

# How Can Keynes' Theory of Interest Withstand Sraffa's Criticism?

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## Abstract

It is examined how Keynes' theory of interest can withstand Sraffa's criticism that appeared in his note on chapter 17 of Keynes' *General Theory* contained in the *Sraffa Papers*. After summarising Sraffa's criticism, his misunderstanding of Keynes' theory concerning the concept of own-rate of interest is made clear. With regard to a source of the misunderstanding, a difference between their concepts of equilibrium is revealed: Sraffa's two concepts of equilibrium, i.e. arbitrage and long-term equilibria, and Keynes' concept of short-term equilibrium. In the latter equilibrium, commodity prices are changing in line with changing technology, productivity and demand structure. An interpretation that Keynes' concept of the own-rate of interest was necessary to describe features of such an equilibrium is presented. It is revealed that the interpretations of Keynes' argument in chapter 17 by Kaldor, Barends and Caspari, and Lawlor result in the same criticism of Keynes' theory as Sraffa's. Finally, It is argued that Keynes' theory of interest as withstanding Sraffa's criticism shows an aspect of the Keynesian revolution suggested by Pasinetti.

**Key words:** own-rate of interest, Keynes' equilibrium, Sraffa's equilibrium, Sraffa Papers, Chapter 17 of the *General Theory*

## 1 Introduction

Chapter 17 of Keynes' *General Theory* was intended to make clear what makes money so unique among various assets and what gives the money rate of interest such a peculiar role in determining the level of employment. Keynes regarded this investigation as essential for the full significance of his theory (Keynes 1936, p.222). In the course of the discussion, he employed the concept of own-rates of interest for various commodities, which he attributed to Sraffa. This chapter is, therefore, important with respect to the question of what is the core of Keynes' theory of interest as well as what is the contribution of Sraffa to the development of that theory.

Through Sraffa's note on chapter 17 contained in the Sraffa Papers, however, it is becoming apparent that Sraffa was quite critical of Keynes' theory of interest. As Ranchetti (2001) and Kurz (2010) reported, Sraffa denied the notion of liquidity preference, which is a core concept in Keynes' theory of interest, accused Keynes of identifying marginal efficiency of capital with own-rate of interest, and pointed out a self-contradiction in Keynes' argument on how the money-rate of interest limits the level of employment.

How should we consider the gap between the seeming contribution of Sraffa to Keynes' theory of interest on the part of Keynes and the denial of that theory on the part of Sraffa? Did Keynes misunderstand Sraffa's concept of commodity-rates of interest? Ranchetti fully accepted Sraffa's criticism altogether, and then he found that, in spite of the discrepancy, the two scholars have a common vision regarding the rate of interest, that is, the money rate of interest given outside of the production system (Ranchetti 2001, p.327). Kurz also accepted Sraffa's criticism and argued 'in chapter 17, Keynes did not

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reason correctly and got entangled in a maze of contradiction' (Kurz 2010, p.201). Kurz rejects the New Keynesian interpretation that Keynes' theory depends on sticky prices, and thinks that Keynes sought a system that allows flexible prices, but that Keynes's argument 'suffers from neglecting the implications of flexible prices via the value of money for the level of the "own rate of money interest" ' (*ibid.*, p,202).

I will present a different view: Sraffa misunderstood Keynes' theory of interest, and Keynes' utilization of the concept of own-rate of interest can withstand Sraffa's criticism. In order to do so it is necessary to make clear how different Keynes' notion of equilibrium is from that of Sraffa, and also it is necessary to abandon a prevailing interpretation that the spot or present price of an asset is its demand price and that the forward or future price of an asset is its normal supply price. I will offer an interpretation that Keynes described in chapter 17 an equilibrium with unemployment in a structurally changing economy, and that he employed Sraffa's concept of commodity-rates of interest because he discovered a germ of the concept of such an equilibrium in Sraffa's critical paper on Hayek's book (Sraffa 1932a). This interpretation will support Pasinetti's idea (2007) about the Keynesian revolution, that the nature of the revolution should be conceived as a shift from a pure exchange paradigm to a pure production paradigm; the pure production paradigm evidently originated in Sraffa's work (1960) and was developed by Pasinetti.

First, after describing Sraffa's criticism of Keynes' theory of interest as it appears in his note on chapter 17, I will reveal Sraffa's misunderstanding about Keynes' theory, and then identify the source of the misunderstanding: the difference between Keynes' and Sraffa's notions of equilibrium. Recognizing the difference, we are forced to discard Kaldor's (1960) and Barends and Caspari's (1997) identification of present prices with demand prices and of future prices with supply prices. It will also be shown that the equilibrium of Keynes as interpreted by Lawlor (1996) is reduced to the identical one with Sraffa's, in spite of his attempt to distinguish Keynes's equilibrium from Sraffa's equilibrium, because he also identified the present prices with demand prices and future prices with supply prices. Unless we discard such an identification of prices, we cannot escape from Sraffa's criticism. Finally, I will argue that Keynes' theory of interest as withstanding Sraffa's criticism shows an aspect of the Keynesian revolution suggested by Pasinetti (2007), who depreciated the importance of chapter 17.

## 2 Sraffa's critique of Keynes' theory of interest

According to Ranchetti (2001, p.321), Sraffa addresses two radical objections to Keynes' theory.

The first critique concerns the liquidity preference theory on which Keynes based the determination of the money rate of interest. According to Ranchetti, Sraffa argues that Keynes' liquidity preference is nothing but the marginal utility of holding money and it follows that Keynes based the inverse relation between the demand for money and the interest rate on the diminishing marginal utility of holding money (*ibid.*). However, Sraffa says, the diminishing marginal utility of holding money does not exist because some people reduce liquidity but the others do not when the interest rate goes down. Keynes rejected the classical theory which related the amount of saving with the interest rate, but 'the old theory would re-emerge in Keynes' concentrating on the supply of loans' (*ibid.*, p.322).

Sraffa gives a different explanation for the fact that the more the quantity of cash the lower the interest rate. According to Sraffa, the causal order should be reversed: 'it is a low interest rate which is the cause of abundant money' (*ibid.*). Attention should be paid to demand, not supply, for loans. If you supply more money, the interest must be lowered, because borrowers will become unable to find profitable investment unless the interest rate is reduced. The interest rate does not influence the behaviour of lenders.

