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Rethinking the "Marginal Revolution" in the History of Economic Thought: A Brief Examination of the Marginal Utility Theory Before and in the 1870s

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Abstract

The "Marginal Revolution," a well-known event in the history of economic thought, challenged the mainstream classical political economy and introduced new methods to economic study. The "Marginal Revolution" marked the rise of the Marginal Utility School and pushed the formulation of neoclassical economics. Because marginal utility is the core concept of the "Marginal Revolution," this thesis studies the origin of marginal utility theory by examining figures such as Bernoulli, Bentham, Dupuit, and Goseen, and the utility theory with its related topics of Jevons, Menger and Walras in the 1870s. This thesis considers the significance of the "Marginal Revolution," with particular focus on whether this event can be considered revolutionary.

Keywords: marginal revolution; utility; marginal utility; value; history of economic thought

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Chapter One: Introduction

In this chapter, I present the general introduction of the whole thesis and introduce several concepts that are related to the "Marginal Revolution" and the marginal utility theory in the history of economic thought, before examining the representative figures and their theory. The first part is a general introduction of this thesis, about its main contents, motivation and research range. The second part is about some basic concepts in this thesis, before the examination on the main contents; marginalism is a doctrine generated from the "Marginal Revolution" and continues to the present economics academy; utility is the central and fundamental concept for the marginal utility theory, and the two important properties of utility, the subjective feature and the quantitative feature, are introduced; the "Marginal Revolution" in the 1870s and its significance is introduced from a common point of view. In addition, I show the direct purpose and the structure of the whole thesis in the last part.

1.1. General Introduction of the Thesis

This thesis is about the "Marginal Revolution" and the marginal utility theory before and in the 1870s. In the history of economic thought, the "Marginal Revolution" is usually considered as a revolutionary event, since it established a subjective utility theory of value and adopted the marginal approach as an effective analytical tool for economics.

The "Marginal Revolution" marked the rise of the Marginal Utility School[1] in the 1870s and probably the start of modern neoclassical economics. However, I have some doubts about this idea, and through the examination of the "Marginal Revolution" in terms with its central theory and the most representative achievement, the marginal utility theory, I will discuss some factors that may be opposed to the idea that the "Marginal Revolution" is a revolutionary event in the history of economic thought. By doing this, we will have a better understanding of what the "Marginal Revolution" was, what influence of this process had on the later development of economics, the origin of the "Marginal Revolution" and its direct connection with and the difference from the modern neoclassical economics[2].

Rethinking the "Marginal Revolution" and the marginal utility theory is of value not only for me but also for the other readers. For myself, this study helps me to understand the origin of the classic marginal utility theory, including utility theory of value and marginal analysis, which are the fundamental elements of marginalism and modern neoclassical economics. Through this study, I will have a general scope on many topics based on the utility theory, gradually find what specific topics interest me the most and narrow my future research range. Also, trying to understand utility, a fundamental concept, from its origin will help me think about the related fields from an original perspective. For the other readers, helping people recall and reconsider the "Marginal

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[1] The representative pioneers of the Marginal Utility School in the 1870s are William Stanley Jevons, Carl Menger and Léon Walras and their works are considered as the most important achievement of the "Marginal Revolution", which is introduced in Part 1.2.3 and examined in the whole of Chapter 3.

[2] Some people may think that the "Marginal Revolution" or the rise of the Marginal Utility School in the 1870s is the start of modern neoclassical economics, but I disagree with this idea. This thesis presents a few general differences between them and discuss the less significance of the "Marginal Revolution" compared with Marshall's *Principles*, in Part 4.2. However, because this thesis does not focus on Marshall but only the Marginal Utility School in the 1870s, the contrast is not detailed.

Revolution" and the classic marginal utility theory is the direct motivation, by presenting

the representative figures, their original theory and their influence. Furthermore, I write

this thesis about the three pioneers, Jevons, Menger and Walras, with their predecessors,

in order to show some of their disputable merits[3] and deficiencies[4], which is for what

George J. Stigler concluded that one of the purposes to study the history of economic

thought:

> Or one may, and most often does, simply set forth the major steps in the
> development of a branch of economic theory, hoping that it can be justified by its
> contribution to the understanding of modern economics. (Stigler, 1950, p. 307)

Though the discussion of the marginal utility theory is related to many topics in

economics, including its later development, its relation with the classical economics and

its specific implication and application, due to the limitation of my study, the research

range of this thesis should be mentioned. The first range is about time. As the title says,

this thesis is about the "Marginal Revolution" and the marginal utility theory before and

in the 1870s only. Specifically, the examination on the representative figures is from the

18th century to the 1870s. The utility theory of Jevons, Menger and Walras occupies the

main part of this thesis, and the utility theory before the three pioneers in the 18th and 19th

centuries serves as the origin of the utility theory of the three pioneers and holds the

second part. Hence, this thesis does not cover the utility theory and its related topics after

the 1870s. Even though the development of the marginal utility theory experienced a long

period, this thesis stops the discussion at its peak, namely the rise of the Marginal Utility

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[3] For example, the three pioneers systematically established and adopted a theory of subjective economic value, developed a new analytical tool, the marginal approach, and challenged the dominance of the classical political economy making economics lively at their time.

[4] For example, the three pioneers probably repudiated the classical theory intensively and ignored some of its cogent contents, made many basic models in their theory hard to fit the reality, and overestimated the importance of quantitative analysis and mathematics for economics.

School in the 1870s. Hence, the consideration of the later development of the marginal utility theory and neoclassical economics is not included, but with the limited examination of Marshall's work and my assumption, this thesis presents a few differences between the Marginal Utility School and general neoclassical economics, in the part of discussion, but does not further discuss the marginal utility theory after the 1870s in detail. The second range is about classical economics. In the history of economic thought, the classical political economy was a prevailing and even dominant stream at the years of the rise of the Marginal Utility School. So the presentation on the connection between the two streams was inevitable while I examine the marginal utility theory at that time. However, since this thesis is only about the marginal utility theory, I do not cover the works of the classical economics but only present some general connections between the two streams and the attitudes of the Marginal Utility School towards the classical theory. The third range is about the depth of the study. Because utility theory is a fundamental economic value theory, there are many specific topics (its implication and application) based on the utility theory, such as the exchange theory, the continuous variation, the measurement of utility and the demand function. Every specific topic based on the fundamental utility theory can be extended as a research topic, but thesis is only an examination of the marginal utility theory and a brief presentation of these related topics. Hence, the relevant specific topics are not furthered discussed in this thesis.

1.2. Basic Concepts

1.2.1. Marginalism

The word "margin" was created in the late 16th century, from the Medieval Latin "marginalis." The word "marginalism" was probably first formally created and used by John Atkinson Hobson, in his *Work and wealth* (1904), because he needed an expression to cover the terms "marginal utility" and "marginal productivity," which economists at his time had widely accepted (Howey, 1989, p. xiii). The term first appeared when he wrote that "this slightly technical disquisition is rendered necessary by the wide acceptance which 'marginalism' has won in academic circles" (Hobson, 2010, p. 110). Hobson used the word seven times in *Work and wealth*, in a disparaging tone, because he found fault with the concept and its unwelcome policy application (Howey, 1989, p. xiii). However, the word "marginalism" was not frequently used until twenty-five years after Hobson's first coinage. The widespread employment of marginal cost, marginal revenue, marginal rate of substitution, and marginal propensity to consume during the 1930s drove Richard Allen Lester to complain in 1946 that the "minutiae of marginalism" were consuming one-half to one-third of the leading American textbooks, and this complaint reintroduced the term "marginalism," once again as a disparaging word (Howey, 1989, p. xiv). The word "marginalism" first entered a general dictionary in English in 1966, when Webster's Third defined "marginalism" as "economic analysis that stresses the use of marginal qualities in the determination of equilibrium" (Howey, 1989, p. xiv).

Though economic analysis has adopted plenty of marginal properties, economists generally accept that the history of marginalism began with the emerging of a property that is now called "marginal utility." Even though some people, like Jules Dupuit in 1844 and Hermann Heinrich Gossen in 1854, showed some enlightenment about marginal utility in their works, "according to the conventional accounts, marginal utility, in a form

later acceptable to economists, was first successfully and independently created during the twelve years from 1862 to 1874 by William Stanley Jevons, Carl Menger, and Léon Walras" (Howey, 1989, pp. xiv–xv). Jevons, Menger and Walras wrote their books at the right moment (Kauder, 1965, p. 66); these three economists are regarded as the pioneers of marginalism.

1.2.2. Utility

Utility as a concept of marginalism represents a consumer's satisfaction with a good. A good satisfies human wants and has utility. In general, there are two main features of utility. First, utility is a subjective valuation of economic value. Different from classical economics, in which economic objective production cost (from the supply side) determines value, utility can be another determinant of value (from the demand side). Though utility is not a purely subjective concept in philosophy, compared with production cost, utility differs for each individual and thus tends to be subjective. Because utility is a subjective valuation, how utility can be measured and whether it can be interpersonally compared are worthwhile topics of economic study.

The second main feature of utility is that utility is more a quantity than a quality, different from usefulness and use-value in classical economics. With the introduction of utility as a new valuation, some tools and concepts from mathematics and other natural sciences, such as differentials, analytical geometry, and behavioral science, gradually entered the political economy, giving economics more scientific features. Under a series of fundamental assumptions, utility, like production cost, was quantified. Utility could be calculated and certified by mathematical tools, so utility theory gradually matured with neoclassical economics. Due to the need to simplify its definition and application, utility

has become a one-dimensional quantitative concept. Though this simplification makes the understanding of economic value direct, it also makes utility an abstract concept, ignores possible real-world factors and has influenced economic analysis so far. This phenomenon may reflect a controversy between the fact that people want to easily understand the real world and the true difficulty in knowing the real world. Some economists are trying to find an easy way to know the truth, but that way may omit some necessary facts and lead to misunderstandings.

1.2.3. "Marginal Revolution"

A revolution, from Latin "revolutio," meaning "a turn around," is "a sudden, radical, or complete change" (Merriam Webster Online). The definition indicates two parts of the meaning of a revolution, namely generating a fundamental change and taking place in a short period. Besides, a revolution can occur not only in the economy and in socio-political institutions but also in people's thoughts.

Beginning in the 1870s, economists began to formally accept marginal utility theory, on account of the work of three economists. Jevons in England, Menger in Austria, and Walras in Switzerland, independently produced a similar economic theory based on subjective utility. This period marked a turning point in the history of economic thought: the analysis of production and exchange was not only the task of social theory but also more scientific methods. Compared with classical economics, which asked about "the true basis of value, activities that contributed to national wealth, systems of rights, or about the forms of government under which people grow rich" (Unger, 187, pp. 120–122), marginalism, as a means "to escape the conundrums of value theory and to answer how," was established with the aim "to withdraw economics from debates about how society

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worked and what kind of society we wanted to live in, and escalate it to an objective and universal realm" (Unger, 2007, pp. 55–64). This thesis will consider whether this process was truly revolutionary or whether it was only a kind of "ideology," but usually, economists and sociologists consider the 1870s the years of the "Marginal Revolution."

1.3. Purposes of the Thesis

The purpose of this thesis, by studying two things, "origins of the revolution (if revolution it was)" and "its eventual triumph" (Blaug, 1972, p. 270), in terms of the development of the marginal utility theory before and in the 1870s, is to consider whether the "Marginal Revolution" can be called a revolution and how revolutionary this process is, in the history of economic thought, from its period and significance. If it can be regarded as a revolution, was this event historically inevitable, and what influence did it have on the later economic academia and society? If the "Marginal Revolution" is not a real revolution, did something happen to make the event seem revolutionary, or did it mislead later economic analysis in some aspects? For utility is the fundamental and central concept of marginalism and then neoclassical economics, with the help of a few secondary references, I focus on utility theory and study its relevant topics. In Chapter 2, the origin of the "Marginal Revolution", I choose Bernoulli, Bentham, Dupuit, and Gossen as representative figures who made significant contributions to formation of marginalism. In Chapter 3, the "Marginal Revolution", I examine the primary works of the three pioneers, Jevons, Menger and Walras. Also, I will present my discussion in Chapter 4.

Chapter Two: Utility Theory of the Representatives before the 1870s

"But I have planted the tree of utility. I have planted it deep, and spread it wide."

— Jeremy Bentham (Bentham & Bowring, 1843, p. 588)

Before the 1870s, while the three pioneers of the Marginal Utility School, Jevons, Menger and Walras, published their representative work about the marginal utility theory, there were many writers having worked on this fresh topic. Some of them might have vague but original ideas about either the method or the thought of the utility theory, and some of them developed the utility theory and laid a foundation for the three pioneers in the 1870s. In this chapter, I chronologically examine some representative writers with their utility theory before the 1870s and analysis their influence, the figures including some early writers, Bernoulli, Bentham, Dupuit and Gossen.

2.1. Early Writers

The earliest reference to the notion of diminishing marginal utility can probably be found in Aristotle's *Politics*: "External goods have a limit, like any other instrument, and all things useful are of such a nature that where there is too much of them they must either do harm, or at any rate be of no use" (Aristotle, 1323, Book Seven, Part I). Though we can not deduce whether this "useful" property is an intrinsic or extrinsic property, it revealed the negative correlation between the quantity of goods and this "useful" property to people, as the law of diminishing marginal utility. But several writers have disagreed

that Aristotle had marginal considerations in his value theory (Gordon, 1964; Kauder, 1953, pp. 638–650; Meikle, 1997; Schumpeter, 1995; Soudek, 1952, pp. 45–75).

