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Chapter 8

Menger and the Austrian School

1. Menger's Marketability.

1. The Austrian school of economics was founded by Carl Menger (1840-1921) and developed by, among others, Friedrich von Wieser (1851) and Eugen von Böhm-Bawerk (1851-1941). Its contributions to the development of economic science are substitutes as well as complements to the neoclassical orthodoxy or Walrasian economics. As some of recent neo-Austrians argue, the Austrian school differentiates itself by its emphasis on subjectivism, not confined to preference but extended to expectations, time as the dimension of changes, fragmented information and process of learning.[1] An excellent example is provided by Menger's non-Walrasian theory of market and money, which will be discussed in this section after a brief scketch of Menger's life and works. Some contributions made by Austrian school can, however, be considered as most valuable additions to the neoclassical general equilibrium theory, for example, Wieser's theory of value and allocation (to be discussed in section 2) and Böhm-Bawerk's theory of capital and interest (to be discussed in sections 3 and 4). Incidentally, it is interesting to know that Menger rejected Böhm-Bawerk's theory of capital.[2]

Born in 1840 at Galicia in Austria (now in Poland), Carl Menger studied in the Universities of Vienna and Prage, with his two brothers, Anton, later the well known writer on the right to the whole produce of labor, and Max, who became a famous politician. Carl took his doctor's degree at the University of

Cracow and devoted himself first to journalism, then to the Civil Service. It is reported that one of his duties was to write surveys of the state of the markets and he was struck by the glaring contrast between the traditional theories of price and the facts which experienced practical men considered as decisive for the determination of prices (Hayek[11]). The first edition of Grundsätze der Volkswirthschaftslehre was published in 1871 and Carl Menger was qualified in 1872 as a Privatdozent for political economy in the University of Vienna. In 1876 Menger was appointed one of the tutors to the Crown Prince Rudolph and accompanied him during the next two years on his extensive travels through the greater part of Europe. After his return Menger was appointed in 1879 to the chair of political economy in Vienna.

In the Preface of the first edition of Grundsätze, Menger states his method which he called atomistic and, according to Hayek, later came to be known as methodological individualism (Hicks and Weber[12], P.8). "I have endeavored to reduce the complex phenomena of human economic activity to the simplest elements that can still be subjected to accurate observation, ---, to investigate the manner in which the more complex economic phenomena evolve from their elements according to definite principles" (Menger[25], pp.46-47). What he aims in Grundsätze is mainly "the investigation of the causal connections between economic phenomena involving products and the corresponding agents of production," "for the purpose of establishing a price theory based upon reality and placing all price phenomena (including interest, wages, ground rent, etc.) together under one unified point of view" (Menger[25], p.49).

While a school was being formed by economists following Menger in Austria, Schmoller's Historical School had the greatest influence in Germany at that time. In Germany, therefore, Menger's work was neglected simply because it is useless from the point of view of the Historical School which insists that political economy is a historical science and not a theoretical one. Under these circumstances, it is no wonder that Menger thought it necessary to defend the method he had adopted against the claims of the Historical School rather than to continue the theoretical work. He published Untersuchungen über die Methode der Socialwissenschaften und der politischen Oekonomie insbesondere in 1833, which initiated the Methodenstreit with Schmoller. In Untersuchungen, Menger vindicated the rights of theoretical analysis, which consists of an exact or atomistic orientation and an empirical or realistic orientation, and tried to covince historicists that some of what they were already doing was a form of theory, i.e., empirical laws.

Now the significance of the Methodenstreit is mainly historical,[3] but what may still be interesting for those economists considering economic theories of institutions is Menger's view on the organic understanding of social phenomena and social institutions like the institution of money. "Natural organism are composed of elements which serve the function of the unit in a throughly mechanical way. --- The so-called social organism, on the contrary, simply cannot be viewed and interpreted as the product of purely mechanical force effects. --- social phenomena come about as the unintended result of individual human efforts (pursuing individal interests) without a common will directed toward their establishment" (Menger[27], P.133).

After he published articles on capital and money in 1888, 1892, and 1900, Menger resigned in 1903 from his chair in order to devote himself entirely to his works. His interest and scope expanded to philosophy, psychology and ethnography. In 1921 he died with his system of political economy left unfinished. Grundsätze was merely the "First, General Part" of his system, which treats the general conditions which led to economic activity, value exchange, price and money. It was planned that the second part was to treat interest, wages, rent, income, credit, and paper money, the third part was the applied one on the theory of produciton and commerce, and the fourth part was the criticism of the present economic system and proposals for economic reform (Hayek[11], Menger[24], p.vi).

Out of manuscripts left by Carl Menger, the second edition of Grundsätze was edited and published in 1923 by Karl Menger, a mathematician and the son of Carl Menger. The evaluations of this second edition are divided among scholars. Schumpeter ([38], P.827) regarded it as the work of old age, which adds nothing essential. Translaters of Grundsätze into English decided to use the first edition "because it was the first edition only that influenced the development of economic doctrine, because of the posthumous character of the second edition, and because the numerous difference between the two editions make a variorum translation impractical" (Menger[25], p.39).[4] It is, however, Karl Polanyi[32], an anthropologist, who evaluated the second edition high on the ground that it extended the range of inquiry so as to comprise the facts of anthropology, sociology, and economic history, and provided a definition of the economy which would satisfy the requirements of the social sciences in general.

The first edition of Grundsätze consists of eight chapters, The General Theory of the Good, Economy and Economic Goods, The Theory of Value, The Theory of Exchange, The Theory of Price, Use Value and Exchange Value, The Theory of the Commodity, and The Theory of Money, while the second edition has nine chapters, two new chapters, The Theory of Wants, and Human Wants and Measure of Goods, are added and one old chapter, Use value and Exchange Value, is dissolved. Materials of the first edition are essentially kept but enlarged so that the second edition is twice as large as the first.

As summarized by Hayek (Hicks and Weber[12], p.7), Menger's main achievement in the first edition is the "extension, of the derivation of the value of a good from its utility, from the case of given quantities of consumers' goods to the general case of all goods, including the factors of production." In the second edition, however, Menger's view of the economy is wider than that of the scarcity, maximization and market, which he called the economizing direction of the economy. The other direction is called technical and derived from the requirements of production irrespective of insufficiency. "I call these two directions that the human economy can take - the technical and the economizing - basic; though these appear as a rule, indeed, almost always linked with each other, they nevertheless spring from causes that are essentially different and independent from one another, and in some branches of the economy actually make their appearance alone. --- The technical direction of the human economy is neither necessarily dependent upon economizing one, nor is it necessarily linked with it" (Menger[24], pp.77-78, Polanyi[32]). As is pointed out by Polanyi[32], however, Menger

was content to generalize the concept of economy and made no further attempt to consider particularly the pre-industrial, non-market economies.

As for the value which gives a foundation of the theory of market economy, Menger emphasizes its subjectivity. "Value is thus nothing inherent in goods, no property of them, nor an independent thing existing by itself. It is a judgment economizing men make about the importance of the goods at their disposal for the maintenance of their lives and well-being. Hence value does not exist outside the consciousness of men" (Menger[25], pp.120-121, [24], p.108). What is important is, then, Menger not only insists the principle of marginal utility of a directly consumable good (a good of lower order) but also develops the theory of imputed value for the factors of production (goods of higher order). "Hence the value to this person of any portion of the whole available quantity of the good is equal to the importance to him of the satisfactions of least importance among those assured by the whole quantity and achieved with an equal portion" (Menger[25], p.132, [24], p.127). "Nor can the value of the goods of higher order already expended in producing a good of lower order be the determining factor in its present value. On the contrary, the value of goods of higher order is, in all cases, regulated by the prospective value of the goods of lower order to whose production they have been or will be assigned by economizing men" (Menger[25], p.150, [24], p.147).

In the theory of production or input-output relations, Menger recognizes the technological substitutability and complementarity among factors of production. "A given quantity

of some one good of lower order can be produced from goods of higher order that stand in very different quantitative relationships with one another. In fact, one or several goods of higher order that are complementary to a group of certain other goods of higher order may often be omitted altogether without destroying the capacity of the remaining complementary goods to produce the good of lower order" (Menger[25], p.162, [24], p.155). The principle of marginal productivity is insisted that "the value of a given quantity of a particular good of higher order is not equal to the importance of the satisfactions that depend on the whole product it helps to produce, but is equal merely to the importance of the satisfactions provided for by the portion of the product that would remain unproduced if we are not in a position to command the given quantity of the good of higher order" (Menger[25], p.164, [25], pp.156-157).

Unlike in the case of the value theory of classical and Marxian economics, which insist that the embodied quantity of labor (a good of higher order) determines the value of a labor product (a good of lower order), Menger considered that the value of a good of lower order is determined by its marginal utility and that the value of a good of higher order is imputed from that of a good of lower order on the basis of the former good's marginal productivity in the production of the latter. Menger's attempt to explain the value of everything by the utility and marginal principle was developed further by his successors like Wieser, as we shall see in the next section.[5)]

Not all the aspects of Menger's theory were, however, fully developed by his successors. For example, Menger insists that

"the process by which goods of higher order are progressively transformed into goods of lower order and by which these are directed finally to the satisfaction of human needs is --- subject, like all other process of change, to the law of causality. The idea of causality, however, is inseparable from the idea of time" (Menger[25], p.67, [24], p.28), and emphasizes the uncertainty (Unsicherheit) in the determination of the value of goods of higher order from the expectations of the value of lower order goods. Streissler (Hicks and Weber[12], pp.171-173) evaluates such a dynamic aspect of Menger's theory highly and considers that Menger is a precursor of Keynes.

2. Unlike Walrasian theory of price, which assumes the perfect, well-organized markets, Menger's theory of price is characterized by the fact that he considered mainly more realistic, imperfect markets. The result is that Menger has no notion of the existence of a deterministic market price. "Thus commodities that can be exchanged against each other in certain definite quantities (a sum of money and a quantity of some other economic good, for instance), that can be exchanged for each other at will by a sale or purchase, in short, commodities that are equivalents in the objective sense of the term, do not exist - even on given markets and at a given point in time" (Menger[25], p.193, [24], p.185).

We must note, above all, that Menger distinguishes the commodity from the good and has a separate cahpter on the theory of commodity in his Grundsätze. The commodity is defined by him as follows.

"Products that the producers or middlemen hold in readiness for sale are called commodities. In ordinary usage the term is

limited in its application to movable tangible goods (with the exception of money). --- But in scientific discourse a need was felt for a term designating all economic goods held ready for sale without regard to their tangibility, mobility, or character as products of labor, and without regard to the persons offering them for sale. A large number of economists, --- defined commodities as (economic) goods of any kind that are intended for sale" (Menger[25], pp.238-239, [24], pp.219-220).

Menger explains further the relation between goods and commodities.

