Scarcity Measurement

1 Consumer Appeal and Utility

In an $n-$commodity world, the elasticities of demand can explain the relative preference of items. If a utility function for every individual is given by $u = f(q_1, q_2...q_n; p_1, p_2...p_n)$ for n commodities in the consumer universe where quantities consumed are denoted by q_i and prices as p_i, then every consumer is said maximize her utility by choosing quantities $q_1, q_2...q_n$. With the assumption that every consumer is rational and adjusts the quantities $q_1, q_2, q_3...q_n$ to optimize the utility function, we fit the utility function given fixed $q_{1i}, q_{2i}...$ values for every consumer i. The parameters of the function f that optimize the set of data are thus inferred from the consumption data. A model that considers the visual and positional appeal of every item, would require the utility function to include the parameters related to positional and visual appeal of the item. The interpretation of Slutsky equation which is derived $dq = \frac{\partial q}{\partial p}dp + \frac{\partial q}{\partial x}dx$ (where $\Sigma_n q = x$) would also need to change in consideration of the parameters related to positional consumption. Some of these parameters are considered in the section 2. To separate the price and budget concerns in the conventional utility function from these suggested parameters related to positional consumption, we delineate all the price and budget concerns under affordability.

To demonstrate how price and budget concerns are addressed in a discussion of utility curves, we can consider a two-good world comprising of food and education. If we choose a Cobb-Douglas function $u(x, y) = Ax^{\alpha}y^{1-\alpha}$(where x, y are food and education quantities respectively)[1], then we can calibrate $\alpha = \alpha_0$ for a vector of observations X and Y. In the Cobb-Douglas utility, α measures whether consumption is complementary (high α) or necessary (low α). The shape of the curve (marginal propensity to consume) can tell us which product is preferred more over the other. The total expenditure elasticities of demand similarly provide an estimate of the preference between education and food[2]. It is easy to see from Figure 1 for the LSMS data from Tanzania, that most

[1] A utility curve can be visualized as $y = e^{\frac{(lnu - lnA) - \alpha lnx}{1-\alpha}}$ or `a=.8;plot(x,exp(-(a/(1-a))*log(x)),xlim=c(0,100),ylim=c(0,1))`

[2] Strictly speaking we cannot use total expense elasticity since we should consider the cost of education in the area to calculate education unit consumed and calculate food units consumed based on the food price in the survey. A multiple regression approach - which can easily include region, education or other factors affecting consumer preferences - is often preferred over an analysis based on utility curves.

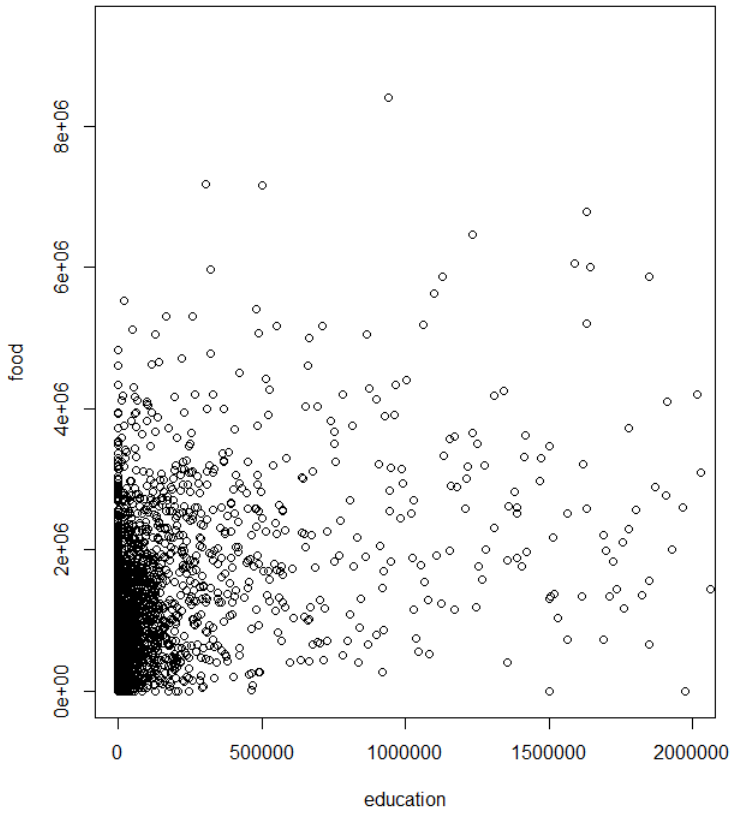

Figure 1: Education vs Food expense in LSMS data

consumers would rather spend on food than on education. For multiple items, we would rely on the elasticities of demand to understand the relative preferences of the consumer. A model for positional consumption needs to be be developed to enhance the utility function so that elasticities of demand with respect to parameters pertinent to positional consumption can be interpreted similarly.