The discussion of the determination of economic value was the beginning of utility theory. Classical political economy held that value was explained mainly by production cost, but there were several people who protested this explanation before the nineteenth century. In the eighteenth century, Italian mercantilists such as Antonio Genovesi, Giammaria Ortes, Pietro Verri, Cesare Beccaria, and Giovanni Rinaldo had significant utilitarian considerations in their proposals of economic policy (Pribram, 1983, pp. 86–88). Abbé Ferdinando Galiani, a pupil of Genovesi, in his *Della moneta* in 1751, wrote that value was explained quantitatively by a ratio of utility and scarcity, and value was formed by human minds; Anne Robert Jacques Turgot, in his *Réflexions sur la formation et la distribution de richesse* in 1769, thought that value was derived from the general utility of the class to which the good belonged, by comparing present and future wants and expected difficulties in procurement; Étienne Bonnot de Condillac, in his *De commerce et le gouvernement* in 1776, emphasized that value was not only determined by cost but also explained by utility (Pribram, 1983, pp. 115–120). Even though these writers did not form a complete theory of utility-determined value, and the implication of utility in their works was probably not the same as the later works of marginalism and neoclassical economics, they indeed provided new angles for later economists to question the classical cost-determined value theory.

2.2. Bernoulli

2.2.1. Calculus Applied in Economics

Isaac Newton and Gottfried Leibniz initially developed modern calculus, independently of each other, in the seventeenth century, and then, during the eighteenth century, many attempts were made to apply this method in different fields, including economics (Bower, 1939; Brunschvicg, 1912, p. 243ff). Several later writers defined marginal utility mathematically as follows. Let u(q) be the utility of goods at the quantity q, and then u(q + △q) – u(q) is the increase in utility (from u(q) to u(q + △q)) corresponding to the increase in quantity (from q to q + △q). Marginal utility is the limit of the ratio when △q tends to zero (Cassirer, 1953, p. 15–111; Jevons, 2012, pp. 58–61; Kells, 1943).

$$\text{Marginal Utility} = \lim_{\Delta q \to 0} \frac{u(q + \Delta q) - u(q)}{\Delta q}$$

After the application of calculus, mathematical tools started playing an important role in economic analysis.

2.2.2. Bernoulli's Discovery

Among the many writers talking about utility in the eighteenth century was Daniel Bernoulli. Bernoulli first unambiguously discovered marginal utility in his *Exposition of a new theory on the measurement of risk* in 1738 (Kauder, 1965, p. 32). As a member of a family of famous mathematicians, Bernoulli skillfully applied calculus to several economic problems. Bernoulli considered that value was not determined by price, but by utility and income:

> To do this, the determination of the value of an item must not be based on its price, but rather on the utility it yields… The utility, however, is dependent on the particular circumstances of the person making the estimate. (Bernoulli, 1954, p. 24)

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Further, "[a]ny increase in wealth, no matter how insignificant, will always result in an increase in utility which is inversely proportionate to the quantity of goods already possessed" (Bernoulli, 1954, p. 25). Here Bernoulli substituted scarcity with individual income (Kauder, 1965, p. 32).

Bernoulli recognized that the law of diminishing utility was not "a theoretical law gained by reasoning" but "the offshoot of empirical observation," which was "a rule with exceptions" (Kauder, 1965, p. 32). For example,

> A rich prisoner who possesses two thousand ducats but needs two thousand ducats more to repurchase his freedom, will place a higher value on a gain of two thousand ducats than does another man who has less money than he. (Bernoulli, 1954, p. 25)

But Bernoulli thought these examples represented "exceedingly rare exceptions" (Bernoulli, 1954, p. 25).
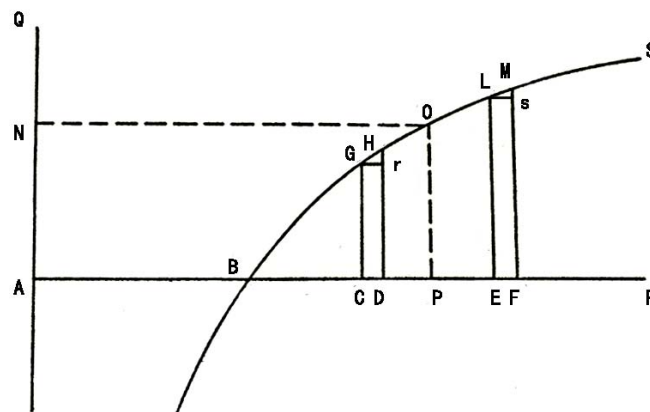
Figure 2.1[5]

Bernoulli also elaborated the law of diminishing utility in mathematical language. AC is the wealth previously owned, CD is the increase of wealth, CG is the previous total

utility, and rH is the small increase in utility corresponding to the increase of wealth. If AC is x, CG is y, rH is dy, and b designates the constant data, we get:

$$dy = b\frac{dx}{x}$$

Assume the increment of wealth EF equals CD. The increment of utility sM is smaller tan rH, showing the law of diminishing utility. Besides, it should be noted that Bernoulli connected income (money) with utility, instead of quantity of goods.

However, this demonstration was only an introduction of Bernoulli's primary interest, "the solution of problems connected with making decisions under risk," and economists finally paid attention to his marginal thought on this introductory part two hundred years later (Kauder, 1965, p. 34). But Bernoulli's discovery of marginal utility and application of mathematics more or less influenced the Marginal Utility School and neoclassical economics.

2.3. Bentham

2.3.1. Utilitarianism

In the eighteenth centuries, Jeremy Bentham was another writer who had the significant influence on the utility theory in the nineteenth century. Though Bentham's thoughts involved many different subjects, just for economic thought, his utilitarianism and felicific calculus had significant influence on the Marginal Utility School.

Bentham started from his utilitarianism. The law of utility (pleasure and pain) was the fundamental of his utilitarianism. "Nature has placed mankind under the governance of two sovereign masters, pain and pleasure" (Bentham, 2007, p. 1). The principle of utility was the foundation of Bentham's utilitarianism, and Bentham replaced the word

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"utility" with "happiness" and "felicity" in his later work, changing the principle into "the greatest happiness or greatest felicity principle"[6] (Bentham, 2007, p. 1). The principle, which was the foundation of Bentham's (2007) *An introduction to the principles of morals and legislation*, stated that pleasure and pain were the only standard of right and wrong, and they governed everyone's every behavior. "The principle of utility recognises this subjection, and assumes it for the foundation of that system, the object of which is to rear the fabric of felicity by the hands of reason and of law" (Bentham, 2007, pp. 1–2).

According to Bentham, utility was the property "to produce benefit, advantage, pleasure, good, or happiness, or to prevent happening of mischief, pain, evil, or unhappiness" (Bentham, 2007, p. 2). The principle of utility was the principle that "approves or disapproves of every action whatsoever, according to the tendency which it appears to have to augment or diminish the happiness of the party whose interest is in question, or… to promote or to oppose that happiness" (Bentham, 2007, p. 2). In other words, pleasure and pain decided motives and drove actions of individuals. Whatever people did was based on the expectation of pleasure and pain. In this framework, the good or the right (motives and actions) brought pleasure and the evil or the wrong brought pain.[7]

Though "all other principles than that of utility must be wrong," there were principles adverse to that of utility, such as the principle of asceticism and the principle of

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[6] In an 1822 footnote, Bentham thought that the words happiness and felicity were better than utility to clearly indicate the ideas of pleasure and pain (Bentham, 2007, p. 1). However, in order to be loyal to Bentham's original work, I still use "the principle of utility" in this thesis.

[7] This framework considered only the simple form of pleasure and pain, not complex actions or motives with a mixture of pleasure and pain.

sympathy and antipathy[8] (Bentham, 2007, p. 8). The principle of asceticism was "the

reveries of certain hasty speculators" and could not be consistently pursued by most

people (Bentham, 2007, pp. 12–13). The principle of sympathy and antipathy was "rather

a principle in name than in reality" and would frequently coincide with the principle of

utility (Bentham, 2007, pp. 16, 18–20). Therefore, Bentham did not think that these two

occasional conditions were the fundamental principles of humans and reasserted the sole

essentiality of the principle of utility: "The principle of utility neither requires nor admits

of any other regulator than itself" (Bentham, 2007, p. 23).

2.3.2 Felicific Calculus

Felicific calculus was another of Bentham's contributions. "Truths that form the

basis of political and moral science are not to be discovered but by investigations as

severe as mathematical ones, and beyond all comparison more intricate and extensive"

(Bentham, 2007, p. xii). Bentham attached importance to mathematics, introduced

mathematics into social theory and created a series of methods to calculate utility, which

gave utility more quantitative features.

Bentham divided pleasure and pain into the simple and the complex. "The simple

ones are those which cannot any one of them be resolved into more: complex are those

which are resolvable into divers simple ones" (Bentham, 2007, p. 33). The examples of

simple pleasures included: pleasure of sense, pleasure of wealth, pleasure of skill,

pleasure of amity, pleasure of a good name, pleasure of power, pleasure of piety, pleasure

of benevolence or good-will, pleasure of malevolence or ill-will, pleasure of memory,

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[8] Bentham omitted the theological principle, because he thought "it is never anything more or less than one or other of the three before-mentioned principles presenting itself under another shape" (Bentham, 2007, p. 21). The three principles were the principle of utility, the principle of asceticism, and the principle of sympathy and antipathy.

pleasure of imagination, pleasures of expectation, pleasure depending on association, and pleasure of relief. The examples of simple pains included: pain of privation, pain of sense, pain of awkwardness, pain of enmity, pain of an ill-name, pain of piety, pain of benevolence, pain of malevolence, pain of the memory, pain of the imagination, pain of expectation, and pain of association (Bentham, 2007, pp. 33–41). Complex pleasure and pain included: pleasures alone, pains alone, and a pleasure or pleasures and a pain or pains together (Bentham, 2007, p. 33). Bentham tried to summarize all of the kinds of pleasure and pain, but all of them could be attributed to the simple form of pleasure and pain and be calculated. This quantitative analysis was carried on to his further analysis of morals and legislation.

For the quantitative aspect of utility, Bentham gave the way to calculate the value of simple pleasure and pain. First, to estimate a pleasure and a pain itself, we should consider its intensity, its duration, its certainty or uncertainty, and its propinquity or remoteness. Second, to estimate how much an action produces this pleasure and pain, we should consider its fecundity and its purity. Last, to estimate the total value of a pleasure and a pain for a group of people, we should consider its extent (Bentham, 2007, pp. 29–31). Then, there were three ways to take an exact account of the general tendency of an action. First, calculate the value of each pleasure or pain produced by an action in the first instance. Second, calculate the value of each pleasure or pain produced by an action after the first. Last, sum up all the values of pleasures and all the values of pains. If the pleasure side was greater, the tendency was good; if the pain side was greater, the tendency was bad (Bentham, 2007, p. 31). Pleasure and pain differed from one person to

another, so Bentham used the seven factors to calculate the values, in order to quantify subjective pleasure and pain. According to the positivity or the negativity of the value of pleasure and pain that an action produced, an individual decided whether an action should be approved or disapproved and estimated degree devoted to that action. Then, because an action led by pleasure and pain could be observed, it could be risen to the social level, as a standard in his analysis of principles of morals and legislation.

Two features of utility were thus apparent from Bentham's felicific calculus. First, utility is a quantitative concept. Bentham tried to calculate social phenomena with mathematics, giving utility quantitative features. Second, utility was purely subjective. Though the method of calculation was fixed, pleasure and pain varied by individual, so the result was subjective. This subjectivity made the measurement of utility difficult and made interpersonal comparison impossible.

2.3.3. Influence

Bentham's theory inspired the later development of philosophy, ethics, law science, politics, psychology, and others. For economics, especially for marginalism, Bentham laid several foundations.

First, for his utilitarianism, utility (pleasure and pain) was the only way to determine the tendency of an action, including economic actions. Later, the Marginal Utility School thought that marginal utility was the determinant factor of economic value, and might inherit the utilitarianism of Bentham. Second, with his felicific calculus, utility can be calculated with mathematics. Bentham highly praised mathematics for the principle of utility in related fields, making utility a quantitative concept. Third, Bentham

repudiated all of the other principles and thought that utility was a homogenous property, without qualitative distinction. Marginalism inherited this feature and assumed that utility was the only determinant of economic value and mainly analyzed utility quantitatively.

After Bentham, more and more writers studied utility. In the nineteenth century, some economists were giving the clear statement of the law of diminishing marginal utility, but failed to apply this law to economic problems; such economists include Lloyd (1833), Senior (1836), Jennings (1855), and Hearn (1864). There were other economists applying utility theory to economic events without explicitly developing the law of diminishing marginal utility, including A. Walras (1831) and Longfield (1834) (Stigler, 1950, p. 313). However, compared with the representatives I choose, these writers achieved relatively less in utility theory. Instead, there were at least two economists who both elaborated the law and applied it to economic problems, but failed to convince most economists of their time. They were Jules Dupuit and Hermann Heinrich Gossen (Stigler, 1950, p. 313).

2.4. Dupuit

2.4.1. More about Utility

Jules Dupuit published his *On the measurement of the utility of public works* in 1844. Dupuit tried to construct a theory of prices that maximized utility, and he distinguished total and marginal utility clearly and discovered consumers' surplus (Stigler, 1950, p. 313).