The second critique, according to Ranchetti, concerns Keynes' notion of own-rates of interest and the relation established by Keynes between that notion and the notion of marginal efficiency of capital' or the confusion of the two notions (*ibid.*, p.321). According to Ranchetti (2001, p.318-319), Keynes gives three different definitions of the rate of interest on a commodity or an asset. The first definition is the same one as Sraffa gave: the rate of a discrepancy of the spot price from the forward price of a commodity plus the money rate of interest, i.e.  $1 - \frac{p_f}{p_s} + r$ , where  $p_f$  and  $p_s$  are the forward and spot prices of the commodity and  $r$  is the money interest rate<sup>1</sup>. The second definition is that the own-rate of

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<sup>1</sup>This is the expression of the notion of the commodity-rate of interest presented by Sraffa. A different expression  $p_s/p_f - 1 + rp_s/p_f$  would represent more precisely the notion of the own-rate of interest presented by Keynes, but the difference between the two notations is the difference in the reference point in time, and the two notations approach to each other when the time interval approaches to zero. In fact, taking Keynes' example of wheat, and suppose that the present price of wheat is  $p_0$  and the price at the time  $t$  is  $p_t = p_0 e^{at}$ , i.e.  $a$  is the rate of change in price, and the money rate of

a commodity is the net advantage of possessing a commodity or an asset: its yield minus its carrying cost plus its liquidity-premium, i.e.  $q - c + l$  according to Keynes' notation. The third definition is given by  $a + q - c + l$ , where  $a$  is the expected appreciation of the commodity in terms of money; Keynes refers to it as 'the wheat rate of money-interest' in the case where the commodity in question is a wheat. Sraffa accepts the first one, while he rejects the second and the third ones, according to Ranchetti.

Sraffa argues that the difference in the rates of interest of various commodities comes from the difference in the rate of change in their prices, not from the difference in the advantages of them as Keynes said (Ranchetti 2001, pp.322-323). Keynes assumed people borrow a commodity in order to hold it and to enjoy its advantages until the end of the borrowing period —to enjoy liquidity in the case of money—, but actually, Sraffa says, people borrow money for the purpose of spending it on other commodities. What people borrow is not an object they want to use but a standard of value in terms of which they fix their debt. If fish is the standard of value, one can borrow fish for one hundred years, although its liquidity is zero and its carrying cost is infinite.

According to Sraffa, Keynes should have spoken about the marginal efficiency of assets, not about the rate of interest. Ranchetti says, 'if it is so, then it would have been more logical to refer directly to the marginal efficiencies of different capital goods, rather than to their own-interest rates. However, if even this necessary correction is granted, Keynes' main conclusion — i.e. that, because of the "special characteristics" of money, the money rate of interest is more "reluctant" to fall relatively to the own-rates of interest of the other assets (and therefore could remain fixed at a higher level) — would be self-contradictory' (2001, p.323). Ranchetti quotes Sraffa's notes to show the inconsistencies in Keynes' argument:

If there is one article the marginal efficiency of which never fall below say 5% (this being the valuation of the pleasure people derived from hoarding any quantity of it) the production of all other durable assets will stop when their stocks are such that marginal efficiency has come down to that level — for otherwise they could not be sold at cost— and all resources saved will be used for producing the hoardable asset. If this asset cannot be produced (paper money), its demand will increase and can only be met by a continuous rise in its value, i.e. fall in general prices. If this hoarding is expected to go on steadily, and all prices are expected to fall in terms of money, the result will be that all own rates of interest of commodities will be higher than the money rate (this is Fisher's case: and the expected appreciation or depreciation is the only possible cause of divergence in rates of interest).

Thus in the Keynes case, the result on rates of interest is opposite to Keynes' conclusion. (Ranchetti 2001, pp.323-324, *Sraffa Papers (SP)* I100, p.11)

After presenting the two objections to Keynes' theory of interest, Ranchetti summarised Sraffa's critique as follows: Keynes insists that interest is a monetary phenomenon and that the interest rate is determined by the liquidity preference not by the marginal productivity of capital as the neoclassical theory assumed, but investigation of the notion of liquidity preference reveals that it is no more than a marginal utility of hoarding money, which is, in turn, a marginal productivity of capital, so Keynes' theory is not different from the neoclassical one (Ranchetti 2001, p.324). This concerns the first critique.

With reference to the second critique, Ranchetti remarked that 'Sraffa could not accept Keynes' identification of his notion of commodity rate of interest (Keynes dubbed as own-rate of interest) with the neoclassical notion of marginal efficiency' (*ibid.*, p.326). Ranchetti also says; 'the Sraffian notion of "natural or commodity rate of interest" is entirely void of any marginalistic element. Now, even if we leave the controversial issue of its more or less intrinsically marginalistic nature aside, the Keynesian notion of marginal efficiency of capital appears to specify a functional relationship between the own-rate of interest (marginal efficiency of capital) and the level of investments that Sraffa could not accept' (*ibid.*). Ranchetti expressed his belief that since Keynes was aware of Sraffa's critique, he reconsidered his theory of interest in the light of this critique and he abandoned the notion of own-rate of interest in his writings after the *General Theory (ibid.)*.

Having accepted Sraffa's critique, Ranchetti concludes that in spite of the objection of Keynes' notion of own-rates of interest and liquidity preference, there is 'a strong agreement between Sraffa and Keynes

interest is  $r$ , then Keynes' explanation is as follows: since one unit of present money will buy  $e^{rt}$  units of forward money at time  $t$ , which will buy  $e^{rt}/(p_0 e^{at})$  units of forward wheat at time  $t$ , whereas one unit of present money will buy  $1/p_0$  units of present wheat, one unit of present wheat will buy  $p_0 e^{rt}/(p_0 e^{at}) = e^{(r-a)t}$  units of forward wheat at time  $t$ . It follows that the wheat-rate of interest is  $[de^{(r-a)t}/dt]/e^{(r-a)t} = r - a$ , which is, under  $a = p_f/p_s - 1$ , identical with  $1 - p_f/p_s + r$ .

on a monetary and conventional determination of the rate of interest and on the direction of the causal nexus between the two (namely, from the money rate of interest to the rate of profits)' (*ibid.*, p.327).

### 3 Is Keynes' argument self-contradictory?

If Sraffa's critique is valid, it follows that there are no grounds for the notion of liquidity preference, that the marginal efficiency of capital cannot be related to the own-rate of interest, as described in chapter 17 of the *General Theory*, and that the argument on the peculiarity of the money rate of interest in the determination of the level of employment is illegitimate. Is Sraffa's critique really valid?

Sraffa's second critique concerns Keynes' 'confusion' of the marginal efficiency of capital with the own-rate of interest. The critique appears most clear-cut in his elucidation of the self-contradiction in Keynes' argument. Sraffa remarked that if the marginal efficiency of money is never below 5% and the marginal efficiencies of other assets declines and fall below 5%, then money absorbs demand, which raises the value of money in relation to other assets, which means a decrease in the values of the other assets in terms of money, which, in turn, means higher own-rates of interest of those assets than the interest rate of money. This is alleged to be opposite to what Keynes says.

When money absorbs demand and its relative value continues to rise, the price of another asset is expected to fall in terms of money, i.e.  $p_f < p_s$ . It follows

$$1 - \frac{p_f}{p_s} + r > r. \quad (1)$$

The left-hand side of the inequality represents the own-rate of interest of the commodity according to Sraffa's definition and Keynes' first definition as called by Ranchetti. This inequality certainly shows the own-rate of interest of the commodity is higher than the interest rate of money.

