

An Organizational Perspective on Patenting and Open Innovation

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Online Supplementary Appendix

Table A1: Sample means for key variables, 1979-1998

Year	Patents		R&D expenses in M\$		Plant & Equipment expenses in M\$		Sales in M\$	
	IBM	Control group	IBM	Control group	IBM	Control group	IBM	Control group
1979	532	37.8	3,223.2	111.4	28,897.4	3,887.6	54,184.8	3,377.1
1980	533	38.2	3,176.8	109.8	31,385.5	3,561.3	54,785.2	3,203.7
1981	589	34.9	3,046.7	109.6	32,655.4	3,253.1	54,942.3	2,956.6
1982	568	34.9	3,654.3	111.6	31,262.2	3,034.1	61,167.9	2,802.5
1983	580	30.1	4,349.2	114.2	27,925.7	2,628.2	69,511.4	2,635.0
1984	487	29.7	5,225.7	115.7	27,162.6	1,071.2	76,255.4	1,864.6
1985	509	28.9	5,531.2	140.1	31,488.0	1,323.1	80,089.6	2,371.1
1986	547	33.7	6,240.8	181.3	33,390.8	1,449.7	80,462.5	2,897.1
1987	541	43.5	6,077.0	197.5	34,841.4	1,438.3	82,409.8	3,084.2
1988	637	47.7	6,451.7	206.1	34,202.0	1,404.2	87,134.3	3,217.9
1989	709	55.7	7,229.4	215.1	34,670.8	1,423.4	87,166.9	3,220.8
1990	877	58.8	6,486.5	231.0	35,958.1	1,512.1	91,103.8	3,487.0
1991	1,234	59.6	6,301.3	239.7	34,748.3	1,521.8	81,637.9	3,436.8
1992	1,500	63.5	6,252.1	245.8	26,561.9	1,545.7	79,363.3	3,557.2
1993	1,265	57.8	5,272.9	242.8	20,850.0	1,470.8	74,632.1	3,575.8
1994	1,844	73.9	3,923.1	265.5	19,330.2	1,628.3	74,300.3	4,120.3
1995	2,557	94.0	5,906.5	289.2	18,734.3	1,336.1	81,292.2	4,374.8
1996	2,725	102.9	4,327.4	265.8	19,147.7	1,327.6	83,541.7	4,191.5
1997	3,604	132.4	4,608.5	303.1	19,631.3	1,466.2	84,003.6	4,463.5
1998	3,777	119.0	4,734.0	264.6	20,808.9	1,387.0	86,567.0	3,907.8
AVG(1979-98)	1,280.8	58.4	5,100.9	199.7	28,182.6	1,825.4	76,227.6	3,324.7

Table A1 Notes: The table shows sample means for the key variables of our study for IBM and the 114 control- group firms in the electronics and semiconductors industry. Column 2 shows the number of successful U.S. patent applications for the sample firms by the corresponding patent-application year. R&D expenses, Plant and Equipment expenses and Sales are in Millions of FY2000 dollars.

Table A2: Pairwise correlations among variables

#	Variable	1	2	3	4	5	6	7	8	9
1	N of Patents	1								
2	R&D not-zero	0.06*	1							
3	log (R&D/Sales)	0.02	0.27*	1						
4	log (P&E/Sales)	0.18*	-0.01	0.22*	1					
5	IBM	0.51*	0.02	-0.01	0.07*	1				
6	log Sales	0.55*	0.12*	0.06*	0.32*	0.25*	1			
7	log Age	0.16*	0.08*	-0.04	0.07*	0.11*	0.33*	1		
8	Operating income change	-0.01	-0.01	-0.02	0.02	0.00	0.03	-0.04	1	
9	N of years missing	-0.15*	-0.12*	0.09*	0.11*	-0.11*	-0.17*	-0.48*	0.07*	1
10	Tobin's Q	-0.01	0.00	0.16*	-0.11*	0.00	-0.04	-0.23*	0.03	0.12*

