Bundle-Size Pricing as an Approximation to Mixed Bundling

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Web Appendix

This appendix includes a discussion of identification of the demand system that is estimated using the data from TheatreWorks, followed by numerous tables providing an expanded summary of the numerical experiments from the paper.

1 Identification of estimated demand system

What variation in the data serves to identify each parameter of the demand model? The variance terms, $\Sigma(k,k)$, are identified by the plays' relative overall market shares: relatively high-share plays must have relatively higher variances. Note, however, that the observed ranking of market shares need not be a one-to-one mapping with the estimated play variances, because the covariance terms in Σ also have an impact on choice probabilities. For example, a given play can have a high market share either because the variance in valuations is high, or because it has a strong positive correlation with another high-variance play. The covariance terms themselves are identified by the bundle combinations chosen by multi-play buyers, such as the *pick-5* subscribers. Pairs of plays that consumers choose to bundle relatively often will have more positive covariances. Importantly, we assume the covariance in tastes is the same for theater-lovers as for non-theater-lovers. Note that while a large fraction of consumers choose to subscribe to the full season of all 8 plays, this does not necessarily imply strong positive covariances, because other features of the model can explain this particular behavior, as we explain below.

The degree of price sensitivity, α, is identified by variation in per-play prices across bundles. Because *TheatreWorks'* pricing involves discounts for larger bundles, consumers' sensitivity to

price explains why market shares for larger bundles are higher than would otherwise be the case.[1] Besides quantity discounts, an additional source of pricing variation comes from the fact that one specific 3-play bundle is offered at a discount ($36.20 per play) while all other 3-play combinations have no discount ($40.80 per play). The taste distribution alone may explain why a specific 3-play bundle is more popular than other 3-play bundles. Hence, α is identified by the extent to which demand for the discounted 3-play bundle exceeds the demand implied by the taste distribution alone. We also assume there are no complementarities in demand between these particular plays, which seems reasonable in this context. Imposing the supply-side pricing condition also helps to assure a reasonable estimate of price sensitivity.

A standard concern with demand estimation is the possibility that observed prices are correlated with unobserved demand shifters, which may bias parameter estimates. However, in the estimation we integrate over all unobserved demand components. There is no remaining error term that may be correlated with observed prices. Consider, for example, the discounted 3-play bundle. We estimate the variances and covariances of the taste distribution—i.e., we control for the qualities of these plays, and we control for the tendency of consumers to want to bundle these particular plays together. The fact that this specific bundle is offered at a discount is exogenous variation for our purposes. Stated differently, we assume there are no bundle-specific error terms. And even if there were, endogeneity is only a concern if bundle-specific errors vary systematically by bundle size, because *TheatreWorks'* prices are in any case only dependent on the total number of plays (with the exception of one particular three-play bundle).

How do the data identify $\bar{\theta}$ and λ? This aspect of the model is important for explaining a key feature of the data. Suppose that $\bar{\theta} = 0$ (or equivalently, $\lambda = 0$). In this case, the relationship between bundle size and market share depends on the degree of correlation in tastes for plays, but in a very particular way. If play valuations are weakly or negatively correlated, the probability of a consumer having high valuations for all 8 plays is less than the probability of having high valuations for any 5 plays, say. Hence, controlling for the effect of price, the

[1] Note that even in the model where we estimate the mean of the play valuations (μ), α is separately identified from μ. While an increase in μ implies an increase in bundle valuations that is proportional to the number of plays, a decrease in α implies a disproportionately large increase in the net utility from purchasing large bundles.

number of 8-play subscribers would be less than the number of 5-play subscribers. Similarly, the number of 5-play subscribers would be less than the number of four-play subscribers, and so forth. On the other hand, the higher the degree of (positive) correlation, the more often we ought to observe purchases of larger bundles. But in fact the observed purchases are heavily skewed toward both individual purchases as well as purchases of all eight plays. This pattern cannot be explained by a simple joint-normal distribution, because the two most commonly purchased bundle sizes convey conflicting information about the correlation in play valuations. This is why we distinguish theater-lovers in the demand model (i.e., the reason for including λ and $\bar{\theta}$).

Clearly, the relatively high fraction of 5-play and 8-play subscribers serves to identify $\bar{\theta}$ and λ. But how are these parameters separately identified? Since the number of single-play and 8-play buyers are both greater than the number of 2, 3, 4 or 5-play buyers, λ must not be too large or too small. If λ is near to 1, nearly everyone is a theater-lover, and the model would predict a low level of single-play sales. If λ is near to zero, we have the same problem described in the previous paragraph. This logic implies that λ is identified by the ratio of subscribers (i.e., 5-play and 8-play buyers) to non-subscribers (i.e., buyers of fewer than 5 plays).

Applying similar logic, if $\bar{\theta}$ is very large then all theater-lovers will choose the 8-play bundle. If $\bar{\theta}$ is near zero then we have the same problem described above: we cannot explain the bimodality of market shares in the data. Therefore, the role of $\bar{\theta}$ is to deliver an accurate prediction of the ratio of 5-play subscribers to 8-play subscribers. Hence, λ and $\bar{\theta}$ are identified by separate features of the data.

The supply-side price constraints provide identification of the market size, M. To see why, consider estimation of the demand model without price constraints. In this case we would simply assume a market size, and estimate all other parameters using demand-side information only. While this approach can deliver a good fit of the observed market shares, there is no assurance that the optimal prices for the estimated demand model will be equal to the observed prices. In fact, if we set the market size to 100,000 and estimate using demand-side moments only,

we compute predicted optimal prices that are significantly less than the observed prices. This suggests α is over-estimated—consumers are too sensitive to price.