Most of Dupuit's thoughts about utility were based on J. B. Say. At the beginning of his paper, Dupuit briefly talked about the definition of utility: "In political economy,

utility is the power possessed by things of being able to serve man in some manner or other" (Dupuit, 1952, p. 256). Unlike Bentham, whose measurement of utility was subjective, Dupuit also thought that "utility and its measurement lie at the foundation of political economy" (Dupuit, 1952, p. 256) and used price as the measurement of utility (Dupuit, 1952, p. 256). Measuring by price was different from the later Marginal Utility School, which used demand to infer utility, similar to the approach of classical political economics. Dupuit gave an example of the judgment of utility: "If society is paying 500 million for the services rendered by the road, that only proves one thing — that their utility is at least 500 million. But it may be a hundred times or a thousand times greater…" (Dupuit, 1952, p. 256). This example also showed Dupuit's consideration on demand and consumers' surplus.

Dupuit presented a few warnings when applying utility, with a few features of the classical political economy. First, production cost should also be considered to acquire economic value, but not as an independent factor. "Utility, thus understood, is the basis of the demand for products and consequently of their value. But this value does not exceed the costs of production…" (Dupuit, 1952, p. 256). Second, qualification of utility should not be ignored; utility should not just be a quantitative concept. Third, price as the measurement of utility is an objective factor.

Though these "warnings" seem to contradict the Marginal Utility School, when Marshall and later neoclassical economists tried to synthesize the thoughts of the Marginal Utility School and classical political economy, they revealed that economic

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value is governed by both utility and cost of production, thereby reflecting Dupuit's wisdom.

2.4.2. Diminishing Demand (Marginal Utility)

Though Dupuit's thoughts about utility were different than those of the later Marginal Utility School, Dupuit also tried to explain the law of marginal utility in his example. Dupuit used the optimum toll on a bridge to illustrate his ideas about demand and marginal utility. He did not explicitly explain the difference between demand and marginal utility, so he analyzed the two things in one diagram.
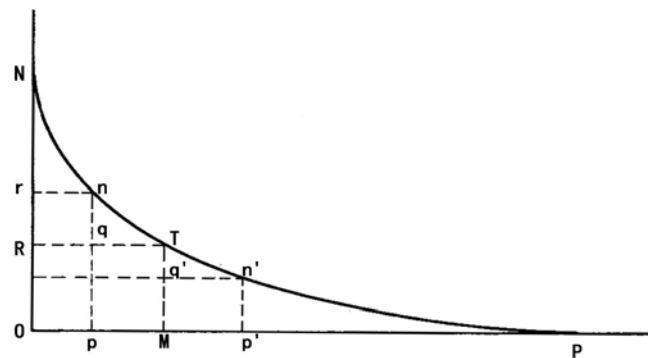
Figure 2.2[9]

In Figure 2.2, NP is the demand (marginal utility) curve, which is a downward and slightly convex curve. If Or was the quantity consumed at the price Op, then Opnr was the absolute utility that consumers gained from the use of the bridge and rnN was the relative utility. If OR was the quantity consumed (decreasing by Rr) at the price OM, then OMTR was the absolute utility and RTN was the relative utility. Since the absolute utility could be considered as the expenditure that should be deducted, we only considered the relative utility, so the net gain of utility was qTn. Hence, when the price

---

[9] The graph is redrawn according to Dupuit (1952, p. 280).

was zero, utility was maximized. Dupuit concluded that "the utility of a means of communication, and in general of any product, is at a maximum when the toll or the price is zero" (Dupuit, 1934, p. 161). However, Dupuit did not wholly advocate the zero toll:

> It will not be our conclusion, when we treat of tariffs; but we hope to have demonstrated that must be studied, combined on rational principles to produce simultaneously the greatest possible utility and a revenue which will repay the expense of maintenance and the interest on the capital investment. (Dupuit, 1934, p. 51)

Dupuit failed to complete his optimum price theory because he did not have a coherent theory of cost (Dupuit, 1934, pp. 52–53; Stigler, 1950, p. 314). His thoughts about production cost were within his theory of utility; production cost was not an independent factor in deciding economic value. Hence, despite Dupuit's attempt to consider utility overall and his explicit formulation and application of marginal utility and consumer surplus, Dupuit did not attempt to devise a larger theoretical framework to solve his problems, and his work was not strictly within the framework either of the Marginal Utility School or of neoclassical economics.

2.5. Gossen

2.5.1. Gossen's Crank

Heinrich Gossen, a tragic figure in the history of economic thought, "hid his thought behind painfully complex arithmetical and algebraic exercises", and he was profound and original but ignored by people in his time (Stigler, 1950, p. 314). Gossen, in his *The development of the laws of human intercourse and the consequent rules of human*

action in 1854, explicitly developed the theory of marginal utility,[10] which was inherited

by the three pioneer economists of the Marginal Utility School, especially Jevons:

> It is quite apparent that Gossen has completely anticipated me as regards the general principles and method of the theory of Economics. So far as I can gather, his treatment of the fundamental theory is even more general and thorough than what I was able to scheme out. (Jevons, 1957, p. xxxv)

Gossen, much like Bentham and his principle of utility, founded his theory on

pleasure and its maximum: "Enjoyment must be so arranged that the total life pleasure

should be a maximum… Man should organize his life so that his total life pleasure

becomes a maximum" (Gossen, 1983, pp. 1, 3). Gossen then explained the difference

between the total pleasure and the magnitude (or intensity) of pleasure, and he revealed

the law of the change of the magnitude of pleasure, which can be understood as the law

of diminishing marginal utility today: "The magnitude [intensity] of pleasure decreases

continuously if we continue to satisfy one and the same enjoyment without interruption

until satiety is ultimately reached" (Gossen, 1983, p. 6). Gossen's definition of pleasure

was different from later neoclassical economics, which assumed the insatiability of

human wants.

> Gossen's magnitude pleasure was a function of time (duration):
>
> A similar decrease of the magnitude [intensity] takes place if we repeat a previously experienced pleasure. Not only does the initial magnitude [intensity] of the pleasure become smaller, but also the duration of the pleasure shortens, so that satiety is reached sooner. Moreover, the sooner the repetition, the smaller the initial magnitude [intensity] and the shorter the duration of the pleasure. (Gossen, 1983, p. 6)

---

[10] Gossen used pleasure instead of utility in his work, so "the magnitude or intensity of pleasure" can be understood as marginal utility.

Gossen then used the quantity of commodities to replace time as the variable, as most

economists analyzing utility do today:

> The single atoms of one and the same means of enjoyment have very different
> values, and, in general, for each individual only a definite number of atoms, that is,
> a definite quantity, has value. An increase in this quantity beyond this point is
> without any value for that individual, but this point of no value is reached only
> after the value has little by little moved through many gradations of magnitude…
> With the increase in that quantity, the value of each additional atom must decrease
> steadily until it sinks to zero. (Gossen, 1983, p. 35).
> Morever, Gossen tried to talk about the negative aspect of utility, in which labor

generated discomfort (disutility).[11] Gossen's theory of the marginal disutility of labor was

completely symmetrical with his theory of the marginal utility of consumer goods (Stigler,

1950, p. 315):

> The value [pleasure] of what is obtained by effort is decreased exactly by the
> proper measure of the discomfort… Through labor we can increase our total life
> pleasure as long as the pleasure of what is produced by labor is valued [produces
> a pleasure that is] higher than the discomfort caused by labor. (Gossen, 1983, pp.
> 40, 43)

As illustrated in Figure 2.3, the two curves represented pleasure and discomfort. "The

value reaches a maximum if the quantity $\overline{ad}$ is produced, that is, if production is

continued until [the intensity of] discomfort becomes equal to the [intensity of] value

[pleasure]" (Gossen, 1983, p. 45). After a series of algebraic analysis, Gossen concluded:

> In order to maximize his life pleasure, man must distribute his time and energy
> among various pleasures in such a way that for every pleasure, the intensity of
> pleasure of the last atom produced shall be equal to the magnitude [intensity] of
> the discomfort experienced by him at the very last moment of his expenditure of
> effort. (Gossen, 1983, p. 53)

---

[11] However, Gossen's discomfort was not strictly the negative pleasure, and it could also be positive (see Figure 2.3.

The maximization of one's life pleasure means the equalization of marginal utility and

marginal disutility. In Figure 2.3, the line cb is the marginal utility curve and the line gf is

the marginal disutility curve, so point e is the maximization of life pleasure.
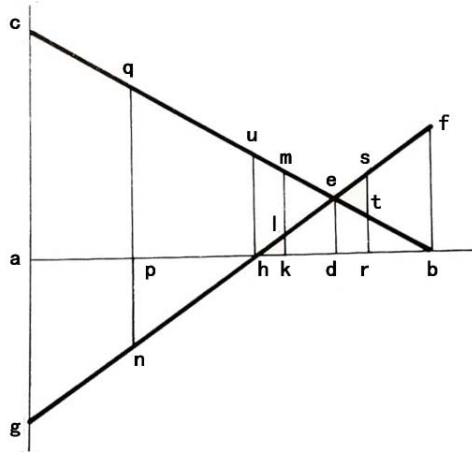
Figure 2.3[12]

Gossen was the first writer to explicitly get what Stigler (1950) called "the

fundamental principle of marginal utility theory" (p. 315). This achievement marks "a

long step forward in the development of the relationship between utility and demand

curves" (Stigler, 1950, p. 315).

> Man obtains the maximum of life pleasure if he allocates all his earned money E
> between the various pleasures and determines the e in such a manner that the last
> atom of money spent for each pleasure offers the same amount [intensity] of
> pleasure. (Gossen, 1983, pp. 108–109)

We can translate this statement into the prevailing mathematical form:

$$\frac{MU_1}{p_1} = \frac{MU_2}{p_2} = \frac{MU_3}{p_3} = \ldots$$

---

[12] The graph is redrawn according to Gossen (1983, p. 44).

where MU_i represents the marginal utility of the ith commodity and p_i represents its price (Stigler, 1950, p. 315).

Gossen also talked about measuring utility in quantity, like Dupuit, using money as measurement:

> We obtain a notion of the magnitudes of different spaces only by taking a certain space as yardstick, of the weights of different bodies by using a certain weight as measure, and so forth. Similarly, we have to decide on some one pleasure as a yardstick, and we can do this because one pleasure remains undetermined in the calculation. It does not matter which pleasure we use for this purpose. It may perhaps be convenient for the future if we use as unit the pleasure generated by the commodity serving as money. (Gossen, 1983, p. 146)

However, Gossen did not solve problems like how to find which pleasure can be a yardstick, whether the money reflecting on this yardstick pleasure can also reflect other pleasures, and how to convert the significance among different pleasures. Hence, this measurement of utility was just a vague idea, and Gossen did not talk more about economic value (Stigler, 1950, p. 315).

2.5.2. Gossen's Laws

Three economic laws were named after Gossen and were widely accepted by later economists. Among the three laws, the first two were about pleasure (utility).

The first law can be regarded as the law of diminishing marginal utility: "The magnitude [intensity] of pleasure decreases continuously if we continue to satisfy one and the same enjoyment without interruption until satiety is ultimately reached" (Gossen, 1983, p. 6). The marginal utility diminishes across the range relevant to the decision-making.
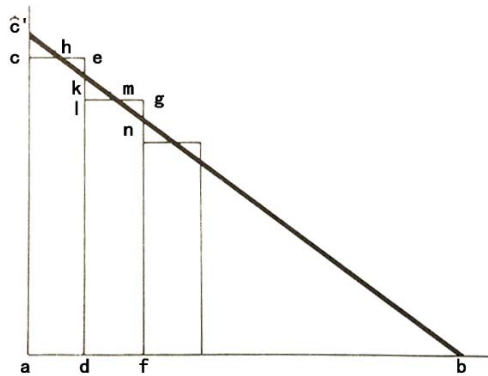
Figure 2.4[13]

The second law was the law of equi-marginal utility:

> Man obtains the maximum of life pleasure if he allocates all his earned money E
> between the various pleasures and determines the e in such a manner that the last
> atom of money spent for each pleasure offers the same amount [intensity] of
> pleasure. (Gossen, 1983, pp. 108–109)

This law presumed that pleasure could be quantified, and that there was an equilibrium at

which an individual would allocate expenditures to reach an equal ratio between marginal

utility and price across all goods and services consumed. Gossen's maximization of

pleasure (utility) can be shown in modern mathematical form:

$$\frac{MU_1}{p_1} = \frac{MU_2}{p_2} = \frac{MU_3}{p_3} = \ldots$$

$$\frac{\partial U / \partial x_1}{p_1} = \frac{\partial U / \partial x_2}{p_2} = \frac{\partial U / \partial x_3}{p_3} = \ldots$$

The third law, omitted here, implied that scarcity of resources was a precondition

for economic value:

> The external world has value for us, from which it follows that the value of the
> external world for us increases or decreases in direct proportion to the help it

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[13] The graph is redrawn according to Gossen (1983, p. 11) and slightly revised.

gives us in attaining our life's purpose and that, consequently, the magnitude of its value is measured exactly by the magnitude of life pleasure that it gives us. (Gossen, 1983, p. 28)

The external world was a precondition to influence pleasure humans gained. But Gossen did not further discuss scarcity or recognize the relationship between utility and scarcity. Moreover, Gossen insisted that pleasure (utility) was the only determinant of economic value, which made his theory one-sided, only focusing on the consumption and the demand side, and this feature was passed to his descendants.

