

# "Unveiling Marginal Utility: An In-depth Examination of MU and MUx in Micro Economics Theory"

**CA (Dr.) Pankaj Jain**  
Chartered Accountant  
MA Economics (Gold Medallist)  
Assistant Professor, Delhi University, INDIA

Email - [Ca.jainpankaj@gmail.com](mailto:Ca.jainpankaj@gmail.com)

**Aryan Sehrawat**  
Student, BA Economics  
New York University, USA

**Abstract:** Alfred Marshall, a towering figure in British economics during the late 19th and early 20th centuries, introduced the concept of Cardinal Utility, positing that utility could be quantitatively measured. However, the feasibility of quantifying utility has been a subject of contention, with critics arguing its impracticality. This paper contends that while measuring utility in precise quantitative terms may prove challenging, it is unnecessary to do so, eliminating the need for specific units such as the hypothetical 'Utils'. Utility defined as the value a consumer attributes to a good or service, varies inherently across individuals, locations, time periods, and contexts, leading to fluctuations in willingness to pay. As such, utility is best understood as a psychological phenomenon, inherently subjective and dynamic. This paper explores the complexities of utility measurement, highlighting its multifaceted nature and emphasizing the dynamic interplay between consumer preferences and willingness to pay and using cardinal approach to establish relationship between Marginal Utility (MU) and Marginal Utility of product (MUx) and to distinguish them clearly.

**Key words:** Marginal Utility (MU), Marginal Utility of product (MUx), Total utility, Consumer Equilibrium, Law of Diminishing Marginal Utility, Consumer Surplus.

## 1. INTRODUCTION:

Alfred Marshall was the dominant figure in British economics from about 1890 until his death in 1924. He pronounced the concept of Cardinal Utility i.e. utility that can be measured in quantitative terms.

It is argued that it is practically not possible to measure utility in quantity, but there is no need to measure it separately or in any specific unit like imaginary unit 'Utils'.

Utility is the amount a consumer is willing to pay for a given product, for example if consumer willing to pay \$5 for a product he derives 5 utility. It is psychological phenomenon that changes from person to person, place to place, time to time and usage to usage, and on that basis willingness to pay changes hence the utility also changes.

## 2. OBJECTIVES :

This paper aims to:

- Establish the relationship between MU and MUx.
- Measure cardinal utility in real terms.
- Apply cardinal utility in understanding consumer behaviour.

## 3. DEFINITION OF KEY TERMS:

- Utility refers to the value or satisfaction that a consumer derives from purchasing and consuming a particular product or service. In economic terms, it represents the amount a consumer is willing to pay for a given product. It is typically assumed that each unit of currency (e.g., \$1) corresponds to one unit of utility. For example, if a consumer is willing to pay \$5 for a product, it indicates that they derive 5 or more units of utility from acquiring and using the product.

- Marginal Utility (MU) can be defined as the additional utility gained from consuming one more unit of a product. It is calculated by subtracting the total utility derived from consuming  $n-1$  units from the total utility derived from consuming  $n$  units. In mathematical terms, it is represented as  $MU = TU_n - TU_{n-1}$ , where  $TU_n$  represents the total utility derived from consuming  $n$  units and  $TU_{n-1}$  represents the total utility derived from consuming  $n-1$  units.
- The Marginal Utility of a product ( $MU_x$ ) refers to the monetary value, typically measured in dollars (\$), that a consumer is willing to pay for the purchase and consumption of each additional unit of that product. In other words,  $MU_x$  represents the maximum amount of money a consumer is willing to sacrifice in exchange for the satisfaction derived from consuming one more unit of the product.
- Total Utility (TU) refers to the overall satisfaction or utility derived from the consumption of all units of a particular product taken together. It is calculated by summing up the marginal utilities (MU) of each individual unit consumed. In mathematical terms, Total Utility (TU) can be represented as the sum of all marginal utilities:  $\sum MU$ . This means adding together the marginal utilities derived from consuming each unit of the product to obtain the total satisfaction or utility experienced from consuming all units combined.
- Law of Diminishing Marginal Utility (DMU) states that as a consumer purchases and consumes more units of a product, the additional utility or satisfaction derived from each successive unit diminishes. In other words, the more of a particular product a consumer consumes, the less satisfaction or utility they gain from each additional unit. This principle is applicable to most goods and services, with few exceptions. The Law of Diminishing Marginal Utility is a fundamental concept in economics and helps explain consumer behaviour and preferences.
- Consumer Equilibrium refers to the allocation of a consumer's income between various goods and services in a way that maximizes the total satisfaction or utility derived from consumption. In other words, it is the point at which a consumer has optimized their spending to achieve the highest possible level of utility given their budget constraint. Consumer equilibrium occurs when the marginal utility per dollar spent on each good or service is equal across all goods and services. At this point, the consumer is effectively allocating their income in a manner that maximizes overall satisfaction or utility, given the prices and quantities of goods and services available in the market.
- Consumer surplus refers to the economic benefit or gain that consumers experience when they purchase a product at a price lower than the maximum price they are willing to pay. It is calculated as the difference between the amount that a consumer is willing to pay for a given product (known as their reservation price or willingness to pay) and the actual price they pay for it in the market. Essentially, consumer surplus represents the additional value or satisfaction that consumers receive from their purchases beyond what they had expected or were willing to pay. It is a measure of the net benefit to consumers resulting from market transactions.