"From the definition just given of a commodity in the scientific sense of the term, it appears that commodity-character is nothing inherent in a good, no property of it, but merely a specific relationship of a good to the person who has command of it. With the disappearance of this relationship the commodity-character of the good comes to an end. A good ceases to be a commodity, therefore, if the economizing individual possessing it gives up his intension of disposing of it, or if it comes into the hands of a persons who do not intend to exchange it further but to consume it --- Commodity-character is therefore not only no property of goods but usually only a transitory relationship between goods and economizing individuals. Certain goods are intended by their owners to be exchanged for the goods of other economizing individuals. During their passage, sometimes through several hands, from the possession of the first into the possession of the last owner, we call them "commodities," but as soon as they have reached their economic destination (that is, as soon as they are in the hands of the ultimate consumer) they obviously cease to be

commodities and become "consumption goods" in the narrow sense in which this term is opposed to the concept of "commodity." But where this does not happen, as in the case very frequently, for example, with gold, silver, etc., especially in the form of coins, they naturally continue to be "commodity" as long as they continue in the relationship responsible for their commodity-character" (Menger[25], pp.240-241, [24], pp.221-222).

But why do some goods cease to be commodities quickly while coins never cease to be commodities? In other works, why is it that little metal disks apparently useless as such can be commodities and exchanged against useful things that can become consumption goods? This is because of the different degrees of salability or marketability of commodities (Absatzfähigkeit der Waren). Money is the most marketable of all commodities. "The theory of money necessarily presupposes a theory of the salableness of goods."[6] Degree of marketability of commodities is defined by Menger as "the greater or less facility with which they can be disposed of at a market at any convenient time at current purchasing prices, or with less or more diminution of the same" (Menger[23]).

Behind this definition is Menger's observation that the smaller the difference between the higher buying price and lower selling price, the more marketable the commodity usually is.

"The most cursory observation of market-phenomena teaches us that it does not lie within our power, when we have bought an article for a certain price, to sell it again forthwith at that same price --- The price at which any one can at pleasure buy a commodity at given market and a given point of time, and the price at which he can dispose of the same at pleasure, are two essentially different magnitudes" (Menger[23]).

Prices vary between different places, between different times, and between different people. But, as far as the difference between the buying and selling prices is concerned, it is to the determinate direction and by no means stochastic, in spite of Streissler's emphasis on the stochastic price variation in Menger's theory of price (Hicks and Weber[12], p.171).

Although Menger detailedly describes circumstances upon which the degree of marketability of commodities depends, what is interesting from our point of view is the fact that it depends on whether the relevant market is well organized or poorly organized.

"If the competition for one commodity is poorly organized and there is danger therefore that the owners will be unable to sell their holdings of the commodity at economic prices, at a time when this danger does not exist at all, or not in the same degree, for the owners of other commodities, it is clear that this circumstance will be responsible for a very important difference between the marketability of that commodity and all others --- Commodities for which an organized market exists can be sold without difficulty by their owners at prices corresponding to the general economic situation. But commodities for which there are poorly organized markets change hands at inconsistent prices, and sometimes cannot be disposed of at all" (Menger[25], pp.248-49, [24], pp.233, 235).

Walras assumed that the market is well organized. Menger's theory of commodity for which the market is poorly organized and for which marketability is not high suggests that Menger's is a non-Walrasian theory of market. Menger's criticism on pre-

Mengerian economics, that "investigation into the phenomena of price has been directed almost exclusively to the quantities of the commodities exchanged, and not as well to the greater or less facility with which wares may be disposed of at normal prices" (Menger[23], [25], p.242, [24], p.223), can also be applied to Walrasian or neoclassical economics. In other words, Menger's theory of marketability of commodities is a first attempt at non-Walrasian economics.

In recent studies of non-Walrasian economics, i.e., fixprice models or quantity constraint models, an important role is played by the short-side principle that disequilibrium transaction equals the minimum of supply and demand (Hahn and Negishi[9], Benassy[2]). From the point of view of Menger's marketability, the short-side principle can be seen that commodities are highly marketable when its suppliers are on the short side of the relevant market and not so marketable when they are on the long side of the market. Unlike those recently working in non-Walrasian economics, however, Menger was not so much interested in fixprice situation of the perfectly competitive market as in the flexprice case of the imperfectly competitive market, as was pointed out by Streissler (Hicks and Weber[12], p.169). In the latter type of the market, we can consider that suppliers are likely to be on the long side of the market in general, in the sense that they wish to sell more at the current price if there is enough demand.

This point was well recognized be Sraffa[40], a pioneer of modern theory of imperfect competition.

"It is not easy, in times of normal activity, to find an undertaking which systematically restricts its own production to

an amount less than that which it could sell at the current price, and which at the same time is prevented by competition from exceeding that price. Businessmen, who regard themselves as being subject to competitive conditions, would consider absurd the assertion that the limit to their production is to be founded in the internal conditions of production in their firm, which do not permit the production of a greater quantity without an increase in cost. The chief obstacle against which they have to contend when they want gradually to increase their production does not lie in the cost of production but in the difficulty of selling the larger quantity of goods without reducing the price, or without having to face increased marketing expenses."

In Figure 1, we consider the case of a firm under imperfect competition and measure the level of output x horizontally, and price p and costs vertically. A downward sloping demand curve DD is perceived by this firm, not particularly because it is a monopolist, nor particularly because its product is differentiated, but more fundamentally because the market in which the commodity is sold is poorly organized, so that the larger amount of the commodity can be disposed of in the market only with the less favorable price. The equilibrium of the firm is shown to be at A, or $(\bar{p}, \bar{x})$, with the marginal revenue MR equalized with marginal cost MC at $\bar{x}$. At the current price $\bar{p}$, the firm wishes to sell as much as x', but is quantitatively constrained at $\bar{x}$, since there is not enough demand. There exists an implicit excess supply AB or $x' - \bar{x}$, and the marketability of the commodity is not high. The only possible exception is the case where the firm is at the full capacity and MC curve is perpendicular at $\bar{x}$ so that A and B coincide. In the

poorly organied market, therefore, the commodity is not highly marketable when firms are operating at less than full capacity.

There are two kinds of demand and supply: regular, stable demand and supply, and irregular, casual demand and supply. For example, the demand curve in Figure 1 is concerned with regular demand as perceived by a regular supplier. When A and B do not coincide and there exists an excess supply of regular supplier, casual demand will be easily satisfied by regular suppliers with current price $\bar{p}$. Casual supply has to compete with regular excess supply to catch casual demand and will not be easily satisfied, unless price is reduced. The marketability of the relevant commodity is low and the resale price of those casual suppliers who want to get rid of the commodity they just bought will be much lower than the price at which they bought as regular demanders. When, on the other hand, A and B coincide with supply inelasticity of regular suppliers, casual suppliers do not have to compete with regular suppliers to catch demand and their supplies will be easily satisfied. The marketability of the commodity is high and there is no gap between resale price of those casual suppliers who wanted to get rid of the commodity they had just bought and the price at which they had bought.

Menger explains the origin of money on the basis of his theory of marketability of commodities.[7] "As <u>each</u> economizing individual becomes increasingly more aware of his economic interest, he is led by this <u>interest</u>, <u>without and agreement</u>, <u>without legislative compulsion, and even without regard to the public interest</u>, to give his commodities in exchange for other, more salable, commodities, even if he does not need them for any

immediate consumption purpose" (Menger[25], p.260, [24], pp.248-249). This makes, unintendedly, the marketabilitty of latter commodities increased so that they are acceptable to everyone in trade and become the means of payment.

In Figure 1, the case of money is explained by a horizontal DD curve which makes A and B coincide. The suppliers of money (demanders of non-monetary commodities) are not on the long side of markets and the marketability of money is the highest. Even if DD curve is not horizontal, but not very steep, however, A and B also coincide in the case where no suppliers can increase supplies - that is, the supply elasticity is zero, which Keynes ([19], pp.230-231) recognized as an essential property of money. In a well-organized market considered in Walrasian economics, DD curve is horizontal so that A and B coincide. Every commodity has high marketability and, in this sense, can be accepted as a medium of exchange, even if the supply is elastic. If a special commodity called money is introduced, therefore, its role is limited in Walrasian economics. Money as a medium of exchange presupposes low marketability of other commodities.

2. Wieser's Welfare Economics.

Friedrich von Wieser was born in Vienna in 1851. After taking a law degree in 1875 from the University of Vienna, he studied economics at the Universities of Heidelberg, Leipzig and Jena. In 1883 Wieser became Privatdozent at Vienna, and was soon made professor in the University of Prague. He succeeded to Menger's chair at Vienna in 1903. He also served for a while as Minister of Commerce. Wieser retired from the Uiversity in 1922 and died in 1926. His main contributions are Der

natürliche Werth (1889) and Theorie der gesellschaftlichen Wirtschaft (1914), in which he followed Menger to develop the subjective theory of value statically. Schumpeter ([38], p.987) evaluated Wieser high on the ground that Wieser was the first to realize "that any attempt to develop a general logic of economic behavior will automatically yield a theory of the socialist economy."

In his Theorie der gesellscaftlichen Wirtschaft, Wieser started with the consideration of the simple economy, which is an essential prerequisite to the theory of social economy and in which the elementary law of valuation, as developed by consideration of a Robinson Crusoe economy, can be applied directly. Although the theory of the simple economy assumes that the subject is a single person whose satisfaction should be maximized, Wieser emphasized that he does "not have in mind here the meagre economy of an isolated Crusoe. The imagined conditions of production have a breadth that is only realized in the activities of an entire nation. At the same time millions of persons are regarded as a massed unit. In the same way one contrasts humanity and nature or thinks of a people directing its great forces to some common goal" (Wieser[43], p.9). We may suppose, therefore, that an aggregate of individual utilities or the utility of the model man is maximized in a rationalistic utilitarian way in the simple economy where the influence of social and economic power is eliminated.[8)]

Value established in the simple economy corresponds to the natural value defined in Wieser's Der natürliche Werth.

"That value which arises from the social relation between amount of goods and utility, or value as it would exist in the

comminist state, we shall henceforth call Natural Value" ([45], p.60).

"Natural value shall be that which would be recognized by a completely organic and most highly rational community --- it will be excellent aid in realising what would remain out of present economy if we could think away private property, as well as all the troubles which are a consequence of human imperfection" ([45], p.61). Althouth natural value is realized in a communist society where there exists no private property, it is, of course, also important for our present economy, if we are interested in the social judgement of value, or the estimate put upon goods by society. Price does not denote it.

"--- that point of view from which price become a social judgement of value, really amounts to a disregard of all the individual differences which emerge in purchasing power, and which separate price from natural value. A great many theorists have thus written the value theory of communism without being aware of it, and in doing so have omitted to give the value theory of the present state" (Wieser[45], p.61, see also p.52).

In the simple economy, the natural value of a consumption good is estimated according to its unstratified marginal utility. In the case of production goods which have no utility, "the consideration that, from production goods, one can obtain a return in goods which posses not only utility but value, gives production goods their value" (Wieser[45], p.70). In other words, value is imputed to a production good according to its productive contribution, i.e., "that portion of return in which is contained the work of the individual productive element in the total return of production. The sum of all the productive

contributions exactly exhausts the value of the total return" (Wieser[45], p.88). In this way, values are determined by utilities and not by costs. However, "between costs and utility there is no fundamental opposition. Costs are goods valued, in the individual case, according to their general utility. The opposition between costs and utility is only that between the utility of the individual case, and utility on the whole" (Wieser[45], p.183).