By reducing the stipulated market size, the actual market share of inside goods increases. This implies the estimate for α must decrease in order to predict higher probabilities of purchase.[2] Importantly, optimal prices depend on α but not M. Hence, lowering M leads to a lower estimate of α, which in turn leads to higher predicted optimal prices. We can therefore estimate M by incorporating an optimal pricing constraint in the estimation. This is why the supply-side pricing constraints provide identification of the market size, and allow us to fit the demand moments while generating reasonable predicted prices.[3]

As a final comment on the flexibility of the model, notice from the last two columns of Table 6 that the rank-ordering of play popularity is different for non-subscribers (mainly single-play buyers) than it is for subscribers (which is driven by the tastes of *pick-5* buyers because full season buyers attend all plays). Our specification can explain this difference in the following way. The variance terms, $\Sigma(k,k)$, explain the relative popularity of plays among the single-ticket buyers. The covariance terms in Σ explain the popularity of certain pairings by the *pick-5* buyers, which also helps to explain differences in the popularity of plays that are contrary to the rankings of the single-ticket buyers. In other words, allowing for covariance in tastes gives us the flexibility to explain differences in play shares between single-play buyers and multi-play buyers.

[2]This reasoning suggests α and M are not separately identified from demand-side moments alone. From a practical standpoint this is right, since rich variation in the data is needed for separate identification. Formally, however, α and M are separately identified from demand moments, based on functional form.

[3]We assume the firm faces no unobserved competition, which in theory would lead us to over-estimate consumers' price sensitivity (because our model attributes any competition-induced depression in prices to higher consumer price-sensitivity). In turn, overestimating price sensitivity would lead to an upward bias in the estimated market size (because a larger number of potential consumers would be needed to explain the observed demand.) We are confident that our assumption is reasonable for the firm we study. We also note that our estimate of M (36,055) is substantially less than the combined adult populations of Palo Alto and Mountain View, and is for this reason unlikely to be an overestimate. Finally, note that small perturbations in the values of α and M—in contrast to the parameters determining the joint distribution of gross valuations for plays—are unlikely to have dramatic effects on the *relative* profitability of different pricing schemes.

2 Additional tables based on numerical experiments

Tables C1 through C5 report additional statistics corresponding to Tables 3 through 7. Each table represents numerical experiments for a given assumption about costs. Each cell in the table reports the 1st, 50th, and 99th percentile of profits (as a ratio of BSP profits) for the corresponding taste distribution and number of products (K).

Table C1. Profits relative to BSP, zero marginal costs

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Exponential	2	0.809	0.875	0.994	1.000
		0.866	0.887	1.000	1.000
		0.887	0.986	1.000	1.024
	3	0.700	0.802	0.997	1.000
		0.782	0.831	1.000	1.002
		0.816	0.954	1.000	1.041
	4	0.648	0.762	0.996	1.000
		0.735	0.789	1.000	1.002
		0.770	0.907	1.000	1.044
	5	0.601	0.723	0.998	1.000
		0.698	0.754	1.000	1.002
		0.734	0.870	1.000	1.046
Logit	2	0.685	0.924	0.952	1.000
		0.878	0.940	0.986	1.000
		0.972	0.988	1.000	1.017
	3	0.576	0.884	0.957	1.000
		0.793	0.908	0.987	1.003
		0.931	0.968	1.000	1.019
	4	0.547	0.854	0.967	1.000
		0.758	0.885	0.989	1.004
		0.906	0.949	1.000	1.019
	5	0.513	0.831	0.972	1.000
		0.730	0.870	0.991	1.004
		0.888	0.936	0.999	1.020
Lognormal	2	0.727	0.859	1.000	1.000
		0.810	0.876	1.000	1.000
		0.875	0.957	1.000	1.000
	3	0.591	0.799	1.000	1.000
		0.721	0.825	1.000	1.000
		0.800	0.911	1.000	1.001
	4	0.399	0.759	1.000	1.000
		0.668	0.789	1.000	1.000
		0.759	0.876	1.000	1.002
	5	0.350	0.729	0.999	1.000
		0.633	0.763	1.000	1.000
		0.733	0.849	1.000	1.004

Table C1, continued. Profits relative to BSP, zero marginal costs

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Lognormal(+)	2	0.771	0.934	0.999	1.000
		0.852	0.941	1.000	1.000
		0.935	0.979	1.000	1.000
	3	0.650	0.911	0.999	1.000
		0.806	0.920	1.000	1.000
		0.911	0.957	1.000	1.000
	4	0.436	0.899	0.999	1.000
		0.772	0.908	1.000	1.000
		0.900	0.941	1.000	1.001
	5	0.386	0.890	0.998	1.000
		0.751	0.900	1.000	1.000
		0.891	0.931	1.000	1.001
Lognormal(-)	2	0.514	0.549	0.985	1.000
		0.555	0.611	1.000	1.000
		0.845	0.924	1.000	1.035
	3	0.469	0.547	1.000	1.000
		0.543	0.635	1.000	1.000
		0.707	0.857	1.000	1.031
	4	0.381	0.542	1.000	1.000
		0.530	0.639	1.000	1.000
		0.671	0.810	1.000	1.028
	5	0.324	0.540	0.999	1.000
		0.521	0.633	1.000	1.000
		0.646	0.784	1.000	1.027
Normal	2	0.739	0.899	0.969	1.000
		0.920	0.960	0.998	1.000
		0.989	1.055	1.000	1.055
	3	0.667	0.852	0.973	1.000
		0.851	0.907	0.994	1.000
		0.976	1.000	1.000	1.041
	4	0.623	0.820	0.976	1.000
		0.805	0.879	0.995	1.001
		0.960	0.986	1.000	1.042
	5	0.580	0.795	0.976	1.000
		0.776	0.857	0.995	1.001
		0.945	0.981	1.000	1.021

