

# Price Variation Antagonism and Firm Pricing Policies

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# Firm Pricing Policies

- Economists have proposed many schemes to efficiently allocate fixed resources in the presence of demand uncertainty.
- Survey evidence reveal that **firms are not willing to change prices** as much as they should to maximize profits.
- There could be many reasons for not doing so (technological feasibility, implementation cost...) but one reason often mentioned is that *firms fear to antagonise consumers* (Blinder et al. 1998, and Zbaracki et al. 2004).

# Price Variation Antagonism (PVA)

- **Are consumers averse to fluctuations in price that are meant to clear markets?**
- Hall and Hitch (1939) claim that “price changes [are] disliked by buyers” .
- Okun (1981) argues that “suppliers must beware of rocking the boat with their price actions”.
- More recent survey evidence is also consistent with this view.

# Survey Evidence

- Kahneman-Knetsch-Thaler
  - KKT (AER, 86) “The survey responses suggest that charging the market-clearing price for the most popular goods would be judged unfair”, p.738
  - KKT (JoB, 86) “An increase in demand unaccompanied by an increase in costs is not an acceptable reason to raise prices”, p. 296
- Frey-Pommerehne
  - FP (1993) “The random survey reveals that pricing, at least in the context of an excess demand situation, is considered unfair by almost four of five respondents.” (p. 296)
  - First-come first-served is considered to be the fairest allocation procedure.

# Illustration

- In 1999, Coca-Cola began testing a vending machine with a temperature sensor and computer chip to determine when to automatically raise prices for its drinks in hot weather.
- Coca-Cola's chief executive argued that the technology would cater to the basic law of supply and demand.
- When the news became public, many were shocked by the proposal. A public relation fiasco followed "causing Coke to promptly deny that it would ever have a vending machine do any such thing."

Washington Post, September 27 2000, p. A1

# Research Program

- *Project 1: Does demand decrease when prices vary more in response to demand fluctuations?*
  1. Are consumers antagonized by changes in price that are meant to smooth demand fluctuations?
  2. Test this hypothesis in a case study.
  3. Finding: evidence is not consistent with the hypothesis that consumers are antagonized by price variation.
- *Project 2: Are consumers willing to trade-off more price variation for lower average prices or less congestion? (In progress)*
- *Project 3: Look for evidence that firms do not vary prices because they fear antagonizing consumers (Very preliminary)*

# Theoretical Framework I

- Define a measure of ‘variability’,  $\sigma$ , (e.g. price variance) and a measure of price level,  $p$ , (e.g. mean price).
- Pricing schemes can be described by the price level and the price variability they generate.
- Standard demand:  $q(p,\varepsilon)=F(p)+\varepsilon$  .

- We postulate that price variance enters the demand:

$$q(P,\varepsilon)=F(P(\varepsilon),\sigma)+\varepsilon$$

- $H_0: dq/d\sigma < 0$ .

- Taking Taylor expansion and expectations,

$$E_{\varepsilon}q(\varepsilon;\gamma) = F(\sigma(\gamma)) + F_p * E_{\varepsilon}P(\varepsilon;\gamma).$$