Let us now formulate Wieser's theory of natural value in the simple economy. Suppose there are m consumption goods denoted by j = 1, ---, m, and n individuals denoted by i = 1, ---, n in the economy. Let us denote the utility of the i-th individual by $U_i(x_{i1}, ---, x_{im})$, where x_{ij} signifies the amount of the j-th good consumed by the i-th individual. If the j-th good is not consumed, simply $x_{ij} = 0$. The utility to be maximized in the simple economy is a function of individual utilities denoted by $W(U_1, ---, U_n)$. For example, W is the utility of the model man or average man obtained from n individuals. Since marginal use of a good is equalized everywhere in the simple eocnomy and unstratified marginal utility signifies the natural values, we have

$$(1) \qquad (\partial W/\partial U_i)(\partial U_i/\partial x_{ij}) = \partial U_i/\partial x_{ij} = v_j \qquad i = 1, ---, n, \quad j = 1, ---, m,$$

where v_j is the natural value of the j-th good. We can integrate (1) into

$$(2) \qquad W = \Sigma_i U_i(x_{i1}, ---, x_{im}).$$

In the theory of imputation, Wieser ([45], pp.86-89) asssumed the constant coefficient of production and solved for

the natural value of the k-th productive goods v_k, k = 1, 2, 3, from

(3) $\quad v_h = \Sigma_k a_{hk} v_k \qquad h = 1, 2, 3,$

where a_{hk} is the input coefficient of the k-th production good in the production of the h-th consumption good and V_h denotes the natural value of the h-th consumption good. In view of Menger's emphasis on the substitutability of factors of production (section 1.1), we may generalize the input-output relations into production functions

(4) $\quad X_j = F_j(Y_{j1}, ---, Y_{jr}), \quad j = 1, ---, m,$

where X_j is the output of the j-th consumption good and Y_{jk} is the input of the k-th production good or factor of production in the production of the j-th consumption good. Then the natural value of r production goods are derived from the natural values of consumption goods by

(5) $\quad v_j(\partial F_j/\partial Y_{jk}) = v_k \qquad j = 1, ---, m, \quad k = 1, ---, r,$

where v_j and v_k are natural values of the j-th consumption good and the k-th production good, respectively. If production function (4) are assumed to be linear homogeneous, furthermore, (5) implies

(6) $\quad v_j X_j = v_j \Sigma_k (\partial F_j/\partial Y_{jk}) Y_{jk} = \Sigma_k v_k Y_{kj} \qquad j = 1, ---, m,$

i.e., "the sum of all the productive contributions exactly exhausts the value of the total return," which is a generalization of (3).

Finally, we should have equalities of demand and supply of consumption and production goods, i.e.,

(7) $\quad \Sigma_i x_{ij} = X_j, \qquad j = 1, ---, m,$

and

(8) $\quad \Sigma_j Y_{jk} = \bar{Y}_k, \qquad k = 1, ---, r,$

where $\bar{Y}_k$ is the given supply of the k-th production good.

Consider the maximization of (2) being subject to (4), (7) and (8). If we denote the Lagrangean multipliers corresponding to (7) and (8) by v_j and v_k, respectively, conditions (1) and (5) are satisfied by the conditions for the constrained maximization. In other words, natural values are derived as Lagrangean multipliers from the maximization of utilitarian social welfare function (2) being subject to resources and technological constraints (4), (7) and (8).

Armed with the theory of the simple economy and natural value, Wieser proceeds to the study of the social economy and exchange value.

"The theory of exchange presupposes a social economy, unhampered by interference on the part of the state. The theory of the simple economy having shown in what manner a single subject manages and calculates his economic affaires, we now show how the numerous juridical subjects, who meet in the course of exchange as they seek their economic advantage, determine prices and thus erect the structure of a social eocnomy. Private propery is presupposed" ([43], p.10).

The relation between the simple economy and the social economy is clear. Since "the collective private economies that are associated in the national economy are in themselves simple economies" (Wieser[43], p.151), both economies are identical if we assume that all the individuals have identical income, needs and valuation. "With an assumption such as this, the economic exchange value equals the unitary personal exchange value of all connected individual economies. The money computation in the national economic process has, therefore, precisely the

significance it would have in the simple economy of a people" (Wieser[43], 306).

The exchange value in the social economy is, however, different from natural value in the simple economy, if we drop such a simplifying assumption.

"In natural value goods are estimated simply according to their marginal utility; in exchange value, according to a combination of marginal utility and purchasing power. In the former, luxuries are estimated far lower, and necessaries, comparatively, much higher than in the latter. Exchange value, even when considered as perfect, is, if we may so called it, a caricature of natural value; it disturbs its economic symmetry, magnifying the small and reducing the great" (Wieser[45], p.62, see also p.52).

"In the theory of the simple economy, the assumption is directed to the utmost possible equalization of the margin of use. In our social economy where the stratified marginal utility is decisive, the satisfaction of need is exceedingly disproportionate" (Wieser[43], p.189).

Since the stratified marginal utility is decisive in our social economy and goods are estimated, in exchange value, according to a combination of marginal utility and purchasing power, we may replace (1) by

$$(9) \qquad (\partial W'/\partial U_i)(\partial U_i/\partial x_{ij}) = a_i(\partial U_i/\partial x_{ij}) = P_j$$

$$i = 1, ---, n,$$

$$j = 1, ---, m,$$

where p_j is the price or exchange value of the j-th consumption good, $a_i(\partial U_i/\partial x_{ij})$ is the marginal utility stratified by the purchasing power, and W' is the social welfare function

corresponding to the social exchange economy. We can integrate (9) into

(10) $W' = \Sigma_i a_i U_i(x_{i1}, ---, x_{im})$.

In the social economy, private property is presupposed, so that factors of production are privately owned by individuals, i.e.,

(11) $\bar{Y}_k = \Sigma_i \bar{Y}_{ik}$, $\quad k = 1, ---, r,$

where $\bar{Y}_{ik}$ is the k-th factor of production owned by the i-th individual. Prices of factors of production are derived, like in (5), from those of consumption goods, i.e.,

(12) $p_j(\partial F_j/\partial Y_{jk}) = P_k$, $\quad j = 1, ---, m, \quad k = 1, ---, r,$

where p_k is the price of the k-th factor of production. Then, the purchasing power of the i-th individual is given by $\Sigma_k p_k \bar{Y}_{ik}$.

Each individual disposes this purchasing power so as to maximizes $U_i(x_{i1}, ---, x_{im})$ being subject to

(13) $\Sigma_j P_j x_{ij} = \Sigma_k P_k \bar{Y}_{ik}$.

The conditions for this constrained maximization includes

(14) $(\partial U_i/\partial x_{ij}) = s_i P_j$, $\quad j = 1, ---, m,$

where s_i is the marginal utility of the purchasing power.

Unlike in the simple economy, the allocation of goods is carried out decentralizedly in the social economy. In view of (14), therefore, a_i's in (9) and (10) should be inversely proportional to s_i's in (14). Then, allocation of resources in a competitive social economy can be viewed as if the weighted utilitarian social welfare function (10) is maximized being subject to (4), (7) and (8). Prices are derived as Lagrangean multipliers corresponding to (7) and (8) in the constrained maximization. As was shown in Negishi[29], to choose a_i's in (10) so that they are inversely proportional to s_i's in (14)

obtained from such prices is possible under some plausible conditions, i.e., there exist a general equilibrium in a competitive economy, which maximizes properly defined social welfare function (10).

Taking (13) and (14) into consideration, we can easily see from the comparison of (1) and (9) that exchange and natural values are identical when all the individuals have an identical taste and the same income. Otherwise, prices (exchange values) and natural values are generally different. Then, the marginal utility of income s_i for the rich is smaller than that for the poor, if Gossen's first law, i.e., diminishing marginal utility is assumed so that utility function is concave. Prices of luxuries are high, relative to necessaries, even though marginal utilities are low, since s_i of those who purchase them is small.

Wieser's theory of natural and exchange values can be considered as a precursor of the welfare economics of Lange[21], in which the optimality of a competitive economy is discussed by the use of social welfare functions. Lange called a_i's in our social welfare function (10) as the marginal social significance of individuals. Furthermore, Lange[20] based his argument for the possibility of the market socialism on the formal similarity between socialism and capitalism, which corresponds to that between natural and exchange values in Wieser's theory of a simple and social economies. In the socialist calculation debate, however, Lange's position based on Walrasian or neoclassical static theory was attacked by Austrians who believe that dynamic rivalry among capitalists and entrepreneurs is necessary for the coordinating market process which makes complex capitalist production in a monetary economy possible.

It is to be emphasized that even Wieser was critical to the possibility of the socialist economy.[9)]

Wieser was also against the equal distribution of income. Following argument is very interest, from the point of view of recent theories of optimal income distribution.

"Were the task of economy to consist merely in distributing stores of goods, given without human cooperation, to the most needy, then, indeed no other distribution could be tolerated but one guided by the rational needs, as well known socialistic formula prescribes. But the most important task of economy consists in acquisition. The stores of commodities are not turned over to man by nature, ready for immediate use; they have to be procured painstakingly before they can be enjoyed. And to this principal problem of acquisition the economic law, now become a fact of history, is fittingly adjusted. It is not a simple law of enjoyments to be obtained, it is a rigorous law of acquisitions to be made, --- It may well be that a system of rules, which distributes very unequally the enormous gains to which it is instrumental, is after all more beneficial to the mass of the citizens than another, doing out its much smaller proceeds according to principles of right and reason. --- Society dares not withhold the higher wage from the competent worker. To do so is to risk losing the most valuable services. But when the strict rule declares against him also, who without fault of his own, lost what he had and perhaps even his working ability as well, symphathy prevails and we cannot quite approve of the rigorous discipline. So, too, the excessive income and riches which go far beyond moderate wealth, can no longer be sanctioned by the general conscience" (Wieser[43], p.398).

The inequalities in the distribution of income and wealth are justified, therefore, if and only if they work out to the advantage of the most unfortunate individuals, as is recently insisted by Rawls ([33], p.78). Consider a two individual economy. Suppose, in Figure 2, that the first individual whose utility U_1 is measured horizontally represents entrepreneurs and competent workers, while the second individual whose utility U_2 is measured vertically represents ordinary workers and those who cannot work. Let us assume that the special ability of the first individual cannot be mobilized unless there exists an incentive that his utility is higher relative to that of the second individual. Line oa indicates equal distribution of real income while line ob shows the minimum requird utility difference. Utility frontier, i.e., the boundary of the set of utilities possible under resources and technological constraints, is curve cjde when there is no incentive for entrepreneurs and competent workers. If there is a sufficient incentive for them, on the other hand, utility frontier is shifted into curve fgh. Since the minimum required incentive is indicated by line ob, utility combinations between f and g are actually impossible. Realizable utility frontier is, therefore, considered to be cjdgh, having a rising portion dg.[10] The utility combination recommended by Wieser and Rawls is clearly g, where higher utility of the first individual is justified on the ground that it makes the lower utility of the second individual higher than it is otherwise, for example, at the point j of the equal distribution.

To make a comparison of points j and g in Figure 2, however, we have to make interpersonal comparison of utilities.

It may be made, if ever possible, by introspection on which Austrians in general, and Wieser in particular, put a great emphasis.

"For all actions which are accompanied by a consciousness of necessity, economic theory need never strive to establish a law in a long series of inductions. In these cases we, each of us, hear the law pronounced by an unmistakable inner voice" (Wieser[43], p.8).

