1.1. Related Literature

1.2. Marketing Capital as a Barrier to Entry

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~>

$b > 0$

b

2.1. Equilibrium Outcomes

$$\max_{e \in [0;1]} \{V^e = {}_e(1 \quad {}_i)[\sim \quad b] \quad rf({}_e); 0\}$$

$$\max_{i \in [0;1]} V^i = {}_i \sim + (1 \quad {}_i)(1 \quad {}_e) \quad rf({}_i); (1 \quad {}_e) \quad :$$

$$(1 \quad {}_i)[\sim \quad b] \quad rf'({}_e) = 0 \qquad \sim \quad (1 \quad {}_e) \quad rf'({}_i) = 0:$$

$$jJj = r^2 f''({}_i) f''({}_e) + \quad [\sim \quad b] > 0:$$

$$rf({}) = r\frac{(1 \quad)^1 \quad 1}{1}$$

r

f( );

1 the expected marginal cost of an R&D

f( ) ;

g(y)~ ry g(y) = :

Proposition 2 (a) If $b < Min\{\hat{b}_e; \tilde{r}\}$, where $\hat{b}_e = \tilde{r}(\tilde{r}/r)^{1}$

b

2.1.2. Comparative Statics

Proposition 4 (a) $\tilde{}_e$ is decreasing in b and increasing in ; (b) $\tilde{}_i$ is decreasing in b; ; r; and and increasing in ~; (c) ∇_e is decreasing in b and increasing in ; ∇_i is increasing b and .

b

b

:

Proposition 5 (a) If < 1, $\tilde{}_e$ and ∇_e are increasing in r and decreasing in ~; while ∇_i is decreasing in r and increasing in ~; (b) If > 1, $\tilde{}_e$ and ∇_e are decreasing in

~ r

b

> 1;

b r

~

b

r

c

c

c + ":

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4.1. Trends in Firm R&D Intensity

4.2. R&D Reaction Functions

$$\sim \quad r;$$

$$MV_{j;t}^{\sim i}$$

$$Pat_{j;t}^{\sim i}$$

comp

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$(r = [\sim \quad b])^{\frac{1}{}}$

$$\frac{@^2V_e}{@_e@b} = \quad (1 \qquad _e) \qquad \frac{@^2V_i}{@_e@b} = 0$$

$$\frac{@^2V_e}{@_e@} = (1 \qquad _i) \qquad \frac{@^2V_i}{@_i@} = 1$$

$$\frac{@^2V_e}{@_e@} = 0 \qquad \frac{@^2V_i}{@_i@} = \quad (1 \qquad _e)$$

$$\frac{@^2V_e}{@_e@r} = \quad f^0(\ _e) \qquad \frac{@^2V_i}{@_i@r} = \quad f^0(\ _i)$$

$$\frac{@^2V_e}{@_e@} = rf^0(\ _e)\ln(1 \qquad _e) \qquad \frac{@^2V_i}{@_i@} = rf^0(\ _i)\ln(1 \qquad _i)$$

Proof.

$$\frac{@_e}{@b} = \frac{r}{jJj} f^0(_i) \qquad \frac{@_e}{@} = \frac{1}{}$$

$$\frac{@\Psi_i}{@r} = \frac{\Psi_i}{r} \quad \frac{@\tau_e}{@r} + r\tilde{}_i f^{00}(\tilde{}_i)\frac{@\tau_i}{@r}:$$

$< \quad 1$

$\Psi_i; @\tau_e \ @r \quad @\tau_i = @r$

$$\frac{@\Psi_i}{@r} = \quad f^{0}(\tilde{}_i) \quad \frac{[\tilde{} \quad b]}{jJj} f^{0}(\tilde{}_i)(1 \quad \tilde{}_i)(1 \quad):$$

$\tilde{}$

$$\frac{@\tau_e}{@\ } = \frac{[\tilde{} \quad (1 \quad \tilde{}_e) \ ] \quad [\tilde{} \quad b]}{jJj} \quad \text{and} \quad \frac{@\Psi_e}{@\ } = r\tilde{}_e f^{00}(\tilde{}_e)\frac{@\tau_e}{@\ }:$$

$@\tau_e \ @\ \quad [\tilde{} \quad b]$

$$rf^{0}(\tilde{}_i) \left\{ f^{0}(\tilde{}_e) \quad \frac{\tilde{} \quad (1 \quad \tilde{}_e)}{r} \right\}^{\frac{1}{\quad}}$$

$\tilde{} \quad (1 \quad \tilde{}_e) \quad r:$

$f^{0}(\tilde{}_e)$

$1; \quad \div$

$@\Psi_e \ @\ :$

$\tilde{}$

$$\frac{@\Psi_i}{@\ } = r\tilde{}_i f^{00}(\tilde{}_i)\frac{@\tau_i}{@\ } \quad \frac{@\tau_e}{@\ }:$$