The non-parametric methods specified by Afriat and Varian take a different path by not assuming the nature of the utility function (Cobb-Douglas, CES etc.)[1, 5]. These may be more relevant for the fitting of utility function. Afriat's utilities consider prices and quantities that sum up to the total expenditure. Even though we don't have the price-data available from the survey, an approach

similar to Afriat equations has the advantage that it provides a utility function that is consistent with data (unlike a parametric method). This is planned to be explored later in the study.

2 A model for ranking of appeals

2.1 Availability, Affordability, Popularity and the Bandwagon effect

The challenge to a theory for conspicuous consumption is the difference between what people can buy (with the available options for a given price and budget in the market locally) and what they wish to buy instead (options that could change the current consumption when they become available). While the income elasticity for every item in the consumption category indicates how the consumption changes with response to increase in income or prices, the degree to which consumption on existing items would change by introduction of a new item or category (e.g. a new technology) is not explained by elasticities of demand of existing categories.

In analysis of a typical consumption survey, the substitution effect of the item explains whether consumers like an item more than the other while whether consumers buy more of the same item as they become richer and the price goes lower is captured by the income effect. While the analysis is typically based on the utility derived from products in the consumer basket, the research on conspicuous consumption has pointed out to relevance of visibility and scarcity of items in the utility function. To explore some such factors into the model for utility, the current study introduces four parameters to measure the consumer appeal of the item. The conventional price and budget concerns are encompassed by **affordability** of the item (which is simply a statement of price of the item).

Since the elasticities of products interpreted from the consumption data cannot measure how consumption might be transformed if new items were introduced, we introduce a parameter to measure the availability of the item. This is based on the observation that consumption on the same item varies between regions that have another item available vs places where the item is completely unavailable. In developing countries, the issue of availability is particularly relevant since rural areas are faced with unavailability of services and goods that

are available (although limited) in the urban areas[3]. In the data from Tanzania, not only are region dummies significant in consumption of items in the survey (particularly with respect to such as electricity which is completely unavailable in large parts of the country), but the availability of electricity seems to transform the income elasticities of demand for other expenditures as well (e.g. marriage). A model that we wish to develop for appeal of an item attempts to include this difference in availability between regions. This is why **availability** is introduced as a concern different from affordability.

Given the unavailability of items like electricity in the developing world, the number of non-users of the item (those with zero quantity of consumption) can be quite high. To measure the appeal of an item, therefore we also consider how popular the item is among the consumers. The **popularity** of item is derived from the percentiles of consumers. Higher popularity of the item (i.e. higher number of purchasers of the item in the population of consumers) can drive the appeal of the item down or up. Items like jewelry and luxury cars are those that cannot become extremely popular by definition. If such items were to become popular, then the richer consumers would rush to something else that indicates their higher status. Such items are known as snob items. Items which people rush to purchase - on the other hand - are called bandwagon items.

It is worth emphasizing that in a market where product differentiation exists, items can change from snob type to bandwagon type (or vice versa) over time. It is therefore important to have a dynamic model for bandwagon characteristics of an item. Items like new electronics are snob items when they're not affordable - but as they become more affordable with time they become bandwagon items. As consumers rush to them, they get replaced by a new snob item in the market. The effect of popularity of an item on to its demand can thus be in either direction i.e. low popularity canr be associated with high demand (for a snob item) or high popularity can be associated with high demand (for a bandwagon item). In other words, for snob items, limited supply would mean a higher appeal but the high supply would mean less appeal. A time-series of expenditures can help us understand the trend in rushing towards certain items. The degree to which consumers rush to an item is termed as the **bandwagon effect** in the study. The snob or bandwagon effects must be seen in combination with affordability and availability. If the item is available and not affordable - then the price and budget constraints dominate the bandwagon characteristics of the

[3]The unavailability can spiral into severe demand pressures through pressures on urban migration.

item. The snob or bandwagon nature of the item can reflect in demand only when it is affordable (thus potentially popular) as well as available - if the item is not affordable or not available then its appeal cannot be measured in the consumption surveys. This is in accordance with the discussion in Section 2.6 i.e. all direct physical scarcities are perceived scarcities.