"We can observe natural phenomena only from outside but ourselves from within. --- This psychological method chooses the most advantageous position for observation. It finds for us in common experience all the most important facts of necessity. --- It finds that certain acts take place in our consciousness with a feeling of necessity. What a huge advantage for the natural scientist if organic and inorganic world clearly informed him of its laws, and why should we neglect such assistance?" (Wieser[44], p.17, see also Hutchison[15], p.155).

3. Böhm-Bawerk and the positive Rate of Interest.

Eugen von Böhm-Bawerk, brother in law of Wieser, was born in Brünn in Austria (now in Czechoslovakia) in 1851. He first studied law at the University of Vienna, and then economics, along with Wieser, in Heidelberg, Leipzig, and Jena. In 1881 he was appointed professor of economics at the University of Innsbruck, but in 1889 entered the Austrian Finance Department and was named Austrian Minister of Finance in 1895, 1897 and 1900. It was in 1904 that Böhm-Bawerk resigned and thereafter he devoted his life to writing and teaching economics at the University of Vienna. In his article, "Grundzüge der Theorie

des wirtschaftlichen Güterwerts" (1886), Böhm-Bawerk developed the theory of value that Carl Menger had outlined. Böhm-Bawek established that it is marginal pairs of buyers and sellers that determine price. More detailedly, it is the evaluations of the weakest of successful buyers and the strongest of successful sellers coupled with the evaluations of the strongest of unsuccessful buyers and the weakest of unsuccessful sellers that set the limit to exchange value. The greatest contribution of Böhm-Bawerk was, however, his theory of capital and interest in his Positive Theorie des Kapitales(1889), the second volume of Kapital und Kapitalzins, where he insisted that the rate of interest is positive in a stationary eocnomy. This is a very interesting argument, since modern theories of economic growth suggest positive relations between the rate of growth and the rate of interest.

As is well known, Böhm-Bawerk adduced three causes of the existence of interest, Kapitalzins, i.e., a premium (agio) attached to the present consumers' goods in the exchange against the future consumers' goods. They are (1) better provision for wants expected in the future than in the present, (2) undervaluation of future wants, and (3) the superiority of more roundabout or more protracted method of produciton (Böhm-Bawerk[4], pp.259-289, especially 283). More detailedly, the first cause implies that the marginal utility of the future consumption is lower than that of the present consumption, since one is given more goods in the future than in the present. If everybody is in such a situation, the positive rate of interest is necessary, since otherwise everybody wishes to borrow to consume more in the present and no body will lend to consume

more in the future. The second cause insists, on the other hand, that the marginal utility of the future consumption is lower than that of the present one, even if one is provided equally in the future as well as in the present. In other words, the rate of interest is positive, since people are myopic and consume more in the present unless the rate of interest is positive. The second cause alone, therefore, assures the positive rate of interest in a stationary state. While the first two causes are both concerned with the supply of capital or saving, finally, the third cause implies that the capital or saving is demanded even if the rate of interest is positive, since more roundabout and more capital-using method of production is technically superior than less roundabout and less capital-using one.

Böhm-Bawerk's explanation runs as follows for his first cause of the interest. "A first principal cause capable of producing a difference in value between present and future goods is inherent in the difference between the relation of supply to demand as it exists at one point in time and that relation as it exists at another point in time." "If a person suffers in the present from appreciable lack of certain goods, or of goods in general, but has reason to hope to be more generously provided for at a future time, then that person will always place a higher value on a given quantity of immediately available goods than on the same quantity of future goods. This situation occurs with very great frequency in our economic life." Of course, "it must be admitted that the counterpart is no rarity in economic life. There are people who at the moment are relatively well provided for and for whom there will presumably

be less provision in the future." However, "most goods are durable, especially money, which with its aspect of non-particularization is capable of representing all classes of goods, hence they can be reserved for the advice of the future" ([4], pp.265-268). On the average, therefore, people expect to be better provided for their wants in the future than in the present.

The situation can be shown in Figure 3. Present goods are measured horizontally, and future goods, vertically. Line 0a has slope 1 and indicates the equal provision for wants in the present as well as in the future. If a person is provided with 0d amount of present goods and expects to be provided with 0e amount of future goods, the indifference curve passing point b which has slope - 1 at f (no undervaluation of future wants) has slope less than - 1 at b (the curve is more steeper at b than at f) indicating the positive rate of interest, since marginal utility of future goods is less than that of present goods.

The situation where the second cause of Böhm-Bawerk exists can also be seen at the point c in Figure 3. Since future wants are systematically undervalued (Böhm-Bawerk[4], pp.268-273), the slope of the indifference curve at point c is less than - 1. The rate of interest is positive even if there exists no "difference between the relation of supply to demand as it exists at one point in time and that relation as it exists at another point of time." The second cause is independent of the first cause and can explain by itself the positive rate of interest in a stationary state. It is clear that the second cause is also independent of the third cause, since the second cause is independent of the relative availability of future

goods with respect to present goods, which is caused by the technical superiority of more roundabout method of production. It is also clear that the first cause is independent of the second cause, and can explain by itself the positive rate of interest in a growth situation. The first cause is, however, not independent of the third cause, since the latter can create the relative abundance of future goods over present ones.

As for the third cause of the interest, Böhm-Bawerk had two different models i.e., the model of the circulating capital and the period of production which he explained by his famous numerical examples (Böhm-Bawerk[4], pp.356-358) and the model of the fixed capital and the capital-labor-ratio for which he gave some examples like a boat and net in fishing and a sewing machine in tailoring.[11] In view of his detailed exposition of the circulating capital model by the use of numerical examples, it is clear that Böhm-Bawerk put the utmost emphasis on the third cause, i.e., the superiority of roundabout production. Following Böhm-Bawerk, Wicksell ([42], pp.172-184) developed a stationary state model in which positive rate of interest is explained by the marginal productivity of the period of production in the sense of Jevons ([16], p.246). In such a one-sided productivity model, however, there is one equation missing, since the supply or the maintaining of capital is not assured. This can be solved independently either by the consideration of the first cause, i.e., the better provision of future wants or by the introduction of the second cause, i.e., the undervaluation of future wants. While the recent theories of capital and interest rely too heavily on the second cause,[12] it should be noted that the third cause, can explain a positive

rate of interest without the help of the second cause, since the third cause itself generates and works through the first cause, as Böhm-Bawerk admitted in the controversy with I. Fisher and Bortkiewicz (Böhm-Bawerk[5], pp.192-193). From the point of view of economic theory as well as that of the history of economic thoughts, then, it seems more natural to demonstrate positive interest in a stationary state by the combination of the third cause and the first cause which necessarily follows from the third cause rather than by the combination of the second and the third causes whose coexistence is regarded by Böhm-Bawerk as accidental.

As was pointed out by Arvidsson [1], we have to consider a life cycle model of individual members of the economy, in which people live for finite periods, have rising incomes, and consume their life-incomes, to apply the first cause in a stationary state where the economy as a whole is equally provided in the future as well as in the present.[13] Life-cycle model is not alien to Böhm-Bawerk, since he considered the case of "all the indigent beginners in every calling, especially the budding artist or jurist, the first year medical student, the civil servant or business man just breaking in," as examples of those who expect future wants better provided than present ones and value future goods less, and admitted also the counterpart, "a clerk in an office, for instance, who is fifty years old and is earning sixty dollars a week must face the prospect that in ten or fifteen years he will have nothing of his own but a few hundred dollars a year from an annuity, perhaps, that he purchased from an insurance company" ([4], p.266).

Let us consider an economy of stationary population, where each individual lives for two periods so that the size of young and working population and that of old and retired population are equal in each period. In the first period, each individual works for given hours but consumes less than he earns and lends his saved capital to firms, while he not only consumes yield from his capital but also dissaves all his capital in the second period. The second cause, i.e., time preference, is assumed away, so that

(1) $\quad U_1(c_1,c_2)/U_2(c_1,c_2) = 1, \quad \text{if } c_1 = c_2,$

where $U = U(c_1,c_2)$ is the utility of the representative individual, c_1 and c_2 denote respectively the amount of consumers' good he consumes in the first and second periods, and U_1 and U_2 are partial derivatives of U with respect to c_1 and c_2, i.e., marginal utilities of the first and second period consumption.

The life-time budget equation for the representative individual is

(2) $\quad p\,c_1 + p\,c_2/(1 + r) = w\bar{L}/b$

where p, w, r, $\bar{L}$, b are, respectively, the price of consumers' good, wage, rate of interest, given total labor supply and the scale ratio of representative individual and the whole eocnomy. If the life-time utility $U(c_1,c_2)$ is maximized being subject to (2),

(3) $\quad U_1(c_1,c_2)/U_2(c_1,c_2) = 1 + r$

should be satisfied. Since time preference is assumed away, the left-hand side of (3) is 1, if $c_1 = c_2$ from (1). When r is positive, therefore, c_2 should be larger than c_1 from usual assumption of quasi-concavity of U, which implies that the

future want is better provided than the present one (the first cause). In Figure 4, c_1 is measured horizontally, and c_2, vertically. Budget equation (2) is represented by the line fg whose slope is such that than $a = 1 + r$. The condition (3) is satisfied at b, where an indifference curve whose slope is - 1 at c (i.e., when $c_1 = c_2$) is tangent to the budget line fg. As b in Figure 3, b in this Figure 4 also indicates that the future want is better provided than the present one.

The possibility for the better provision of future want is assured by the third cause, i.e., the superiority of more roundabout method of production. In the circulating capital model, the third cause implies that the labor productivity is an increasing function of the period of production, i.e.,

$$(4) \qquad Y = f(t)\, L, \qquad f'(t) > 0,$$

where Y is the volume of output of a consumers' good, L is labor input and t is the time interval between Y and L, i.e., the period of production. Wages have to be advanced at the time of labor input since laborers are stripped of any means of subsistence, though wages can be higher than the subsistence level so that capital can be accumulated out of wage income. Capital in this model is heterogeneous, composed of past labor inputs of different dates or of semi-finished goods of different stages, and its value is

$$(5) \qquad K = \Sigma\, w\bar{L}(1 + r)^s$$

where the summation runs from $s = 0$ to $s = t - 1$, and w, r and $\bar{L}$ denote respectively the rate of wage, the rate of interest, and the given total supply of labor.

