentage of price, $(p_j - mc_j)/p_j$. Quality markups are reported as a percentage of the (dollar-denominated) utility from the quality offered on that product, $FOC^{SP}[q_j]/(\frac{\alpha q_n}{\alpha p^n})q_{jn}$, where $FOC^{SP}[q_j]$ is the social planner's first-order condition for q_j , defined in equation (33) above. Estimated values are averaged across markets by market type (1, 2, or 3-product markets) and product type within market type.

Table 7: Welfare effects of market power over quality (and price)

	Column A: Market Power over Quality (MPQ)		Column B: Market Power over Price (MPP)		Column C: Total Welfare Effect	
	(p^{Obs}, q^{Obs})		(p^{Obs}, q^{SP})		(p^{Obs}, q^{Obs})	
	vs		vs		vs	
	(p^{Obs}, q^{SP})		(p^{SP}, q^{SP})		(p^{SP}, q^{SP})	
	Mean	StdDev	Mean	StdDev	Mean	StdDev
Prices						
Low-quality products	—	—	-0.330	0.180	-0.330	0.180
Medium-quality products	—	—	-0.590	0.220	-0.590	0.220
High-quality products	—	—	-0.740	0.130	-0.740	0.130
Qualities						
Low-quality products	0.550	0.720	—	—	-0.230	0.910
Medium-quality products	0.070	0.110	—	—	-0.370	0.410
High-quality products	0.070	0.040	—	—	-0.550	0.260
Welfare						
Consumer surplus	0.430	0.290	0.540	0.420	1.160	0.520
Profit	-0.330	0.240	-1.000	—	-1.000	—
Total Surplus	0.100	0.060	0.070	0.050	0.170	0.070
Share of welfare						
Due to Market Power over Price (MPP)					0.460	0.290
Due to Market Power over Quality (MPQ)					0.540	0.290

Figure 5: Histograms for MPP^* and MPQ^*



Crawford, Gregory S, Oleksandr Shcherbakov, and Matthew Shum. 2015. "The welfare effects of endogenous quality choice in cable television markets." Working paper. URL <https://dx.doi.org/10.2139/ssrn.2670428>.

Gregory S. Crawford and Matthew Shum. 2007. "Monopoly Quality Degradation and Regulation in Cable Television." *The Journal of Law and Economics* 50 (1):181–219. URL <https://doi.org/10.1086/508310>.

Hammond, Christopher J., Geraint Johnes, and Terry Robinson. 2002. "Technical Efficiency under Alternative Regulatory Regimes: Evidence from the Inter-war British Gas Industry." *Journal of Regulatory Economics* 22 (3):251–270. URL <https://doi.org/10.1023/A:1020818127738>.

Joskow, Paul L. 2014. *Incentive Regulation in Theory and Practice: Electricity Distribution and Transmission Networks*, book 5. University of Chicago Press, 291–344. URL <http://www.nber.org/chapters/c12566>.

Mussa, Michael and Sherwin Rosen. 1978. "Monopoly and product quality." *Journal of Economic theory* 18 (2):301–317.