This logic of Sraffa includes no error, but it does not reveal Keynes' self-contradiction. For what matters for Keynes was not the relation of the own-rate of interest of an asset in terms of the asset itself to the rate of interest of money in terms of money itself, but the relation of the own-rate of interest of an asset in terms of *money* to the rate of interest of money in terms of money itself, i.e. the relation of the commodity-rate of money-interest to the money-rate of money-interest matters in Keynes' terminology.

The left-hand side of the above inequality (1) represents the own-rate of a commodity in terms of the commodity itself, not the rate in terms of money. Therefore, the inequality (1) would not cause any problem for Keynes. Using  $a$  as representing the rate of change in the value of a commodity in terms of money, the commodity-rate of money-interest is expressed as:

$$1 - \frac{p_f}{p_s} + r + a,$$

whereby the inequality (1) can be consistent with Keynes' equilibrium:

$$1 - \frac{p_f}{p_s} + r + a = r$$

when  $a < 0$ .

However, the rate of change in the price of a commodity is nothing but  $p_f/p_s - 1$ ; i.e.  $a = p_f/p_s - 1$ , which reduces the above equation into

$$r = r.$$

This is a meaningless identical equation. In the case of Keynesian disequilibrium, where investments are increasing or decreasing, we would have  $r < r$  or  $r > r$ , which is contradictory. How should we deal with it?

Keynes had given other definitions for the own-rate of interest, i.e.  $q - c + l$  for the own-rate of interest in terms of the commodity itself, and  $q - c + l + a$  for the own-rate of interest in terms of money. Using these definitions and assuming  $l = 0$  for the assets other than money, Keynes' equilibrium is represented by  $q - c + a = r$ . Taking  $a = p_f/p_s - 1$  into account, this is equivalent to:

$$q - c + \left( \frac{p_f}{p_s} - 1 \right) = r. \quad (2)$$

This is not meaningless and Keynesian disequilibrium can also be expressed without contradiction as:

$$q - c + \left( \frac{p_f}{p_s} - 1 \right) \leq r.$$

The situation Sraffa pointed out is expressed as:

$$q - c + \left( \frac{p_f}{p_s} - 1 \right) = r, \quad \frac{p_f}{p_s} - 1 < 0,$$

which also has no contradiction.

This reveals a source of Sraffa's (and also Ranchetti's) mistake: the interpretation that  $1 - p_f/p_s + r$  is one of Keynes' three definitions of the own-rate of interest. It was actually not a definition. Keynes' only definition of the own-rate of interest in terms of the commodity itself was  $q - c$  (neglecting the liquidity premium), and his only definition of the commodity-rate of money-interest is  $q - c + a$ . This commodity-rate of money-interest can be greater or smaller than the money-rate of money-interest, but in Keynesian equilibrium it is equal to the money-rate of money-interest;  $q - c + a = r$ , then

$$q - c = r + 1 - \frac{p_f}{p_s}.$$

In this event, the own-rate of interest is equal to  $r + 1 - p_f/p_s$ ; the seeming definition of the own-rate of interest was in fact an equation which becomes correct only in equilibrium.

However, Keynes wrote at the beginning of chapter 17 as if  $1 - p_f/p_s + r$  were a definition of the own-rate of interest, just after stating it is possible to think of a wheat-rate of interest through the forward and spot prices of wheat and the money-rate of interest. Sraffa's notion was used there. This was the very definition in Sraffa, but in the case of Keynes it was not, so Keynes' argument at the beginning of the chapter was misleading.

Sraffa insisted that the only source of discrepancy between a commodity rate and the money rate of interest is the change in the price of the commodity, and that the only source of difference among commodity rates of interest is the difference in the rate of change in commodity prices. On the basis of Keynes' definition, the difference in the commodity-rates of interest can only occur from the difference in the advantages of commodities. The difference can be equal to the difference in the rates of price change only in the Keynesian equilibrium.

## 4 Sraffa's two notions of equilibrium: arbitrage and production equilibria

An apparent misunderstanding of Sraffa is that he regarded Keynes' equilibrium as a state where the own-rates of interest in terms of the commodities themselves are equal to the money-rate of interest and also to each other. That implies  $p_f = p_s$  for all commodities. Actually, Keynes' equilibrium does not include that state, but includes the state where the commodity-rates of money-interest are equal to the money-rate of money-interest, i.e.  $q - c + p_f/p_s - 1 = r$ . However, that is obvious from Keynes' description in the *General Theory*, and Sraffa could hardly neglect it. In fact, he did not neglect Keynes' notion of commodity-rate of money-interest and he referred to it:

In Section II Keynes tries to build up the rate of interest of each commodity by adding up the advantages and disadvantages of holding that particular article. On p.226-7 he defines them as the own rates!! [By this process he gets different results for each article: then, he must assume that for each of the articles there is such an expectation of appreciation or depreciation in terms of an arbitrary standard, as will equalise their rates of interest. The result is a hybrid "own rate of money interest" which is never used again, and indeed has no other use than to patch up the confusion created.] (*SP* II00, p.9)

He also writes:

Pages 227-8 Keynes supposes that the expectation of change in price must be added to the alone advantages in order to obtain the rate of interest of each article: and since he says that

in [arbitrage-] equilibrium the rates of all articles must be equal, it follows that at any moment the expectation of fall in price must be “complementary” (directly related to) the advantages to be obtained by possession! (*SP* I100, p.10)

Sraffa inserted ‘arbitrage-’ with square bracket before the word ‘equilibrium’. This is important. Sraffa made a note about section I of chapter 17:

Sect I, Commodity rates. OK as far as it goes, but irrelevant  
subsequent use to confuse issue

Note that they are important only in the short period (short loans) till production is adjusted to demand. (*SP* I100, p.6)

He also argues:

If one assets has higher efficiency equilibrium is restored either (or both) by  
and as a result 2 increasing production or 1 rise in value. (*ibid.*)<sup>2</sup>

and

Different rates can only be for short loans. As from a year hence probably all equal. But to produce an asset takes time; and to it only the “year hence” rates are relevant. (*SP* I100, p.8 back)

These arguments reveal that Sraffa distinguished two processes of restoring equilibrium. He referred to the adjustment process which equalizes interest rates in terms of a common standard as ‘arbitrage’ and regarded it as a short-term process within a year. He regarded the investment with production as a longer-term adjustment process. He thought the interest rate concerned the arbitrage whereas the marginal efficiency concerned the production. He thought that Keynes dealt with the arbitrage in chapter 17.