Since the maximization of r with respect to t gives

$$(6) \qquad f(t)/f(t-1) \geqq 1 + r \geqq f(t+1)/f(t),$$

$r > 0$ in a stationary state, provided that $t \geq 1$. The latter condition is assured in our life-cycle model in which people live for two periods. There is, however, no assurance that the period of production chosen by firms is shorter than the life-span of individual person. If the period of production is not shorter than the life-span, the value of existing capital, i.e., labor inputs in the past which have not yet matured into output, is larger than the value of the saving made in the past by the retired generation in the present. In a stationary state the representative individual cannot dissave all his capital at the end of his life but must leave the capital to the next generation, the value of which is equal to that ot what he inherited at the beginning of his life. Because of the inherited capital, of course, one can consume more than what he earned in his life-time, if he wishes to do so. As one's life-time consumption is related to the capital inherited at the beginning of his life, so is the life-time consumption of the next generation is related to the capital he is going to leave at the end of his life. A positive rate of interest is, therefore, impossible in a stationary state, unless the representative individual undervalues the consumption of the next generation in comparison with his own consumption. This seems, however, to re-introduce Böhm-Bawerk's second cause from the backdoor.[14)]

We can get rid of the difficulty with respect to the problem of the bequest and inheritance in the case of the fixed capital model in which more roundabout method of production is regarded as more capital intensive method with higher capital-labor-ratio. In view of the difficulty with respect to the

concept of the period of production (Faber[7], pp.29-33), this model of Böhm-Bawerk seems to be more acceptable to contemporary economists than his circulating capital model.[15] Let us consider that consumers' goods can be produced instantaneously from labor and capital goods while it takes a unit period to produce capital goods. "The sewing by machine is only a portion - and indeed the smallest portion - of the circuitous capital path. The principal length of that path is covered by the making of the sewing machine" (Böhm-Bawerk[4], p.83, [5], pp.57, 59). If we assume away the durability aspect of capital goods and suppose that the life-span of capital goods is also a unit period, we can get rid of the problem of bequest and inheritance so that the second cause is completely assumed away.

It might seem that the second cause of Böhm-Bawerk is inherent in a life-cycle model in which an individual lives for a finite period.[16] It is certainly true if the problem of bequest and inheritance of capital is assumed away even though the life-span of capital goods is longer than that of individuals. By considering its own utility only, each generation of individuals underevaluates the wants of future generations completely, which implies the existence of a variety of the second casuse. In our case, however, such a second cause does not exist, since the possibility of bequest and inheritance is ruled out by the assumption that the life-span of capital goods is shorter than that of individuals. The latter assumption is, of course, highly unrealistic. But, our purpose is not so much to construct a realistic model as to make conceptual experiments by separating different causes of the positive rate of interest.

The superiority of more roundabout method of production is defined that the production with higher capital-labor-ratio requires smaller amount of labor directly and indirectly necessary to produce a given amount of consumers' goods. The capital-labor-ratio is chosen by firms so as to maximize the rate of return or the rate of interest. We shall assume, at first for the sake of simplicity, that capital goods are produced by labor alone and show the positive rate of interest in a stationary state is assured by the first and the third causes, by combining life-cycle model and capital-labor-ratio model.

Suppose the production function of consumers' good industry is

(7) $X = F(L,K)$

where X, L, K are respectively the output, labor input, and capital input, and F is homogeneous of degree one with respect to L and K. By difining capital-labor-ratio $\underline{a}$ as

(8) $\underline{a} = K/L$

we can reduce (7) into

(9) $X = L\, f(\underline{a})$

where $f(\underline{a}) = F(1,\underline{a})$. Capital goods are assumed to be putty-clay, in the sense that $\underline{a}$ can be variable when capital goods are newly to be produced, but $\underline{a}$ remains unchanged once capital goods are installed.

If we assume that the amount of labor necessary to produce a unit of capital good with given $\underline{a}$ is $N(\underline{a})$ such that $N'(\underline{a}) > 0$, total amount of labor directly and indirectly necessary to produce X is given as

(10) $W(X,\underline{a}) = L + K\, N(\underline{a}) = L + LN(\underline{a})\underline{a} = X(1 + N(\underline{a})\underline{a})/f(\underline{a})$.

The superiority of more roundabout method of production, i.e., the third cause, is defined that for given X, W is a decreasing function of $\underline{a}$, which requires that

(11) $f(\underline{a})N(\underline{a}) + \underline{a}N'(\underline{a})f(\underline{a}) - f'(\underline{a}) - f'(\underline{a})N(\underline{a})\underline{a} < 0.$

The rate of return or the rate of interest r is implicitly defined by

(12) $F(L,K) - wL = w\ N(\underline{a})\ K\ (1 + r)$

or

(13) $f(\underline{a}) - w = w\ N(\underline{a})\ \underline{a}\ (1 + r)$

where w is the rate of wage in terms of consumers' good. Competitive firms producing capital goods choose $\underline{a}$ so as to maximize r, when w is given. By differentiating (13) with respect to $\underline{a}$ and r to obtain $dr/d\underline{a} = 0$, we have

(14) $f'(\underline{a}) - w\ N(\underline{a})\ (1 + r) - w\ N'(\underline{a})\ \underline{a}\ (1 + r) = 0.$

By eliminating w from (13) and (14), r can be expressed as a function of $\underline{a}$,

(15) $r = (- f'(\underline{a}) - f'(\underline{a})N(\underline{a})\underline{a} + f(\underline{a})N'(\underline{a})\underline{a} + f(\underline{a})N(\underline{a}))$
$/(f'(\underline{a})N(\underline{a})\underline{a} - f(\underline{a})N(\underline{a}) - f(\underline{a})N'(\underline{a})\underline{a}).$

The numerator of the right hand side of (15) is negative in view of (11) while the denominator is also negative since $N'(\underline{a}) > 0$ and $f(\underline{a}) > f'(\underline{a})\underline{a}$. This assures the positive rate of interest in a stationary state.

More generally, we can determine six variables w, r, $\underline{a}$, L, c_1 and c_2 from six equations, which are, in addition to (13) and (14),

(2) $c_1 + c_2/(1 + r) = w\ \bar{L}/b$

(3) $U_1(c_1,c_2)/U_2(c_1,c_2) = 1 + r$

(16) $b(c_1 + c_2) = Lf(\underline{a})$

(17) $\bar{L} = L + L\ N(\underline{a})\underline{a}$

where c_1 and c_2 are consumption of the representative individual when he is young and when he is old, $\bar{L}$ is the given total supply of labor, and b is the scale ratio of representative individual and the whole economy. Equations (2) and (3) are already explained, though we made p = 1 (consumers' good is numeraire) here. Demand and supply of consumers' goods are eualized in equation (16). The right hand side of (17) is, finally, demand for labor, i.e., that from the production of consumers' goods and that from the production of the capital goods, since $\underline{a}L = K$.

The assumption that capital goods are produced by labor alone may be typically Austrian but is certainly unrealistic. Let us next consider the case that capital goods are also necessary to produce capital goods. To produce X consumers' goods, we need L labor and $K = \underline{a}L$ capital goods. To produce $\underline{a}L$ capital goods, $N(\underline{a})\underline{a}L$ labor is necessary, as was assumed already. If we consider that the capital-labor-ratio is identical in the production of consumers' goods and in the production of capital goods, $N(\underline{a})\underline{a}L$ labor has to be combined with $\underline{a}N(\underline{a})\underline{a}L$ capital goods. To produce $N(\underline{a})\underline{a}^2L$ capital goods, $N(\underline{a})^2\underline{a}^2L$ labor is necessary, which has to be combined with $N(\underline{a})^2\underline{a}^3L$ capital goods, and so on.

Total amount of labor directly and indirectly necessary to produce X consumers' goods is then

(18) $V(X,\underline{a}) = L + N(\underline{a})\underline{a}L + N(\underline{a})^2\underline{a}^2L + \cdots = X/(1 - N(\underline{a})\underline{a})f(\underline{a})$

in view of (9). The condition for the convergence in (18), i.e., $\underline{a}N(\underline{a}) < 1$, is natural, since it does not make sense to use $N(\underline{a})\underline{a}^2L$ capital goods to produce $\underline{a}L$ capital goods, unless $\underline{a}N(\underline{a}) < 1$. The superiority of more roundabout method of production is that V is a decreasing function of $\underline{a}$, given X. From (18), it requires that

(19) $- f'(\underline{a}) + N(\underline{a})f(\underline{a}) + f'(\underline{a})\underline{a}N(\underline{a}) + \underline{a}f(a)N'(\underline{a}) < 0.$

The rate of return or the rate of interest r is implicitly defined in

(20) $F(L,K) - wL = (1 + r)\, wN(\underline{a})K + (1 + r)\, \underline{a}N(\underline{a})K(F(L,K) - wL)/K$

since capital goods has to be equally rewarded in the production of consumers' goods and in the production of capital goods, i.e., $(F(L,K) - wL)/K$ and to produce K capital goods we need $N(\underline{a})K$ labor and $\underline{a}N(\underline{a})K$ capital goods. In view of (8) and (9), (20) is reduced to

(21) $f(\underline{a})N(\underline{a})\underline{a}(1 + r) - f(a) = 0.$

Competitive firms producing capital goods choose $\underline{a}$ so that r is maximized, when w is given. By differentiating (21) with respect to $\underline{a}$ and r to obtain $dr/d\underline{a} = 0$, we have

(22) $f'(\underline{a})N(\underline{a})\underline{a}(1 + r) + f(\underline{a})N(\underline{a})(1 + r) + \underline{a}f(\underline{a})N'(\underline{a})(1 + r) - f'(\underline{a}) = 0$

from which r can be expressed as a function of $\underline{a}$,

(23) $r = (f'(\underline{a}) - f'(\underline{a})N(\underline{a})\underline{a} - f(\underline{a})N(\underline{a}) - \underline{a}f(\underline{a})N'(\underline{a}))$
$/(f'(\underline{a})N(\underline{a})\underline{a} + f(\underline{a})N(\underline{a}) + \underline{a}f(\underline{a})N'(\underline{a})).$

The numerator of the right hand side of (23) is positive in view of (19), while the denominator is clearly positive. This assures the positive rate of interest in a stationary economy.

We can determine seven variables w, r, $\underline{a}$, L, c_1, c_2 and the total amount of capital goods $\bar{K}$ in a stationary state from seven equations, which are, in addition to (2), (3), (16), (21) and (22),

(24) $\bar{L} = L + \bar{K}N(\underline{a})$

(25) $\bar{K} = L\underline{a} + \bar{K}N(\underline{a})\underline{a}.$

Equation (24) states that the given total supply of labor $\bar{L}$ is equal to demand for labor, L in the production of consumers'

goods and $\bar{K}\ N(\underline{a})$ in the production of capital goods, since $\bar{K}$ has to be reproduced in each period. Equation (25) shows the equality of the supply of capital goods $\bar{K}$ and demand for capital goods, $K = \underline{a}L$ in the production of consumers' goods and $\bar{K}N(\underline{a})\underline{a}$ in the production of capital goods.

4. Böhm-Bawerk versus Schumpeter.

In the previous section, we argued for the existence of the positive rate of interest in a stationary state on the basis of Böhm-Bawerk's first and third causes, the latter cause being interpreted that the labor productivity can be increased by making capital-labor-ratio higher. We had to, however, admit that the existence of the third cause in this sense in a stationary state requires fairly stringent conditions on the technological nature of production functions. Unfortunately, our conditions, i.e., (11) and (19) in the previous section, are somewhat complicated and their implications are not necessarily clear. It may be desirable, therefore, to consider what restriction is imposed on the form of production function in a drastically simplified model.