Table C1, continued. Profits relative to BSP, zero marginal costs

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Normal(+)	2	0.794	0.955	0.936	1.000
		0.957	0.986	0.987	1.000
		0.996	1.004	1.000	1.012
	3	0.724	0.940	0.918	1.000
		0.914	0.966	0.975	1.000
		0.986	1.015	1.000	1.142
	4	0.680	0.932	0.901	1.000
		0.887	0.957	0.976	1.001
		0.977	1.034	1.000	1.065
	5	0.649	0.928	0.890	1.000
		0.869	0.949	0.976	1.001
		0.964	1.041	1.000	1.089
Normal(-)	2	0.521	0.543	0.858	1.000
		0.675	0.706	1.000	1.000
		0.992	1.061	1.000	1.075
	3	0.459	0.542	0.995	1.000
		0.695	0.765	1.000	1.000
		0.972	1.056	1.000	1.117
	4	0.457	0.544	0.996	1.000
		0.674	0.756	1.000	1.000
		0.947	1.001	1.000	1.045
	5	0.441	0.549	0.983	1.000
		0.655	0.740	1.000	1.000
		0.926	0.974	1.000	1.024
Normal(v)	2	0.916	0.954	0.964	1.000
		0.955	0.969	0.983	1.013
		0.961	1.056	0.998	1.095
	3	0.884	0.928	0.956	1.000
		0.920	0.944	0.971	1.017
		0.931	1.025	0.997	1.098
	4	0.853	0.896	0.957	1.001
		0.890	0.919	0.969	1.024
		0.897	0.981	0.994	1.089
	5	0.831	0.871	0.950	1.004
		0.864	0.898	0.969	1.030
		0.873	0.960	0.993	1.091

Table C1, continued. Profits relative to BSP, zero marginal costs

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Normal(v+)	2	0.906	0.982	0.937	1.000
		0.981	0.991	0.946	1.010
		0.983	1.046	0.988	1.067
	3	0.899	0.969	0.910	1.001
		0.960	0.981	0.921	1.014
		0.969	1.027	0.968	1.061
	4	0.872	0.964	0.899	1.002
		0.942	0.978	0.920	1.017
		0.964	1.018	0.952	1.058
	5	0.870	0.956	0.877	1.004
		0.933	0.973	0.904	1.022
		0.956	1.011	0.945	1.057
Normal(v-)	2	0.920	0.936	1.000	1.000
		0.945	0.959	1.000	1.000
		0.983	1.090	1.000	1.121
	3	0.855	0.867	0.991	1.000
		0.885	0.910	1.000	1.018
		0.904	0.990	1.000	1.092
	4	0.780	0.793	0.986	1.000
		0.796	0.842	1.000	1.014
		0.870	0.934	1.000	1.075
	5	0.741	0.758	0.985	1.000
		0.758	0.807	1.000	1.013
		0.842	0.892	1.000	1.077
Normal(+/-)	2	0.739	0.899	0.969	1.000
		0.920	0.960	0.998	1.000
		0.989	1.055	1.000	1.055
	3	0.647	0.817	0.953	1.000
		0.808	0.859	0.997	1.001
		0.973	1.003	1.000	1.039
	4	0.594	0.801	0.963	1.000
		0.767	0.831	0.994	1.001
		0.952	0.980	1.000	1.040
	5	0.564	0.786	0.962	1.000
		0.748	0.826	0.992	1.002
		0.928	0.973	1.000	1.024

Table C1, continued. Profits relative to BSP, zero marginal costs

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Uniform	2	0.501	0.916	0.989	1.000
		0.889	0.953	0.994	1.029
		0.919	1.004	1.000	1.050
	3	0.419	0.861	0.982	1.000
		0.806	0.901	0.999	1.022
		0.869	0.993	1.000	1.067
	4	0.433	0.824	0.980	1.001
		0.762	0.863	0.998	1.022
		0.826	0.971	1.000	1.074
	5	0.383	0.795	0.986	1.002
		0.730	0.835	0.998	1.022
		0.799	0.952	1.000	1.083

Table C2. Profits relative to BSP, positive and equal marginal costs

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Exponential	2	0.858	0.891	0.859	1.000
		0.891	0.922	0.985	1.002
		0.960	1.005	0.995	1.026
	3	0.777	0.832	0.832	1.000
		0.829	0.875	0.976	1.003
		0.918	1.006	0.993	1.043
	4	0.740	0.792	0.809	1.001
		0.789	0.837	0.970	1.005
		0.868	0.995	0.990	1.048
	5	0.708	0.753	0.773	1.001
		0.757	0.804	0.968	1.006
		0.828	0.984	0.989	1.054
Logit	2	0.693	0.924	0.447	1.000
		0.899	0.945	0.955	1.000
		0.995	1.000	0.995	1.017
	3	0.595	0.882	0.445	1.000
		0.812	0.917	0.958	1.003
		0.987	0.996	0.994	1.021
	4	0.568	0.855	0.459	1.000
		0.773	0.891	0.959	1.004
		0.977	0.992	0.993	1.021
	5	0.540	0.834	0.434	1.000
		0.746	0.872	0.961	1.004
		0.971	0.989	0.995	1.018
Lognormal	2	0.758	0.858	0.892	1.000
		0.853	0.905	0.997	1.000
		0.950	0.978	1.000	1.002
	3	0.645	0.795	0.864	1.000
		0.765	0.845	0.995	1.000
		0.897	0.955	1.000	1.003
	4	0.578	0.755	0.851	1.000
		0.718	0.802	0.994	1.000
		0.846	0.930	1.000	1.003
	5	0.539	0.724	0.833	1.000
		0.684	0.774	0.994	1.000
		0.815	0.909	1.000	1.010