$1:$

$\tilde{} \quad (1 \quad \tilde{}_e) \quad r$

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$$\frac{@V_i}{@} = r\tilde{}_i f^{00}(\tilde{}_i)\frac{@\tilde{}_i}{@} \quad \frac{@\tilde{}_e}{@}:$$

$@\tilde{}_e=@$

$@\tilde{}_i=@ \quad @\tilde{}_e=@ \quad @V_i=@$

$$\tilde{}_i jJj \ln(1 \quad \tilde{}_i) + (1 \quad \tilde{}_i)\ [\tilde{} \quad b] \ \ln(1 \quad \tilde{}_i) \quad \ln(1 \quad \tilde{}_e) \ :$$

$@\tilde{}_e=@ :$

$@V_i=@ > 0:$

$\tilde{}$

$$\frac{@V_i}{@} = r\tilde{}_i f^{00}(\tilde{}_i)\frac{@\tilde{}_i}{@} \quad \frac{@\tilde{}_e}{@}:$$

$1 \quad @\tilde{}_e=@ < 0 \quad \forall_i$

$\div \quad 1 < \ < \ [\tilde{} \quad b]=r; \quad @\tilde{}_e=@$

$> \ [\tilde{} \quad b]=r;$

$@\tilde{}_e=@ > \ 0; \quad @V_i=@ \quad @\tilde{}_i=@$

$@\tilde{}_e=@; \quad @V_i=@$

$$[\tilde{} \quad b] + \tilde{}_i r^2 f^{00}(\tilde{}_i) f^{00}(\tilde{}_e) \quad r \quad (1 \quad \tilde{}_i)^1 \ :$$

$\tilde{}_e \ ! \ 0;$

Proof.

$$(1 \quad {}^{i}_{2}) = \frac{r\,[\sim + \quad b]}{\sim[\sim \quad b]} + \frac{r\ (1 \quad)^2}{\sim[\sim \quad b]} \quad \frac{{}^{e}_{2}}{1 \quad {}^{e}_{2}} \quad ^2 = (1 \quad {}^{i}_{1}) + \frac{r\ (1 \quad)^2}{\sim[\sim \quad b]} \quad \frac{{}^{e}_{2}}{1 \quad {}^{e}_{2}} \quad ^2 :$$

■

Lemma 9 $V_1^j > V_2^j$ and $V_2^i > V_1^i$:

Proof.

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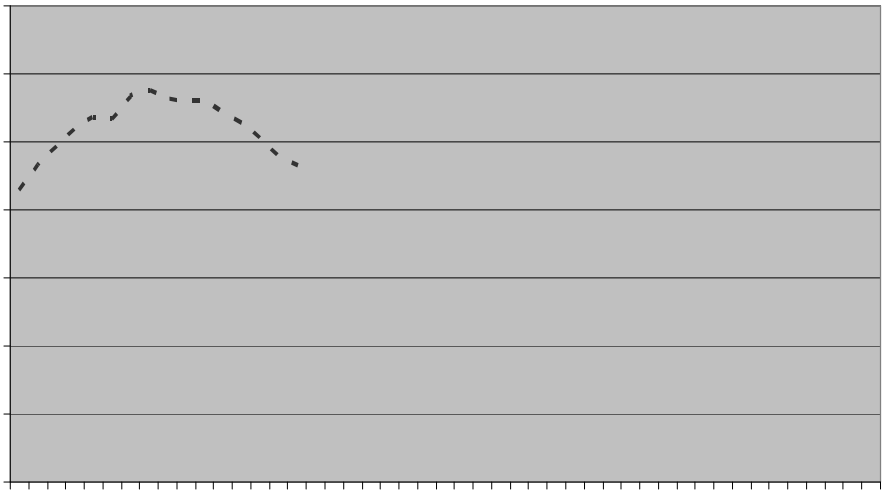