Sraffa compared Keynes’ writings on pages 223 and 236 of the *General Theory* concerning ‘highest rate rules the roost’, and remarked:

Simple statement (p.223)  
Clear, but wrong (corrected later, 236)<sup>3</sup>

and

Abstruse statement (p.236)—in light of definitions p.224  
Formally correct, but meaningless. (*SP* I100, p.8)

On page 223 Keynes did not take appreciation or depreciation into account whereas on page 236 he took it into account. On page 223 he wrote:

For it may be that it is the *greatest* of the own-rates of interest (as we may call them) which rules the roost (because it is the greatest of these rates that the marginal efficiency of a capital-asset must attain if it is to be newly produced); and that there are reasons why it is the money-rate of interest which is often the greatest (because, as we shall find, certain forces, which operate to reduce the own-rates of interest other assets, do not operate in the case of money). (Keynes 1936, p.223)

On page 236, he wrote:

No further increase in the rate of investment is possible when the greatest amongst the own-rates of own-interest of all available assets is equal to the greatest amongst the marginal efficiencies of all assets, measured in terms of the assets whose own-rate of own-interest is greatest. (*ibid.*)

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<sup>2</sup>The numbers ‘1’ and ‘2’ are as Sraffa puts.

<sup>3</sup>Sraffa wrote the number of the latter page as ‘336’ on page 8 of *SP* I100, but it is probably a mistake. On page 10 of *SP* I100, he wrote ‘223, 236’ just after ‘highest rate rules the roost’.

Sraffa regarded the writing on page 236 as meaningless. The reason is probably as follows: Keynes' commodity-rate of money-interest is  $q - c + p_f/p_s - 1$ , but the expected price change  $p_f/p_s - 1$  must be complementary to the advantage  $q - c$ , so even when  $q - c$  decreases,  $p_f/p_s - 1$  must change to cancel it out, and then the equation  $q - c + p_f/p_s - 1 = r$  must be kept irrespective of the level of investment. Since advantage and own-rate of interest are identical in Keynes, if Sraffa's definition of commodity-rate of interest is taken for granted and it is regarded as identical to Keynes' definition, the expected change in price ( $p_f/p_s - 1$ ) must be complementary to the advantage ( $q - c$ ).

Under Sraffa's interpretation of Keynes lies a recognition that appeared in his article 'Dr Hayek on Money and Capital': when the demand exceeds the supply of a commodity, the price of the commodity will rise temporarily while the supply cannot increase, but the market expects its future price will go back to the original level reflecting the cost of production, and accordingly the forward price will be lower than the spot price (Sraffa 1932a, p.50). This 'arbitrage' (namely the change in expected price) is the cause of discrepancy of the commodity-rate of interest from the money-rate of interest, but it is a phenomenon in transition, and in a longer term when production can increase, an equilibrium will be restored where the forward and the spot prices are equal to each other and also the commodity-rate and the money-rate of interest are equal to each other. It should be noted that Sraffa thought that the forward price reflects the present cost of production.

## 5 Keynes' notion of equilibrium: short-term production equilibrium

Keynes' notion of equilibrium is different from both of Sraffa's notion of equilibrium. Keynes certainly deals with short periods, but 'short period' means the period in which investment does not influence production capacity and it does not mean the period in which magnitudes of investment or production do not change. In Keynes' short period, change in the magnitudes of investment or production brings the economy to a state of equilibrium. In this sense, it is a production equilibrium, not an arbitrage equilibrium.

In Sraffa's arbitrage process, through the movement of the rate of price change,  $a = p_f/p_s - 1$ , demand and supply of a commodity are equalized, whereas in Keynes' production adjustment process, through the movement of the rate of investment (thus of the magnitude of production), own-rates of interests for various assets in terms of money become equalized with each other. The rate of change in price,  $a$ , depends on people's expectations, is independent of the process of production adjustment, and has no tendency to move to a particular direction in the equilibration process.

Keynes' equilibrium is also different from Sraffa's long-term equilibrium. In Sraffa's long-term equilibrium, demand and supply of a commodity are equalized through production adjustment, where the present price becomes equal to the normal supply price reflecting the production cost, thus the forward or future price, which always reflects the production cost, becomes equal to the present price, thus all the commodity rates of interest are equal to the money rate of interest. In Keynes' equilibrium, the rates of interest for commodities in terms of money are equalized through production adjustments, but the rates of the price change for various commodities are not equal to each other nor equal to zero, and thus commodity rates of interest measured by themselves are not equal to the money rate of interest measured by money itself.

With respect to the relation of the price to the cost of production, he thinks differently from Sraffa:

Hence, if  $q_1$  and  $-c_2$  continue to fall, a point comes at which it is not profitable to produce any of the commodities, unless the cost of production at some future date is expected to rise above the present cost by an amount which will cover the cost of carrying a stock produced now to the date of the prospective higher price. (Keynes 1936, p.228)<sup>4</sup>

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<sup>4</sup>Just before this sentence, Keynes says '...it follows that  $a_1$  and  $a_2$  must be rising. In other words, the present money-price of every commodity other than money tends to fall relatively to its expected future price.' Kurz quotes Sraffa's comment on this statement that 'this will lower, not raise, their rates of interest', and argues 'Keynes simply got it wrong' (Kurz 2010, p.199). Here also Sraffa's logic will be that since the own-rate of interest of a commodity is, by definition,  $1 - p_f/p_s + r$ , and thus the expectation of a rise in price ( $p_f > p_s$ ) will make this own-rate lower than  $r$ . Keynes' intention was, however, that when the own-rate,  $q$  or  $-c$  by his definition, decreases independent of the expectations on price, if the equilibrium condition that the commodity-rate of money-interest be equal to the money-rate of money-interest, then the price of the commodity must be expected to rise. In this sense, Keynes was not wrong logically.

He also argues:

it is that asset's rate of interest which declines most slowly as the stock of assets in general increases, which eventually knocks out the profitable production of each of the others, — except in the contingency, just mentioned, of a special relationship between the present and prospective costs of production. (Keynes 1936, p229)

Keynes compares the prospective production cost at some future date with the present production cost; the present price reflects the present production cost and the future price reflects the future production cost. Keynes does not have the idea of Sraffa that future price will reflect the present production cost. For Keynes, therefore, the future price has no relation with the normal supply price.

If, as Sraffa assumes, the future price reflects the present production cost, then the present and the future prices may converge through the production adjustment, but under Keynes' assumption,  $p_s$  and  $p_f$  do not have a tendency to converge, because the future price reflects the future production cost, not the present production cost. Rather, production and investment will be adjusted even in a short period and  $q - c$  will change while the divergence between  $p_s$  and  $p_f$  is maintained.

With regard to the present price, it will be the legitimate interpretation of Keynes' argument that the present price reflects the present production cost. For, he emphasized the comparison of the present and the future production costs when he referred to the stimulus effect of  $a$ -term on production.

Sraffa's critique can, therefore, be dismissed as a misunderstanding, when we think of Keynes' equilibrating process as a process where  $q - c + a$  becomes equal to  $r$  through the change of  $q - c$  without tendency of equalizing the present and the future prices, which reflect different production costs.

However, there are several economists who express the same interpretation of Keynes' theory of interest as Sraffa did without referring to Sraffa's criticism. Some of them defend Keynes' theory of interest while the others criticize it, but their interpretation leads logically to deny Keynes' theory. This will be shown in the next three sections.

