(Part of) PS2

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*May need adjust the table number

1 Baseline estimates

Table 1 reports ordered probit results. We include 36 parameters in the specification: three λ's, eleven β's, eight α's, six γ_L's and eight γ's. There are too many parameters in the specification. We intentionally introduce excess variables to incorporate alternative models of entrants' profits. And as a result, most coefficients are statistically insignificant. Bresnahan and Reiss (1991) claims that the insignificance of the coefficients is the evidence of homogeneous sample.

Following Bresnahan and Reiss (1991), we first attempted to impose profit restriction that later entrants do not have higher profits (i.e., $\bar{\Pi}_N \geq \bar{\Pi}_{N+1}$). This constraint is equivalent to holding non-negative α's and γ's, which is consistent with most of our estimates. However, when we continued to estimate the thresholds, the profit constraint gave us negative results. Therefore, the estimates in the following are without the constraint.

Table 2 reports entry threshold estimates for specifications in table 1. The formula to calculate the entry thresholds is given by

$$S_N = \frac{\hat{F_N}}{\hat{V_N}}, \tag{1}$$

where a circumflex denotes the prediction from maximum likelihood estimates in table 1. The optimal conduct in the market is given by the break-even condition. Unfortunately, our results are not satisfying as S_N declines as N increases, leading to an award situation that more entrants, more profit for each firm. Therefore, we cannot estimate the optimal number of dentists as S_8 is still less than 1.

Figure 1 also shows the reverse results. It plots the ratio of the market size required to support 8 versus N firms. For $N < 8$, it varies from 0 to 1, depending on the estimated costs and variable profits. And the ratio increases to 1 as the number of firms approaches to 8. The reason why we have the reverse results dates back to estimates in table 1, and the entry threshold ration increases in the ration of margins, entry costs, inefficiencies, and the slope.

Table 1: Baseline ordered probit results

regTerm	term	value	se
$\lambda 1$	Owner	0.043973899	NaN
$\lambda 2$	Population.percentage.change..2016.to.2021	-0.436143255	NaN
$\lambda 3$	Commuteout	0.027521438	NaN
$\beta 1$	Dwellingperkm	-0.062095061	0.071309388
$\beta 2$	Median.value.of.dwellings	0.037305447	0.0609831
$\beta 3$	AT	0.097142405	0.079628668
$\beta 4$	QC	0.031552684	0.079132411
$\beta 5$	ON	-0.042358815	0.063016032
$\beta 6$	BC	-0.046860441	0.074170611
$\beta 7$	TOTAL_65.years.and.over	-0.151082561	0.076904853
$\beta 8$	Average.number.of.children	0.071261294	0.074405462
$\beta 9$	Average.total.income.in.2020	-0.034863728	0.064358258
$\beta 10$	Edatleasths	-0.004034581	0.081785671
$\beta 11$	Unemployed	0.015146779	0.050779298
γ_L1	Dwellingperkm	0.029801061	0.088273734
γ_L2	Median.value.of.dwellings	-0.078494951	0.108233208
γ_L3	AT	-0.047652243	0.095537816
γ_L4	QC	-0.056257359	0.096401748
γ_L5	ON	-0.085085482	0.090216342
γ_L6	BC	0.059009851	0.113684169
$\alpha 1$	V_1 (a_1)	0.022461159	0.061666657
$\alpha 2$	F_1 (g_1)	0.056783217	0.024471124
$\alpha 3$	V_1 - V_2 (a_2)	-0.096496229	0.012076074
$\alpha 4$	V_2 - V_3 (a_3)	-0.017010608	0.012761205
$\alpha 5$	V_3 - V_4 (a_4)	-5.30E-04	0.018812347
$\alpha 6$	V_4 - V_5 (a_5)	-0.177999155	0.038348365
$\alpha 7$	V_5 - V_6 (a_6)	0.402106217	0.136979519
$\alpha 8$	V_6 - V_7 (a_7)	0.024136647	0.002933992
γ_n1	V_7 - V_8 (a_8)	0.037509481	0.096055429
γ_n2	F_2 - F_1 (g_2)	0.346004586	0.043221486
γ_n3	F_3 - F_2 (g_3)	0.096478143	0.015874658
γ_n4	F_4 - F_3 (g_4)	0.17300883	0.028702114
γ_n5	F_5 - F_4 (g_5)	0.128753531	0.032922849
γ_n6	F_6 - F_5 (g_6)	0.078056261	0.031017745
γ_n7	F_7 - F_6 (g_7)	0.034134112	0.031208544
γ_n8	F_8 - F_7 (g_8)	-0.007261887	NaN
Log likelihood	Log likelihood	693.3082817	NA