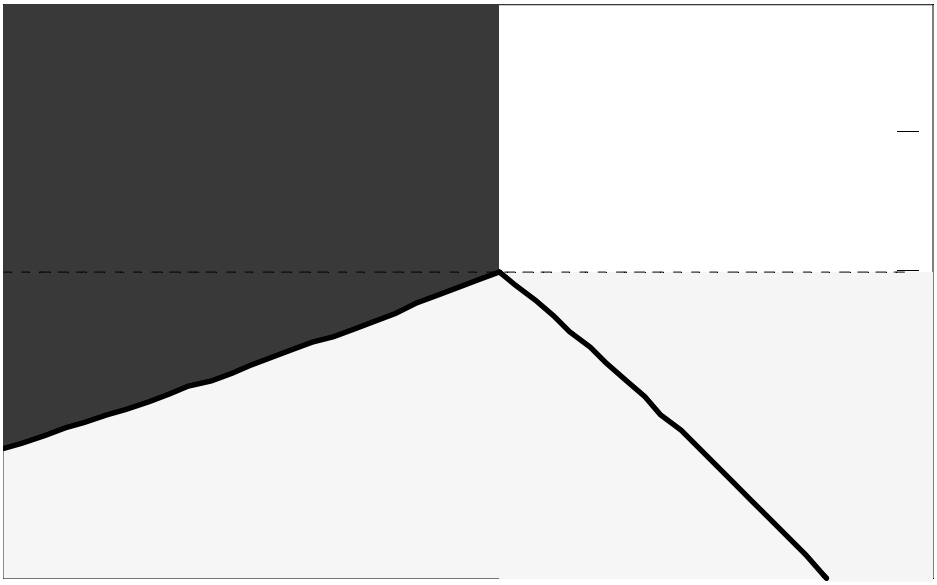

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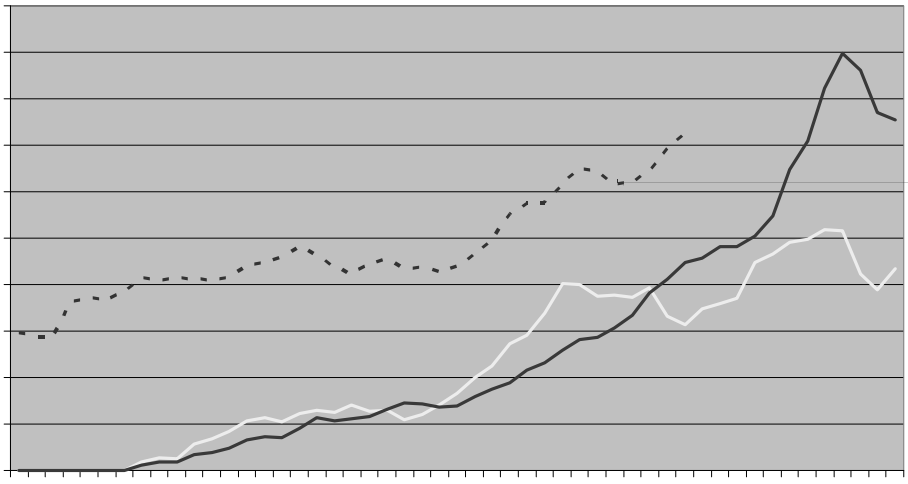

Table 1: Testable Implications of the Duopoly Model*					
Changes in Exogenous Parameters					
	Price of Marketing Capital ( )	Existing Rents ( )	Invention Size ( )	Price of R&D (r)	Curvature of R&D Cost Fct. ( )
R&D Reaction Function (for all values of)					
Incumbent	¢				
Entrant					
(1)					
R&D					
Incumbent					
Entrant				†	?
Ex Ante Firm Value					
Incumbent					#
Entrant					?
(1)					
R&D					
Incumbent					

Table 2: Industries with Aggregate R&D Intensity of 1% or More in 1973 (R&D Industries)			
SIC	Industry Description	SIC	Industry Description
280	Chemicals & Allied Products	362	Electrical Industrial Apparatus
281	Industrial Inorganic Chemicals	363	Household Appliances
282	Plastics Materials & Synthetic Resins	365	Household Audio & Video Equipment
283	Drugs	3661	Telephone & Telegraph Apparatus
2834	Pharmaceutical Preparations	3663	Radio & Television Broadcasting & Communications Equipment
284	Soap, Detergents, & Cleaning Preparations	367	Electronic Components & Accessories
2844	Perfumes, Cosmetics, & Other Toilet Preparations	3674	Semiconductors & Related Devices
2851	Paints, Varnishes, Lacquers, Enamels, & Allied	3678	Electronic Connectors
286	Industrial Organic Chemicals	3711	Motor Vehicles & Passenger Car Bodies
289	Miscellaneous Chemical Products	3713	Truck & Bus Bodies
301	Tires & Inner Tubes	3714	Motor Vehicle Parts & Accessories
322	Glass & Glassware, Pressed & Blown	372	Aircraft & Parts
329	Abrasive, Asbestos, & Miscellaneous	3721	Aircraft
3334	Primary Production of Aluminum	3724	Aircraft Engines & Engine Parts
342	Cutlery, Hand Tools, & General Hardware	376	Guided Missiles & Space Vehicles & Parts
348	Ordnance & Accessories, Except Vehicles	381	Search, Detection, Navigation, Guidance
351	Engines & Turbines	382	Laboratory Apparatus & Analytical, Optical, Measuring, & Control Instruments
352	Farm & Garden Machinery & Equipment	3822	Automatic Controls for Regulating Residential & Commercial Environments & Appliances
353	Construction, Mining, & Materials Handling	3823	Industrial Instruments for Measurement, Display, & Control of Process Variables; & Related Products
3531	Construction Machinery & Equipment	3825	Instruments for Measuring & Testing of Electricity & Electrical Signals
3533	Oil & Gas Field Machinery & Equipment	3826	Laboratory Analytical Instruments