#### **4. LITERATURE REVIEW:**

Existing literature on marginal utility (MU) and marginal utility of a product ( $MU_x$ ) often lacks a clear distinction or explanation of their relationship, leading to these terms being used interchangeably. However, this paper aims to address this gap by comparing MU and  $MU_x$ , thereby establishing a clear distinction between the two concepts and elucidating their relationship.

While previous studies acknowledge the importance of marginal utility in economic analysis, they frequently fail to differentiate between MU and  $MU_x$ . This oversight can hinder a comprehensive understanding of consumer behaviour and decision-making processes.

By focusing on MU and  $MU_x$ , this research endeavours to provide clarity on their definitions and highlight their distinct roles in economic theory. Additionally, by establishing a relationship between these two concepts, this study aims to enhance our understanding of consumer preferences and decision-making mechanisms.

In summary, while existing literature discusses marginal utility and marginal utility of a product separately, there is a lack of clarity regarding their distinction and relationship. This paper seeks to fill this gap by comparing MU and  $MU_x$  and elucidating their relationship within the context of consumer behaviour and economic theory.

#### **5. RESEARCH APPROACH:**

The present research primarily relies on secondary sources supplemented by observational data. A qualitative approach has been adopted to analyze this information and achieve the research objectives effectively.

Utilizing secondary sources allows for a comprehensive review of existing literature, including scholarly articles, textbooks, and other relevant publications. This approach enables the synthesis of diverse perspectives and insights on the topic of marginal utility (MU) and marginal utility of a product (MU<sub>x</sub>).

Observational data complements the secondary sources by providing real-world examples and illustrations of economic phenomena related to MU and MU<sub>x</sub>. This empirical evidence enriches the analysis and enhances the validity of the research findings.

The qualitative approach adopted in this research involves thorough examination and interpretation of the collected data to gain a deeper understanding of the concepts under investigation. By employing qualitative methods such as thematic analysis and comparison, the research aims to uncover patterns, trends, and relationships between MU and MU<sub>x</sub>.

Overall, the combination of secondary sources and observational data, analysed through a qualitative approach, ensures a robust and comprehensive exploration of MU and MU<sub>x</sub> in the context of economic theory.

**6. ANALYSIS AND DISCUSSION:**

To illustrate the concepts of utility and the Law of Diminishing Marginal Utility, let's consider an example: Suppose a consumer has \$10 to spend, and each unit of a given product costs \$1. According to the principle of utility, it is assumed that each dollar spent provides 1 unit of utility. Therefore, the initial utility of the consumer with \$10 is 10.

Now, let's examine the consumer's purchasing decisions based on the utility derived from the product and the price. The consumer will continue to purchase units of the product as long as the utility derived from each additional unit is equal to or greater than the price.

For instance, if the consumer is willing to pay \$5 for the first unit of the product, it implies that he derive 5 units of utility from consuming it. In this case, the consumer will purchase the first unit because the utility gained (\$5) is greater than the price (\$1).

