Non-monotonic utility functions for microeconomic analysis of sufficiency economy

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Abstract

This study invents four types of non-monotonic utility functions that suit the sufficiency economy. With these utility functions, an individual may not get higher utility when consume more goods. Therefore, an individual requires an optimal level of income rather than a maximized level of income to achieve the highest utility.

1.Introduction

Traditional economics assumes monotonic utility function for the calculation of the equilibrium of consumption (Varian, 1999; Binger and Hoffman, 1998; Pindyck and Rubinfeld, 1998; Mas-Colell, et al, 1995). It ensures that the higher consumption level yields the higher utility. This monotonic utility function encourages people to consume as much as possible. However, it may be unrealistic such that an individual may obtain negative marginal utility (MU) after passing a threshold of consumption.

Sufficiency economy encourages people to consume at optimal levels (Piboolsravut, 2000). Mathematically, the optimal point cannot be reached without the presence of the peak of utility function. Monotonic utility function has no decreasing part which means it has no peak. Therefore, traditional utility function cannot yield the optimal consumption. It does not fit for microeconomic analysis of sufficiency economy.

Non-monotonic utility function is more suitable for sufficiency economy. The function does not guarantee that the more units of consumption will yield the more pleasure or higher utility to an individual. The optimality obtained by using non-monotonic utility function can be considered as the 'middle path' of consumption which follows the philosophy of sufficiency economy (Sachayansrisakul,2009; Piboolsravut, 2000).

Only a few academic works emphasize on technical details of microeconomic analysis of sufficiency economy. Suriya(1999) used non-monotonic utility function to find the optimal working productivity to achieve the happiness of life. However his work described the idea using graphs but not mathematical equations. After that, the works of Piboolsravut (2000), Calkins (2008) and Sachayansrisakul (2009) elaborately interpreted the philosophy of sufficiency economy but in descriptive style. This article, therefore, may be possibly among the first academic works that present the microeconomic analysis of sufficiency economy by mathematical approach.

2. Microeconomic theory of consumption

Indifference curves (IC) are located like a mountain seen from an air- plane. The larger oval is the lower altitude of the mountain and also the lower level of pleasure. The smaller oval is the higher altitude of the mountain which yields greater pleasure. A combination of X* and Y* brings an individual to an altitude which is still not the peak of the mountain. The peak is at a point inside the smallest oval.
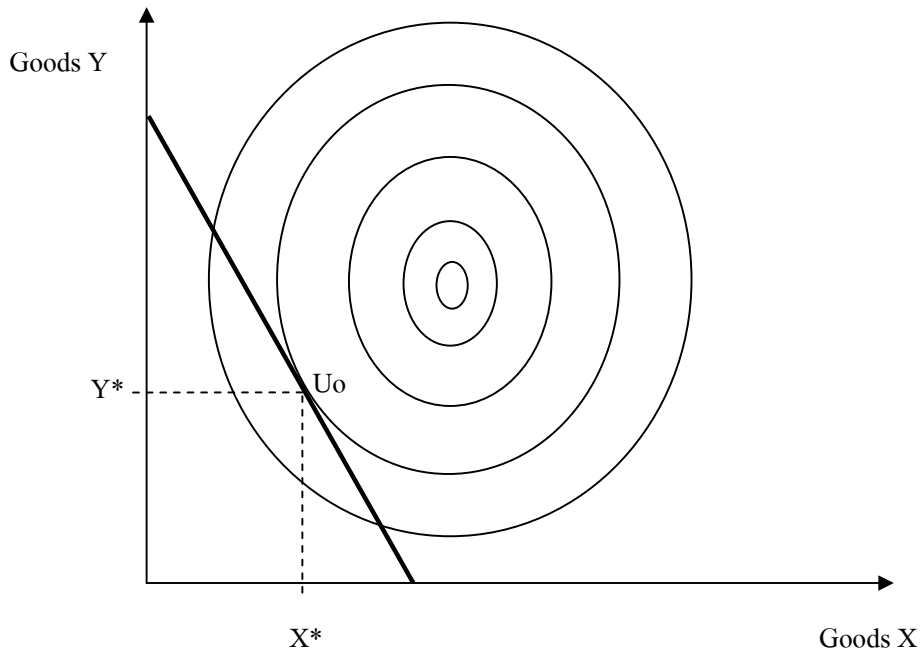

Figure 1:   Non-monotonic utility function

An individual has a limit of budget. In figure 1, he or she can choose his or her budget for a combination of goods X and Y. A straight line combining two points represents the spending of all money to Y on the y-axis and the spending of all money to X on the x-axis. Points along the line are the combinations of goods X and Y. This line is called the budget line.