Table C2, continued. Profits relative to BSP, positive and equal marginal costs

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Lognormal(+)	2	0.808	0.934	0.932	1.000
		0.907	0.958	0.996	1.000
		0.971	0.995	1.000	1.002
	3	0.715	0.912	0.907	1.000
		0.851	0.933	0.992	1.000
		0.942	0.986	1.000	1.002
	4	0.661	0.899	0.890	1.000
		0.826	0.920	0.990	1.000
		0.924	0.979	1.000	1.003
	5	0.625	0.890	0.873	1.000
		0.806	0.911	0.989	1.000
		0.905	0.974	1.000	1.004
Lognormal(-)	2	0.514	0.534	0.835	1.000
		0.568	0.625	0.999	1.000
		0.932	0.960	1.000	1.031
	3	0.485	0.527	0.878	1.000
		0.575	0.650	0.998	1.000
		0.872	0.928	1.000	1.025
	4	0.462	0.518	0.887	1.000
		0.560	0.647	0.998	1.000
		0.803	0.888	1.000	1.018
	5	0.447	0.518	0.879	1.000
		0.548	0.638	0.997	1.000
		0.755	0.854	1.000	1.018
Normal	2	0.766	0.900	0.636	1.000
		0.946	0.978	0.932	1.000
		1.000	1.000	1.000	1.008
	3	0.682	0.853	0.412	1.000
		0.868	0.918	0.921	1.001
		0.999	1.001	1.000	1.009
	4	0.640	0.822	0.329	1.000
		0.819	0.890	0.928	1.001
		0.996	1.000	0.999	1.011
	5	0.625	0.796	0.263	1.000
		0.789	0.863	0.931	1.001
		0.997	1.000	0.999	1.012

Table C2, continued. Profits relative to BSP, positive and equal marginal costs

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Normal(+)	2	0.808	0.956	0.608	1.000
		0.967	0.992	0.908	1.000
		1.000	1.002	0.999	1.005
	3	0.745	0.941	0.481	1.000
		0.927	0.971	0.895	1.000
		0.999	1.000	0.999	1.007
	4	0.705	0.935	0.423	1.000
		0.897	0.960	0.896	1.000
		0.998	1.000	0.998	1.008
	5	0.687	0.928	0.364	1.000
		0.880	0.953	0.892	1.000
		0.995	1.000	0.997	1.010
Normal(-)	2	0.522	0.539	0.600	1.000
		0.729	0.757	0.974	1.000
		1.000	1.029	1.000	1.029
	3	0.472	0.543	0.380	1.000
		0.758	0.791	0.972	1.000
		1.000	1.014	1.000	1.020
	4	0.460	0.543	0.323	1.000
		0.706	0.768	0.968	1.000
		0.998	1.000	1.000	1.018
	5	0.453	0.542	0.247	1.000
		0.683	0.755	0.968	1.000
		0.994	1.000	0.999	1.021
Normal(v)	2	0.929	0.967	0.794	1.000
		0.964	0.976	0.885	1.007
		0.972	1.065	0.910	1.091
	3	0.903	0.941	0.718	1.000
		0.929	0.957	0.828	1.015
		0.944	1.056	0.861	1.109
	4	0.875	0.910	0.676	1.002
		0.907	0.943	0.794	1.027
		0.921	1.028	0.825	1.103
	5	0.854	0.890	0.645	1.004
		0.885	0.922	0.775	1.031
		0.904	1.006	0.802	1.101

Table C2, continued. Profits relative to BSP, positive and equal marginal costs

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Normal(v+)	2	0.898	0.984	0.819	1.000
		0.978	0.989	0.874	1.005
		0.986	1.033	0.931	1.045
	3	0.884	0.970	0.780	1.000
		0.954	0.985	0.844	1.013
		0.975	1.035	0.875	1.063
	4	0.874	0.964	0.756	1.003
		0.944	0.988	0.817	1.025
		0.966	1.024	0.845	1.056
	5	0.856	0.956	0.750	1.006
		0.936	0.980	0.802	1.028
		0.957	1.019	0.825	1.061
Normal(v-)	2	0.950	0.950	0.808	1.000
		0.960	0.997	0.897	1.010
		1.000	1.119	0.925	1.129
	3	0.903	0.905	0.720	1.000
		0.921	0.946	0.843	1.023
		0.936	1.057	0.874	1.117
	4	0.854	0.855	0.648	1.002
		0.879	0.913	0.806	1.032
		0.903	1.030	0.853	1.126
	5	0.819	0.827	0.610	1.004
		0.841	0.879	0.793	1.029
		0.877	0.993	0.843	1.121
Normal(+/-)	2	0.766	0.900	0.636	1.000
		0.946	0.978	0.932	1.000
		1.000	1.000	1.000	1.008
	3	0.656	0.818	0.408	1.000
		0.824	0.862	0.911	1.001
		1.000	1.007	0.999	1.014
	4	0.614	0.799	0.320	1.000
		0.779	0.832	0.920	1.001
		0.997	1.000	0.998	1.016
	5	0.590	0.787	0.240	1.000
		0.761	0.825	0.916	1.002
		0.997	0.999	0.998	1.020

Table C2, continued. Profits relative to BSP, positive and equal marginal costs

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Uniform	2	0.724	0.925	0.746	1.000
		0.911	0.982	0.970	1.023
		0.971	1.027	0.994	1.072
	3	0.648	0.875	0.782	1.000
		0.847	0.933	0.970	1.029
		0.948	1.043	0.989	1.099
	4	0.589	0.838	0.790	1.001
		0.805	0.897	0.965	1.032
		0.906	1.009	0.982	1.083
	5	0.540	0.814	0.772	1.002
		0.775	0.872	0.968	1.033
		0.883	1.005	0.981	1.086