We still consider a two period life cycle generation model of an economy of stationary population given in the previous section. To make the story simple, however, let us specify the utility function of the representative individual $U(c_1,c_2)$ as

$$(1) \qquad U(c_1,c_2) = \log c_1 + \log c_2$$

where c_1 and c_2 denote, of course, the amount of goods he consumes in the first and second periods, respectively. The life-time budget equation for the representative individual is

$$(2) \qquad p_1c_1 + p_2c_2/(1 + r) = w\ \bar{L}/b$$

where p_1, p_2, w, r, $\bar{L}$, and b are, respectively, the price of the present good, that of the future good, wage, rate of interest, the given total labor supply and the scale ratio of representative individiual and the whole economy. The maximization of (1) under the condition (2) requires

(3) $\quad c_2/c_1 = (1 + r)p_1/p_2.$

When r is positive in a stationary state where $p_1 = p_2$, c_2 should be larger than c_1, which implies that the future want is better provided than the present one (Böhm-Bawerk's first cause of interest). Perhaps it may be convenient to decompose the life-time budget equation (2) into single period equations

(4) $\quad p_1c_1 + p_1S/b = w\bar{L}/b$

and

(5) $\quad p_2c_2 = (1 + r)p_1S/b$

where S denotes the total amount of capital to be saved.

We assume away the distinction between consumers' goods and capital goods and consider a homogeneous and malleable good which can be used both in consumption and in production. It is further assumed that the life-span of goods used as capital goods is a unit period. The aggregate production function is assumed to be of Cobb-Douglas type,

(6) $\quad Y = K^a L^{(1-a)}$

where Y, K and L are respectively the total output, total capital input and total labor input. Since capital has to be invested one period earlier, the rate of interest r is implicitly defined in

(7) $\quad p_1Y - w L = (1 + r)p_oK$

where p_o is the price of the good in the previous period.

Competitive firms choose K and L so as to maximize r, when p_1, p_o and w are given. By substituting (6) into (7) and solving $dr/dK = 0$ and $dr/dL = 0$, we have

(8) $\quad ap_1Y = (1 + r)p_oK$

and

(9) $\quad (1 - a)p_1Y = wL.$

If we consider a stationary state, and make the produced homogeneous good numeraire, we have $p_2 = p_1 = p_o = 1$. Since markets for labor, capital and the produced good have to be cleared,

(10) $\quad L = \bar{L}$

(11) $\quad K = S$

(12) $\quad bc_1 + bc_2 + K = Y.$

Among 10 equations (3) - (12), only 8 equations are independent, since (7) can be derived from (8) and (9), and (12) can be derived from (4), (5), (8), (9), (10) and (11). These 8 independent equations can determine 8 unknowns, c_1, c_2, w, r, K, S, L and Y.

Consider (12), which state that the total output is distributed to the consumption of younger population, that of the older population and capital maintenance. From (5) and (11), $bc_2 = (1 + r)K$, then from (3) $bc_1 = K$, while from (8), $Y = (1 + r)K/a$. Condition (12) is, therefore, changed into

(13) $\quad K + (1 + r)K + K = (1 + r)K/a$

from which we have

(14) $\quad r = (3 - 1/a)/(1/a - 1).$

Since $0 < a < 1$, the denominator of the right hand side of (14) is positive. Therefore, r can be positive if and only if $a > 1/3$. If $a = 1/3$, which is by no means unlikely, however, we

have to admit that the rate of interest does not exist in a stationary state.

What has become of Böhm-Bawerk's third cause for interest? The superiority of more roundabout method of production in terms of capital-labor-ratio implies the positive net marginal productivity of capital,

(15) $dY/dK - 1 = aY/K - 1 > 0$

since labor input is given as $\bar{L}$. If $a = 1/3$, however, $aY/K = 1$ in a stationary state, in view of (8) and (14). The third cause ceases to operate when the economy reaches a stationary state, if $a = 1/3$. Then, the first cause for interest also ceases to operate, since $c_1 = c_2$, in view of (3).

What we have to admit is, then, that the rate of interest is zero in a stationary state if a parameter in the aggregate production function takes a certain critical value, i.e., $a = 1/3$ in the case of our simplified model. If $a > 1/3$ in our model, we can still insist that the rate of interest is made positive in a stationary state by Böhm-Bawerk's third cause and first cause of interest, the latter being generated by the former. It is well known, however, that Joseph A. Schumpeter (1883-1950), who studied economics at Vienna as a student of Böhm-Bawerk, insisted the zero rate of interest in a stationary state as the general proposition.

Schumpeter was born in 1883 at Triesch in Austria (now in Czechoslovakia). After graduated from University of Vienna in 1906, he was appointed to the chair of political economy in the University of Czernowitz in 1909, and in the University of Graz in 1911. He published Wesen und Hauptinhalt der theoretischen Nationalökonomie in 1908, Theorie der wirtschaftlichen

Entwicklung in 1912, and Epochen der Dogmen- und Methodengeschichte in 1914. Although he started his study of economics at Vienna, it is clear that he was much more influenced by Walras than by Austrians. In 1919, Schumpeter was named Austrian Minister of Finance, the same office his teacher Böhm-Bawerk had held, but he resigned after six months. Then he became president of the Biedermann Bank, which went bankrupt in 1924. Returning to academic life, Schumpeter was first invited to a chair at the University of Bonn and then went to Harvard permanently in 1932. Business Cycle was published in 1939, and followed by Capitalism, Socialism and Democracy in 1942. Schumpeter died in 1950, with the manuscript of History of Economic Analysis left to be published in 1954.

Schumpeter ([36], p.175) called the following three propositions the basis of his theory of interest. (1) Interest as a great social phenomenon is a product of development. (2) It flows from entrepreneurial profit. (3) It does not adhere to concrete goods. Being "a product of development," interest does not exist in a stationary state. Although Schumpeter admitted later the existence of some interest in a stationary state ([37], pp.105-106), it is done from the point of view of realism, and not from the point of view of theory or principle. Then, how can Schumpeter deny the existence of the rate of interest in principle in a stationary state? His reason can be seen from the following argument.

"It also makes no difference to an individual firm whether it produces consumption or production goods. In both cases it disposes of its products in the same way, receives, under the hypothesis of completely free competition, a payment

corresponding to the value of its land or labor services, and nothing else. If we choose to call the manager or owner of a business" entrepreneur, "then he would be an entrepreneur faisant ni benefice ni perte, without special function and without income of a special kind. If the possessors of produced means of production were called" capitalists, "then they could only be producers, differing in nothing from other producers, and could no more than the others sell their products above the costs given by the total of wages and rents" (Schumpeter[36], pp.45-46).

Schumpeter footnoted for an entrepreneur faisant ni benefice ni perte that it is a construction of Walras. Why can a Walrasian entrepreneur make no profit at equilibrium? It is because he always expands production if there is a positive profit in tâtonnement. If a possessor of produced means of production similarly increases his stock whenever it has a positive net marginal productivity, certainly there is no positive rate of interest at equilibrium. A possessor of produced means of production can, however, increase his stock only by reducing his current consumption and increasing his saving. The problem is, therefore, whether the level of capital stock which makes its net marginal productivity zero is identical to the level of capital stock which individuals wish to maintain through their optimal consumption-saving behavior at the zero rate of interest. In our model given above, the level of the capital stock individuals wish to maintain at $r = 0$ is 1/3 of the level of output, as is seen from the left hand side of (12) and (13). The level of capital stock which makes the net marginal productivity zero is a times the level of output, in view of (15). They are not identical, unless a is 1/3.

As we did, Schumpeter also assumed away Böhm-Bawerk's second cause for interest. "Of the famous three reasons upon which he bases the value premium on present purchasing power, I reject only one: the "discounting" of future enjoyments, so far as Böhm-Bawerk asks us to accept it as a cause not itself requiring any explanation" (Schumpeter[36], p.158). If the representative individual of a stationary population has an infinite time horizon, then, his level of consumption has to be stationary in a stationary economy and a stationary state cannot be maintained with a positive rate of interest, since the positive rate of interest necessarily induces an increase in capital stock through saving. An infinite time horizon implies, however, that an individual takes into consideration, not only his own utility, but also those of future generations. It is natural for rational individuals, then, to discount the significance of the utility of future generations in comparison with that of his own utility and to discount more for the more remote generations. This is, however, to re-introduce the second cause of Böhm-Bawerk. If we continue to assume away the second cause, therefore, we have to assume that the representative individual has a finite time horizon.[17] He may not, then, increase his saving even if the rate of interest is positive, and the capital stock may remain unchanged with a positive net marginal productivity in a stationary state, in spite of Schumpeter's argument to the contrary.[18]

As far as the case of a stationary economy is concerned, therefore, we may conclude that Böhm-Bawerk was right against Schumpeter. To consider the more positive aspect of Schumpeter's theory of interest, however, we have to leave from

the case of a stationary state and turn to the case of a growth equilibrium. Empirical investigations of the economic growth in the developed industrialized capitalist economies since the second half of the nineteenth century have found the following so-called "stylized facts" of economic growth.[19] (1) The investment-output ratio is constant. (2) The capital-output ratio is constant. (3) The capital-labor and output-labor ratios are rising at a constant rate. (4) The rate of interest is constant. (5) The real wage rate is rising. (6) The relative shares of capital and labor are constant.

Let us now introduce a growth factor into our model. Suppose that $\bar{L}$ signifies not the number of laborers but the efficiency units of labor and $\bar{L}$ is assumed to increase steadly at the rate of g, not because the labor population increases but because the efficiency of labor is increased by the introduction of more efficient technology. Consider a balanced growth of all the quantities, Y, K, S, L, c_1 and c_2 at the same growth rate g while the absolute price level is assumed to be constant, so that we still have $p_o = p_1 = p_2 = 1$ and the wage for the efficient unit of labor, w, is kept unchanged through time. It is easily seen that all the stylized facts of economic growth are realized on such a balanced growth path.[20] All the growing quantities should now be dated as $\bar{L}(t)$, $Y(t)$, $K(t)$, $S(t)$, $L(t)$, $c_1(t)$, and $c_2(t)$ in equations (3) - (12), and the equations (6), (7), (8) and (12) should be modified into

$$(6)' \quad Y(t) = [K(t)/(1 + g)]^{a} L(t)^{(1 - a)}$$

$$(7)' \quad Y(t) - wL(t) = (1 + r) K(t)/(1 + g)$$

$$(8)' \quad aY(t) = (1 + r) K(t)/(1 + g)$$

$$(12)' \quad bc_1(t) + bc_2(t)/(1 + g) + S(t) = Y(t),$$

since $K(t-1) = K(t)/(1+g)$ and $c_2(t-1) = c_2(t)/(1+g)$. Still (7)' can be derived from (8)' and (9), and(12)' can be derived from (4), (5), (8)', (9), (10) and (11). Eight unknowns $c_1(t)$, $c_2(t)$, w, r, $K(t)$, $S(t)$, $L(t)$ and $Y(t)$ are determined by eight independent equations among ten equations, (3) - (5), (6)', (7)', (8)', (9) - (11) and (12)', when $\bar{L}(t)$ is given.

While $bc_2(t) = (1+r)\,S(t)$ and $bc_1(t) = S(t)$ from (3) and (5), $Y(t) = (1+r)\,S(t)/a(1+g)$ from (8)' and (11). Condition (12)' is, therefore, changed into

(13)' $(1+g) + (1+r) + (1-g) = (1+r)/a$

from which we have

(14)' $(1+r) = 2(1+g)/(1/a - 1)$.

If we assume that $1/a = 3$ so that $r = 0$ in (14), we now have $r = g > 0$ from (14)' here.