An equilibrium is at X* and Y* where the utility function is tangent to the budget line. An individual chooses to consume X* units of goods X and Y* units of goods Y. The individual gets the utility at Uo level.
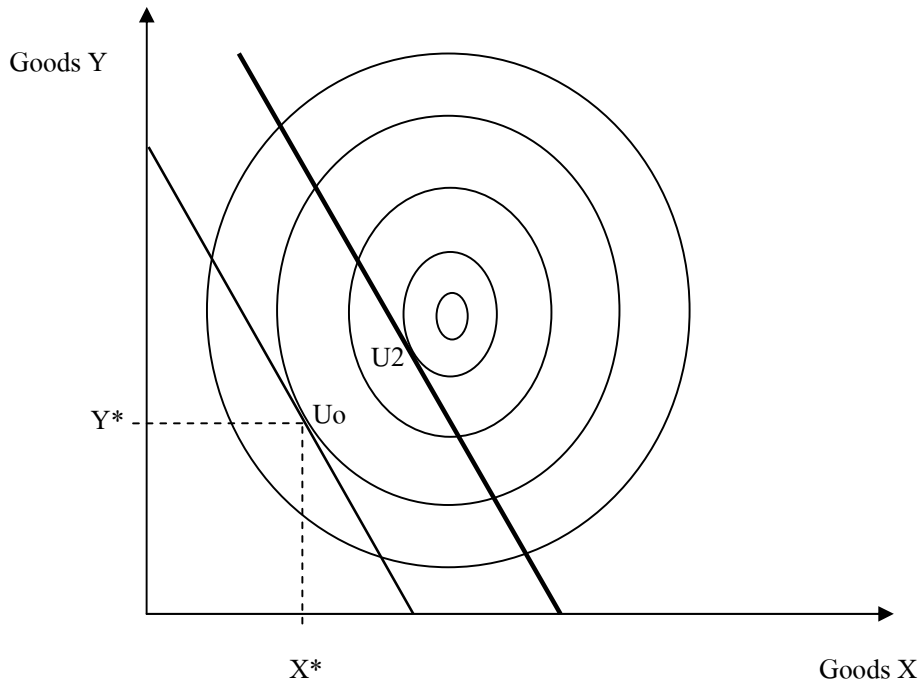
Figure 2:   Higher income yields greater pleasure

An increasing income makes the budget line expand to the right hand side of the initial line. In figure 2, the tangency between the new budget line and the indifference curve yields a higher utility level which is U2. People perceive that the higher income yields the higher pleasure for their lives. Therefore, people spend all efforts to compete to gain higher income. It will happen like this as long as the utility function is monotonic.

Under the non-monotonic utility function, the higher income may not yield higher pleasure for an individual. In figure 3, the higher income drives the budget line further to the right hand side. The combination at the new tangency, X4 and Y4, yields the same pleasure at U2. It means that the higher income is meaningless for happiness.

Law of diminishing marginal utility is behind the decreasing utility. It occurs when an individual consumes a good or a combination of goods too much in a short period of time. An individual will get bored by the consumption. The law is concerned as an important principle of economics. However, it is ignored when an economist solve the equilibrium of consumption by imposing the assumption of monotonic utility function.

