Problem set 6

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1. This section provides some summary statistics of the event of entry and main variables used for estimation. Table (1) shows that the probability of entry by a carrier that has presence at both endpoints of a route (78% in 1997) is significantly greater than the probability of entry by carriers that do not have presence in any of the endpoints (1.15% in 1997). By pooling all of the carriers, the unconditional probability of entry is 21% in 1997. The last column of this table also shows that the number of carriers that operate a route (including incumbent firms) as a proportion of those operating out of both cities in the route is relatively large, 80% in 1997.

Table 1: Summary statistics of probability of entry

Year/quarter	Unconditional probability of entry by a carrier	Probability of entry by a carrier conditional on presence at both ends	Probability of entry by a carrier conditional on no presence at either end point	# of carriers serving a route/ # of carriers operating out of both cities in the route
1996/2	20.95%	76.90%	0%	78.55%
1997/2	21.44%	78.21%	1.15%	80.39%

Table (2) shows the average characteristics in the markets where entry by a carrier is observed and those were no entry is observed. The average population and proportion of touristic destinations in markets where there is entry is significantly higher than in markets where no entry is observed. The same is true about the number of incumbent firms while the average Herfindahl index is significantly smaller in markets with entry. Both of these insights are consistent with the assumption that entry is more likely in more competitive markets.

Table 2: Summary statistics of city-pair market by entry condition

	Entry		
Variable	0	1	diff
pop	0.258	0.283	***
herfCityPair	1961	1937	**
tourist	0.278	0.327	***
incumbents	6.349	7.037	***

Table (3) shows the share of routes owned by incumbent firms in 1996 and 1997 and the share of routes that new carriers acquire following entry into a market. During 1997, new entrants would serve near 0.6% of the routes while incumbents would serve 99%. Comparing both years we see an increase in the proportion of routes served by incumbents, which is also an indication of decreased entry in 1997.

Table 3: Incumbent and entrant carrier characteristics

	Incumbent carrier	Carrier entrant
Share of routes in 1997/2	98.06%	1.94%
Share of passengers 1997/2	99.44%	0.56%

Finally, table (4) shows the overall mean and standard deviation of the main variables used in this study.

Table 4: Overall summary statistics of main covariates

	Summary statistics	
	Mean	Standard deviation
pop	0.263	0.266
distance	1.281	0.695
tourist	0.288	0.453
city2	0.268	0.443
sharepaxdist	0.032	0.072
# routes	14.540	26.972

2. Table (5) shows three probit specifications for the probability of entry. In these models, one observation corresponds to a year-citypair-carrier combination. Following Berry (1992), the subsample of observations used in these results are all potential entrants with presence on at least one of the end points and all incumbents. Focusing on the third column of the table with a more parsimonious set of covariates, we find that larger population, larger distance between the endpoints of the route, and presence at both endpoints of the route, are positively correlated with the probability of entry. In particular, an increase of a thousand miles in the distance between the two end points increases probability of entry by 0.092 percentage points, and the probability of entry by a carrier with presence at both endpoints is 0.324 percentage points greater than the probability of entry by a carrier without presence at either endpoint (see table 6). The advantage of this estimation technique is its computational simplicity and interpretability of results in terms of marginal effects, however it does not allow to predict the number of entrants into a market nor identify the firms that would enter. I also does not allow to control for the effect of entry by carriers $-i$ in the probability of entry by carrier i.

Table 5: Probit results

	(1)	(2)	(3)
Constant	-1,860***	-2,022***	-1,428***
	(0.125)	(0.129)	(0.074)
pop	0,363***	0,350***	0,178*
	(0.109)	(0.110)	(0.098)
distance	1,078***	1,169***	0,297***
	(0.178)	(0.182)	(0.039)
distance2	-0,275***	-0,293***	
	(0.061)	(0.063)	
tourist	-0,093	-0,075***	
	(0.064)	(0.065)	
city2	1,034***	0,599***	1,043***
	(0.061)	(0.073)	(0.060)
sharepaxdist	3,493***		3,466***
	(0.365)		(0.363)
# route		0,019***	
		(0.001)	
-2 log likelihood	2913.3	2773.8	2935.1
N	2681	2681	2681

Table 6: Marginal effects in probit (3)