In summary, the appeal of a certain commodity is provided by its availability, affordability, popularity and bandwagon effect. Availability encompasses all issues that put an item in the market. Regional and supply-side issues thus affect availability. In absence of the data on supply of the items, we assign availability as a binary variable which is set to true in a region when the item appears in the consumption data for the region. Affordability, on the other hand, sums up price-related concerns on the demand-side. An item is affordable solely based on the price of the average consumption unit. Further, the popularity of an item is measured as percentile of users of item i.e. the percentile which consumes the quantity. Popularity of an item may increase or decrease the consumption of an item based on whether the item is a snob or bandwagon type. An individual is likely to lose interest in a particular jewelry product if it the latter is available and affordable to everybody. The effect of popularity on the appeal of the item is thus measured by another parameter called the bandwagon effect. Snob items are considered those with negative bandwagon effect in the study. In the Hirschian terminology[4], a physical scarcity is only realized by the availability of an item while social scarcities are realised through the rest of the three parameters.

The Table 1 summarizes the essential claims from the the model using the four parameters and is discussed in more detail in Section 3.

2.2 Measuring Availability

In the absence of supply data, availability is simply a binary variable - indicating whether an item is either available or not in the local consumer.

2.3 Measuring Affordability

For every individual an item is more affordable if its cost is within the threshold percentage of the (permanent) income. If consumers spend a high portion of

their income on rice than on vegetables, then for the purposes of this study, rice is less affordable than fruits. One reason for choosing this simple method (instead of a regression of demand against household characteristics such as size and age of the consumers) is the unavailability of quantities of consumption in the diary recall section - where only total costs of the item have been collected (rather than prices or quantities). Semantically, affordability is a statement of price in the market should be calculated from the average price of the item.

For example, to answer whether AC is more affordable than electricity, we decide only based on average cost of AC in the population of N consumers for item i amongst total number of items K ($\frac{1}{N}\Sigma_{n=1}^{N}(\frac{q_i}{\Sigma^K q_k})$). If average expenditure on AC amongst those who buy AC (i.e. the cost of AC) is higher than than the respective mean for electricity, then AC would be considered less affordable than electricity. That electricity is a service and consumed immediately (as opposed to AC which is an asset) is currently ignored in the model. The dependency amongst items is also ignored in the model. For example, one cannot have A.C. without having electricity - so even if A.C. is cheaper (more affordable) than electricity, a rational consumer wouldn't run to AC without having purchased electricity.

We also note that prices can be significantly different between regions. As discussed there are categories for which difference prices may exists within the same region. The way to incorporate this in the model would be to split the item category into multiple price band categories and treat each of the bands as different items - thus assigning them respective affordability values.

2.4 Measuring Reference Popularity

Appeal of items within the social-psychological communication is based on perceived differences between life standards and is thus relative to a reference area. At local levels this could be due to disparate neighborhoods while at national levels, reference areas could be metropolitan cities. The choice of reference area cannot be arbitrary - reference area is decided only between regions that are socially and economically inter-connected and thus where sufficient flow of information and people is possible. For the current analysis, Dar-es-salaam (region =7) is chosen as the reference area. The measure of popularity of an item is thus the reference area - i.e. the percentile of consumers using the product in the reference area. For example, only about 25% of the surveyed population

uses electricity. Thus the popularity metric is set to .25 for electricity.

2.5 Measuring the Bandwagon effect

Bandwagon effect is the measure of increase in appeal if the popularity in reference area were to increase (through increase in local availability). If we denote the popularity of an item in the reference area by ρ_{ref}, then the measure of the bandwagon effect is $\frac{\partial A}{\partial \rho_{ref}}$ i.e. the change in appeal of the item in the reference area with respect to the change in the popularity of the item. Since appeal is represented by the demand of the item in the consumption survey, we can set $\frac{\partial \gamma}{\partial \rho_{ref}} = \frac{\partial A}{\partial \rho_{ref}}$ where $\gamma = \frac{q}{x}$, q is the quantity purchased, x is the total expenditure, A is the appeal and ρ_{ref} is the item's popularity in the reference area. If items have become more popular over time and if consumers are on average spending a higher portion of their income on the item, then the bandwagon effect of the item would be considered strong.