Table A2 Notes: Pairwise correlations and significance; * p<0.05

Table A3: PPML estimates of patent propensity for IBM and control-group firms, 1979-1998

D.V.=N of Patents	1979-83	1984-88	1989-93	1994-98
IBM	4.31** [0.54]	-0.79* [0.35]	22.34** [1.79]	4.38** [0.44]
log (R&D/Sales)	-0.6 [3.45]	5.21+ [3.05]	4.63* [2.07]	8.15** [3.09]
IBM X log (R&D/Sales)	-80.90** [11.11]	0.86 [5.93]	-308.86** [22.49]	-58.00** [3.42]
log (P&E/Sales)	-1.23** [0.24]	-0.74 [0.57]	1.16 [0.75]	2.84** [0.97]
Operating income change	-0.18 [0.16]	0 [0.00]	0.08** [0.02]	0.20* [0.08]
log Sales	0.91** [0.04]	0.89** [0.09]	0.81** [0.08]	0.79** [0.07]
log Age	-0.01 [0.27]	0.05 [0.22]	-0.18 [0.32]	-0.02 [0.25]
R&D not-zero	2.51** [0.53]	2.24** [0.78]	2.27** [0.84]	6.60** [1.51]
Number of years missing	-0.04 [0.03]	-0.05 [0.04]	-0.27** [0.10]	0.03 [0.07]
Constant	-5.27**	-5.46**	-4.19**	-9.54**
Observations	307	525	550	511
R-squared	0.899	0.64	0.767	0.748
Log likelihood	-3198	-8763	-11711	-20128
N of Clusters	87	115	114	113

Table A3 Notes: Method of estimation is Poisson Pseudo-Maximum-Likelihood (PPML) regression. The dependent variable is the number of successful patent applications for each firm-year. Time-period subsamples are drawn from the larger sample of 115 firms (including IBM), each with annual Compustat records, without gaps, for at least 15 years during 1979-1998 and at least one successful patent application in the USPTO patent classes of IBM patents during the period. 3-year moving averages (for years t, t-1 and t-2) are used for R&D/Sales, Plant & Equipment/Sales and Sales. R&D expenses, Plant and Equipment expenses, and Sales are expressed in Millions of FY2000 Dollars. Employees are in 1000s. Robust standard errors, clustered at the firm-level in brackets; ** p<0.01, * p<0.05, + p<0.1

Table A4. Estimates of patent propensity and others' citations for IBM and other sample firms

	N of Patents		N of Others' Cites	
	Coeff.	S.E.	Coeff.	S.E.
R&D not-zero	4.16**	[0.97]		
log (R&D/Sales)	7.71**	[2.37]		
log (P&E/Sales)	0.38	[0.46]		
IBM	-0.12	[0.29]	-0.12+	[0.064]
log Sales	0.8**	[0.06]		
log Age	-0.06	[0.18]		
N of years missing	-0.04	[0.07]		
IBM X Year 1980	-0.04	[0.03]	-0.03	[0.07]
IBM X Year 1981	0.11+	[0.06]	0.01	[0.068]
IBM X Year 1982	-0.01	[0.06]	0.07	[0.066]
IBM X Year 1983	0.05	[0.06]	0.06	[0.065]
IBM X Year 1984	-0.41**	[0.12]	0.06	[0.066]
IBM X Year 1985	-0.15	[0.15]	0.08	[0.066]
IBM X Year 1986	-0.13	[0.21]	0.05	[0.066]
IBM X Year 1987	-0.39**	[0.14]	0.11	[0.065]
IBM X Year 1988	-0.32*	[0.16]	0.1	[0.065]
IBM X Year 1989	-0.35+	[0.18]	0.14*	[0.064]
IBM X Year 1990	-0.15	[0.2]	0.12+	[0.065]
IBM X Year 1991	0.18	[0.2]	0.04	[0.065]
IBM X Year 1992	0.38+	[0.23]	0.01	[0.065]
IBM X Year 1993	0.35	[0.24]	0.11	[0.065]
IBM X Year 1994	0.65**	[0.24]	0.05	[0.066]
IBM X Year 1995	0.79**	[0.23]	0.03	[0.067]
IBM X Year 1996	0.8**	[0.23]	0.11	[0.068]
IBM X Year 1997	0.87**	[0.23]	0.11	[0.068]
IBM X Year 1998	0.93**	[0.24]	0.02	[0.07]
SCITES			-0.07**	[0.014]
SCITES X IBM			0.1**	[0.02]
Constant	-6.89**	[1.24]	-0.05	[0.127]
N of Observations	2,009		273,882	
N of Clusters (Firms or Patents)	115		43,722	
R-Squared	0.758		0.072	
Log-likelihood	-52061		-449209	
Year FE	Y		Y	
Class FE	N		Y	