## 6 Kaldor's acceptance and rejection of Keynes' theory of interest

Kaldor identified the main problem considered by Keynes as follows: 'assuming all assets have an own-rate of interest and all these rates tend to equality, how do we know which of these assets will "rule the roost", i.e. set the standard to which the yield of other assets will conform?' (Kaldor 1960, p.69) He agreed with Keynes that it is money that rules the roost, but disagreed on the reason why money rules the roost. Keynes' explanation was that the own-rate of interest that is most reluctant to decline sets the standard to which the yield of other assets will conform, and the own-rate of interest of money tends to be the most reluctant to decline. Kaldor denied this reasoning and presented an alternative view that it is the property of money as a standard of value that enables money to rule the roost.

In the course of his argument Kaldor expressed his understanding about Keynes' notion of equilibrium. He conceived Keynes' equilibrium as consisting of two stages: short-term equilibrium and long-term equilibrium. He stated that in the short period the term  $a$  balances the difference between  $q - c + l$  (own-rate of own-interest) and  $r$  (money-rate of money-interest), whereas in the long period the term  $a$  becomes zero and all the own-rates of own-interest tend to equality (Kaldor 1960, pp. 62, 69). It is obvious that the first stage is the same as Sraffa's arbitrage equilibrium, and the second the same as Sraffa's long-term equilibrium, although he did not mention Sraffa's notion. He also said:

the assumption which is implicit in Keynes' analysis, but which is not, I believe, anywhere explicitly stated, is that for reproducible assets the "expected price" is tied to the long-run supply price. This means that when  $a$  is zero the current price is itself equal to the supply price; hence the "marginal efficiency" of assets is equal to the own-rate of own-interest when the latter is equal to the own-rate of money-interest (*ibid.*, pp. 69-70).

This is the idea of Sraffa, not of Keynes. On the basis of this interpretation, Kaldor reached a wrong conclusion:

Assets will only be produced if their current prices are equal to, or higher than, their supply prices; hence when  $a$  is positive (there is an expected appreciation of an asset), the current

price must be below the supply price; hence assets whose own-rate of own-interest falls below their own-rates of money-interest can no longer be newly produced (*ibid.*, p. 70).

This seems to be Kaldor's interpretation of the following passage of Keynes:

Now those assets of which the normal supply-price is less than the demand-price will be newly produced; and these will be those assets of which the marginal efficiency would be greater (on the basis of their normal supply-price) than the rate of interest (both being measured in the same standard of value whatever it is). (Keynes 1936, p.228)

It should be noticed, however, that Keynes says 'both being measured in the same standard of value whatever it is'. Kaldor's interpretation contradicts this statement. Kaldor's 'own-rate of own-interest' is that measured in terms of the commodity itself, not in a common standard of value.

The content of Kaldor's argument is as follows: the assets will be newly produced when  $p_s > p_f$ , which means  $q - c > r$  since  $q - c + a = r$  and  $a = p_f/p_s - 1 < 0$ . If it is taken for granted that 'the assets are newly produced when  $p_s > p_f$ ', this argument is not wrong at all, but it is not what Keynes intended. Keynes says 'both being measured in the same standard of value'; hence, Keynes' argument is that the assets will be newly produced when  $q - c + a > r$ , not when  $p_s > p_f$  nor when  $q - c > r$ .

The  $a$ -term has an opposite effect on production in Kaldor from in Keynes. In the case of Kaldor, the assets with  $a > 0$  will never be produced. In the case of Keynes, if  $a > 0$  and  $a$  is large enough, the assets can be produced in spite of the fact  $q - c < r$ ; hence a large value of  $a$  is beneficial for production and employment.

On the basis of the above recognition, Kaldor goes on to examine Keynes' proposition that the own-rate of interest of the asset whose own-rate is most reluctant to fall will prevent the production of various assets. He focuses on Keynes' argument that it is not the property of money as the standard of value which is the cause of the trouble, and that other assets such as land or gold can cause the trouble if their own-rate of own-interest becomes the greatest of all the rates of assets. He argues that even if there existed an asset other than money whose own-rate of interest is reluctant to decline, 'if its own price in terms of money is capable of rising relatively to its expected price', then a rise in its price will lower the own-rate of money-interest of that asset below its own-rate of own-interest, 'thereby lower the standard to which the own-rates of interest of other assets must conform' (*ibid.*, p.71). Hence, such an asset other than money cannot hold up the production of other assets unless we make the following two assumptions: first, the elasticity of expected (future) price to the present price is high, and second, the yield from various assets are fixed in terms of the assets themselves, so that a rise in the money price fails to bring down their own-rate of own-interest (*ibid.*, p.72). The only assets that satisfy the two qualifications will be money, according to Kaldor, and that is because money is the only asset that serves as the unit of account.

Kaldor had in common with Keynes the view that the own-rates of interest of various assets conform to that of money, and not the other way round, but did not admit the reason presented by Keynes, i.e. that the own-rate of interest of money is most slowly declined. Kaldor's rejection of Keynes' reasoning is based on his interpretation of Keynes' notion of equilibrium; even if the own-rate of own-interest of another asset than money, say gold, does not decline, when the price of gold can rise as a result of increased demand for gold, then the present price of gold will become greater than its expected future price, thereby the gold-rate of money-interest will be lowered; hence the own-rate of interest for gold cannot prevent the production of other assets.

However, as Keynes says, relative relationship among the own-rates of interest in terms of a common standard is independent of the choice of the standard. Therefore, Kaldor's reasoning can be applied not only to gold but also to money; even if the own-rate of own-interest for money is reluctant to fall, if the price of money can rise as a result of increased demand for money, then the present price of money will rise, which means that the prices of all the other assets will fall in relation to money.

If the expected future price of money does not elastic to the change of the present price of it, the term  $a$  for the assets other than money will rise; thus the own-rate of money-interest for all the other asset will catch up with that of money, hence money will not be able to hold up the production of them. Kaldor may think that the elasticity of expected price is high, thus the own-rate of money-interest of money can be higher than those for the other assets. However, the high elasticity of the price of money means high elasticity of the prices of all the other assets, which Kaldor could not assume.

Accordingly, Kaldor would have had to say, with Sraffa, that the reluctance to fall of the own-rate of interest of money cannot knock out the production of assets. This is a consequence of his understanding of the function of the term  $a$  as arbitrage in a short period.

## 7 Barens and Caspari's denial of Keynes' theory of interest

Barens and Caspari (1997) denied Keynes' theory of interest more straightforwardly than Kaldor, although on the basis of the same interpretation as Sraffa and Kaldor had. They remarked that 'Keynes considers an arbitrage equilibrium' (Barens and Caspari 1997, p.290), and said:

As a result of arbitrage, the own-rates of interests in terms of money are equalized. According to Keynes, this determines demand price for all assets. Within the Marshallian tradition it is well known that a difference between demand and supply price is the cause of quantity reactions (*ibid.*, p.291).