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Table 4: Distribution of R&D

(Percent of Total)

Year	Non-R&D Industries	R&D Industries			
		Incumbent Industries			Non-Incumbent Industries
		All Firms	Incumbent Firms	Other Firms	
1974	16.8	71.2	54.6	16.7	12.0
1979	17.3	70.8	53.2	17.5	11.9
1984	18.3	68.3	48.2	20.2	13.4
1989	15.7	71.0	49.1	21.9	13.3
1994	13.6	67.6	41.6	26.0	18.8
1999	7.6	63.5	34.7	28.8	28.9

Notes: Incumbent firms are those firms with at least 25,000 employees in 1965. Incumbent industries are those SICs with at least one incumbent firm. R&D industries are defined as industries where R&D/Sales 1 in 1973.

Table 5: R&D Intensity

(R&D Operating Expense, percent)

Year	Non-R&D Industries	R&D Industries			
		Incumbent Industries			Non-Incumbent Industries
		All Firms	Incumbent Firms	Other Firms	
1974	0.31	3.32	3.50	2.84	2.63
1979	0.31	3.32	3.49	2.90	3.00
1984	0.45	4.53	4.52	4.56	4.85
1989	0.46	5.08	4.89	5.56	4.72
1994	0.42	5.42	4.94	6.43	5.54
1999	0.28	6.38	5.56	7.75	7.01

Notes: Incumbent firms are those firms with at least 25,000 employees in 1965. Incumbent industries are those SICs with at least one incumbent firm. R&D industries are defined as industries where R&D/Sales 1 in 1973.

Table 6: Descriptive Statistics (R&D Industries, 1973-97)

Variable:	All Firms	Computers	Non-computer Industries			
			Incumbent Industries			Non-incumbent Industries
			All Firms	Incumbent Firms	Other Firms	
	Compustat Variables					
Employment (1,000s)	6.78 6.74	3.60 4.52	16.38 11.38	93.36 31.18	5.38 3.02	2.09 1.59
Operating Costs ($ mil.)	906 1,292	442 1,138	2,259 2,075	13,594 5,704	668 587	263 267
R&D†	0.0595 0.0306	0.0922 0.0393	0.0374 0.0251	0.0362 0.0147	0.0375 0.0263	0.0537 0.0274
Rival's R&D†	0.0609 0.0141	0.0927 0.0153	0.0407 0.0109	0.0345 0.0113	0.0415 0.0109	0.0544 0.0153
Book Net Worth‡	0.5797 0.2618	0.6294 0.2738	0.4971 0.2230	0.3805 0.1143	0.5135 0.2343	0.6053 0.2785

Table 7: Simple Reaction Function Regressions with Fixed and Year Effects
(R&D Industries, 1973-97)

Dependent Variable: $R\&D^{i}_{j,t}$	All Firms	Computers	Non-computer Industries	
			Incumbent Industries	

Table 8: Reaction Function Regressions with Additional Controls, Fixed and Year Effects (R&D Industries ex Computers, 1973-97)

Dependent Variable: $R\&D^{i}_{j,t}$	Incumbent Industries		Non-incumbent Industries	Incumbent Industries		Non-incumbent Industries	Incumbent Industries		Non-incumbent Industries
	Incumbents	Other		Incumbents	Other		Incumbents	Other	
Constant	0.0318***	0.0283***	0.0473***	0.0236***	0.0267***	0.0631***	0.0071	0.0271***	0.0621***
	(0.0026)	(0.0027)	(0.0024)	(0.0036)	(0.0031)	(0.0028)	(0.008)	(0.0053)	(0.0046)

Table 9: Reaction Function Regressions with Fixed and Year Effects (R&D Industries, 1973-97)

	Early PC Adopters					
	All Firms	Computers	Non-computer Industries			
Dependent Variable: $R\&D^{i}_{j,t}$			Incumbent Industries			Non-incumbent Industries
			All Firms	Incumbent Firms	Other Firms	

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Table 11: Marginal Effects (1995) of an increase in Computer Investment/GDP

Dependent