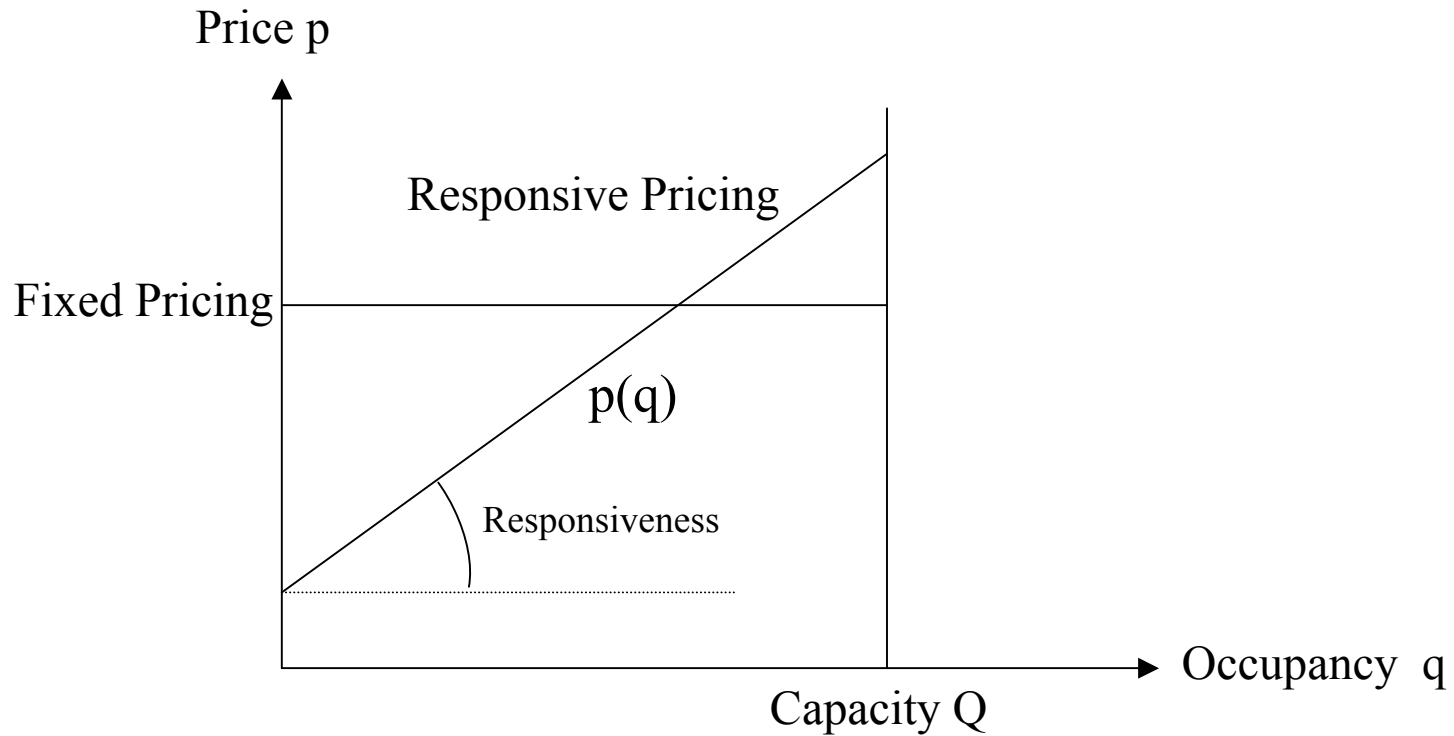
# Theoretical Framework II: Interpretation

- Different question from consumer surveys on fairness.
- Many reasons why  $\sigma$  may enter the demand:  
risk aversion (-), re-optimization (+), state dependent demands (+/-).
- First order approach: If antagonism is first order then  $dq/d\sigma < 0$ .
- If find  $dq/d\sigma \geq 0$ , however, then revenue increases with price variations. Then, the fear of demand withholding is not a justification for not varying prices.

# easyEverything - Background

- Stores with 300 to 700 computers .
- Under responsive pricing:
  - The price depends on occupancy:  $\mathbf{P(q)} = \alpha + \beta\mathbf{q}$ .
  - Exogenous changes in  $\alpha$  and  $\beta$  .
  - The price is updated every 5 minutes .
  - The price is displayed at the entrance and on each terminal.
  - Consumers are charged continuously (as for phone cards).
  - Consumers are capped at their entry price but benefit from price decreases.

# Responsive Pricing



# Data

- Paris store in Boulevard de Sebastopol. Capacity of 373 terminals.
- Occupancy rate and price at hourly level (February-July 2001).
- The pricing rule has been changed 12 times under responsive pricing + 5 under fixed pricing.
- Changes in the pricing function generate the exogenous variability in price and price variability.

# Specification and estimation

- Consider 17 pricing regimes characterized by different pricing functions,  $j=1,\dots,17$ .
- Aggregate demand in period  $i$  during regime  $j$  is

$$q_{j,i} = a_0 + a_1 p_j + a_2 \sigma_j + a_3' x_{j,i} + u_{j,i} \quad j = 1,\dots,17, i = 1,\dots,I_j$$

- Disaggregated demand model

$$q_{j,h,i} = a_0 + a_{0,h} + a_{1,h} p_{j,h} + a_2 \sigma_j + a_{3,h}' x_{j,h,i} + u_{j,h,i} \\ j = 1,\dots,17, h = 0,\dots,23, i = 1,\dots,I_j$$

- $P_j$  and  $\sigma_j$  are potentially endogenous (correlated with  $u$ ). IV using  $\alpha, \beta, \alpha^2, \beta^2$  as instruments.