In all, the work of these four figures is representative of the work that influenced the Marginal Utility School. Bernoulli applied advanced mathematics to solve economic problems and revealed the diminishing law of marginal utility. Bentham defined utility as the dominant factor in social problems with subjective and quantitative features; the Marginal Utility School and neoclassical economics later followed this definition. Dupuit and Gossen further explained the law of diminishing marginal utility. In spite of the different definition of utility from the Marginal Utility School, Dupuit applied the law to a real problem. Gossen systematically interpreted the law and his utility theory could be regarded as a "bridge" from Bentham to Jevons. All of them, some creating new angles to valuation in economic thought and some developing new tools in economic research, laid a solid foundation for the Marginal Utility School in the 1870s.

Chapter Three: Utility Theory of the Three Pioneers in the 1870s

"Value depends entirely on Utility." — William Stanley Jevons (2012, p. 2)

Three eminent books of the three pioneers that launched the Marginal Utility School came out at nearly the same time. William Stanley Jevons's *Theory of political economy* and Carl Menger's *Principles of economics* both appeared in 1871, and the first part of Léon Walras's *Elements of pure economics* was published in 1874; its second part followed in 1877. The three books offered discussion of utility theory "far higher in quality and much greater in scope than that contained in the many earlier fragmentary discussions," which provided "the sound base upon which the Marginal Utility School rose" (Howey, 1989, p. 39). In this chapter, because the concept of marginal utility is the core of the "Marginal Revolution," I examine utility theory and its relevant topics of in the three books. Professor R. S. Howey's *The rise of the marginal utility school, 1870–1889* is the major reference for this chapter, which helps me organize the structure and review the works of the three pioneers.

3.1. Marginal Utility and Its Diminishing Law

The term "marginal utility" did not appear in Jevons's, Menger's, and Walras's original works. In fact, "marginal utility" did not enter the German language until 1884, English until 1888, and French even later (Howey, 1989, p. 39). Hence, like the writers before them, all three economists used synonyms equal to "marginal utility."

Both Jevons and Walras employed the term "utility" with the meaning now usual in economics (Howey, 1989, p. 40). As Jevons described the definition of utility, "but it is convenient to transfer our attention as soon as possible to the physical objects or actions which are the source to us of pleasures or pains" (Jevons, 2012, p. 44). Jevons called the power of a good to satisfy wants "utility" (Howey, 1989, p. 41). More carefully, he mentioned that this power is not an intrinsic quality of goods, implying the subjective feature of utility, which was quite similar to what Bentham defined (Jevons, 2012, p. 52). As for the law of diminishing marginal utility,

> the variation of the function expressing the final degree of utility is the all-important point in all economical problems. We may state, as a general law, that it varies with the quantity of commodity, and ultimately decreases as that quantity increases. (Jevons, 2012, p. 62)

This was Jevons' general statement of the law of diminishing marginal utility.

Walras had the same approach as Jevons. At the beginning when introducing the concept of utility, Walras called marginal utility "intensive utility," and then Walras suddenly began to use "rareté," a term that he borrowed from his father and the term for marginal utility that was the most closely associated with the writings of Walras (Howey, 1989, pp. 40–41). Specifically, Walras used "the term rareté [to] designate the intensity of the last want satisfied by any given quantity consumed of a commodity…" (Walras, 2003, p. 119). From this point on, Walras used "rareté" and "intensity of the last want satisfied" to denote marginal utility (Howey, 1989, p. 41). Similar to Jevons, Walras emphasized it in all of the editions of his book that rareté must be "personal or subjective" (Wood, 1993 p. 81). As for the law of diminishing marginal utility, Walras's general statement of the law of diminishing marginal utility was: "whether the curve be

continuous or discontinuous, I postulate that intensive utilities always diminish from that of the first unit or fraction of a unit consumed to that of the last unit or fraction of a unit consumed" (Walras, 2003, p. 118).

Menger was slightly different from Jevons and Walras. Menger insisted that utility with the meaning now usual in economics "played no part in the determination of the value of a good" (Howey, 1989, p. 40). But in fact Menger was talking about the same concept as utility, which he described as the difference between satisfaction (without the quantitative feature) and the importance of satisfaction (with the quantitative feature). "We saw earlier that the different needs of men and very unequal in importance of satisfaction, being graduated from the importance of their lives down to the importance they attribute to a small passing enjoyment" (Menger, 2007, p. 125). Here, Menger employed "the importance of satisfactions," thinking that though satisfaction did not vary in quantity, its importance did (Howey, 1989, p. 40). This importance of satisfaction was exactly the value and the value was not an intrinsic property of things:

> Value is therefore nothing inherent in goods, no property of them, but merely the importance that we first attribute to the satisfaction of our needs, that is, to our lives and well-being, and in consequence carry over to economic goods as the exclusive causes of the satisfaction of our needs. (Menger, 2007, p. 116)

Also, Menger's general statement of the law of diminishing marginal utility was:

> "the satisfaction of any one specific need has, up to a certain degree of completeness, relatively the highest importance, until eventually a stage is reached at which a more complete satisfaction of that particular need is a matter of indifference." (Menger, 2007, p. 125)

Table 3.1 summarizes the terms Jevons, Menger and Walras used for the concept of marginal utility.

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	Marginal utility
Jevons	Final degree of utility Terminal utility
Menger	Importance of satisfactions Dependent utility
Walras	Intensive utility Intensity of the last want satisfied Rareté

Table 3.1

3.2. Utility for Production

Jevons, Menger and Walras all wrote that the factors of production also yielded utility only when they produced goods that satisfied consumers' wants (Howey, 1989, p. 42). However, none of these pioneers discussed further the implication of production, and they believed that utility also determined production. This feature reflected that their theories emphasized the side of demand and consumption and repudiated the classical theory of cost of production.[14]

Compared with the other two economists, Menger studied utility for production more elaborately. He divided goods into different orders, from the first order to the highest order. Direct satisfaction was related to the first order goods which were immediately suited to consumption, and indirect satisfaction was related to the higher order. The higher order goods depended upon the values of the first order goods.

> The fact that goods of first order have a direct and goods of second order an
> indirect causal relation with the satisfaction of our needs gives rise to no

---

[14] Considering the time at which they were writing, when the political economy was dominated by classical economics and its cost of production valuation, we may understand the desire of the three pioneers to introduce something new by critiquing or avoiding former achievements.

difference in the essence of that relationship, since the requirement for the acquisition of goods-character is the existence of some causal connection, but not necessarily one that is direct, between things and the satisfaction of human needs. (Menger, 2007, p. 57)

Hence, the production of the higher order goods relied on the consumption of the first order goods, utility as the determination to this consumption and then production.

Jevons used the term "mediate utility" for the utility from production factors and the term "immediate utility" for the utility from consumption goods (Jevons, 2012, p. 74). Jevons began, like Menger did, by analyzing the determination of the value of consumption goods, and then he tried to tie the production analysis to the consumption, but he never finished this analysis. On the one hand, for Jevons, not only was value based on utility, but his subsequent theory (including production analysis) also was. For example, he thought that labor was "any painful exertion of body or mind undergone with the view to future good" (Jevons, 2012, p. 164) and that labor was "to determine value, but only in an indirect manner, by varying the degree of utility of the commodity through an increase in the supply" (Jevons 2012: 2), like the concept of "disutility" later introduced by his followers. On the other hand, Jevons's arguments about production were vague, for he was sort of stuck in the traditional framework of labor, rent, and capital; he spent three chapters on these topics, not completely establishing a production theory based on consumption or utility (Howey, 1989, p. 42; Jevons, 2012, pp. 162–253).

Walras provided a relatively complete system through mathematics, where "n" equations of production services and "m" equations of demand for products determined all unknowns. The values of all products and all factors were completely interconnected in his system (Howey, 1989, p. 42; Walras, 2003, p. 239).

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3.3. Utility for Exchange

Jevons, Menger and Walras all noted that "the usefulness of many goods frequently comes from the fact that these goods command other goods in exchange, rather than from the direct satisfaction that the goods return their owners" (Howey, 1989, pp. 42–43). They distinguished goods for direct use and goods for indirect use. Indirect use was for exchange.

> Walras discussed this distinction less than the other two writers.

> Once all things that can be appropriated (that is, all scarce things and nothing else) have been appropriated, they stand in a certain relationship to each other, a relationship which stems from the fact that each scarce thing, in addition to its own specific utility, acquires a special property, namely, that of being exchangeable against any other scarce thing in such and such a determinate ratio. (Walras, 2003, p. 67)

Walras used the term "specific utility" to denote the utility directly derived from goods.

> According to Jevons,

> things which have no direct utility may be the means of procuring us such by exchange, and they may therefore be said to have indirect utility. To the latter form of utility I have elsewhere applied the name acquired utility. (Jevons, 2012, p. 74)

Jevons noted that people valued goods, not only because goods had direct utility when consumed, but also because people exchanged them for acquired utility. Jevons used the term "acquired utility" for the things with the power of "procuring commodities possessing immediate and direct utility — that is, the power of satisfying want" through exchange (Jevons, 2012, p. 74). Jevons talked about the reason and the result of trade, but

he finally failed to make further use of acquired utility or discuss further gains from

trade.[15]

> But the power of exchanging one commodity for another greatly extends the
> range of this utility. We are no longer limited to considering the degree of utility
> of a commodity as regards the wants of its immediate possessor; for it may have a
> higher usefulness to some other person, and can be transferred to that person in
> exchange for some commodity of superior utility to the purchaser. The general
> result of exchange is, that all commodities sink, as it were, to the same level of
> utility in respect of the last portions consumed. (Jevons, 2012, p. 130)

Menger also used the words "direct" and "indirect" to describe the distinction

between the commodities obtained for the consumption of the commodity itself and as a

means of exchange. Menger divided value into use value and exchange value, but these

two terms had the different meaning with "use value" and "exchange value" in the

classical framework. The two types of value depended on whether commodities derived

their "value by being employed directly in the first case and indirectly in the second"

(Menger, 2007 p. 228). Menger also said that a few goods might have only use value or

exchange value, but most goods had both. The degree of each value determined the

importance of satisfaction (direct or indirect) and the final economic value.

Table 3.2 summarizes the terms the three thinkers used for different levels of

utility.

	Utility for use	Utility for production / exchange
Jevons	Immediate utility	Mediate utility (for production) Acquired utility (for exchange)
Menger	Direct satisfaction	Indirect satisfaction

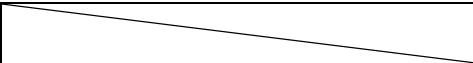[15] Later, Edgeworth developed the theory of gains from trade based on Jevons's utility theory.

Walras	Specific utility	

<div align="center">Table 3.2</div>

3.4. Discontinuity and Indivisibility

Both Jevons and Walras used mathematical models, so they found it convenient and necessary to assume the continuous divisibility of quantities. Then they realized that their models did not fit reality, because all or most, of quantities could not divide in their ways. Hence, they amended their basic models to consider indivisibility in the quantities of goods consumed (Howey, 1989, p. 45). However, in spite of these attempts, divisibility and continuous variation still remained primary in Jevons's and Walras's work.

Jevons began his analysis with finite increments, but soon found that the law of diminishing marginal utility "may be considered to hold true theoretically, however small the increments are made" (Howey, 1989, p. 45; Jevons, 2012, p. 57). Jevons then decided, "in every sale of a house, factory, or other building, it is usually impracticable to make any division without greatly lessening the utility of the whole" (Jevons, 2012, p. 120). Jevons realized that discontinuities occurred everywhere in the real world. To fit such discontinuities into his general model, he constructed special models. The first one was for the exchange of two indivisible goods (paper and wine), where the equations of exchange changed into two inequalities, which showed that two traders preferred the good of the other (Howey, 1989, p. 45; Jevons, 2012, p. 125). The second model, about bottles of ink, was more elaborate. Using the graph in Figure 3.1, Jevons showed that "three bottles will be purchased, but the fourth will not be purchased unless the space $p_3q_3q_4p_4$ exceed in area $p_3r_3r_4p_4$" (Jevons, 2012, pp. 125–126). This model indicated that

<div align="center">35</div>

the buyer must decide whether "each successive bottle gives more utility than the utility

the money would return if spent elsewhere" (Howey, 1989, p. 45). However, these were

just several attempts that Jevons made to fix his models to fit reality, and his basic

models still assumed continuity. Generally, Jevons's primary goal was to make

economics an "exact science," so in order to apply mathematical tools like calculus, his

basic models had to assume continuity and divisibility.

> Nay, finding that the quantities with which we have to deal are subject to
> continuous variation, I do not hesitate to use the appropriate branch of
> mathematical science, involving though it does the fearless consideration of
> infinitely small quantities. (Jevons, 2012, p. 4)

Hence, Jevons's changes to his model were not significant but showed only the worry

about his models not fitting reality.