Table C3. Profits relative to BSP, positive and unequal marginal costs (0.5)

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Exponential	2	0.835	0.936	0.908	1.000
		0.915	0.974	0.934	1.031
		0.941	1.038	0.992	1.079
	3	0.717	0.888	0.863	1.001
		0.859	0.950	0.916	1.050
		0.910	1.050	0.981	1.127
	4	0.646	0.855	0.830	1.002
		0.828	0.923	0.890	1.058
		0.879	1.060	0.969	1.161
	5	0.606	0.819	0.807	1.003
		0.801	0.902	0.875	1.075
		0.864	1.068	0.964	1.192
Logit	2	0.606	0.923	0.829	1.000
		0.829	0.947	0.952	1.005
		0.960	1.003	0.993	1.047
	3	0.477	0.881	0.836	1.000
		0.733	0.915	0.948	1.013
		0.918	0.989	0.984	1.058
	4	0.415	0.850	0.832	1.000
		0.686	0.886	0.948	1.016
		0.888	0.969	0.983	1.074
	5	0.342	0.828	0.832	1.001
		0.650	0.863	0.953	1.018
		0.859	0.957	0.984	1.078
Lognormal	2	0.737	0.911	0.964	1.000
		0.813	0.945	0.989	1.005
		0.911	0.996	0.997	1.031
	3	0.583	0.836	0.957	1.000
		0.740	0.904	0.989	1.032
		0.860	0.982	0.997	1.053
	4	0.490	0.789	0.957	1.001
		0.683	0.865	0.989	1.037
		0.814	0.961	0.996	1.073
	5	0.435	0.758	0.950	1.003
		0.644	0.835	0.989	1.045
		0.777	0.950	0.996	1.085

Table C3, continued. Profits relative to BSP, positive and unequal marginal costs (0.5)

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Lognormal(+)	2	0.760	0.958	0.971	1.000
		0.851	0.976	0.992	1.000
		0.960	0.995	1.000	1.015
	3	0.620	0.931	0.973	1.001
		0.792	0.960	0.992	1.015
		0.936	0.984	0.999	1.022
	4	0.534	0.920	0.972	1.001
		0.739	0.950	0.991	1.020
		0.922	0.981	0.997	1.028
	5	0.497	0.911	0.967	1.003
		0.721	0.945	0.990	1.023
		0.912	0.975	0.998	1.031
Lognormal(-)	2	0.511	0.540	0.949	1.000
		0.583	0.674	0.989	1.012
		0.944	1.055	1.000	1.185
	3	0.442	0.528	0.979	1.000
		0.566	0.758	0.993	1.048
		0.814	0.997	0.998	1.189
	4	0.401	0.523	0.981	1.000
		0.536	0.726	0.995	1.049
		0.767	0.972	0.999	1.211
	5	0.333	0.514	0.981	1.000
		0.515	0.699	0.995	1.049
		0.724	0.944	0.999	1.230
Normal	2	0.686	0.901	0.863	1.000
		0.909	0.969	0.966	1.002
		0.987	1.135	1.000	1.198
	3	0.571	0.852	0.838	1.000
		0.820	0.922	0.949	1.008
		0.968	1.093	1.000	1.129
	4	0.509	0.818	0.825	1.000
		0.760	0.889	0.946	1.011
		0.953	1.030	1.000	1.076
	5	0.438	0.788	0.001	1.000
		0.718	0.859	0.946	1.013
		0.950	1.049	1.000	1.107

Table C3, continued. Profits relative to BSP, positive and unequal marginal costs (0.5)

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Normal(+)	2	0.726	0.958	0.878	1.000
		0.944	0.988	0.955	1.000
		0.995	1.021	1.000	1.158
	3	0.623	0.941	0.828	1.000
		0.866	0.971	0.932	1.003
		0.982	1.023	1.000	1.160
	4	0.001	0.934	0.809	1.000
		0.827	0.958	0.926	1.004
		0.976	1.044	1.000	1.088
	5	0.000	0.927	0.778	1.000
		0.765	0.952	0.924	1.006
		0.964	1.022	0.999	1.090
Normal(-)	2	0.423	0.534	0.805	1.000
		0.691	0.772	0.992	1.004
		1.000	1.163	1.000	1.163
	3	0.351	0.526	0.865	1.000
		0.688	0.825	0.988	1.005
		0.963	1.082	1.000	1.127
	4	0.000	0.523	0.825	1.000
		0.620	0.774	0.986	1.007
		0.934	1.038	1.000	1.098
	5	0.303	0.514	0.858	1.000
		0.601	0.747	0.980	1.009
		0.918	1.021	1.000	1.095
Normal(v)	2	0.897	0.968	0.876	1.000
		0.961	0.979	0.884	1.011
		0.969	1.107	0.951	1.135
	3	0.875	0.942	0.810	1.000
		0.924	0.966	0.830	1.024
		0.942	1.096	0.905	1.154
	4	0.842	0.911	0.772	1.002
		0.902	0.952	0.802	1.042
		0.916	1.060	0.875	1.151
	5	0.821	0.892	0.758	1.004
		0.877	0.933	0.790	1.046
		0.892	1.034	0.859	1.148

Table C3, continued. Profits relative to BSP, positive and unequal marginal costs (0.5)