# Summary statistics

	Regime	Number of observations	Responsiveness ( $\beta$ )	Mean Occupancy Rate	Mean Price	Price Variance	
	(1)	(2)	(3)	(4)	(5)	(6)	
<b>Peak-load</b>	1	170	0	0.44	3.00	0.17	
	2	72	0	0.48	5.17	9.06	
	3	94	0	0.53	5.15	1.26	
<b>Pricing</b>	4	217	0	0.55	5.73	3.60	
	5	126	0	0.51	7.44	8.43	
<b>Responsive</b>	6	132	10.73	0.55	7.75	10.97	
	7	166	12.24	0.52	8.69	13.90	
	8	336	15.10	0.53	9.59	19.38	
	9	304	15.14	0.50	10.16	18.28	
	10	268	16.09	0.48	11.09	15.59	
	<b>Pricing</b>	11	344	15.54	0.45	11.59	16.41
		12	667	12.67	0.40	13.02	12.45
		13	518	14.08	0.41	12.36	29.16
		14	291	17.27	0.45	12.22	28.93
		15	135	33.72	0.45	14.02	48.73
16		168	32.78	0.44	14.16	54.48	
17		135	41.88	0.41	14.76	57.50	
	<b>All regimes</b>	4,143	17.11	0.46	10.67	28.73	

# Baseline results

	(1)	(2)
Price index ( $p_j$ )	-1.120*** (0.267)	
Price Variance ( $\sigma$ )	0.097** (0.048)	0.006 (0.020)
Price 0-1 am		-1.940*** (0.288)
Price 1-2 am		...
...		...
...		...
Price 11-12 pm		...
Centered $R^2$	0.03	0.87
Observations	4,143	4,143

Note: The dependent variable is the mean occupancy rate  $\times$  100. Price denotes the average price (computed by hour and regime). Price level and price variance are treated as endogenous. Coefficients are estimated using instrumental variables. Instruments are the slope and the intercept of the pricing functions and their squares (interacted with hour indicator variables in column 2). Day-of-the-week fixed effects (Tuesday to Sunday, Monday omitted), National Holiday fixed effect and a constant are included in both specifications. Hour specific fixed effects (omitted 8-9 am) and weekend cycle fixed effects are included in column 2. Robust standard errors (clustered by observation day) are reported in parentheses.

# Direct Response to Pricing Rule

Price index ( $p_j$ )	-1.192*** (0.207)	-2.109*** (0.441)	
Responsive Pricing Fixed Effect	4.226** (2.081)	7.646*** (2.588)	4.470*** (1.385)
Price Variance ( $\sigma$ )		0.184*** (0.059)	-0.027 (0.019)
Price 0-1 am			...
...			...
Price 11-12 pm			...
			...
Centered $R^2$	0.03	0.04	0.87
Observations	4,143	4,143	4,143

Note: The dependent variable is the mean occupancy rate x 100. Price denotes the average price (computed by hour and regime). Price level and price variance are treated as endogenous. Coefficients are estimated using instrumental variables. Instruments are the slope and the intercept of the pricing functions and their squares (interacted with hour indicator variables in column 3). Day-of-the-week fixed effects (Tuesday to Sunday, Monday omitted), National Holiday fixed effect and a constant are included in all specifications. Hour specific fixed effects (omitted 8-9 am) and weekend cycle fixed effects are included in column 3. Robust standard errors (clustered by observation day) are reported in parentheses.

# Different Sources of Price Variability

	(1)	(2)
Price index ( $p_j$ )	-1.072*** (0.322)	
Price Variance (Responsive Pricing)	0.106** (0.051)	0.032 (0.024)
Price Variance (Peak Load Pricing)	0.276 (0.263)	0.320 (0.278)
Price 0-1 am		...
Price 11-12 pm		...
Centered $R^2$	0.03	0.87
Observations	4,143	4,143

Note: The dependent variable is the mean occupancy rate x 100. Price denotes the average price (computed by hour and regime). Price level and price variance are treated as endogenous. Coefficients are estimated using instrumental variables. Instruments are the slope and the intercept of the pricing functions and their squares (interacted with hour indicator variables in column 3). Day-of-the-week fixed effects (Tuesday to Sunday, Monday omitted), National Holiday fixed effect and a constant are included in all specifications. Hour specific fixed effects (omitted 8-9 am) and weekend cycle fixed effects are included in column 2. Robust standard errors (clustered by observation day) are reported in parentheses.

# Conclusions

- In our case study, rather than being antagonized by price variations, consumers take advantage of the opportunities offered by such variations:
  1. Demand depends negatively on the level of price.
  2. Aggregate demand depends positively on the level of price uncertainty.
  3. Disaggregate demand does not depend on the level of price uncertainty (importance of composition effect).
  4. Demand is higher under responsive pricing than under fixed pricing.
- These results are specific to our case. The framework to analyze consumer attitude toward pricing rules is general.