Table A4 Notes: Method of estimation is Poisson Pseudo-Maximum-Likelihood (PPML) regression. The dependent variables are the number of successful patent applications for each firm-year and the number of others' annual citations to patent. See notes for Table 2 for additional details. Robust standard errors, clustered at the firm-level or patent-level in brackets; ** p<0.01, * p<0.05, + p<0.1

Table A5: Estimates of patent propensity and market value for sample firms, 1979-1998

Column #	1	2	3	4
Specification	Poisson, RE	Poisson, FE	LS, RE	LS, FE
D.V.=	N of Patents	N of Patents	Tobin's Q	Tobin's Q
TREATED	0.02 [0.61]		0.60* [0.30]	
TREATED_AFTER	0.96** [0.02]	0.96** [0.02]	-0.91+ [0.52]	-1.13* [0.52]
log PAT			-0.03+ [0.02]	-0.06** [0.02]
TREATED X log PAT			-0.07 [0.05]	0.03 [0.06]
TREATED_AFTER X log PAT			0.20* [0.08]	0.22** [0.08]
R&D not-zero	-1.13** [0.19]	-0.3 [0.23]	0.04 [0.10]	0.12 [0.10]
log (R&D/Sales)	3.43** [0.22]	3.46** [0.22]	0.71 [0.53]	-0.81 [0.65]
log (P&E/Sales)	-0.15** [0.03]	-0.16** [0.03]	-1.25** [0.16]	-1.69** [0.20]
log Sales	0.97** [0.01]	0.98** [0.01]	0.04* [0.02]	-0.09** [0.03]
log Age	-0.12** [0.01]	-0.12** [0.01]	-0.14** [0.03]	-0.07+ [0.04]
N of years missing	-0.36** [0.05]		0.01 [0.02]	
Constant			0.79	1.51
N of Observations	1,989	1,989	1,989	1,989
N of Firms	114	114	114	114
Year FE	Y	Y	Y	Y
Firm RE	Y		Y	
Firm FE		Y		Y
Log likelihood	-12914	-12181		
Chi2	34436	34362		
p value	0	0		
R-squared, within				0.221
R-squared, overall			0.205	

Table A5 Notes: Method of estimation is Maximum Likelihood Poisson for estimates in Columns (1) and (2) and Least Squares (LS) for estimates in Columns (3) and (4). The dependent variable is the number of successful patent applications for each firm-year in (1) and (2) and log of Tobin's Q in (3) and (4). Sample is composed of 114 firms, each with annual Compustat records, without gaps, for at least 15 years during 1979-1998 and at least one successful patent application in the USPTO patent classes of IBM patents during the period. 3-year moving averages (for years t , $t-1$ and $t-2$) are used for R&D/Sales, Plant & Equipment/Sales and Sales. R&D expenses, Plant and Equipment expenses, and Sales are expressed in Millions of FY2000 Dollars. Employees are in 1000s. Robust standard errors, clustered at the firm-level in brackets; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$