Clearly, it is marginal utility, and not total utility, that determines the consumer's willing-to-pay price. Since we consume few diamonds, the MU is high, and consumers are willing to pay a high price. This can be seen by looking at the marginal utility curves for water in figure 2 and for diamonds in figure 3 respectively.

The magnitude of marginal utility depends on the magnitude of utility. Hence, the way we measure utility becomes important. This means that marginal utility itself has no behavioral substance and we can't calculate marginal utility from a consumer's choice behavior.
This gives rise to the question, how do we measure utility? How do we assign a number to the utility? This is answered in the next section.

4. Utility Functions

The Concept of Utility Functions

How well do Economists measure utility?
To measure utility, we need a function which enables us to assign a number to each consumption bundle so that we can compare the satisfaction derived from each consumption bundle.

In simple words, utility function (U_f) is a method of assigning a numeric value to each and every consumption bundle in a way that more preferred consumption bundle gets a higher value than a less preferred bundle. It is a function of all the goods consumed by a consumer. It there are two goods, x and y, then the utility function would be:

$$U_f = U(x,y)$$

In general, individuals consume many goods and individuals' preferences are assumed to be represented by a utility function of the form

$$U_f\,(x, y, z, \ldots\ldots\ldots, l, m)$$

where x, y, z,…, l, m are the quantities of each of n goods, (X,Y,Z,…., L,M) that might be consumed in a period.

For simplification, we stick to two commodities X and Y. So, if there are two consumption bundles (x_1,y_1) and (x_2,y_2), and (x_1,y_1) is preferred to (x_2,y_2), then the numeric value of utility from (x_1,y_1) is greater than the numeric value of the utility from (x_2,y_2). i.e.

$$\text{If } (x_1,y_1) \succ (x_2,y_2), \text{ then } U_f\,(x_1,y_1) > U_f\,(x_2,y_2)$$

There are different types of utility functions. We discuss some of the important and commonly used utility functions below:

Types of Utility Functions

4.1.1. The Cobb-Douglas utility function

consumer, while a cup of coffee gives 10 units of utility, it becomes clear that tea is preferred more than coffee. The numeric value by assigning a higher utility, besides telling the more preferred good, will also exactly tell us the intensity of preference. This reveals that a cup of tea gives twice as much utility as attained from a cup of coffee.

For this, we require a standard unit of measurement in which utility of all goods can be measured. “Money” is the most appropriate measure which can possibly be used to measure and compare the utility derived from different bundles. But the value we place on a good depends on the value of the measurement unit i.e. money. Its value has to be constant and hence Marshall brought in an assumption of constant utility of money. This means a rupee means same to you whether you are rich or poor. Hence if you have money, the utility from 100^{th} rupee should give same utility as 1^{st} rupee or for that matter 10^{th} rupee. It should not be the case that as you get richer, the value of the extra rupee diminishes; or as the money left with you gets smaller and smaller, we start valuing it more so that marginal utility of money keeps on increasing. Hence, there are certain assumptions on which this theory is based. a) The utility is cardinal – it can be measured quantitatively; b) The marginal utility of money is constant.

This method is not very appealing as economists are of the view that to tell whether one consumption bundle or another will be chosen, we only have to know which is preferred i.e. which has the larger utility. Knowing how much larger doesn’t add anything to the description of choice. The cardinality assumption is difficult to justify. Another school of thought gave the concept of ordinality of utility. This is discussed in detail in the next sub section.

Theory of Ordinal Utility

Ordinal utility just ranks the consumption bundles on the basis of utility attained from each bundle. The magnitude of the utility function is only important insofar as it ranks the different consumption bundles; the size of the utility difference between any two consumption bundles doesn’t matter. Because of this emphasis on ordering bundles of goods, this kind of utility is referred to as **ordinal utility**. In the above example of tea and coffee, tea gives utility equal to 20 units, whereas coffee gives utility equal to 10 units. This clearly shows that as tea is assigned a higher number, it gives more utility than coffee and hence tea is preferred over coffee. We are not bothered about exactly how much more. Even if coffee gives utility equal to 19 units, then also tea is preferred over coffee. Hence bigger numerical value indicates only higher ranking and higher preferences and no importance is attached to actual numeric differences in utility.

Some important points:

- **More is better (MIB) - Monotonicity**

It says, if one bundle has more of a good than another, and no less of any other goods, then it’s a prefered bundle. For example: if a consumption bundle $A(x_1,y_1)$ has the following combination of $x_1=3$, $y_1=7$ and another consumption bundle $B(x_2,y_2)$ has the following combination $x_2=10$, $y_2=7$; then B is preferred to A. This assumption fails if you assume that there is a satiation point (when $MU= 0$ & $MU < 0$, thereafter).

Figure 4: More is better