Continuing with this example, let's assume the consumer's willingness to pay decreases for each subsequent unit of the product due to the Law of Diminishing Marginal Utility. This principle suggests that as the consumer consumes more units of the product, the additional satisfaction derived from each extra unit diminishes.

For instance, if the consumer is willing to pay \$4 for the second unit of the product, it implies that they derive 2 units of utility from consuming it. In this scenario, the consumer will purchase the second unit because the utility gained (\$4) is still greater than the price (\$1).

However, as the consumer continues to purchase more units, the utility derived from each additional unit decreases, eventually reaching a point where the utility gained is equal to the price. At this point, the consumer's willingness to pay matches the utility derived, indicating consumer equilibrium.

Overall, this example demonstrates how the concepts of utility and the Law of Diminishing Marginal Utility influence consumer behaviour and purchasing decisions.

**Table Showing Q<sub>x</sub>, P<sub>x</sub>, MU<sub>x</sub>, TU and MU**

Q <sub>x</sub>	P <sub>x</sub>	MU <sub>x</sub>	TU	MU=MU <sub>x</sub> -P <sub>x</sub>
0	\$1	-----	10	----
1	\$1	\$5	14	4
2	\$1	\$4	17	3
3	\$1	\$3	19	2
4	\$1	\$2	20	1
5	\$1	\$1	20	0
6	\$1	\$.5	19.5	-.5

**Q<sub>x</sub>= Quantity of product X purchased.**

**P<sub>x</sub>= Price of product per unit.**

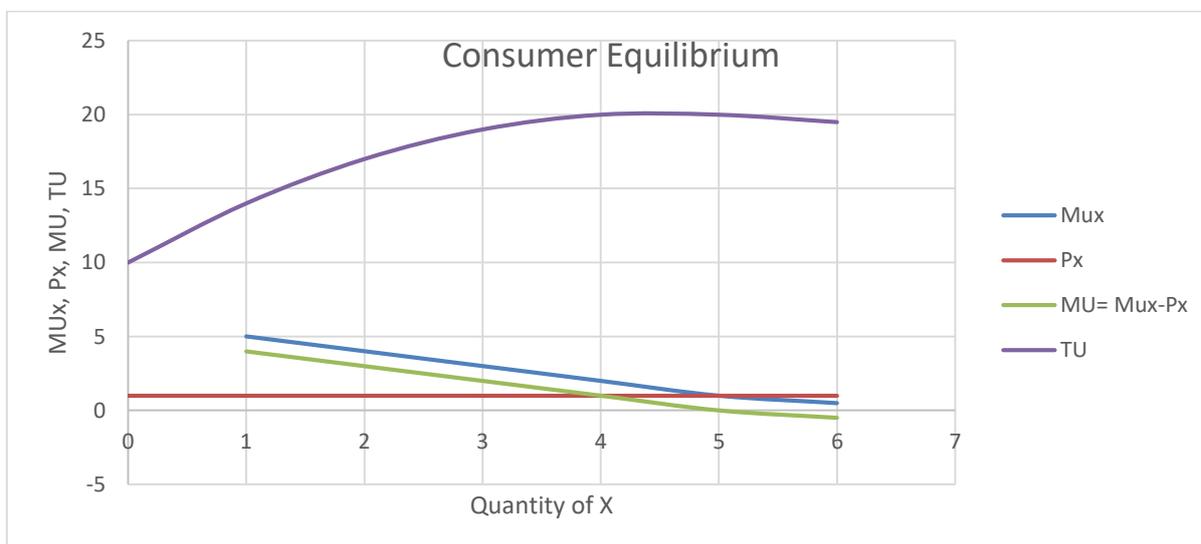
In the provided example, the consumer's willingness to pay for each unit of the product decreases due to the Law of Diminishing Marginal Utility. Initially, the consumer is willing to pay \$5 for the first unit, indicating that they derive 5 units of utility from it. As the consumer purchases additional units, their willingness to pay decreases, reflecting the diminishing additional satisfaction gained from each extra unit consumed.