Figure 3.1[16]

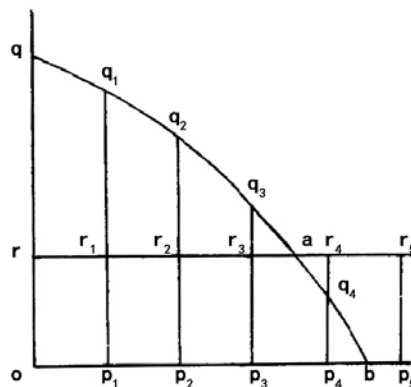Walras did not discuss discontinuities in his first edition. However, in his second

edition, he found the problem of discontinuous variables in individual demand curves

(Howey, 1989, p. 45). Walras drew a "step curve" to express the discontinuous individual

demand curve and provided a solution similar to Jevons's (see Figure 3.2). Also, Walras

---

[16] The graph is redrawn according to Jevons (2012, p. 126).

thought that the aggregate demand curve could be considered "continuous by virtue of the so-called law of large numbers," but this justification offered him little consolation, because his models were mainly based on utility functions instead of empirical demand functions (subject to aggregation) (Walras, 2003, pp. 95, 97; Howey, 1989, pp. 45–46). Late in his book, Walras made another attempt to handle discontinuous utility functions, by "the substitution of continuous functions for discontinuous ones, presumably as approximations" (Walras, 2003, p. 577; Howey, 1989, p. 46). Here, his "approximation" might be the best way to explain the rough conditions of the real world. Like Jevons, these revisions were mainly to make his models that assumed continuity better fit the real world, instead of changing the basic models themselves.

Figure 3.2[17]

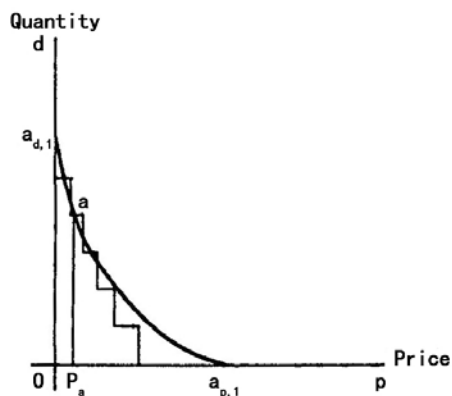Hence, although Jevons and Walras made several attempts to consider the discontinuity and indivisibility to fit the reality, their models mainly remained continuous and divisible. The continuous variation not only was the prerequisite for their marginal analysis with the derivative, but also became a fundamental assumption for later

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[17] The graph is redrawn according to Walras (2003, p. 97).

neoclassical economics. Starting from Bernoulli who introduced calculus to social problems, the discussion of marginal utility was much suited for this powerful tool (Kauder, 1965, 31). First, for marginal analysis studied the change in the dependent variable with one additional unit of the independent variable, it was in accordance with what the partial derivative in calculus described, and continuum was a representative property for calculus, so the quantities in economics also had the property of continuity if calculated by calculus. Second, since both Jevons and Walras thought highly of applying mathematics in economics, especially Jevons who wanted to make economics "an exact science" (Jevons, 2012, p. 14), the adoption of continuity met their wishes. With the assumption of continuity in their models, they could calculate both the small and great numbers that did not exist in most real conditions, like physics, to study the tiny differences, to predict the remote huge changes and to continue other theoretical research that was hard to be observed in reality. Hence, continuity played an important role in not only the most of their models but also the expectation of Jevons and Walras to make economic exact and mathematical. However, it should be noticed that not all of the representative figures of the utility theory before and in the 1870s adhered to calculus and the assumption of continuity. For example, some early writers, Galiani, Bentham and Lloyd, still used the literary method (Kauder, 1965, 31). Also, Menger, unlike the other two pioneers, followed this non-calculus tradition.

Different from Jevons and Walras, Menger employed arithmetic tables, the quantities were originally discontinuous in his models, so he did not need to alter his analysis to consider indivisible goods (Menger, 2007, pp. 125–128), and he interpreted

his marginal thought without continuous variation. Menger even emphasized discontinuities repeatedly in other parts of his work (Howey, 1989, p. 45; Menger, 2007, pp. 118, 140, 145, 162). In addition, Menger's immediate successors in Vienna also never used continuous functions (Howey, 1989, p. 45).

3.5. Measurement

Jevons, Menger and Walras all implied the measurability of pleasures, wants, or utilities. They assumed the measurability of these things, but no one ever measured them in quantities. Hence, the measurement of subjective quantities is still a lively topic in modern economics (Howey, 1989, p. 46). Generally, Jevons was the most explicit. Jevons denied that utility was directly measurable, but he devised a way of measurement: money (Stigler, 1950, p. 317). Menger and Walras said nothing about the existence of utility as indicative of an equally complete acceptance, and they both glossed over measurability of utility (Stigler, 1950, p. 317).

> This problem worried Menger least (Howey, 1989, p. 46):
>
> I need hardly point out that the figures in the text are not intended to express numerically the absolute but merely the relative magnitudes of importance of the satisfactions in question. Thus when I designate the importance of two satisfactions with 40 and 20 for example, I am merely saying that the first of the two satisfactions has twice the importance of the second to the economizing individual concerned. (Menger, 2003, p. 183)

Menger unintentionally introduced the cardinal utility, because he stated that the first satisfaction was twice the second. He chose both a zero point and a certain unit of measurement, while the smallest satisfaction would add nothing to the total satisfaction and the greatest satisfaction would have an arbitrary importance of value of ten. In between these two extremes, there were nine other stages of satisfaction (Howey, 1989,

pp. 46–47; Menger, 2003, pp. 125–128). However, Menger's Austrian successors did not follow his cardinal ways but generally adopted the ordinal measures.

Walras thought that utility was immeasurable at least at his time, but he also anticipated that it could be measurable (Howey, 1989, p. 47). He could not find a way of measuring utility but assumed later economists would discover such a way (Walras, 2007, p. 117). Walras assumed a cardinal measurement of utility, but he did not clarify it. However, he admitted that his assumption made his utility functions not determinable, and demand functions based on utility functions should be empirical (Walras, 2007, p. 126). Hence, demand could be measured so that the utility could be inferred from demand measures. Walras stopped the discussion at Dupuit's error and pointed out that he had regarded all the inadequacies of the analysis of Dupuit, which was failure to perceive "the maximum pecuniary sacrifice which a consumer is willing to make" (Walras, 2007, pp. 445–446; Howey, 1989, p. 47).

Among the three pioneers, Jevons was the only one who offered the hope that, although measurement was impossible at his time, it might be possible in the future (Howey, 1989, p. 47; Jevons, 2012, p. 9). Jevons pointed out that measurement had come slowly in studies other than economics (Howey, 1989, p. 47): "Previous to the time of Pascal, who would have thought of measuring doubt and belief?", and he gave a series of examples, including petty games of chance, electricity, and heat (Jevons, 2012, pp. 9–10).

> We know it as a magnitude before we give it a name: any child can discover the more that there is in a bullet, and the less that there is in a cork of twice its size. Had it not been for the simple contrivance of the balance, which we are well assured (how, it matters not here) enables us to poise equal weights against one another, that is, to detect equality and inequality, and thence to ascertain how many times the greater contains the less, we might not to this day have had much

clearer ideas on the subject of weight, as a magnitude, than we have on those of talent, prudence, or self-denial, looked at in the same light. All who are ever so little of geometers will remember the time when their notions of an angle, as a magnitude, were as 'vague as, perhaps more so than, those of a moral quality; and they will also remember the steps by which this vagueness became clearness and precision.' Now there can be no doubt whatever that pleasure, pain, labour, utility, value, wealth, money, capital &c. are all notions admitting of quantity: nay, the whole of our actions in industry and trade certainly depend upon comparing quantities of advantage or disadvantage. (Jevons, 2012, p. 11)

Jevons also mentioned Bentham's measurement of pleasure and pain to test legislation,

but Jevons did not know where to find Bentham's numerical data (Jevons, 2012, pp. 11–

12). In spite of this, Jevons had a strong belief in the abundance of data in political

economics:

'Then where', the reader will perhaps ask, 'are your numerical data for estimating pleasures and pains in Political Economy?' I answer, that my numerical data are more abundant and precise than those possessed by any other science but that we have not yet known how to employ them… The private account books, the great ledgers of merchants and bankers and public offices, the share lists, price lists, bank returns, monetary intelligence, Custom-house and other Government return, are full of the kind of numerical data required to render Political Economy an exact mathematical science. (Jevons, 2012, pp. 12–13)

However, Jevons said he failed to apply this large amount of data in his theory, and

Jevons did not construct utility curves from these data, for two reasons: "want of

methods" and "want of completeness" (Jevons, 2012, p. 13). So Jevons's failure to use

the data was his first problem, and his second excuse seemed to contradict his belief in

the abundance of data (Howey, 1989, p. 48). "I know not when we shall have a perfect

system of statistics, but the want of it is the only insuperable obstacle in the way of

making Political Economy an exact science." (Jevons, 2012, p. 14). Jevons mentioned the

importance of "perfect statistics" as the prerequisite for his measurement of utility.

> We can no more know or measure gravity in its own nature than we can measure a feeling, but just as we measure gravity by its effects in the motion of a pendulum, so we may estimate the equality or inequality of feelings by the varying decisions of the human mind. The will is our pendulum, and its oscillations are minutely registered in all the price lists of the markets. (Jevons, 2012, p. 14)

Unlike Walras, who thought that utility could be only roughly inferred from demand, Jevons believed that utility could be exactly measured unless economics became an "exact science" and his expected "perfect statistics" was created. Instead of finding "perfect statistics," Jevons used demand functions as "approximations of utility function with price as a rough measure of marginal utility" (Howey, 1989, pp. 48–49). Hence, though failing to find a direct way of measurement, Jevons thought that utility could be exactly measured through demand, just like gravity measured indirectly through pendulum in physics.

Elsewhere, Jevons talked about measurement with a more cautious attitude: "Because we have no means of defining and measuring quantities of feeling, like we can measure a mile, or a right angle, or any other physical quantity" (Jevons, 2012, p. 19). This attitude was opposite to his earlier high hope that utility could be exactly measured cardinally. Instead, Jevons limited himself to an ordinal view of utility (Howey, 1989, p. 49):

> But we only employ units of measurement in other things to facilitate the comparison of quantities; and if we can compare the quantities directly, we do not need the units… I should not for a moment think of claiming for the mind any accurate power of measuring and adding and subtracting feelings, so as to get an exact balance. We can seldom or never affirm that one pleasure is a multiple of another in quantity… It seldom involves the comparison of quantities of feeling differing much in amount. (Jevons, 2012, pp. 19–20)

Jevons then returned to his cardinal conception when considering pleasure and pain (Howey, 1989, p. 49): "Two days of the same degree of happiness are to be twice as much desired as one day; two days of suffering are to be twice as much feared" (Jevons, 2012, p. 35), which implied his consideration in cardinal utility. However, using the graph in Figure 3.3, Jevons also assumed the diminishing intensity of the pleasure in the equivalent unit of time. Specifically, "utility must be considered as measured by, or even as actually identical with, the addition made to a person's happiness" (Jevons, 2012, p. 53–54). Then like Walras that utility was inferred from demand, Jevons used demand curves as approximations of utility curves as he designed in the previous passages, only after he introduced utility functions in the determination of exchange rates, and the utility functions in the analysis of exchange assumed cardinal utility. However, this assumption did not stand out, because he "used a general functional notation and illustrated his conclusions with graphs of utility curves that retain only the principal characteristics he attributed to his generalized functions," so he missed "some of the concreteness he had found in the physical sciences where the investigator determines the shape and parameters of the functions he uses" (Howey, 1989, p. 49–50).
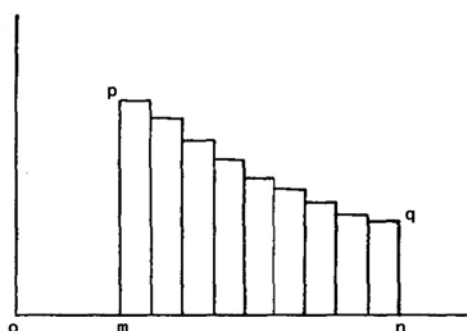
Figure 3.3[18]

Third, Jevons discussed the measurement of utility, returning to an optimistic tone

by assuming the utility of money was constant (Howey, 1989, p. 50):

> And if we could tell exactly how much people reduce their consumption of each
> important article when the price rises, we could determine, at least approximately
> the variation of the final degree of utility — the all-important element in
> Economy. (Jevons, 2012, p. 140)

"For the first approximation we may assume that the general utility of a person's

income is not affected by the changes of price of the commodity" (Jevons, 2012, p. 140).

Hence, we can get the equation:

$$\phi x = m.\psi c$$

Here, m was the existing ratio of exchange. "We may have many different corresponding

values for x and m, we may treat ψc, the utility of money, as a constant, and determine

the general character of the function ϕx, the final degree of utility" (Jevons, 2012, p. 141).

Using this assumption, Jevons could finally approximate, not just infer, utility curves

with demand curves (Howey, 1989, p. 50).

3.6. Interpersonal Comparison

Bentham's assumption of subjective utility meant that utility varied across

individuals. Though Jevons, Menger and Walras all supposed cardinal measurement of

utility, none of them found a way to compare interpersonally, because the units that one

individual chose had no relation to the units that another chose (Howey, 1989, p. 51).

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[18] The graph is redrawn according to Jevons (2012, p. 36).

Only Jevons emphasized the impossibility of interpersonal comparison (Howey,

1989, p. 51). Menger avoided the topic and Walras made only an incidental comparison

(Stigler, 1950, p. 318). Jevons explained:

> The reader will find, again, that there is never, in a single instance, an attempt made to compare the amount of feeling in one mind with that in another. I see no means by which such comparison can ever be accomplished. The susceptibility of one mind may, for what we know, be a thousand times greater than that of another. But, provided that the susceptibility was different in a like ratio in all directions, we should never be able to discover the profoundest differences. Every mind is thus inscrutable to every other mind, and no common denominator of feeling is possible. (Jevons, 2012, p. 21)

Though all three pioneers avoided interpersonal comparison, they had a few rough

discussions about its possibility (Howey, 1989, p. 51). Jevons's attempt to compare the

marginal utility of the same amount of money for poor and rich people (Jevons, 2012, p.