Notice that the bandwagon effect is only calculated in the reference area. In the local area, the bandwagon effect must be calculated even if the item were not available i.e. the bandwagon effect b is calculated even when the item is the item is not locally available. In other words, we compute b for when the item is to become available. b is interpreted as the tendency to flock i.e. changes in quantity demanded as the popularity of the item grows.

A better measure of the bandwagon effect would be providing by observing the effect of popularity on demand over time (a term series). As a first-cut analysis, we may approximate the change in quantity demanded in two randomly selected sub-samples with respect to the change in observed popularity (percentile of non-zero consumption). If slightly different quantiles of the society are spending more or less on the item then it may allow us to compute the $\Delta\gamma/\Delta\rho$. More specifically, for two samples M and N, we look for $(\gamma_M - \gamma_N)/(\rho_M - \rho_N)$. The quantity $\gamma_M - \gamma_N$ represents the combined effect of differences in income, education level etc. between the two samples. A regression on the in-sampled data - `lm(expenditure/total_expenditure ~ consu + highest_educ + age + occupation_rank+housingstatus` - can thus provide a rough estimate of $\frac{\partial \gamma}{\partial \rho}$(notice that region - which cannot be ranked easily - is excluded from this equation - since we only consider the reference region)[4].

[4]To consider differences in categorical (dummy) variables - we use a transformation of every categorical variable into an ordered variable (education becomes education level, region

Notice also that services and products don't follow a different treatment in the above analysis. The average analysis considers the average cost spent on the item - regardless of the quantity consumed.

2.6 The notion of Scarcity

Scarcity can be a confusing term since it encompasses both a so-called physical scarcity (unavailability) and the perceived scarcity (what we feel as scarce). We'll assume that all felt scarcities are physically scarce (otherwise consumers would acquire the item that is meant to be scarce). In other words, $F \subset S$ where F denotes the felt scarcities and S the direct physical scarcities. Unfortunately, the perceptions of quality of life are entities that cannot be measured easily but still may qualify as felt scarcities. This makes the claims on scarcity as a driver of demand particularly difficult. The term scarcity in this study implies the notion of perceived scarcity (F) which may be affected by artificial unavailability or barriers (i.e. expanding S with entities available only through status competitions, advertising or other social-psychological communication).

Further, the nature of item matters for perceived scarcity since the direction of the effect of popularity on perceived scarcity can reverse depending on the "appeal" of the item (visual or status-related). If everybody has a certain item, then consumers may not consider it so important to acquire the item (since everyone else already has it) whereas for other types of item, consumers may rush to the item solely because there is a trend amongst everybody else to acquire. These are the snob and bandwagon types of item considered in the literature [2][5].

If F is the set of items that one feels are scarce and S is the set that is physically or socially difficult to achieve (unavailable and/or unaffordable) then we assume that $F \subset S$ i.e. there can be items that are physically scarce (not available and/or not affordable) have a tendency to be be felt scarce. In other words, all items that are felt as scarce must be scarce - either physically or socially (otherwise consumers would purchase it). Thus items that are not scarce (i.e. both affordable and available) cannot be felt as scarce. Conditions for physical scarcity - when included with snob and bandwagon effects must

becomes an order of uranbization etc.). The transformations are considered only as long as the sorting criteria is significant (using regions sorted based on popdensity for example would treat two regions with same popdensity as equivalent - this may or may not be desirable).

[5] Researchers have used an extended social-means model to measure these in experiments[3].

local availability	affordability	bandwagon effect	popularity	appeal rank (low to high)
1	1	0	1	1
1	0	0	1	2
0	1	0	1	3
0	0	0	1	4
0	0	1	0	5
1	0	1	0	6
0	1	1	0	7
1	1	1	0	8
0	0	1	1	9
0	0	0	0	9
0	1	1	1	10
0	1	0	0	10
1	0	1	1	11
1	0	0	0	11
1	1	1	1	12
1	1	0	0	12

Table 1: The list of binary parameters sorted by appeal

capture all conditions for scarcity i.e. we cover all felt scarcities with a generic definition of a physical scarcity.

The goal of sorting the commodities by their appeal (or perceived scarcity) is to see how closely list of top appeals matches with the list of visible items. Within the items that are scarce, the visible commodities (i.e. those that are talked about often in society) might have higher income elasticities and exhibit variations across social clusters. The analysis attempts to view an overall alignment of visible ranking with that of scarcity ranking..