Let's break down the calculation of total utility (TU) and marginal utility (MU) based upon the following example:

Initially, the consumer has \$10, and the first unit of the product is purchased for \$1, yielding a utility of 5. The consumer foregoes \$1 to acquire this unit, resulting in a net gain of 4 utility. Therefore, the total utility becomes 14 after the first unit is consumed.

For the second unit, assuming the consumer is willing to pay \$4, he gain 4 units of utility from its consumption. Since the price remains at \$1, the consumer sacrifices \$1 for the additional utility gained. This results in a net increase of 3 utility, bringing the total utility to 17. This process continues until the consumer's willingness to pay equals the utility derived from the product, achieving consumer equilibrium.

Based on this example, the relationship between marginal utility (MU) and marginal utility of the product (MU<sub>x</sub>) can be observed. MU represents the additional utility gained from consuming each additional unit, while MU<sub>x</sub> reflects the utility derived from purchasing and consuming one more unit of the product. The relationship between MU and MU<sub>x</sub> can be expressed as  $MU = MU_x - P_x$ , where  $P_x$  represents the price of the product. This equation illustrates how the additional utility gained (MU) relates to the price paid ( $P_x$ ) and the utility derived from consuming one more unit (MU<sub>x</sub>). It emphasizes that MU and MU<sub>x</sub> are distinct concepts and cannot be used interchangeably in economic analysis.



In all cases equilibrium is when Quantity =5 units

$$TU = M \cdot U_m + MU_x \cdot X_n - P_x \cdot X_n$$

Where :

M = money income (given and constant)

U<sub>m</sub> = utility of money per unit and assumed to be constant @\$1 per unit

MU<sub>x</sub> = marginal utility of given product X.

X<sub>n</sub> = number of unit of product X

P<sub>x</sub> = price of product X

Objective is to maximise total utility.

Differentiating w.r.t.  $X_n$

$TU' = MU_x - P_x$ , put it equal to zero for optimisation.

$$MU_x - P_x = 0$$

$$MU_x = P_x$$

Again Differentiating w.r.t.  $X_n$

$TU'' = MU_x'$  since  $MU_x$  is diminishing in nature due to law of diminishing marginal utility therefore  $MU_x'$  is negative.

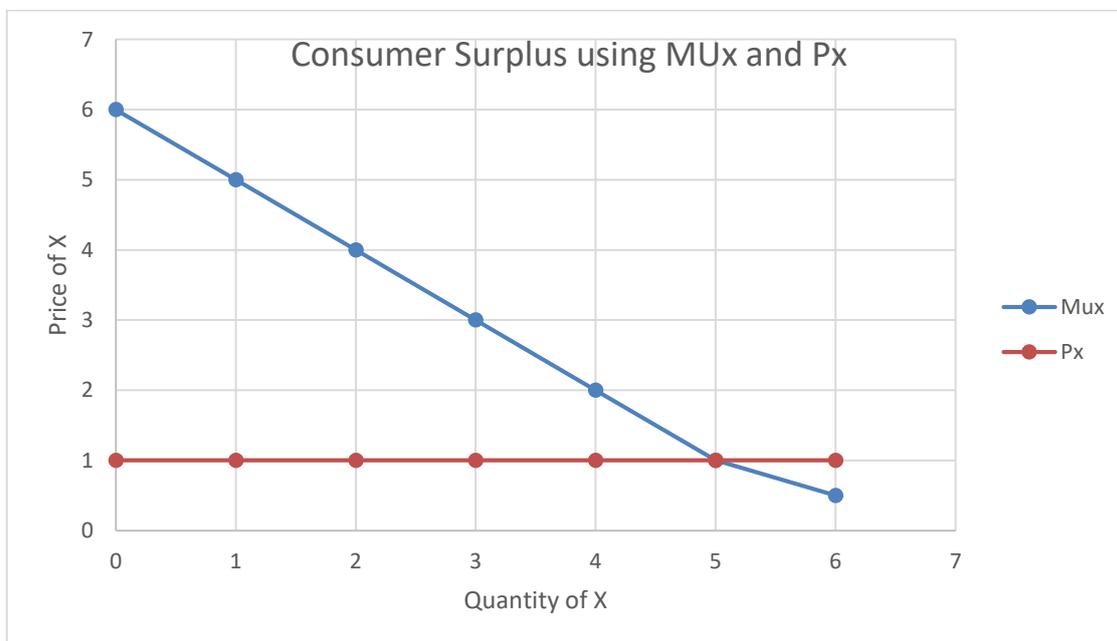
$TU''$  is negative hence maximum (2<sup>nd</sup> order derivative condition for Maximisation.)