133) contradicted his claim of the impossibility of interpersonal comparisons. But if his

assumption of constant utility of money income was questionable, utility of money to

different individuals was as subjective as other goods and also could not be directly

compared. Menger indicated the difference in the value according to importance of

satisfaction among different individuals: "For the use value of one and the same good is

usually very different for two different individuals, since it depends upon the

requirements of and quantities available to each of them" (Menger, 2003, p. 299). Walras

faced the difficulty without the assumption of interpersonal comparison, while analyzing

free competition maximizes the utilities of an economy (Howey, 1989, p. 52).

> Though Walras supposes that rareté can be defined as a cardinal magnitude, nowhere does he allude to any actual addition of the utilities enjoyed by different persons… Either Walras means by maximum utility for society as a whole a situation in which it is impossible to increase the utility of any one party without decreasing that of another once competitive equilibrium has been attained or he

means something so vague as to defy any clear interpretation at all. (Walras, 2007, p. 511, translator's notes)

3.7. Utility Function

None of these three economists explicitly discussed the form of the utility function that they used, and all of them used the utility function in which the marginal utility of a good depended only on the quantity of that good alone, without any other variable, such as the income, the distribution of the income, the quantity consumed by other people, and complementary and substitute goods (Howey, 1989, p. 53). Moreover, the economists' analyses were static, mentioning the importance of time but not including it in their basic models. Although their analyses were limited to their time periods, they focused on repudiating the classical political economy and establishing new theories of their own, instead of further interpreting them. Even though Jevons, Menger and Walras failed to develop their theories more deeply, the work of these pioneers still influences modern economic study, in which many mainstream beginning economics textbooks repeat their static utility-quantity analysis.

All three economists emphasized that "the marginal utility decreases when the quantity of the good increases,"—that is, the law of diminishing marginal utility—and none of them gave an exception to this fundamental law (Howey, 1989, p. 53). As Jevons said:

> No commodity can be named which we continue to desire with the same force, whatever be the quantity already in use or possession. All our appetites are capable of satisfaction or satiety sooner or later, both these words meaning, etymologically, that we have had enough so that more is of no use to us. (Jevons, 2012, pp. 62–63)

All of Jevons' curves were concave. Both the tabular representations of Menger and the curves from Walras's first edition were linear. The second edition of Walras quoted Dupuit, who assumed the utility curve was concave. Concave utility functions implied the assumption of risk aversion that commonly existed in individuals' decision-making, which became a basic assumption of the demand theory of marginalism and later neoclassical economics.

Jevons, Menger and Walras all analyzed the utility function only in static forms and never used dynamic functions; though they all mentioned "time," they passed dynamic analysis to their successors. For example, Jevons explained:

> It is only as a purely statical problem that I can venture to treat the action of exchange… If we wished to have a complete solution of the problem in all its natural complexity, we should have to treat it as a problem of dynamics. But it would surely be absurd to attempt the more difficult question when the more easy one is yet so imperfectly within our power. (Jevons, 2012, pp. 93–94)

Similarly, Walras stated:

> I am assuming that, during this interval, the utility both extensive and intensive, remains fixed for each party, which makes it possible for me to include time implicitly in the expression of utility. Were this not the case and had I supposed utility to be a variable functionally related to time, then time would have to figure explicitly in the problem. And we should then have passed from economic statics to economic dynamics. (Walras, 2007, p. 117)

Menger essentially agreed:

> Even if human needs can be considered unlimited in their development into the most distant periods of the future, they are nevertheless capable of quantitative determination for all given, and especially for all economically significant, time periods. Thus, even under the assumption of uninterrupted progress in the development of human needs, we have to deal with finite and never with infinite, and thus completely indeterminate, magnitudes if we concern ourselves only with definite time periods. (Menger, 2003, p. 83)

The three pioneers emphasized the importance of dynamic analysis and saw their incapability to complete such work. Moreover, they implied that they believed that their static analysis could fit with dynamic analysis to some degrees in the future.

3.8. Abstract Quality

Jevons, Menger and Walras all assumed that satisfaction from diverse goods had a common abstract quality, so that an individual could sum it up and compare different goods personally (Howey, 1989, p. 55). This idea was similar to Bentham's felicific calculus—making utility an identical quantitative concept and not for qualitative analysis, which met the need of applying mathematics to make social analysis empirical and scientific, so none of the three pioneers would like to discuss more about the usefulness of goods within the classical framework. In their work, utility was an abstract, homogenous concept, different from heterogeneous usefulness in classical economics. This characteristic might influence their successors to focus on quantitative analysis and ignore the qualitative aspects of social phenomena for a long period. Qualitative analysis might be suited for finding what factors fit a social phenomenon well, so without it economics might incorrectly analyze a phenomenon, such as a crisis.

Though interpersonal comparison seemed impossible at their time, the abstract quality of utility allowed for the possibility of comparison of utility derived from different goods for an individual, and the marginal utility of income (or money) was acquired from this assumption of comparability. However, neither Menger nor Walras explicitly referred to this idea or used the idea in subsequent analysis; only Jevons had a

good notion of the marginal utility of income and made considerable use of it (Howey, 1989, p. 55). As his definition of marginal utility of income,

> it will be seen that we can now conceive, in an accurate manner, the utility of money, or of the supply of commodity which forms a person's livelihood. Its final degree of utility is measured by that of any the other commodities which he consumes. (Jevons, 2012, p. 133)

Jevons used the example of the utility of a penny for a poor family and a rich family to illustrate that the reason that marginal utility of income decreased as income increased was the same as the reason for diminishing marginal utility of goods (Jevons, 2012, p. 133). Before the introduction of marginal utility of income, Jevons presumed the marginal utility of money to be constant:

> A person's expenditure on salt is an inconsiderable item of expense; what he spends thus does not make him appreciably poorer; yet, if he established price or ratio is one penny for each pound of salt, he buys in any time, say one year, so many pounds that an additional pound would not have so much utility to him as a penny. (Jevons, 2012, p. 112)

However, in another example of meat, Jevons explained,

> this case must not be confused with that of purchases which appreciably affect the possessions of the purchaser. Thus, if a poor family purchase much butchers-meat, they will probably have to go without something else. The more they buy, the lower the final degree of utility of the meat and the higher the final degree of utility of something else;[19] and thus these purchases will be the more narrowly limited. (Jevons, 2012, p. 113)

Jevons used the graph in Figure 3.1 to show that with a curve of constant marginal utility of income and a curve of diminishing marginal utility of bottles of ink, the optimum number of bottles of ink was decided by the curves' intercept point (Jevons, 2012, pp.

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[19] This statement also implied that Jevons realized that the utility of a good changed with the consumption of its complementary and substitute goods.

125–126) "This was the first demand curve ever drawn that makes explicit the assumption of the constancy of marginal utility of income" (Howey, 1989, p. 56)

3.9. Maximization of Utility

Different from early writers on utility such as Bernoulli, Senior, and Dupuit, who never used utility for analysis of equilibrium in exchange, Jevons, Menger and Walras all used their utility functions in connection with the problem of exchange and value, which was "the most important advance in utility analysis and the beginning of the Marginal Utility School" (Howey, 1989, p. 56). Though the pursuit of self-interest had been long accepted among economists, the notion of maximization of utility that determined economic quantities such as value and output was a relatively fresh idea. This approach was different from the prevailing focus on "needs" in classical political economy, which should be "enough"; and instead utility was more related to "wants," which should be "more" and could be maximized.

Instead of the maximization, Menger talked about the notion of "effectiveness" at the beginning of his discussion of economy:

> In what follows, it will first be shown how men arrive at a knowledge of their requirements for future time periods; it will then be shown how they estimate the quantities of goods that will be at their disposal during these time periods; and finally a description will be given of the activity by which men endeavor to direct the quantities of goods (consumption goods and means of production) at their disposal to the most effective satisfaction of their needs. (Menger, 2003, p. 80)

Jevons also talked about the maximization of utility:

> To satisfy our wants to the utmost with the least effort — to procure the greatest amount of what is desirable at the expense of the least that is undesirable — in other words, to maximise comfort and pleasure, is the problem of Economy. (Jevons, 2012, p. 44)

50

The principle of maximization of utility in exchange appeared as a broad

empirical observation in Walras's first edition but was reduced to a hypothetical

proposition in his second edition (Walras, 2007, pp. 569–570, translator's notes). Walras

described the maximization of utility with his equations and graphs, and included an

example of the description of the maximum condition:

> If we suppose that his object in trading is to gratify the greatest possible sum total of wants, then, surely d_a is determined for a given p_a by the condition that sum of the two areas, Oy β $\beta_{r,1}$ and Od$_a$ α $\alpha_{r,1}$ be maximized. Now the condition of such a maximum is that the ratio of the intensities $r_{a,1}$ and $r_{b,1}$ of the last wants satisfied by the quantities d_a and y, i.e. the ratio of their respective raretés upon completion of this exchange, be equal to the price p_a. (Walras, 2007, p. 121)

However, regrettably, the three economists failed to obtain the maximizing

conditions, by "pointing to the quantities to be maximized, then stating the conditions to

which the maximization was subject (budget conditions), and next developing at least the

necessary conditions (if not the sufficient) for a maximum," and all of them,

> began their analysis, not with the total utility function of the consumer, of which all three certainly knew the importance, but with the marginal utility functions which they could use immediately to express the conditions of the maximum. (Howey, 1989, pp. 57–58)

On the topic of maximization, later neoclassical economists such as Hicks studied

these economists' problems and more completely analyzed the assumption of human

insatiable wants and scarcity of resources.

3.10. Demand Function

Menger had a loose idea of demand functions and presented them with only a few

verbal references (Howey, 1989, p. 59): "The higher or lower level of the price has, as we

saw, a very important influence on the total sales of a commodity as well as on the

quantity that each competing buyer will actually acquire" (Menger, 2003, p. 219). In addition, Menger discussed pricing under bilateral monopoly, duopoly, and competition (Stigler, 1950, p. 318).

Walras began his analysis with given demand curves and got his equilibrium without saying a word about utility, but he later introduced utility as the foundation of his demand curves (Howey, 1989, p. 59). The Walrasian demand function was the relationship between the quantity and all prices of a commodity, holding individuals' money and utility functions constant (Stigler, 1950, pp. 319–320):

> If, in fact, prices result mathematically from demand curves, the causes and primary conditions that generate and affect demand curves will also generate and affect prices… It depends upon a certain kind of utility of the commodity which we shall call extensive utility… It depends upon another type of utility of the commodity which we shall call intensive utility. (Walras, 2007, pp. 115–116)

Both the extensive utility and the intensive utility were the one attribute of utility, and utility was still the only basis of Walras's prices and demand curves.

Jevons hoped to discover some ways to obtain data for utility curves, but he failed. Though Jevons's demand curves were similar to Walras's, they were founded on different assumptions. Jevons's curves, with the assumption that the exchange did not change the marginal utility of his own good, namely the constant marginal utility of money, were approximations of utility function with price, which were more similar to the demand curves that later became popular (Howey, 1989, pp. 59–60). However,

Jevons's attempt to connect utility and demand was seriously hampered, probably due to his inability to translate his thoughts into mathematics (Stigler, 1950, p. 318).[20]

3.11. Repudiation of Labor Theory of Value

In the late nineteenth century, the labor theory of value had more prestige and more followers than any opposing theory of value, but Jevons, Menger and Walras all explicitly repudiated the labor theory of value, and this repudiation shaped a common bond among them (Howey, 1989, p. 58). The reason that they rejected the labor theory of value was probably the essential difference in economic valuation. They intended to establish a new utility theory of value and the subsequent economic theory based on it, which fundamentally contradicted the production cost or labor theory of value. No matter whether they subverted the dominance of the classical political economy, their efforts shook it and developed the utility theory of value.

> Surely, if labour has value and is exchangeable, it is because it is both useful and limited in quantity, that is to say because it is scarce. Value, thus, comes from scarcity. Things other than labour, provided they are scarce, have value and are exchangeable just like labour itself. So the theory which traces the origin of value to labour is a theory that is devoid of meaning rather than too narrow, an assertion that is gratuitous rather than inacceptable. (Walras, 2007, p. 202)

Walras thought that labor was part of scarcity, because scarcity was also the subjective evaluation of the available resources. But he did not explicitly discussed labor, so Walras's argument would certainly ruffle those who accepted labor as the objective value determinant.

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[20] Stigler suspected that Jevons's fundamental equation for the maximization of utility in exchanges, which was presented as $\frac{MU_1}{MU_2} = \frac{p_1}{p_2}$, could be satisfied only for fixed prices, not for competitive markets (Stigler, p. 1950, p. 318).

Menger critiqued the labor theory of value even more harshly than Walras (Howey, 1989, p. 58):

> Among the most egregious of the fundamental errors that have had the most far-reaching consequences in the previous development of our science is the argument that goods attain value for us because goods were employed in their production that had value to us... Here I want to state, above all, that this argument is so strictly opposed to all experience (p. 146[21]) that it would have to be rejected even if it provided a formally correct solution to the problem of establishing a principle explaining the value of goods. (Menger, 2003, p. 149)

Menger thought that labor was just a specific cause for production, unlike satisfaction, which was the essential determinant of economic value and both consumption and production.