3 Appeal Ranking of Items

If the four parameters where strictly binary (i.e. if an item was available or not, affordable or not, popular or not and was bandwagon or snob), then order of appeals would be as shown in the table 1 - with appeals ranked from low to high for every tuple of the 4 four parameters (16 in total). An available, affordable and popular bandwagon would have a higher appeal than an unavailable, unaffordable and and unpopular bandwagon item and so on. Notice that popular bandwagon and unpopular snob type items are given the same rank if availabil-

ity and affordability is the same for them. Another key feature of the ranking is that availability and affordability make a snob item less interesting while they both increase the appeal of the bandwagon item. If we were to map the appeal from these four parameters in a linear function it may look something like that following:

$$\pi = k_\alpha \alpha + k_\aleph \aleph + k_b b + k_\rho \rho + k_{b\rho} b\rho + \nu$$

where$\alpha \epsilon \{0, 1\}$, $0 \leq \aleph \leq 1$,$0 \leq b \leq 1$ and $0 \leq \rho \leq 1$

$\alpha = availability$

$\aleph = affordability$

$b = bandwagon\ propensity$

$\rho = popularity$

$\pi = appeal$

An easier formulation of the function would be of the form $-(1-b)\rho(\alpha + mb\aleph)+b(1-\rho)(\alpha+mb\aleph)+b\rho(\alpha+mb\aleph+\kappa)+(1-b)(1-\rho)(\alpha+mb\aleph+\kappa) = K_1+\kappa K_2$.

In the decomposition $K_1 + \kappa K_2$, K_1 represents the appeal for misaligned items (unpopular bandwagon and popular snob) while K_2 represents the aligned items (popular bandwagon and unpopular snob). Appeal of a bandwagon item is only affected by a constant factor $\kappa b\rho$ in addition to the purchase concern $\alpha + mb\aleph$. If an item is a snob item then popularity switches the sign of appeal from negative ($\rho = 1$) to positive ($\rho = 0$).

A simpler form of the above equation can be written as follows:

$$B = \frac{(1-b)(1-\rho)}{(1+\delta-\alpha)(1+2\delta-\aleph)} + \frac{(1-b)\rho}{(1-2\delta+\alpha)(1-\delta+\aleph)} + \frac{b(1-\rho)}{(1+2\delta-\alpha)(1+\delta-\aleph)}$$

$$\sigma = (1-b)\rho + 2b(1-\rho) + \kappa(b\rho + 2(1-b)(1-\rho))$$

$$A = \sigma B$$

where δ, κ are constants to control the scale. The sorting of items identified of potential positional value is shown in Table 2.

category	affordability	availability	popularity	bandwagon effect	appeal
vehicle service	0.0002	1	0.032	1	1.590
skincream	0.0306	1	0.885	0.012	1.886
meat	0.0013	1	0.796	0.1	2.391
toothbrush	0.0223	1	0.69	0.004	2.582
cosmetics	0.0242	1	0.654	0.012	2.672
rice	0	1	0.583	0.08	2.822
marriage	0.0125	1	0.542	0.04	2.889
fruits	0.0077	1	0.399	0.04	3.095
barsoap	0.0131	1	0.349	0	3.171
donations	0.0131	1	0.349	0	3.171
electricity	0.0028	1	0.258	0.04	3.259
carpetsrugs	0.0231	1	0.234	0.008	3.305
alcohol	0.0379	1	0.075	0.12	3.398
personal items repair	0.0238	1	0.049	0.08	3.440
funeral	0.0254	1	0.089	0.02	3.442
tobacco	1	1	0.18	0.08	4.105

Table 2: Items with the four parameters and predicted appeal

References

[1] S. N. Afriat. The construction of utility functions from expenditure data. *International Economic Review*, 8(1):67–77, 1967.

[2] Giacomo Corneo and Olivier Jeanne. Conspicuous consumption, snobbism and conformism. *Journal of Public Economics*, 66:55–71, 1997.

[3] Heribert Gierl and Verena Huettl. Are scarce products always more attractive? the interaction of different types of scarcity signals with products' suitability for conspicuous consumption. *International Journal of Research in Marketing*, 2010.

[4] Fred Hirsch. *Social Limits to Growth*. Routledge and Kegan Paul Ltd, 1977.

[5] Hal R Varian. The nonparametric approach to demand analysis. *Econometrica*, 50(4):945–973, Jul 1982.