If the rate of interest is zero in a stationary state, it is positive and identical to growth rate in a balanced growth equilibrium induced by a steady growth of labor productivity. The reason for the existence of a positive rate of interest is that the increase in the supply of capital is constantly lagged behind the growth of the productive power of labor due to the technological progress. Such an economic growth may be identified with Schumpeter's development, which is defined as follows.[21)]

"By "development," therefore, we shall understand only such changes in economic life as are not forced upon it from without but arise by its own initiative, from within. --- Nor will the mere growth of the economy, as shown by the growth of population and wealth, be designated here as a process of development. For it calls forth no qualitatively new phenomena, but only

processes of adaptation of the same kind as the changes in the natural data" (Schumpeter[36], p.63).

"To produce means to combine materials and forces within our reach. --- Development in our sense is then defined by the carrying out of new combinations. This concept covers the following --- cases. --- (2) The introduction of a new method of production, that is one not yet tested by experience in the branch of manufacture concerned, which need by no means be founded upon a discovery scientifically new, ---" (Schumpeter[36], pp.65-66).

In other words, the economic growth made possible by the introduction of new technology is definitely a Schumpeterian development, since it is not induced by passive adjustment of an economy to changes in data exogenously given like an increase in the population, but caused by active decisions to adopt newly such technologies that have not been used before, from the stock of technologies newly invented or already accumulated.

Schumpeter ([36], p.83) emphasized the distinction between two types of individuals: mere managers and entrepreneurs. "The carrying out of new combinations we call "enterprise"; the individuals whose function is to carry them out we call "entrepreneurs"" ([36], p.74). The reason for this distinction is that "carrying out a new plan and acting according to a customary one are things as different as making a road and walking along it" ([36], p.85). Schumpeter further insisted that entrepreneurs with new combinations compete with other managers with old combinations. "New combinations are, as a rule, embodied, as it were, in new firms which generally do not arise out of the old ones but start producing besides

them" ([36], p.66). This co-existence of two methods of production leads to the appearance of entrepreneurial profit.

"The looms produce a greater physical product than the services of labor and land contained in them could produce by the previous method, although in the case of constant prices of production goods and products this latter method would also enable production to be carried on without loss. --- Hence there arises a difference between receipts, which are determined according to the prices which were equilibrium, that is cost, prices when hand labor alone was being used, and outlays, which are now essentially smaller per unit of product than for other business" (Schumpeter[36], p.131).

"The surplus is realised, --- Now to whom does it fall? Obviously to the individuals who introduced the loom into the circular flow [the stationary state], --- And what have they done? They have not accumulated any kind of goods, they have created no original means of production, but have employed existing means of production differently, more appropriately, more advantageously. They have "carried out new combinations." They are entrepreneurs. And their profit, the surplus, to which no liability corresponds, is an entrepreneurial profit" ([36], p.132).

In our growth equilibrium which is a Schumpeterian development, however, there exist a positive rate of interest but no entrepreneurial profit, while Schumpeter insists his second proposition of interest that "interest must flow from entrepreneurial profit" ([36], p.175). Perhaps we may conceive that entrepreneurs are followed by all the other managers very quickly, so that "the surplus of the entrepreneur in question and of his immediate followers disappears" ([36], p.132).

Of Schumpeter's three propositions of interest ([36], P.175), we can support the first proposition that interest is a product of development, since the rate of interest is positive in a steady development, even if it is zero in the circular flow, i.e., the stationary state. The second proposition that interest flows from entrepreneurial profit is a questionable one, if it implies that the rate of interest is zero when entrepreneurial profit disappears. Similarly, the third proposition that interest does not adhere to concrete goods is also objectionable. Certainly, the entrepreneurial profit does not adhere to concrete goods. But, interest is a quasi-rent to capital goods whose supply is constantly in short of demand in a growth equilibrium. It seems that Schumpeter himself admitted, in a sense, this last point.[22)]

"If entrepreneurs were in a position to commandeer the producers' goods which they need to carry their new plans into effect, there would still be entrepreneurs' profit, but no part of it would have to be paid out by them as interest. --- It is only because other people have command of the necessary producers' goods that entrepreneurs must call in the capitalist to help them to remove the obstacle which private property in means of production or the right to dispose freely of one's personal services puts in their way" ([36], p.177).

Footnotes

1) See articles of Lachmann and Egger in Spadaro[39], pp.1 - 39, particularly, 1 - 2, 17, 19 and 34.

2) This is because Böhm-Bawerk's concepts of time preference and period of production do not represent all of those economically relevant aspects of time. See Spadaro[39], pp.1 - 2, and Schumpeter[38], p.847.

3) For Methodenstreit, see Schumpeter[38], pp.814 - 815, White's Introduction to Menger[27], and the article of Hutchison in Hicks and Weber[12], pp.15 - 37.

4) Menger[26] is, however, a variorum translation into Japanese. The title is changed into Allegemeine theoretische Wirthschaftslehre, because it was so suggested by Menger himself in a material which is kept in Menger Library of Hitotsubashi University, a fact noted first, as far as we know, by Y. Yamada ([47], p.98).

5) The marginal productivity theory of Menger and Wieser is reformulated in terms of linear programming by Samuelson ([35], pp.505 - 512) and Uzawa [41].

6) See Menger[23], where Absatzfähigkeit is translated into salableness. See also Menger[25], P.242, where Absatzfähig is translated into liquid and Absatzfähigkeit into marketability.

7) For recent discussions on Menger's theory of money, see Nagatani[28], pp.118 - 130, O'Driscoll[30] and Hirayama[13].

8) See Wieser[43], pp.20, 142, 165 and 398.

9) For Austrians in the socialist calculation debate, see Lavoie[22], particularly, pp.22 - 27. See also Wieser[45], pp.61, 63, [43], pp.396 - 397, and Lavoie[22], pp.80 - 85 for Wieser's view on the practical possibility of the communistic state.

10) Phelps[31] also uses a utility frontier with a rising portion to explain Rawls's theory of optimal distribution, though he does not discuss detailedly why his utility frontier is not downwardly sloping.

11) See for the example of a boat and net, which is originally due to Rocher, Böhm-Bawerk[4], pp.280 - 281. The example of a sewing machine is discussed in [4], p.83.

12) See, for example, Hirshleifer[14]. It is true that the first cause is introduced implicitly along with the second cause in Bernholz, Faber and Reiss[3]. In the case of a stationary state where net investment is zero, however, the positive rate of interest is still explained by the second cause. See also Faber[7], pp.111 - 130.

13) We are indebted to Professor G. O. Orosel for the suggestion that the life-cycle model should be used, while we owe to Professor M. Faber the reference to Arvidsson[1].

14) Discussion with Professor Makoto Yano of Yokohama National University was very useful in this respect.

15) For example, see Kaldor[17] and Hawtrey[10], p.31, the reference to the latter we owe to Professor Ryuichiro Tachi of Aoyamagakuin University.

16) See Samuelson[35] where Turgot's fructification theory of interest is considered by a life-cycle model.

17) In spite of Haberler[8], finite horizon does not imply the second cause of Böhm-Bawerk. It is rather infinite horizon that is consistent with the second cause.

18) The problem is, therefore, not whether the marginal net productivity of capital is positive for any, possibly very large, amount of capital, but whether it is positive for an equilibrium amount of capital in a stationary state.

19) The stylized facts are originally due to Kaldor[18]. See Burmeister[6], pp.46, 291.

20) It is easily seen that facts (1) and (2) are realized. Since the labor population is constant, while capital and output are increasing, the fact (3) is also realized. While the wage for the efficiency unit is constant, the real wage for a laborer is rising, since prices remain constant and labor efficiency is increasing, i.e., the stylized fact (5). Finally, the rate of interest is constant (the fact (4)), while both $w\bar{L}$ and rK increase at the rate of g, so that we observe (6) is satisfied.

21) If the development is financed by the creation of purchasing power by banks (Schumpeter[36], p.73), the price level may not be unchanged. Suppose the supply of money and therefore prices are increased at the rate i. The wage w is now dated as $w(t)$ and changes at the rate i, while prices are also dated and change at the same rate in such a way that $p_o(t)(1 + i) = p_1(t)$, $p_1(t)(1 + i) = p_2(t)$. From the point of view of the rate of interest, only relevant change is that the left hand side of (14)' is now $(1 + r)/(1 + i)$, so that the real rate of interest is equal to the rate of growth if $1/a = 3$.

22) Schumpeter's emphasis on entrepreneurs and banks may make one feel that the role of capitalists is not properly recognized. See Yagi[46] for a critical discussion on this point.

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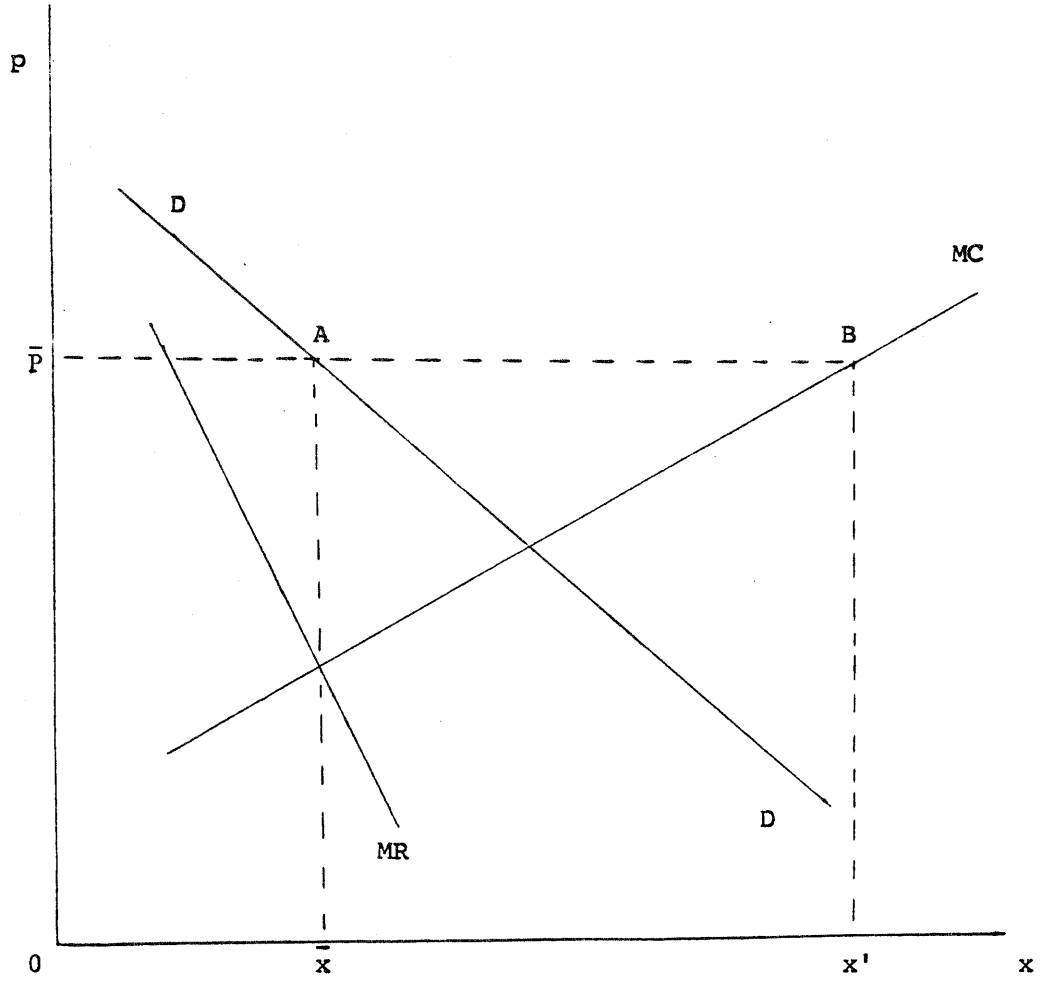