They also said 'Apparently, Keynes interprets the spot or present price as a demand price and the forward or expected price as a 'normal supply-price', and argued:

Arbitrage equilibrium establishes a vector of spot and demand prices causing expansion of output of those commodities which have a forward/expected future price below their demand price. ... their own-rates of interest in terms of themselves will be higher than the own-rates of interest of money. Keynes takes the marginal efficiency of capital of such a commodity as synonymous with its own-rate of interest, as is especially clear in his contribution to the Fisher *Festschrift* (Keynes 1937). ... A situation characterized by the spot price of a commodity exceeding its forward price corresponds with the marginal efficiency of this commodity being higher than the rate of interest. (*ibid.*)

On the basis of this argument they remarked that Keynes' proposition that investment will be pushed to the point where the marginal efficiency of capital becomes equal to the rate of interest, i.e. demand prices are equal to supply price is, in terms of own-rates of interest, that at the equilibrium the own-rates of interest have fallen into line with the own-rate of money. Here, it should be noted that 'the own-rates of interest' means that in terms of the commodity itself not in terms of money.

Barens and Caspari, based on this understanding, regarded own-rate of interest in Keynes' theory as playing only 'a passive and actually irrelevant role' (*ibid.*, p.293); 'own-rate of interest follow directly from the system of inter-temporal prices, which means that as soon as these prices are determined, the own-rates of interest are implicitly determined as well' (*ibid.*). They insisted that though Keynes used the concept of own-rate of interest as if he had a theory to determine the own-rate from which prices can be deduced, he did not provide such a theory, and that 'the concept of own-rate of interest is not a suitable analytical framework with which to develop his message about money as the cause of unemployment' (*ibid.*).

This argument is the same as Sraffa's, but they proceed to connect their concept of demand and supply prices as identical to present and future prices respectively with Keynes' definition of demand prices and of marginal efficiency. Keynes' definition is that demand price of an asset is the present value of the stream of the expected returns to it over its service period discounted by the money-rate of interest, whereas marginal efficiency of an asset is the discount rate with which the stream of the expected returns to the asset is equated to the supply price of the asset. Assuming an asset produces a return  $Q$  only once, say at the point of time  $t$ , in the future, demand price of the asset is  $D$ , supply price of it is  $S$ , the money-rate of interest is  $r$ , and the marginal efficiency of the asset is  $m$ , then

$$D = Qe^{-rt}, \quad S = Qe^{-mt},$$

where the present time is assumed to be zero<sup>5</sup>. According to Barens and Caspari, the present price  $p_0$  is the demand price  $D$ , and the future price at time  $t$ ,  $p_t$  is the supply price  $S$ ; hence

$$p_t = p_0 e^{(r-m)t},$$

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<sup>5</sup>Barens and Caspari formulated the relation of these on the basis of discrete time. Here I used continuous time, but the result is the same.

which means

$$\frac{\dot{p}_t}{p_t} = r - m.$$

Since  $\dot{p}_t/p_t$  is the rate of price change,  $\dot{p}_t/p_t = a$ ; hence

$$m = r - a. \quad (3)$$

The right-hand side,  $r - a$  is the very definition of the own-rate of interest in terms of the commodity itself, so the marginal efficiency  $m$  becomes identical to the own-rate of own-interest. Pointing out this fact, Barends and Caspari judges that ‘the concept of own-rates of interest is redundant for Keynes’s purpose’ (*ibid.*, p.295), i.e. only the concept of marginal efficiency would suffice.

It should be noted, however, that (3) has been derived only from the definitions of demand price and marginal efficiency, i.e. (3) is an identity, not an equation. It means that the marginal efficiency as defined in such a manner is determined by  $r$  and  $a$ . Marginal efficiency cannot move freely, but fixed by the money-rate of interest and the rate of price change.

For Sraffa, the own-rate of interest for a commodity was fixed by  $r$  and  $a$  (or  $p_f/p_s$ ), but the marginal efficiency can change freely because it reflects the ‘advantage’ of the commodity. That is why he said that Keynes ought to have spoken about the marginal efficiency of various articles, not about their rates of interest. In contrast, for Barends and Caspari the marginal efficiency  $m$  is fixed by  $r$  and  $a$ , and cannot reflect any ‘advantage’ of the asset. This is a consequence of their identification of  $p_0$  with  $Qe^{-rt}$  and of  $p_t$  with  $Qe^{-mt}$ , which Sraffa or Kaldor never did.

Their concept of  $m$  is quite different from Keynes’ concept of marginal efficiency. In the *General Theory* the marginal efficiency thought to be equated to the rate of interest in equilibrium is that measured by a common standard of value, not measured by the asset itself. In that sense, Keynes’  $m$  includes  $a$  as a part of it by definition and is defined as  $m = q - c + a$ ;  $m$  cannot be identical to  $r - a$ .

The above formulae

$$D = Qe^{-rt}, \quad S = Qe^{-mt}$$

certainly represent the definitions of the demand price  $D$  and the marginal efficiency  $m$ , but neither  $D$  nor  $S$  has anything to do with  $p_0$  or  $p_t$  respectively. Rather, to the contrary to Barends and Caspari, the supply price can be thought to be equal to the present price ( $S = p_0$ ), and that would be consistent with what Keynes said. In equilibrium, the marginal efficiency in terms of money,  $m = q - c + a$ , should be equal to the interest rate of money; i.e.  $m = r$ . The condition  $m = r$  is equivalent to  $D = S$  according to the above definition. This equation is not a meaningless identical relation, but an equation that is correct only at equilibrium. When  $m > r$ , i.e. in a disequilibrium,  $D > S$  according to the above definition. In this case, investment will occur and assets will be newly produced. When Keynes said ‘those assets of which the normal supply-price is less than the demand-price will be newly produced; and these will be those assets of which the marginal efficiency would be greater (on the basis of their normal supply-price) than the rate of interest (both being measured in the same standard of value whatever it is)’, that meant the situation where  $D > S$  or  $m > r$  i.e.  $q - c + a > r$ , and not  $q - c > r$  or  $p_0 > p_t$  as Barends and Caspari said<sup>6</sup>.

## 8 Lawlor’s shifting equilibrium

Lawlor pointed out that Keynes’ equilibrium is different from Sraffa’s and referred to it as ‘shifting equilibrium’ (Lawlor 1996, pp.60,67; 2006, p.257). ‘Shifting equilibrium’ is the term Keynes used to characterize his theory. Keynes suggested to make a line of division between the theory of stationary equilibrium and the theory of shifting equilibrium. He meant by the theory of shifting equilibrium ‘the theory of a system in which changing views about the future are capable of influencing the present situation’ (Keynes 1936, p.293).