Table 2: Entry threshold estimates

S_N		S ratio	
S_1	0.353840027	S_1/S_NA	NA
S_2	0.335408483	S_2/S_1	0.947909952
S_3	0.332164911	S_3/S_2	0.990329488
S_4	0.323690636	S_4/S_3	0.974487747
S_5	0.317179656	S_5/S_4	0.979885176
S_6	0.316076027	S_6/S_5	0.996520492
S_7	0.308003448	S_7/S_6	0.974460009
S_8	0.307994832	S_8/S_7	0.999972028

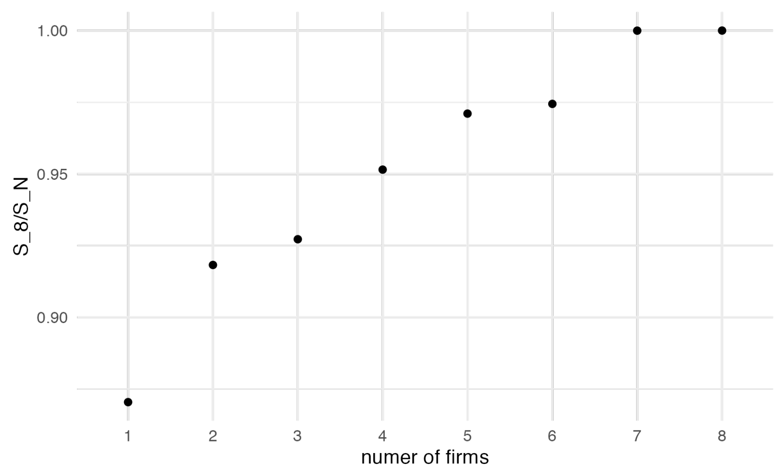

Figure 1: Industry ratios of s_8 to s_N by N

2 Specification issues

Table 1 and figure 1 suggest that the eighth entrant does not change competitive conduct. So we test several profit shifters: entrants' fixed costs, town population, and local economic conditions. For each type of the profit shifters, we test if it can explain the difference in profits and therefore alter the entry threshold under maintained hypothesis.

Table 3 summarizes all the test results. We first test the null that same fixed costs for every firm. As the likelihood ratio test statistic (LRT) is way above the threshold, we should reject the null hypothesis of equal fixed costs, this is consistent with significant γ's in table 1. Moreover, the constrained entry threshold ratios are slightly bigger than unconstrained estimates due to the constrained fixed costs.

Second, we test the effect of market size $S(Y)$ described by town population.

The null hypothesis is that the coefficients of market size are all 0 and it is easily rejected by the test statistic. After removing all the market size effects, the ratios of entry threshold increase slightly just as in the first exercise.

Third, we test for the effects of local economic conditions. While we reject the null that eliminating the effects of local economic conditions, the variation in the constrained ratios of entry thresholds is much bigger, ranging from 0.38 to 1.31. This result reflects the significant contribution of overall local economic conditions in variable profits.

Table 3: Likelihood ratio tests for different hypotheses

Name	Same fixed costs	Market size exclusion	Local economic condition exclusion
LikelihoodValue	825.3121082	904.7645924	904.7645924
LRT	264.0076529	422.9126214	422.9126214
DegreesFreedom/OmittedVar	7	Owner, Population. percentage.change, Commuteout	Dwellingperkm, Median.value.of.dwellings, AT, QC, ON, BC, 65.years.and.over, Average.number.of.children, Average.total.income, Edatleasths, Unemployed
S_2/S_1	0.993097185	0.995404937	0.376140367
S_3/S_2	0.992671884	0.996766619	0.805254603
S_4/S_3	0.995720775	0.997388563	0.804219601
S_5/S_4	0.997879475	0.998288174	1.208973714
S_6/S_5	1.00204492	1.000528132	1.089678467
S_7/S_6	1.001986975	1.000064656	1.185406988
S_8/S_7	1.002495309	1.004060511	1.311457457

Finally, we test the market criteria. If the markets are too close to each other, then the migration of consumers may bias our estimates. The number of population commuting out proxies the migration, but it presents an insignificant weak positive correlation with the market size in table 1 (weird). Besides, the nearby supply-side sources could also affect the demand-side analysis. Hence, we explore two other market criteria, one weaker (2km away) and one stronger (5km away). Table 4 reports the results under alternative market definitions. As is shown in table 4, none of the specification exhibits significant difference in ratios of thresholds for more than 2 firms from our baseline estimates (table 2). However, the second entrant has relatively lower margin than before as we observe higher S_2/S_1 in table 4 if we change the market criterion. Overall, the results from table 4 supports our previous market specification.

Table 4: Entry thresholds for alternative market definitions

Distance	2km	5km
S_2/S_1	1.004616399	0.993312244
S_3/S_2	1.001384557	0.995949242
S_4/S_3	1.005929137	0.99682532
S_5/S_4	1.0031106	0.993926681
S_6/S_5	1.00523086	0.996596202
S_7/S_6	0.993084012	0.993310898
S_8/S_7	1.000234026	1.010782519