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Normal(v+)	2	0.857	0.985	0.855	1.000
		0.978	0.992	0.873	1.006
		0.986	1.060	0.965	1.072
	3	0.847	0.973	0.822	1.001
		0.950	0.993	0.852	1.020
		0.973	1.062	0.920	1.088
	4	0.841	0.964	0.793	1.004
		0.939	0.999	0.827	1.039
		0.965	1.056	0.891	1.092
	5	0.820	0.956	0.784	1.006
		0.928	0.994	0.815	1.045
		0.956	1.050	0.875	1.097
Normal(v-)	2	0.936	0.953	0.879	1.000
		0.956	1.000	0.901	1.015
		1.000	1.178	0.956	1.202
	3	0.879	0.914	0.821	1.001
		0.916	0.951	0.849	1.032
		0.926	1.097	0.895	1.180
	4	0.842	0.863	0.796	1.002
		0.865	0.919	0.819	1.045
		0.896	1.052	0.864	1.184
	5	0.798	0.830	0.776	1.003
		0.826	0.889	0.810	1.045
		0.869	1.014	0.847	1.184
Normal(+/-)	2	0.686	0.901	0.863	1.000
		0.909	0.969	0.966	1.002
		0.987	1.135	1.000	1.198
	3	0.543	0.814	0.807	1.000
		0.780	0.870	0.943	1.005
		0.971	1.026	1.000	1.060
	4	0.000	0.798	0.768	1.000
		0.720	0.827	0.934	1.009
		0.949	1.010	1.000	1.064
	5	0.000	0.784	0.002	1.000
		0.674	0.812	0.930	1.013
		0.941	1.000	1.000	1.095

Table C3, continued. Profits relative to BSP, positive and unequal marginal costs (0.5)

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Uniform	2	0.682	0.945	0.835	1.000
		0.896	1.034	0.953	1.073
		0.947	1.067	0.993	1.122
	3	0.524	0.904	0.805	1.000
		0.837	1.005	0.892	1.098
		0.919	1.084	0.983	1.176
	4	0.438	0.872	0.795	1.001
		0.797	0.995	0.892	1.116
		0.890	1.091	0.978	1.204
	5	0.418	0.851	0.783	1.003
		0.774	0.967	0.883	1.120
		0.872	1.101	0.981	1.250

Table C4. Profits relative to BSP, positive and unequal marginal costs (0.8)

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Exponential	2	0.853	0.959	0.808	1.000
		0.931	1.016	0.862	1.058
		0.965	1.101	0.979	1.129
	3	0.736	0.918	0.720	1.000
		0.896	1.015	0.810	1.094
		0.947	1.142	0.953	1.205
	4	0.680	0.895	0.652	1.002
		0.867	0.997	0.747	1.100
		0.927	1.171	0.929	1.260
	5	0.633	0.866	0.603	1.009
		0.848	0.995	0.707	1.121
		0.910	1.191	0.910	1.305
Logit	2	0.563	0.925	0.729	1.000
		0.754	0.978	0.881	1.034
		0.960	1.055	0.972	1.093
	3	0.407	0.886	0.689	1.000
		0.660	0.961	0.856	1.062
		0.912	1.070	0.947	1.156
	4	0.325	0.853	0.664	1.000
		0.601	0.945	0.849	1.078
		0.887	1.051	0.932	1.172
	5	0.285	0.829	0.653	1.001
		0.552	0.929	0.845	1.089
		0.859	1.053	0.920	1.184
Lognormal	2	0.781	0.937	0.841	1.000
		0.870	1.031	0.938	1.050
		0.944	1.054	0.985	1.092
	3	0.638	0.901	0.772	1.000
		0.806	1.028	0.896	1.122
		0.918	1.093	0.974	1.175
	4	0.550	0.861	0.706	1.001
		0.773	1.030	0.871	1.166
		0.893	1.112	0.970	1.215
	5	0.006	0.830	0.003	1.003
		0.735	1.038	0.865	1.198
		0.884	1.118	0.957	1.253

Table C4, continued. Profits relative to BSP, positive and unequal marginal costs (0.8)

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Lognormal(+)	2	0.765	0.969	0.920	1.000
		0.838	1.009	0.971	1.016
		0.973	1.040	1.000	1.044
	3	0.622	0.956	0.898	1.000
		0.789	1.008	0.958	1.047
		0.957	1.033	0.989	1.070
	4	0.546	0.947	0.853	1.001
		0.760	1.011	0.950	1.060
		0.947	1.038	0.987	1.086
	5	0.004	0.937	0.012	1.005
		0.727	1.014	0.948	1.071
		0.938	1.046	0.983	1.107
Lognormal(-)	2	0.921	0.923	0.616	1.000
		0.997	1.186	0.755	1.200
		1.000	1.335	0.960	1.340
	3	0.712	0.816	0.037	1.000
		0.843	1.120	0.775	1.256
		0.929	1.260	0.942	1.407
	4	0.554	0.749	0.002	1.001
		0.791	1.086	0.797	1.298
		0.911	1.245	0.945	1.449
	5	0.041	0.703	0.001	1.003
		0.733	1.073	0.799	1.341
		0.889	1.229	0.930	1.488
Normal	2	0.634	0.938	0.764	1.000
		0.907	0.993	0.907	1.010
		0.990	1.135	1.000	1.135
	3	0.469	0.880	0.706	1.000
		0.792	0.982	0.867	1.053
		0.966	1.062	1.000	1.131
	4	0.378	0.846	0.001	1.001
		0.731	0.968	0.836	1.070
		0.951	1.056	0.999	1.151
	5	0.334	0.820	0.001	1.003
		0.667	0.949	0.817	1.087
		0.955	1.081	0.999	1.162

Table C4, continued. Profits relative to BSP, positive and unequal marginal costs (0.8)