An individual achieves the highest pleasure at the combination of X3 and Y3 in figure 4. This combination requires less income than that of combination X4 and Y4. This idea shows that an individual does not need too much income. They can live by the optimal consumption as well as the optimal income in the sufficiency economy.
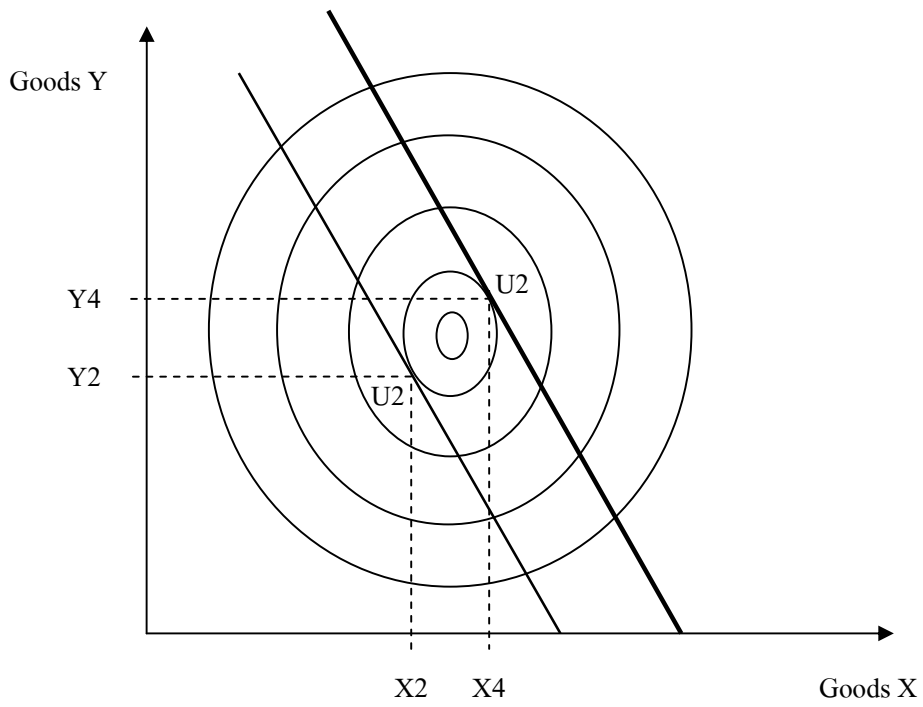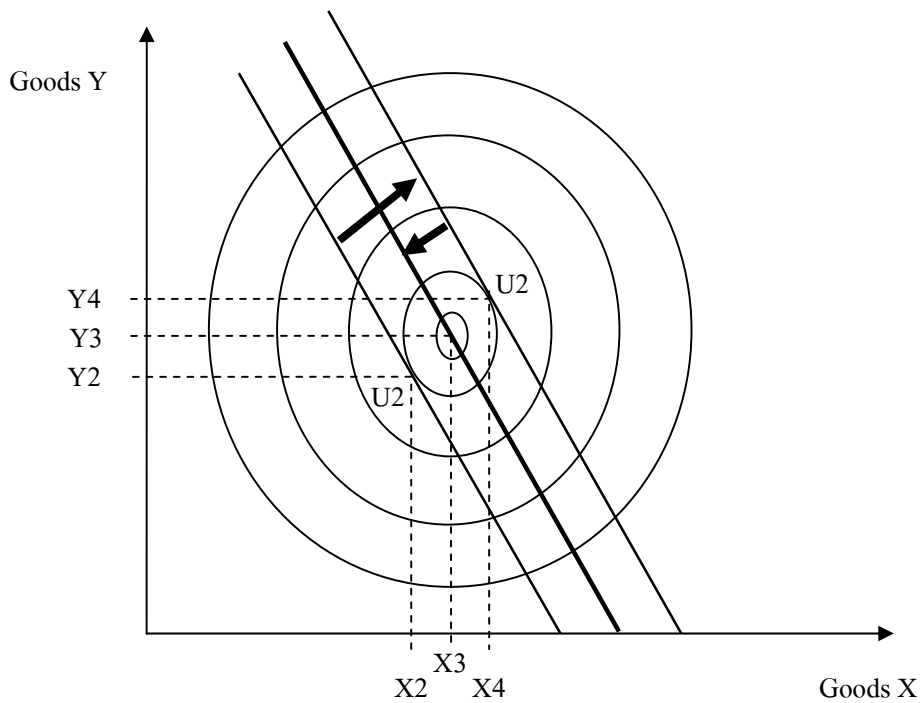
Figure 3:   Higher income may yield the same pleasure