Figure 1

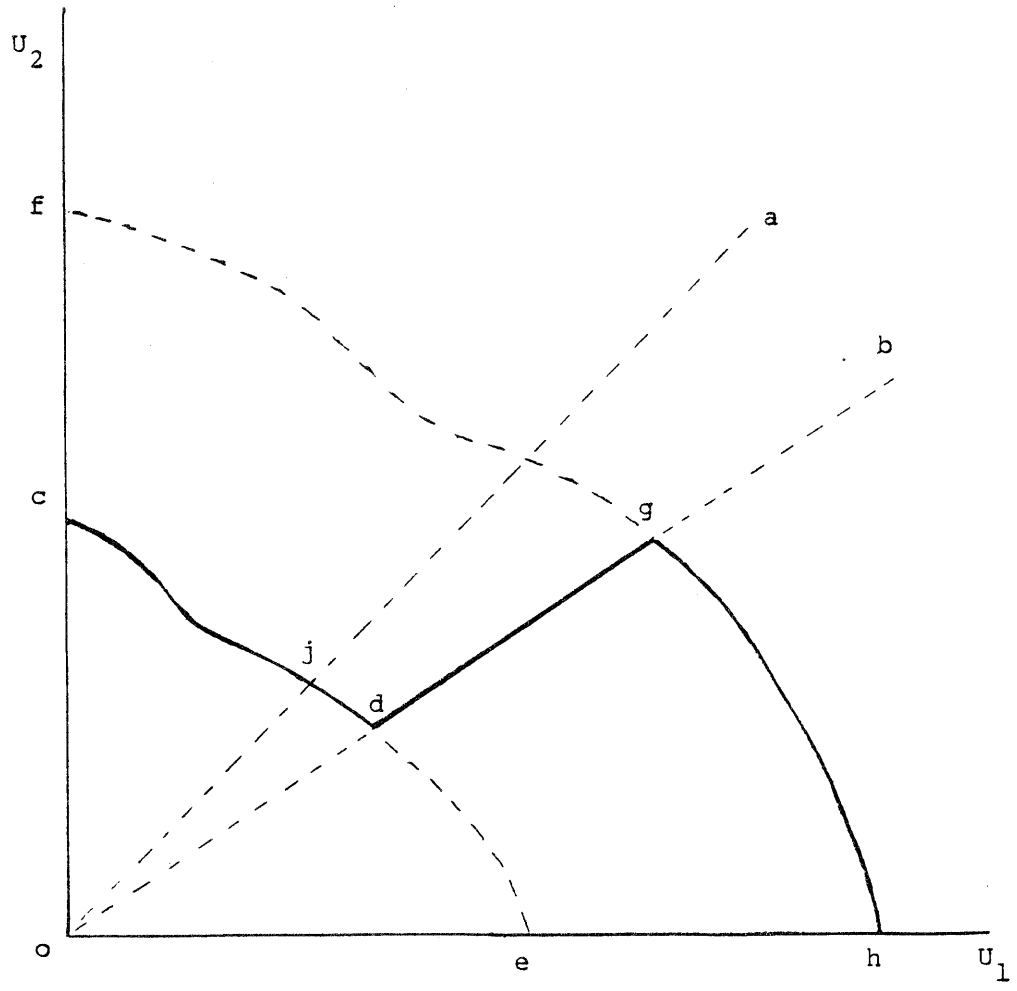

Figure 2

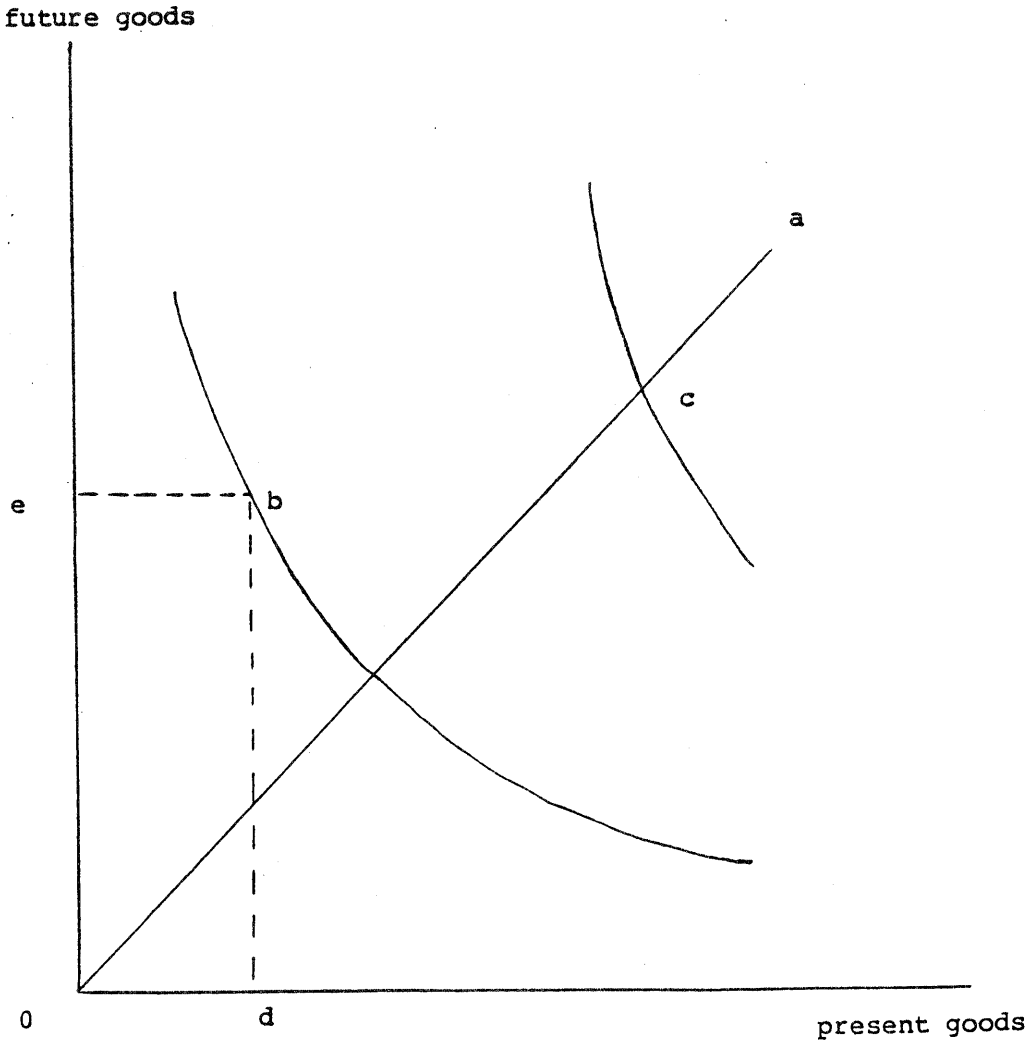

Figure 3

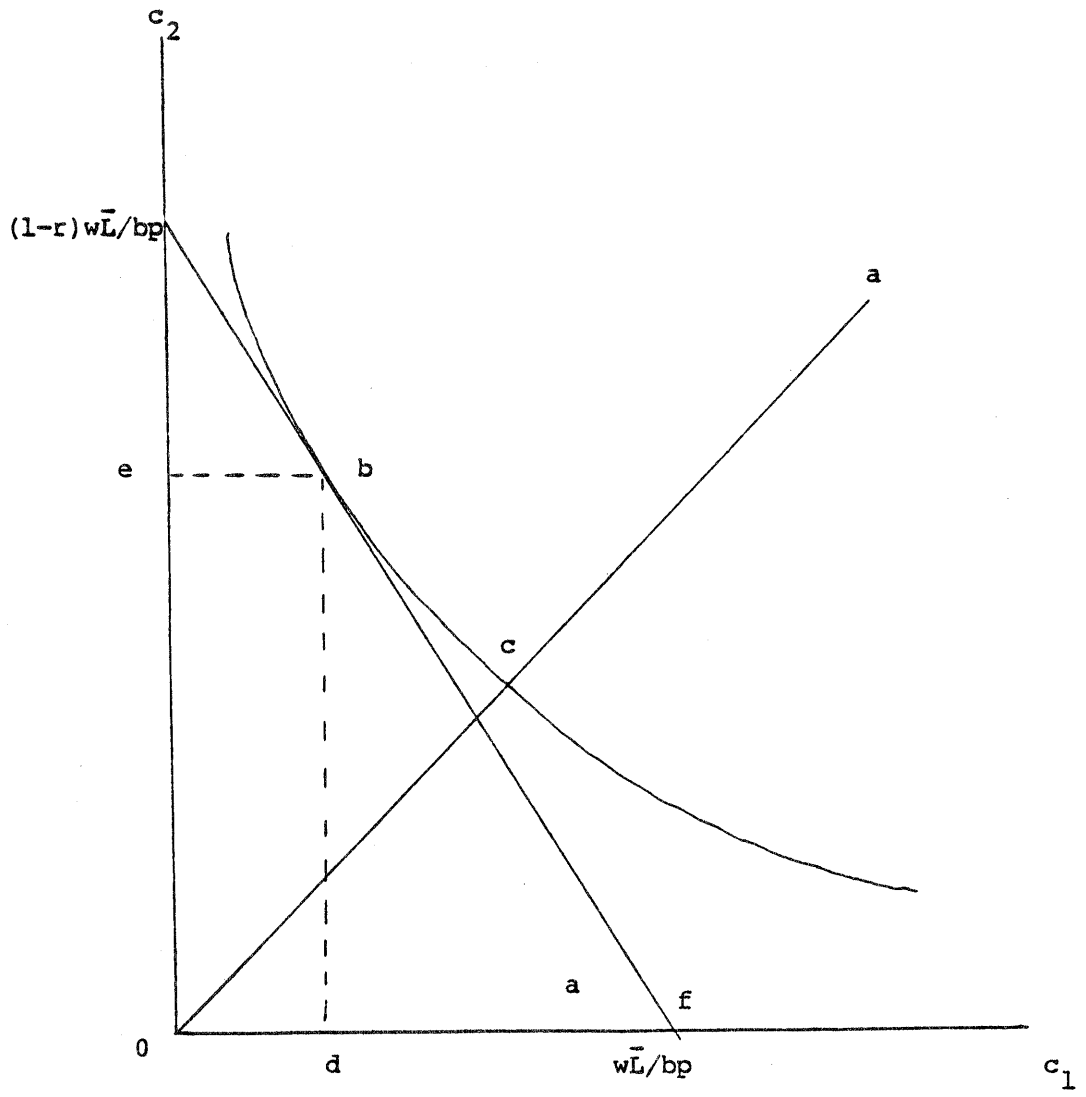

Figure 4

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