Because Jevons was from England, where the labor theory of value was most developed, Jevons risked more by rejecting the labor theory of value than Menger or Walras (Howey, 1989, pp. 58–59).

> Labour affects supply, and supply affects the degree of utility, which governs value, or the ratio of exchange... I hold labour to be essentially variable, so that its value must be determined by the value of the produce, not the value of the produce by that of the labour. (Jevons, 2012, pp. 160–161)

Jevons thought that labor was a factor that influenced utility just from the supply side, but he still applied the traditional framework of labor, rent, and capital to analyze production. He might have used this approach because he was in England, so he might have felt he needed to reconcile his utility theory with the prevailing theory at the time (Howey, 1989, p. 59). Nonetheless, he had a few firmer arguments to reject the labor theory of value, before conciliatorily explaining the relationship between labor and utility.

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[21] Menger mainly talked about the subjective nature and measure of value, and then the importance of satisfaction on this page.

> The fact is, that labour once spent has no influence on the future value of any article: it is gone and lost for ever. In commerce, bygones are for ever bygones; and we are always starting clear at each moment, judging the values of things with a view to future utility. Industry is essentially prospective, not retrospective; and seldom does the result of any undertaking exactly coincide with the first intentions of its founders. (Jevons, 2012, p. 159)

By repudiating the labor theory, Jevons further rejected the classical theory of production and reproduction. His prospective views might partly reflect his marginalism (focusing on the change) and the limitation of static analysis (considering just the single production process).

3.12. More Applications

As for the application utility theory, Jevons gave only one application, which was a demonstration that "both parties to an exchange gain satisfaction" (Stigler, 1950, p. 320).

Menger made utility theory the basis of his economic theory. "It explained exchange, the wages of textile workers during the Civil War cotton shortage, the shifts of goods between free and economic, etc… The theory of production became simply an instance of the theory of marginal utility…" (Stigler, 1950, p. 320).

Walras applied utility theory in the several aspects, including the value of productive services determined by the values of products, demand-curve analysis, the distribution of stocks, and welfare economics (Stigler, 1950, p. 320–322).

Chapter Four: Discussion

A revolution means "a sudden, radical, or complete change" (Merriam Webster Online). In the history of economics, for example, there are two revolutionary works universally acknowledged by economists. One is Adam Smith's *An inquiry into the nature and causes of the wealth of nations* in 1776 and the other is John Maynard Keynes's *The general theory of employment, interest and money* in 1936. The former, together with Steuart in 1767, was the fundament of classical economics and made political economy an independent subject, and the latter challenged both classical and neoclassical economics the most and was regarded as a start of modern economics. Alfred Marshall's *Principles of economics* in 1890, which brought the ideas of marginal utility and cost of production into a coherent whole, might also be considered revolutionary.

The "Marginal Revolution" usually refers to "the nearly simultaneous but completely independent discovery in the early 1870's by Jevons, Menger and Walras of the principle of diminishing marginal utility as the fundamental building block of a new kind of static microeconomics" (Blaug, 1972, p. 269). Hence, compared with Smith, Keynes and Marshall, can the works of Jevons, Menger and Walras in the 1870s be also seen as revolutionary?

4.1. Period

The first part of the meaning of a revolution is its taking place in a relatively short period of time. To clarify the period of the "Marginal Revolution," I divide it into three stages. The first stage is the preliminary introduction of the idea of utility, including its definition and studying method. In spite of some early writers, such as Galiani and Turgot, who had some disputable ideas of utility and usefulness, among the many people who held the explicit opinions of utility, Daniel Bernoulli and Jeremy Bentham's innovation are representative of the first stage. Bernoulli was the first writer to unambiguously publish a statement of the law of diminishing marginal utility, also introducing the application of advanced mathematics into economic problems, and Bentham presented his utilitarianism and felicific calculus in social theory, suggesting that utility as a subjective factor can be used to quantitatively judge the tendency of an action and then the economic value. The second stage is the first presentation of the marginal utility theory. Jules Dupuit applied the marginal utility theory to a real problem of determining bridge tolls, and Hermann Heinrich Gossen explicitly presented marginal utility theory and its implication for individual behaviors in a market economy. William Forster Lloyd's *A lecture on the nature of value* in 1833 also explicitly included the marginal utility theory but failed to elaborate its implications (Seligman, 1903, pp. 335–363). Nassau William Senior's *An outline of the science of political economy* in 1836 said that the final degree of utility was the "ultimate determinant of demand" but also did not pursue its implications (White, 1992), and William Stanley Jevons, in his *On the study of periodic commercial fluctuations* in 1862, claimed that utility was subjective and value

was determined by marginal utility as well. These works laid a solid foundation for the third stage, the peak of the "Marginal Revolution." The third stage is the mature and complete presentation of marginal utility theory in the 1870s, which is usually known as the "Marginal Revolution". Jevons, Menger and Walras independently explicitly introduced the law of marginal utility, explained that marginal utility determined value, and presented other related implications and applications to economics, challenging the dominance of the classical political economy at the time.

However, the process of this challenge needed a period to be recognized and verified, and their theories based on utility-determined value still needed further development, so the works of Jevons, Menger and Walras were not widely accepted into mainstream economics in the late nineteenth century. After the "Marginal Revolution," several writers reintroduced, completed, proved, and further applied marginal utility theory. For example, Böhm-Bawerk's *The positive theory of capital* in 1888 and Wieser's *Natural value* in 1889 introduced marginal utility to the theory of capital and the theory of distribution; Marshall's *Principles of economics* in 1890 synthesized the theory of utility and the theory of cost of production into an independent system, marking the birth of neoclassical economics; Clark's *The distribution of wealth* in 1899 put forward a complete theory of marginal productivity; Pareto's *Manual of political economy* in 1906 presented the theory of cardinal utility and verified Walras's general equilibrium; Pigou's *The economics of welfare* in 1920 applied the marginal utility theory to formulate neoclassical welfare economics; moreover, Hicks's *Value and capital* in 1939 applied indifference curves and rigorously developed Walrasian equilibrium into the general

equilibrium in stability conditions; then, through Samuelson's *Foundations of economic analysis* in 1947, neoclassical economics developed into the modern form (Kan, 2008, p. 79).

In terms of time, the "Marginal Revolution" was a process, not an event (Blaug, 1972, p. 280). Before the "Marginal Revolution," the development of subjective utility valuation and application of advanced quantitative methods had experienced a long period of more than one hundred years, since Bernoulli and Bentham, not only a short period in the 1870s. Even though the works of the earlier writers before the 1870s were not as decisive as the works of Jevons, Menger and Walras, their efforts were relatively original and laid the foundation of the "Marginal Revolution"; Jevons, Menger and Walras mainly made utility theory a relatively complete system. So the works of Jevons, Menger and Walras in the 1870s should not be seen as a revolution on their own.

The coincidence that the three pioneer economists published their works about the same topic at the same time probably determined that the 1870s were remarkable, but we should consider the long disputes about utility and value that proceeded them, as well as their predecessors, who laid the foundation for the maturity of marginal utility theory. Also, the "Marginal Revolution" occurred in the late nineteenth century, when natural sciences were significantly developed and started to influence people's life and other subjects, and Jevons, Menger and Walras's work was consistent with this trend. All in all, the coincidence of the three works published at the same time and the influence of natural sciences in the late nineteenth century seemingly made the "Marginal Revolution" remarkable, but in fact the revolution had been brewing for a long time.

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4.2. Change

The second part of the meaning of a revolution is a fundamental change. In order to recognize the change of the "Marginal Revolution," we ought to consider what significance it had and how it influenced the history of economics.

4.2.1. General Discussion on the Utility Theory of Jevons, Menger and Walras

By examining the works of Jevons, Menger and Walras, we see several features of their utility theory. First, utility or marginal utility was the only determinant to economic value, and they repudiated the cost of production theory and the labor theory of value. This feature made their economic theory partial to the discussion of demand and consumption and use utility to explain the theory of supply and production. Though all three of the economists recognized the side of supply and production, with the introduction of indirect utility, they still thought that utility determined both sides, refusing to accept production cost as the direct determinant of supply and production. Considering the time during which the three economists were writing, when the production theory of value of the classical political economy prevailed, it might be reasonable that three economists repudiated the mainstream theory intensively, to establish a new theory of value. About twenty years later, Alfred Marshall tried to synthesize both the marginal utility theory from marginalism and the cost of production theory from classical economics into a coherent whole. With utility (or marginal utility) as the determinant of the demand side, and cost (or marginal cost) as the determinant of the supply side, the equilibrium of the two sides determined the economic value, which

became the fundamental economic evaluation of neoclassical economics.[22] At this point, though the Marginal Utility School significantly pushed the development of the theory of utility, demand, and consumption, their less emphasizing on the theory of cost, supply and production made their theory hard to be considered as the start of neoclassical economics.

Second, utility, from Bentham to the Marginal Utility School, had two representative features, different from the term usefulness in classical economics. Utility was not an intrinsic property of a good; it was the judgment of an individual to tell the importance of a good for him or her. Hence, utility was highly subjective. Also, because utility was related to the importance of a good to an individual, such importance could become homogenous and be quantitatively considered. Thus, utility had two features, subjectivity and identity. Then the features were also applicable to utility in neoclassical economics. However, these two features brought a contraction while utility was studied. On the one hand, utility was a homogenous quantity; with the application of mathematical methods, utility and its subsequent economic value could be easily recognized and proved, at least on the theoretical level. On the other hand, as the Jevons, Menger and Walras encountered, unlike cost of production, there were not effective ways to measure and interpersonally compare utility. Hence, utility, as economic valuation remaining the foundation of marginalism and neoclassical economics, seemed to lack a basis in the real world, unless the problem of its measurement and interpersonal comparison could be solved.

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[22] Marshall expected to synthesize the theory of utility and cost of production, but his synthesis laid the emphasis on utility theory. After Marshall, Clark and his marginal productivity was the key for neoclassical production theory.

Third, the methods that the three economists applied in their works also had some similar features. Because utility was the only determinant in their economic theory and utility was homogenous, their analysis, especially that of Jevons and Walras, widely applied quantitative methods. The application of equations and graphs made their arguments straightforward and rigorous, but they more or less ignored qualitative analysis. Due to this transformation, economics tended to be a science. However, an essential goal of economics, which was studying the relationship between humans and resources, remained unchanged. Economists began to dispute which approach was good for economic study and how each approach defined the implication of economics. Hence, in the late nineteenth century, not only did natural sciences begin to have a significant influence on economics, but several schools also challenged the dominance of the classical political economy, making economics a lively subject in this period. Moreover, when talking about the approach of marginalism, the application of the marginal amount seemed to be the only incontrovertible contribution of the Marginal Utility School to economics. With the development of advanced mathematics and its introduction by Bernoulli and other writers to social theory, the marginal amount, like the total or average amount, had become important to economic analysis. Based on the differential, marginal amount represented the change of a quantity, which could be applied for explicit prediction in the adjacent future with the empirical data and theoretical assumption.

Fourth, there were some possible deficiencies, at least regarding utility theory, in the Marginal Utility School. Except for the representative features discussed above, there were also some disputable points in the works of Jevons, Menger and Walras. For

example, the three economists believed that the measurement of utility was cardinal and assume static situations, excluding time and other factors.[23] Not only introducing the marginal amount, the three economists elaborated upon marginal utility theory, such as the exchange theory and the utility function, and they formed a relatively complete theory of demand and consumption, which was later succeeded by neoclassical economists, but their analysis on the side of production and supply seemed less and needed amending.

Hence, although the "Marginal Revolution" created a relatively complete theory of utility, demand, consumption, and marginal analysis, the significance of the "Marginal Revolution" should be reconsidered.

4.2.2. Two Central Topics

Because the subjective utility theory of value and marginal analysis were the major achievements of the "Marginal Revolution," it is necessary to discuss more about these two central topics.

From a philosophical perspective, value is neither a connection inside an object nor a connection among objects, but a connection between subjects and objects (Zhang, 2001, p. 24). Value includes moral value, political value, economic value and so on; we consider only economic value here. Because value connects both subjects and objects, it must have both subjective and objective features. The two prevailing theories of economic value in the nineteenth century, the labor theory of value and the utility theory of value, also had these two features. However, because labor was the measurement of cost of production that had more objective features, and utility was the measurement of

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[23] Because this thesis does not cover the development of utility theory after Jevons, Menger and Walras, the correctness of this theory cannot be evaluated in this thesis, from a modern perspective.

individual preference that had more subjective features, usually the labor theory of value was considered objective and the utility theory of value was considered subjective. Hence, the subjective utility theory of value was not subjectively arbitrary or non-related to the objective. Utility, the measure of preference, was related to the objective world but varied across individuals, time, and environment. As for labor, the utility theory of value of the Marginal Utility School thought that labor was actually disutility that generated pain and was one of the factors that determined the supply side, so utility was the essential determinant of economic value. Both the theories of value became fundamental parts of the economic theory for the different schools, and they each repudiated the other. Here, we only continue discussing the utility theory of value. Relatively, utility theory of value emphasized the subjective aspect of value. Because a subject could be an individual, a society, or the entire human world, compared with labor or cost of production, which focused on the objective aspect of value, studying subjects was relatively directly observed and easily understood[24], probably because we were the subjects. If preference was assumed to be continuous, it could be described by real numbers. Though individual wants were insatiable, under certain constraints, individuals tried to satisfy their preferences. Based on this principle, all microeconomic principles and functions, from the individual level to the market, could be derived, which provided the effective way to quantitatively think about microeconomic problems. Since this thesis is only about the utility theory of value, more discussion on the cost theory of value is needed, before comparing the two value theories. However, both the two value theories must have

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[24] However, this easiness probably needs at least one of the two prerequisites. One is that economists find effective ways to measure utility, and the other is that economists establish cogent assumptions based on their empirical observation.

cogent and weak aspects, and with the development of economics, economists supporting either one of the two theories could renovate their theory and synthesize the advisable part of the other value theory. Alternatively, economists could discover a new theory of value to better balance subjects and objects, to focus on universality or difference, and to choose the ways to understand the world directly and easily or accurately and deeply.