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Normal(+)	2	0.645	0.970	0.839	1.000
		0.915	0.996	0.929	1.000
		0.996	1.087	1.000	1.093
	3	0.499	0.954	0.798	1.000
		0.802	0.992	0.900	1.019
		0.980	1.050	0.999	1.162
	4	0.000	0.949	0.752	1.000
		0.699	0.989	0.885	1.031
		0.978	1.070	0.999	1.117
	5	0.000	0.940	0.755	1.000
		0.641	0.986	0.879	1.037
		0.966	1.053	0.998	1.121
Normal(-)	2	0.382	0.545	0.689	1.000
		0.971	1.000	0.936	1.042
		1.000	1.374	1.000	1.374
	3	0.001	0.532	0.000	1.000
		0.644	0.958	0.861	1.080
		0.969	1.139	1.000	1.257
	4	0.000	0.528	0.001	1.000
		0.632	0.915	0.873	1.088
		0.948	1.098	1.000	1.265
	5	0.232	0.518	0.001	1.000
		0.599	0.882	0.880	1.104
		0.933	1.107	0.999	1.268
Normal(v)	2	0.885	0.966	0.800	1.000
		0.965	0.986	0.818	1.021
		0.973	1.134	0.941	1.164
	3	0.851	0.939	0.715	1.000
		0.932	0.981	0.743	1.044
		0.939	1.147	0.867	1.211
	4	0.833	0.921	0.663	1.002
		0.909	0.970	0.697	1.052
		0.921	1.117	0.802	1.207
	5	0.804	0.905	0.626	1.003
		0.887	0.958	0.671	1.061
		0.904	1.087	0.761	1.197

Table C4, continued. Profits relative to BSP, positive and unequal marginal costs (0.8)

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Normal(v+)	2	0.837	0.982	0.824	1.000
		0.977	0.996	0.836	1.013
		0.983	1.071	0.951	1.085
	3	0.812	0.969	0.775	1.000
		0.949	1.002	0.806	1.034
		0.969	1.091	0.900	1.123
	4	0.813	0.965	0.744	1.003
		0.933	1.005	0.780	1.045
		0.964	1.083	0.853	1.124
	5	0.781	0.959	0.733	1.005
		0.928	1.006	0.774	1.054
		0.958	1.082	0.839	1.128
Normal(v-)	2	0.947	0.969	0.797	1.000
		0.969	1.005	0.823	1.017
		1.000	1.232	0.919	1.249
	3	0.880	0.932	0.685	1.001
		0.932	0.979	0.736	1.048
		0.943	1.185	0.825	1.250
	4	0.845	0.893	0.639	1.002
		0.892	0.957	0.674	1.061
		0.908	1.158	0.758	1.276
	5	0.808	0.863	0.619	1.005
		0.856	0.930	0.652	1.065
		0.883	1.108	0.729	1.257
Normal(+/-)	2	0.634	0.938	0.764	1.000
		0.907	0.993	0.907	1.010
		0.990	1.135	1.000	1.135
	3	0.464	0.869	0.664	1.000
		0.771	0.958	0.821	1.050
		0.971	1.087	1.000	1.146
	4	0.000	0.837	0.000	1.009
		0.679	0.925	0.775	1.066
		0.943	1.053	0.999	1.152
	5	0.000	0.820	0.000	1.013
		0.593	0.907	0.777	1.078
		0.951	1.064	0.999	1.164

Table C4, continued. Profits relative to BSP, positive and unequal marginal costs (0.8)

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Uniform	2	0.691	0.955	0.670	1.000
		0.886	1.070	0.853	1.110
		0.957	1.140	0.974	1.192
	3	0.514	0.921	0.604	1.000
		0.846	1.086	0.737	1.166
		0.936	1.239	0.953	1.328
	4	0.405	0.897	0.559	1.001
		0.818	1.100	0.717	1.209
		0.914	1.244	0.937	1.366
	5	0.352	0.877	0.528	1.003
		0.797	1.091	0.680	1.224
		0.903	1.260	0.905	1.406

Table C5. Profits relative to BSP, zero marginal costs with capacity constraints

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Exponential	2	0.750	0.909	0.660	1.000
		0.894	0.989	0.899	1.030
		1.267	1.277	1.000	1.298
	3	0.377	0.863	0.681	1.000
		0.855	0.943	0.855	1.073
		1.128	1.159	1.000	1.281
	4	0.422	0.828	0.616	1.000
		0.850	0.929	0.842	1.072
		1.078	1.154	1.000	1.305
	5	0.455	0.802	0.650	1.000
		0.842	0.931	0.841	1.089
		1.098	1.197	1.000	1.303
Logit	2	0.479	0.910	0.773	1.000
		0.854	0.957	0.985	1.000
		1.000	1.039	1.000	1.045
	3	0.436	0.892	0.719	1.000
		0.779	0.925	0.985	1.005
		0.995	1.016	1.000	1.074
	4	0.408	0.868	0.795	1.000
		0.745	0.910	0.985	1.004
		0.980	0.999	1.000	1.057
	5	0.457	0.848	0.856	1.000
		0.716	0.896	0.989	1.006
		0.979	0.989	1.000	1.083
Lognormal	2	0.667	0.843	0.848	1.000
		0.795	0.894	1.000	1.000
		0.953	0.986	1.000	1.016
	3	0.353	0.805	0.869	1.000
		0.714	0.841	1.000	1.000
		0.871	0.920	1.000	1.042
	4	0.334	0.773	0.884	1.000
		0.667	0.809	1.000	1.000
		0.858	0.941	1.000	1.065
	5	0.330	0.743	0.868	1.000
		0.634	0.789	1.000	1.000
		0.828	0.919	1.000	1.070

Table C5, continued. Profits relative to BSP, zero marginal costs with capacity constraints