Figure 4:   The optimal income yields the highest pleasure

3. Monotonic utility functions

A famous class of monotonic utility functions is the constant elasticity of substitution (CES).

$$U = (\alpha^{(1/s)}X^{(s-1/s)} + \beta^{(1/s)}Y^{(s-1/s)})^{s/s-1}$$

where U   = Utility level
       α, β = Share parameters
       X   = Unit consumption of goods X
       Y   = Unit consumption of goods Y
       s   = elasticity of substitution.

When the elasticity of substitution (ES) is 1, it is Cobb-Douglas utility function,

$$U = X^{\alpha}Y^{\beta}.$$

When ES is zero, it is Leontief utility function,

$$U = \min{(X, Y)}.$$

Marginal utility (MU) of all functions do not follow the law of diminishing marginal utility. Therefore, the utility function does not contain the peak of the function. The optimal level of consumption cannot be achieved.

4. Non-monotonic utility functions

This section will present four types of non-monotonic utility functions for microeconomic analysis. Marginal utilities of them follow the law of diminishing marginal utility. Each utility function contains the peak of the function. Therefore, the optimal level of consumption can be achieved.

Type 1: Linear marginal utility

The first type of utility function has linear marginal utility functions. Marginal utility can be obtained by taking the partial derivative of the utility function subject to each goods,

$$MU_x = \alpha - \beta X \qquad \text{and} \qquad MU_y = \mu - \theta Y.$$

The utility function of this class can be obtained by the integral of marginal utility functions,

$$U = \alpha X + \mu Y - \frac{1}{2}(\beta X^2 + \theta Y^2).$$

Type2: Parabola marginal utility with one goods in a term

The second type of utility function has parabola marginal utility functions. In each term of the marginal utility, only one goods is presented,

$$MU_x = \alpha - \beta X - \eta X^2 \quad \text{and} \quad MU_y = \mu - \theta Y - \rho Y^2.$$

The utility function is

$$U = \alpha X + \mu Y - \frac{1}{2}(\beta X^2 + \theta Y^2) - \frac{1}{3}(\eta X^3 + \rho Y^3).$$

Type3: Parabola marginal utility with two goods in a term

The third type of utility function also has parabola marginal utility functions. However, in each term, both goods X and goods Y are presented. It means that an individual will have greater pleasure when consume both X and Y at the same time. In the first and second type, an individual can get the utility from the consumption of only one goods. In this third type, the consumption just only one goods will yield less utility than consuming both of them because the interaction term between X and Y will be zero.

The marginal utility of this type of utility function is as follows:

$$MU_x = \alpha - \eta XY - \frac{1}{2}\rho Y^2 \quad \text{and} \quad MU_y = \mu - \rho XY - \frac{1}{2}\eta X^2.$$

The utility function is

$$U = \alpha X + \mu Y - \frac{1}{2}(\eta X^2 Y + \rho XY^2).$$

Type4: Parabola marginal utility with flexible terms

The last type of utility function has parabola marginal utility functions. In each term of MU, it is possible to present only one goods or both goods. This type is more flexible than the third type,

$$MU_x = \alpha - \beta X - \eta XY - \frac{1}{2}\rho Y^2 \quad \text{and} \quad MU_y = \mu - \theta Y - \rho XY - \frac{1}{2}\eta X^2.$$

The utility function is

$$U = \alpha X + \mu Y - \frac{1}{2}(\beta X^2 + \theta Y^2 + \eta X^2 Y + \rho XY^2).$$

5. Conclusion

This study invents four types of non-monotonic utility functions for microeconomic analysis of sufficiency economy. The utility functions allow an individual to find an optimal level of consumption and income. It supports the concept of sufficiency economy such that people need not to gain too much income for their livings because the higher income may not yield greater pleasure to their lives. People only find the optimal level of income, the middle path, to achieve the highest happiness of life.

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