As explained  $MU = MU_x - P_x$

- ⇒  $MU = 0$  is also condition for equilibrium.
- ⇒ So it is clear that  $MU_x$  and  $MU$  are two different concept.

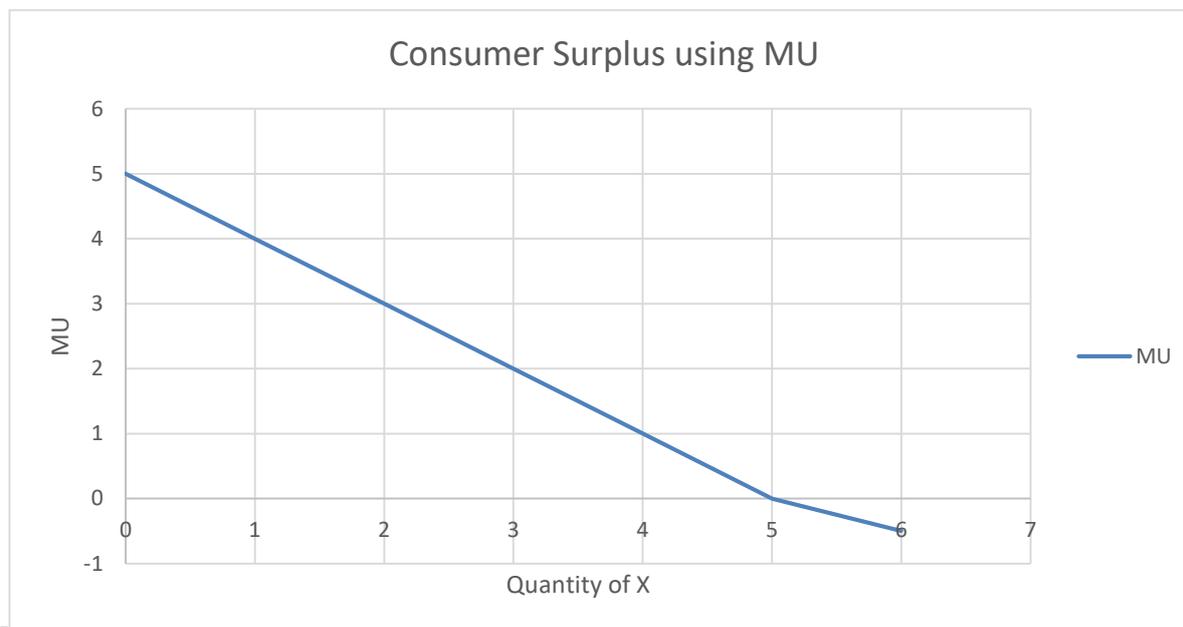
Similarly this concept can be used to explain consumer surplus.

Consumer surplus is the difference between what a consumer is willing to pay and what he actually pays i.e. the area between  $MU_x$  and  $P_x$ . Also area under  $MU$  can be used for consumer surplus. Bottom of Form



Area =  $1/2 * \text{Base} * \text{Height}$ .

$$\Rightarrow .5 * 5 * 5 = 12.5$$



Same area using MU approach.

Area =  $1/2 * \text{Base} * \text{Height}$

$$\Rightarrow .5 * 5 * 5 = 12.5$$

## 7. CONCLUSION:

In conclusion, the discussion highlights that utility can indeed be quantitatively measured through the concept of Cardinal Utility, alleviating concerns about the practicality of its measurement. Furthermore, the distinction between Marginal Utility (MU) and Marginal Utility of product (MU<sub>x</sub>) emerges as significant, underscoring the need to recognize and analyse these differences in economic theory and decision-making. This understanding of utility and its nuances is crucial for accurately assessing consumer behaviour, market dynamics, and welfare implications in economic analysis.

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