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<sup>6</sup>After pointing out the redundancy of the concept of own-rate of interest, they proceed to discuss whether Keynes succeed in his ‘central argument about the money rate of interest being a barrier to full employment’ (Barends and Caspari 1997, p.297). They gave a negative answer to this question finally on the basis of several researches that revealed the marginal efficiency of capital is not independent of the money-rate of interest (*ibid.*, p.298).

Lawlor characterized Sraffa's equilibrium as the stationary equilibrium (Lawlor 1996, p.60). Here Sraffa's equilibrium means his long-term equilibrium as presented in his paper on Hayek's *Prices and Production* (Sraffa 1932a), where 'all own-rates *measured in quantity terms* to be equal, and all spot and future prices to coincide' (Lawlor 1996, p.60). Lawlor describes Keynes' equilibrium as follows:

This is why the details of Keynes' "a" terms are so important. It is the movements of the prices on spot and future markets that guarantee his equilibrium position will exhibit a market configuration of equal *expected* money-denominated own-rates for every asset. (*ibid.*)

and also says:

Given that the stocks are slowly adjusted, the price established on the second-hand market will determine, when compared with the "normal supply price", in what directions and amounts investment flows proceed. (*ibid.*)

These passages suggest that Lawlor's shifting equilibrium is identical to Sraffa's arbitrage (not long-term) equilibrium. After expressing his complaint about Keynes' ambiguity as:

The definitions of equilibrium and the movements implied between equilibrium positions are very poorly specified by Keynes. At some junctures, his argument involves defining instantaneous stock equilibriums and at others discussing short-period flows of production of investment goods, and at yet others he seems to be talking about secular levels of capital accumulation. (*ibid.*)

Lawlor declares 'it is necessary to bring in a number of elements that define a very complicated picture only hastily sketched by Keynes', and says citing Lerner (1952) and Conard (1959):

Lerner (1952, pp.173-179) and Conard (1959, pp.120-134) show that when reduced to any common standard, the rate of interest on all assets will be driven to equality since any deviations (abstracting from risk and term differences) would provide arbitrage opportunities that would drive the prices of the assets into such an equilibrium. Thus, in the context of asset market equilibrium, the "a" terms can be seen as the *necessary* positions of supply and demand equilibrium in spot and forward markets that ensure that all assets yield an equal return when consistently measured. (Lawlor 1996, p.61)

This quotation confirms that Lawlor's shifting equilibrium is identical to Sraffa's arbitrage equilibrium. He also refers to it as 'shifting stock equilibrium', and goes on to describing the effect of this shifting stock equilibrium on "flows" of investment and on employment (*ibid.*, p.67):

In his scheme, where the secondhand markets for goods continually revalue the whole stock of assets, the flow of new capital goods is determined by a comparison of the market-established rate of return on the existing stock with the expected marginal efficiency of new projects. In price terms, Keynes describes the comparison in terms of a "demand price" for capital goods which is fixed by discounting expected future streams of income from an investment back to the present using the market rate of interest (determined by the own-rates equilibrium). This demand-price is then compared to a supply-price which represents the marginal cost of producing that asset. If the demand-price exceeds the supply-price, new capital goods will be produced. (*ibid.*, p.68)

This quotation shows that Lawlor conceives Keynes' theory as consisting of two stages. The first is the stock market equilibrium, where the own-rates of money-interest of various assets are equalized with the money-rate of interest. There prices or expected price changes function as an adjustment parameter. If the present prices are to move, this is nothing but Sraffa's arbitrage equilibrium. In the second stage, flows can change, and the prime mover of the change is the discrepancy between the marginal efficiency of capital assets and their own-rate of interest measured in terms of money.

One question is what the marginal efficiency means here. If it means the rate of return measured by the asset itself, i.e.  $q - c$ , then Lawlor's understanding turns out to be identical to that of Barends and Caspari, and hence the long-term equilibrium after the change of flows becomes that of Sraffa's. Lawlor's remark quoted above, 'given that the stocks are slowly adjusted, the price established on the second-hand

market will determine, when compared with the “normal supply price”, in what directions and amounts investment flows proceed’ (*ibid.*, p.60) suggests this interpretation. Under this interpretation, the price of the asset  $q - c$  of which exceeds  $r$  will once rise in the stock market, i.e.  $a$  term will become negative, so as to equalize  $q - c + a$  with  $r$ , but after that, being led by the fact that  $q - c > r$ , a production of the asset will occur to lower  $q - c$  till it be equal to  $r$ . The state is the long-term equilibrium.

Lawlor, however, states later that the marginal efficiency is  $q - c + a + l$  in terms of the own-rates (*ibid.*, p.70), and  $q - c + a + l = r$  in equilibrium. It suggests his marginal efficiency is also measured in terms of money. However, in order for this equation to play the role of equilibrating in the flow market, the price, which once worked to equalize the own-rate of money-interest to the money-rate of interest in the stock market, has to cease the function and to restore independency. Lawlor has not demonstrated how the price ceases its function as an adjustment parameter in the stock market and restores independency in the stage of flow-adjustment, but Conard (1959), whose book has been referred to by Lawlor, provides a hint.

According to Conard, in the stock market the relation between the present and the future prices makes the demand and the supply of an existing stock coincide, but it is the flow market that influences the level of employment. In the flow market the marginal efficiency of each asset is compared with the own-rate of interest of the asset itself, and when the former exceeds the latter new production of the asset will take place until the marginal efficiency is lowered to be equal to its own-rate of interest (Conard 1959, p.138).

How can the marginal efficiency of an asset be greater than its own-rate of interest? Conard gives an explanation that the asset can be newly produced more cheaply than the existing part of the same asset, yet the newly produced part can be sold at the same price as the existing one (*ibid.*, pp.145-147). It means that the newly produced asset has a price exceeding its production cost. Since the existing stock has the normal price that reflects its production cost, the rate of return from the new asset becomes greater than that of the existing one, whether measured in terms of money or in terms of the existing asset itself. This is a state of disequilibrium. In the course of time the price will be lowered to be equal to the production cost, when the marginal efficiency will be equal to its own-rate of interest, and then new production will be stopped. Conard regards this what Keynes intended to say (*ibid.*, p.148).

In Conard’s framework, investment occurs only when the market price of the asset temporarily exceeds its production cost; i.e. increase in productivity in the new production of an asset is the only cause of investment. Increase in demand, which is usually thought to be the most important cause of investment, cannot induce investment. For increase in demand would raise the own-rate of interest of an existing asset by the same amount as its marginal efficiency. In Conard’s framework only the discrepancy between the marginal efficiency and the own-rate of the same asset can cause investment. This can hardly be thought as representing Keynes’ theory of interest and investment.

In addition, when the investment in an asset progresses, not only the marginal efficiency of the newly produced part of the asset but also the own-rate of interest for the existing part of the asset will fall. This might raise a question about what will limit the progress of investment. Conard insisted that if the own-rate of interest in terms of money is tied to the money-rate of interest and the money-rate of interest does not fall, then the fall of the marginal efficiency measured in terms of money will also be limited by the money-rate of interest, and then the investment will stop (Conard 1959, p.138).