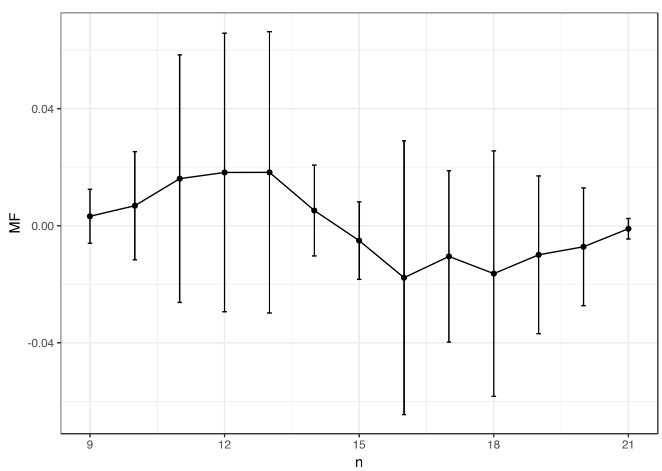
pop	distance	city2	sharepaxdist
0.055	0.092	0.324	1.076

3. The first column of table (7) shows the maximum likelihood model (ordered probit) with no heterogeneity corresponding to profits of the form $\pi_{ik}(N) = X_i\beta + \delta ln(N) + v_{io}$. The underlying assumption in this specification is that additional entrants have the same effect on a carrier's probability of entry as the equilibrium number of firms. In other words, the impact of having two additional entrants on a carrier's probability of entry is twice the impact of having one additional entrant, and this effect is the same across all carriers. In figure (1) where the marginal effect of N on the probability of entry for different values of N is depicted, we can see that this effect is constant on average, consistent with Berry's restriction. The advantages of this estimation technique besides its computational simplicity is the ability to capture the effect of the equilibrium number of firms in the profitability of entry.

Table 7: Maximum likelihood results

	No heterogeneity	Only observed heterogeneity
Constant	-0,765	5,523***
	2.90E+06	(0.227)
pop	0,122	0,872***
	(0.287)	(0.010)
distance	0,736***	1,175***
	(0.138)	(0.098)
city2		0,243***
		(0.110)
sharepaxdist		3,383***
		(0.007)
delta	-0,171	-3,967***
	(0.226)	(0.962)
-2 log likelihood	808.1	807.01
N	184	184

Figure 1: Marginal effect of the equilibrium number of firms on the number of potential entrants



4. The second column of table (7) shows the ordered probit with only observed heterogeneity corresponding to profits of the form $\pi_{ik}(N) = X_i\beta + Z_{ik}\alpha + \delta ln(N) + v_{io}$. Notice that this model fits the data better than the first model based on their log-likelihood measures. With this model we can see that the effect of the number of firms on profitability of entry is larger in magnitude. This means that profits decrease more if an additional firm enters compared to the first model. We also find presence at both endpoints of a route and share of miles traveled by a carrier increase the profitability of entry. As Berry mentions in his paper, this model uses the information of the equilibrium number of firm but can not distinguish the

identities of entering firms. In fact ,it places a strong restriction on the difference in profits between entering and not entering firms:

$$Z_k\alpha - Z_j\alpha > \delta(ln(N) - ln(N+1))$$

This inequality suggests that if firm k enters a market with an $N-$equilibrium and firm j doesn't, then profits of firm j can not be higher in an $N+1$-equilibrium. Table (8) shows that the rejection rate of the above inequality using the model with only observed heterogeneity is 55%. This percentage is calculated using the following formula:

$$\frac{\sum_{t=1}^{T}\sum_{k\in E_t}\sum_{j\in NE_t}\mathbf{1}\{Z_k\alpha - Z_j\alpha > \delta(ln(N) - ln(N+1))\}}{\sum_{t=1}^{T}|E_t||NE_t|}$$

where E_t is the set of firms that enter market t, NE_t is the set of firms that do not enter market t, and $|A|$ is the cardinality of set A. This relatively high rejection rate is an indication that the model with only observed heterogeneity is not suitable to explain the entry patterns in the data.

Table 8: Restriction implied by the model with only observed heterogeneity

Event	Rejection rate
$\mathbf{1}\{Z_k\alpha - Z_j\alpha > \delta(ln(N) - ln(N+1))\}$	54,64%

5. Table (9) shows the estimation of the full model with simulations incorporating the order of entry moments as suggested in the appendix of Berry's paper. I do not estimate a moment condition between v_{io} and the total city output share, hence I have 30 moment conditions unlike Berry who has 31.

Table 9: Simulation estimates

	Most profitable move first
Constant	-1.0379
pop	1.4815
distance	1.6017
city2	3.5467
sharepaxdist	3.2772
δ	-2.2672
ρ	0.7003
GMM Obj. Fun.	5.0999
N	184