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Lognormal(+)	2	0.698	0.846	0.877	1.000
		0.839	0.940	1.000	1.000
		0.975	0.975	1.000	1.005
	3	0.344	0.880	0.887	1.000
		0.777	0.920	1.000	1.000
		0.938	0.950	1.000	1.030
	4	0.344	0.878	0.885	1.000
		0.753	0.910	1.000	1.000
		0.934	0.977	1.000	1.068
	5	0.353	0.843	0.850	1.000
		0.730	0.901	1.000	1.000
		0.919	0.946	1.000	1.041
Lognormal(-)	2	0.593	0.731	0.895	1.000
		0.720	0.794	1.000	1.000
		0.926	0.992	1.000	1.073
	3	0.380	0.675	0.837	1.000
		0.639	0.767	0.978	1.001
		0.816	0.977	1.000	1.132
	4	0.321	0.643	0.864	1.000
		0.602	0.742	0.968	1.001
		0.801	0.913	1.000	1.075
	5	0.313	0.628	0.860	1.000
		0.579	0.724	0.970	1.000
		0.782	0.859	1.000	1.053
Normal	2	0.673	0.888	0.741	1.000
		0.924	0.960	0.992	1.000
		1.040	1.062	1.000	1.082
	3	0.609	0.868	0.631	1.000
		0.850	0.924	0.986	1.003
		0.998	1.012	1.000	1.054
	4	0.589	0.835	0.666	1.000
		0.804	0.903	0.986	1.001
		0.996	1.026	1.000	1.143
	5	0.535	0.813	0.643	1.000
		0.773	0.883	0.984	1.000
		0.994	1.001	1.000	1.085

Table C5, continued. Profits relative to BSP, zero marginal costs with capacity constraints

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Normal(+)	2	0.701	0.900	0.757	1.000
		0.944	0.981	0.978	1.000
		1.008	1.044	1.000	1.056
	3	0.650	0.918	0.739	1.000
		0.893	0.968	0.969	1.000
		0.998	1.018	1.000	1.060
	4	0.597	0.916	0.687	1.000
		0.856	0.960	0.968	1.000
		1.005	1.020	1.000	1.032
	5	0.590	0.900	0.679	1.000
		0.833	0.953	0.968	1.000
		0.996	1.010	1.000	1.044
Normal(-)	2	0.565	0.725	0.854	1.000
		0.884	0.930	0.996	1.000
		1.003	1.068	1.000	1.099
	3	0.504	0.682	0.728	1.000
		0.799	0.878	0.987	1.030
		1.000	1.044	1.000	1.120
	4	0.482	0.671	0.712	1.000
		0.749	0.846	0.990	1.005
		0.998	1.012	1.000	1.129
	5	0.464	0.657	0.670	1.000
		0.719	0.827	0.988	1.008
		0.988	1.001	1.000	1.146
Normal(v)	2	0.827	0.962	0.716	1.000
		0.934	0.996	0.835	1.006
		1.166	1.166	1.000	1.166
	3	0.868	0.953	0.591	1.000
		0.928	0.985	0.706	1.034
		0.992	1.050	0.900	1.118
	4	0.858	0.919	0.523	1.000
		0.910	0.962	0.667	1.032
		0.938	1.029	0.890	1.135
	5	0.843	0.918	0.484	1.000
		0.896	0.951	0.622	1.031
		0.935	1.002	0.921	1.130

Table C5, continued. Profits relative to BSP, zero marginal costs with capacity constraints

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Normal(v+)	2	0.805	0.973	0.710	1.000
		0.962	0.992	0.838	1.000
		0.992	1.046	0.987	1.067
	3	0.868	0.964	0.602	1.000
		0.948	1.002	0.890	1.033
		1.001	1.041	0.972	1.070
	4	0.850	0.955	0.671	1.000
		0.938	0.999	0.874	1.035
		0.995	1.042	0.952	1.084
	5	0.855	0.961	0.616	1.000
		0.934	0.993	0.856	1.036
		0.998	1.029	0.945	1.068
Normal(v-)	2	0.837	0.959	0.815	1.000
		0.970	1.014	0.918	1.021
		1.063	1.154	1.000	1.177
	3	0.886	0.934	0.572	1.000
		0.932	0.980	0.720	1.054
		0.986	1.116	0.960	1.191
	4	0.860	0.882	0.547	1.000
		0.898	0.953	0.715	1.021
		0.958	1.111	0.939	1.266
	5	0.831	0.886	0.468	1.000
		0.874	0.929	0.591	1.026
		0.933	1.077	0.822	1.251
Normal(+/-)	2	0.673	0.888	0.741	1.000
		0.924	0.960	0.992	1.000
		1.040	1.062	1.000	1.082
	3	0.614	0.850	0.714	1.000
		0.837	0.904	0.978	1.010
		1.003	1.025	1.000	1.091
	4	0.568	0.829	0.691	1.000
		0.779	0.877	0.980	1.004
		0.987	1.009	1.000	1.087
	5	0.534	0.803	0.665	1.000
		0.753	0.867	0.979	1.004
		0.986	0.997	1.000	1.108

Table C5, continued. Profits relative to BSP, zero marginal costs with capacity constraints

Taste Distribution	K	Pricing Schemes			
		UP	CP	PB	MB
Uniform	2	0.279	0.928	0.726	1.000
		0.880	0.979	0.885	1.027
		1.076	1.197	1.000	1.248
	3	0.391	0.915	0.726	1.000
		0.848	0.985	0.910	1.067
		1.158	1.197	1.000	1.245
	4	0.413	0.881	0.758	1.009
		0.843	0.979	0.910	1.080
		1.108	1.192	1.000	1.304
	5	0.336	0.855	0.775	1.009
		0.821	0.962	0.920	1.092
		1.136	1.198	1.000	1.285