As for marginal analysis, it studied the change of the dependent variable with one additional unit of the independent variable. Marginal thought could be accurately described by partial derivative in calculus in mathematics, so the two pioneers, Jevons and Walras spoke highly of the application of advanced mathematics and introduced it to social and economic analysis to interpret their marginal thought. Also, continuum was a property of calculus, so the quantitative analysis in Jevons and Walras needed the assumption of continuity for their economic quantities to apply calculus, which had been discussed in Part 3.4. However, marginal thought did not rely solely on the application of calculus. Though calculus was an effective tool, all of the three pioneers also described the diminishing law of marginal utility in their words, seen in Part 3.1, and one of them, Menger, did not use calculus but arithmetic tables to further interpret the law, without the assumption of continuity and divisibility. In all, among the three pioneers, Jevons and Walras adopted the continuous variation to interpret their marginal thought and apply it in their marginal analysis, and Menger did the same thing without the continuous variation. Hence, marginal analysis or marginal thought should be the other central topic for the marginal utility theory and the Marginal Utility School, instead of the continuous variation, which was probably a key for neoclassical economics. The marginal amount,

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either continuous or discontinuous, appeared while the traditional quantitative analysis mainly chose the total and average amount to describe and calculate the data, widely adopted by classical economics before the Marginal Utility School. The total and average amount focused on the past facts or historical data to summarize the law of several phenomena and estimate the future tendency. However, the marginal amount, like differentials in calculus, was used to study the local change of a quantity. Hence, in economics, marginal analysis could use the adjacently past facts to more explicitly explain the current situation, not relying on the large amount of the past data. Therefore, unlike the total and average amounts, which could be broadly used to analyze the laws and trends of social phenomena, marginal analysis could be more concrete and immediate for a limited period of time, and usually accepted by the individual and enterprise level. However, since the marginal amount studied the next additional change and relied on the adjacent data, simply using it, economic analysis would prefer the shorter term and even the static situation, which was different from the prevailing dynamic analysis of production and reproduction in classical political economy. This probably was the main reason that the static situation was assumed by the three pioneers in their utility function and they excluded time. In all, the adoption of marginal thought brought another way for economists to consider the current and static situation with a more exact method and an explicit perspective, especially suited for the development of microeconomics.

4.2.3. Shifting

> The standard history usually contains the comment that the advent of the Marginal Utility School marked the beginning of modern economics, in that it shifted the attention of economists from cost, or more specifically labor cost, to marginal utility in the explanation of value, and from nature to men in the wider picture. It

dates the beginning of 'subjective' or 'psychological' economics from this time. (Howey, 1989, p. 210)

To sum up, the central concept of the "Marginal Revolution," marginal utility, is important to the history of economics in the following respects. First, change from objectivity to subjectivity. The valuation of economic value is always a fundamental topic in economics. Utility, as an extrinsic property of goods with individuals' different and unstable judgments, was used for evaluation, giving economic value more subjective features. Second, change from the side of cost and production to the side of utility and consumption. Because marginal utility was regarded as the major determinant of economic value and it was more related to individuals' consumption, its introduction made economics switch its attention from the supply side to the demand side. Third, change from qualitative analysis to quantitative analysis. Different from use-value, to better and more easily know the usefulness of goods, utility was created as a convenient way to quantitatively measure the importance of a good for an individual and the tendency of individual behaviors. Utility does not consider the specific usefulness of goods, but one quantity abstracted from usefulness. Fourth, change from the total or average amount to the marginal amount. The marginal analysis was a tool to directly and explicitly study the economic value in a limited period of time, which was widely accepted by later economists. Also, to better use the marginal amount, economists applied advanced mathematical tools like calculus for more exact analysis, giving economic value the continuous and divisible feature. Fifth, change with more influence from the natural sciences. With the development of the natural sciences, the application of mathematics, psychology, and other fields gave economics more scientific features and

speeded up the professionalization of economic science. Also, interdisciplinary studies between economics and other fields, and more related topics involved, such as health, environment, and technology, helped people understand the world more widely and let economic theory play a more lively role for society.[25] Sixth, change with more assumptions. Because economists at the time of Jevons, Menger and Walras could not find a way to measure utility, the employment of utility needed to be abstracted from reality, with a series of assumptions, such as the static situation, the continuous variation and the cardinal measurement. Seventh, change with some new schools emerging. The rise of the Marginal Utility School and the introduction of marginal utility theory shook the dominance of classical economics. After the three pioneers, the Marginal Utility School influenced the foundation of several schools of economics, including the Lausanne School and Austrian School, and then Marshall. These transformations, no matter whether they were good or bad, brought new angles, new methods, and new implications to economics, expanding the possibilities for economic study.

Though writers before Jevons, Menger and Walras had recognized subjective valuation, applied the quantitative method, and introduced the thought of diminishing marginal utility, unlike the three pioneers they failed to develop the law into a complete system and extend its implications and applications. So, the works of Jevons, Menger and Walras should be considered as the peak of the "Marginal Revolution". After the peak, economists adopted and developed the methods of marginal analysis, time analysis, general equilibrium, and applied advanced mathematics. Starting in the 1870s, the objects

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[25] However, at the beginning stage of the interdisciplinary study, economists might simply impose the economic theory on the other subjects, which probably also brought the negative effects on both economics and the other subjects. Hence, the interdisciplinary study needs more consideration and further development.

of economic study gradually switched from cost and production, the classical

perspectives, to utility and consumption, and then both were integrated into the

neoclassical perspectives. At this point, economic thinking and economic methods were

indeed significantly changed through the "Marginal Revolution."

4.2.4. The Beginning of Neoclassical Economics?

Generally, neoclassical economics thought that economic value was determined

by the equilibrium of demand and supply, while demand was determined by marginal

utility and supply was determined by marginal cost of production. Alfred Marshall's

Principles in 1890, influenced by both the classical economists, such as Ricardo and J. S.

Mill, and the marginalists, such as Jevons, Menger and Walras, tried to bring the two

relatively conflicting economic streams of thought into a coherent whole, thereby

marking the birth of neoclassical economics.[26]

Marshall supported neither Ricardo nor Jevons but attempted to reconcile the two

writers (Howey, 1989, p. 78):

> It is then incorrect to say, as Ricardo did, that Cost of production alone determines value: but it is no less incorrect to make utility alone, as others have done, the basis of value. It is certainly true that utility is a condition of value always; and that in cases in which the supply of the commodity is fixed, utility determines price. It is true that the price of every commodity must be measure of its Final utility; that is of its value in use to those who are only just induced to purchase it. But it is not true that this Final utility determines value: for it changes itself, according to the Law of Demand, with every change in the amount of the commodity that is offered for sale. This amount, and therefore the Final utility of the commodity, depend upon the relation between the circumstances of supply and those of demand. (Marshall & Marshall, 1885, p. 148)

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[26] However, this thesis does not focus on Marshall. Whether Marshall succeeded in synthesizing the theories of the two schools, and which theory he was partial to, needs more discussion. Here, I assume that he did it but sort of emphasized on the marginalism, so the neoclassical economics and the Marginal Utility School had a more consistent relationship.

As Edmund Whittaker concluded, "just as he drew on the ideas of Jevons, so Marshall incorporated in his theories the doctrines of Mill on the side of production" (Whittaker, 1942, p. 453).

Because neoclassical economics synthesized the value theories of both of the two streams in the late nineteenth century, it is better to think that the start of neoclassical economics was Marshall's *Principles*, instead of the works of the Marginal Utility School in the 1870s. Hence, if my assumption is correct, the "Marginal Revolution" should not be thought of as the beginning of neoclassical economics.

There are some possible counterviews to this argument. The "Marginal Revolution" could be the start of neoclassical economics, for two possible reasons. First, though Marshall expected to absorb both the achievements of classical political economy and the Marginal Utility School, he did not succeed in synthesizing them. Though the economic value of neoclassical economics was apparently determined by the equilibrium of demand and supply, namely marginal utility and marginal cost, economic value was essentially subjectively determined. The production theory, based on the subjective theory of value and influenced by the subjective consumption theory, was also put on a subjective foundation. So the utility theory of value was the crucial change for neoclassical economics. It had been developed since Bentham's time, before Marshall and the Marginal Utility School. Also, supply depended on "discommodities" and production cost in Marshall's system was actually disutility, which was still part of utility theory, similar to the three pioneers who thought labor was an indirect factor to generate pain (negative utility) when they repudiated the labor theory of value. Hence, Marshall

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failed to bring the two streams into a coherent whole but mainly developed the utility

theory of marginalists in the 1870s, so my assumption that he succeeded in synthesizing

the two streams was not correct. Second, in the late nineteenth century, new methods like

marginal analysis, time analysis, general equilibrium, and applied advanced mathematics

established by the Marginal Utility School were directly passed to Marshall and then to

neoclassical economists. The similar analytical approaches might make people think that

Marshall was one of the direct successors of the "Marginal Revolution." These may be

two of the opposing views to the opinion that Marshall, with his *Principles of economics*

in 1890, was the beginning of neoclassical economics.

In all, since this thesis is mainly about the "Marginal Revolution" and the

marginal utility theory before and in the 1870s, more examination on the work of

Marshall and the later neoclassical economists is needed before the discussion on which

event could be considered as the beginning of neoclassical economics. However, there

are two vague differences between the utility theory in the 1870s and after Marshall. The

first is the continuous variation. Part 3.4 and Part 4.2.2 present that though the

assumption of continuous variation and the application of calculus could be an effective

way to describe the thought of marginal utility, in the process of the "Marginal

Revolution", representatives like Galiani, Bentham, Lloyd and Menger did not adhere to

the assumption of continuous variation, different from writers such as Bernoulli, Jevons

and Walras. Though the successors of the Marginal Utility School started to widely adopt

continuous variation as an important assumption, especially by neoclassical economists,

continuous variation was not a central concept for the "Marginal Revolution" and the

marginal utility theory before and in the 1870s. The second is the acceptance of the classical economic theory. Part 3.11 shows the intensive repudiation of the labor theory of value of the three pioneers and they only used marginal utility to interpret both the sides of demand and supply. After them, several concepts like marginal cost and marginal productivity were adopted to more explicitly interpret the theory of production, and Marshall tried to synthesize both the ideas of the classical economists, such as Ricardo and Mill, and the Marginal Utility School. The attitudes towards the classical economics and its cost theory of value were shifted to some degrees, from the Marginal Utility School to the later neoclassical economists.

4.2.5. Before and After

One way to think about whether an event or work is revolutionary is to consider what it destroys and what it initiates. The works of Jevons, Menger and Walras did not succeed in replacing the classical political economy at their time, probably because the dominance of classical economics at their time was still strong or their theory had some deficiencies and incompleteness which needed their successors to amend it. After the three pioneers, the emergence of the theory of equilibrium essentially shocked the dominance of classical economics could be considered as the start of neoclassical economics. Also, although several schools emerged after the "Marginal Revolution," they were relatively immature, and the influence of these schools was not as significant as mainstream economics in the late nineteenth and early twentieth centuries. In other words, these schools could be generally attributed to the wide category of classical economics,

neoclassical economics, or neither. Hence, at this point, the influence of "Marginal

Revolution" was not quite significant.

Chapter Five: Summary

5.1. Conclusion

Therefore, combining the two arguments above, and compared with the three representative revolutionary events (the formulations of the classical political economy, neoclassical economics, and Keynesian economics), the "Marginal Revolution" was less revolutionary in the history of economics than most people usually think.

First, in terms of the time, the "Marginal Revolution" experienced a relatively long period of formulation, beginning in the eighteenth century. The development of marginal utility theory was a long process, beginning before the 1870s by many writers, such as Bernoulli and Bentham in the first stage, Dupuit and Gossen in the second stage, and Jevons, Menger and Walras in the final stage. Second, in terms of influence, even though many new thoughts and analytical methods were added in economic study, the Marginal Utility School focused on its own discovery and avoided some advisable theories from classical political economy, making its theory with some disputable incompleteness. Compared with other representative revolutionary works, such as Marshall's *Principles*, the significance of the "Marginal Revolution" seemed less remarkable. Thus, in terms of the development of the marginal utility theory before and in the 1870s, the history of economic thought tends not to consider the "Marginal Revolution" a revolution.

5.2. Expectation

The period of the "Marginal Revolution" has ended in the history of economic thought, but its influence is still playing an important role in modern economic study. Some disputes, such as what economics should be; what range it can cover; how many kinds of methods we can use for economic study; how to deal with the relationship among thought and tools, assumptions and reality, and quantitative analysis and qualitative analysis; whether the classic laws and assumptions still have deficiencies; whether we can discover a better way to define economic value; and so on are still topics worthy of reconsideration. This thesis expects economists to explore these topics in the future.

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