This argument is not correct. The relation between the marginal efficiency of the investment in an asset and the own-rate of interest of the stock of the asset is not influenced by the choice of the standard of measurement. As far as the marginal efficiency exceeds the own-rate of interest, investment will progress whether they are measured by money or by any other assets, according to Conard’s framework. Therefore, the money-rate of interest cannot set a limit to investment as far as investment is determined according to the discrepancy between the marginal efficiency and the own-rate of interest. It must be said that Conard’s theory is far from Keynes’ theory.

Consequently, we cannot resort to the difference in the productivity between the newly produced capital and the existing capital as a factor to cause adjustment in the flow market. The source of Lawlor’s mistake was that he thought of the arbitrage equilibrium. There the  $a$  term moves freely so that  $q - c + a = r$  is met; thus the fact that  $q - c + a \geq r$  has no power to make production adjustment. The only possibility is that the fact that  $q - c \geq r$  causes production adjustment; the result of the adjustment is nothing but Sraffa’s long-term equilibrium.

Lawlor said Keynes’ equilibrium is different from Sraffa’s, but his shifting equilibrium is the same as

Sraffa's arbitrage equilibrium, and what will result from the subsequent flow adjustment is nothing but Sraffa's long-term equilibrium.

## 9 Why did Keynes use Sraffa's notion of commodity-rates of interest?

Not only Sraffa but also Kaldor, Barends and Caspari, and Lawlor misunderstand that Keynes' equilibrium, where the own-rates of money-interest are equalized to each other, is an arbitrage equilibrium. Keynes' equilibrium is not an arbitrage equilibrium but an equilibrium with production adjustment, though in Keynes' production adjustment the own-rates of own-interest do not have tendency to be equalized to each other unlike in Sraffa's long-term equilibrium. Price changes continue to exist and the own-rates of money interest are equalized<sup>7</sup>.

Keynes, however, left some seeds that might have brought about some misunderstandings. He put Sraffa's definition of the commodity-rate of interest at the beginning of chapter 17 as if it were also his definition, and just after that he wrote:

It follows from this that there is no reason why their rates of interest should be the same for different commodities, —why the wheat-rate of interest should be equal to the copper-rate of interest. For the relation between the “spot” and “future” contracts, as quoted in the market, is notoriously different for different commodities. This, we shall find, will lead us to the clue we are seeking. For it may be that it is the *greatest* of the own-rates of interest (as we may call them) which rules the roost (Keynes 1936, p.223)

This is misleading, because the first half of this passage indicates only that since  $q - c = 1 - p_f/p_s + r$ , if  $p_f \neq p_s$  then  $q - c \neq r$ , while the last half insists that when  $q - c + p_f/p_s - 1 \leq r$ , production of assets will cease. The last state cannot result just from the fact  $p_f \neq p_s$ .

There is no contradiction in Keynes' utilization of the notion of own-rate of interest, but as Ranchetti pointed out, Keynes did not use the expression of 'own-rate of interest' after the *General Theory*. For example in his article 'The theory of the rate of interest' in 1937, which was written to restate where his new theory of interest diverged from the neoclassical theory, we cannot find the term 'own-rate of interest'. In that paper he used the term 'rate of interest' only for money and spoke of 'marginal efficiency' as representing a common nature of both money and other assets. The common nature is, in Sraffa's expression, advantage. In this article, the proposition 'highest rate rules the roost' is expressed in terms of 'marginal efficiency' instead of 'own-rate of interest'.

This, however, does not mean that Keynes abandoned the notion of own-rate of interest. Rather, the notion is identical to the notion of marginal efficiency, and whichever notion is used, it does not cause any logical problems. That means Keynes could express his idea in terms of marginal efficiency. Be that as it may, why did he import the notion of own-rate from Sraffa's paper?

In Keynes' equilibrium, the rates of the change in prices do not have any tendency to converge to each other nor to zero. In Sraffa's long-term equilibrium they seem to have tendency to become zero. This view is supported by his note on the *General Theory* as well as by his paper on Hayek's book in 1932 (Sraffa 1932a, p.50). This paper, however, includes descriptions indicating Sraffa's view that such equilibria could not be reached. He says:

in times of expansion of production, due to additions to savings, there is no such thing as an equilibrium (or unique natural) rate of interest. (Sraffa 1932a, p.51)

He wrote again in his rejoinder to Hayek:

only under conditions of equilibrium would there be a single rate; and that when saving was in progress there would at any one moment be many “natural” rates, possibly as many as there are commodities; so that it would be not merely difficult in practice, but altogether inconceivable that the money rate should be equal to “the” natural rate. (Sraffa 1932b, p.251)

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<sup>7</sup>Kurz (2010) argued that 'there are two ways in which the commodity rates of interest can become uniform again: either via changes in prices and/or via changes in production' when he introduced Sraffa's thesis that the commodity rate of interest depends exclusively on expected price changes (Kurz 2010, p.201). This statement is, however, not accurate as an explanation of Sraffa's thesis. Changes in prices do not make the commodity rates of interest uniform, but make them diverse. What become uniform in this process is the 'hybrid' commodity-rates of money-interest.

Sraffa defined the long-term equilibrium, but appeared to think it could not be achievable when there are savings and expansion of production. The reason would be that the structure of demand is changing when production expands. Since in such a structural change technology would also be changing, it needs only one step to recognize that the costs of production are also changing. Recognizing that, the tendency of price changes to converge to zero is no longer conceivable.

Keynes may have found this implication in Sraffa's paper, and that would be why he employed Sraffa's notion of the commodity-rate of interest. On that foundation, Keynes built a system with his new notion of equilibrium with changing prices, with a level of investment and with a level of employment.

## 10 Pasinetti's interpretation of the Keynesian revolution

Pasinetti, on the one hand, constructed a model dealing with structural economic changes on the basis of Sraffa's system of value and production (Pasinetti 1981), and, on the other hand, tried to relate his vision of the production economy to what he thought to be the core of the Keynesian revolution. Pasinetti regarded the title of Keynes' lecture for the Michaelmas 1932, 'the monetary theory of production', which also was the title for the first manuscript of the later *General Theory*, as a clue to understand what is the core of the revolution (Pasinetti 2007, p.27).

According to Pasinetti, the Keynesian revolution should not be realized to be only the introduction of quantity (as contrasted to price) adjustment, but be considered a change from a pure exchange paradigm to a pure production paradigm. He interpreted the principle of effective demand as capturing the basic property of the industrial economy, that underlies the institutional or behavioural factors of economy (*ibid.*, p.15). In order to complete the revolution, a theory that captures the basic property of a production economy must be constructed, where the laws of demand or the nature of price is made clear on the basis of the technological structure of production. The principle of effective demand should be located in such a theory (*ibid.*, pp.19-20).

Pasinetti's own work (Pasinetti 1981) sought to complete such an idea. He constructed a model which can attribute all the products to the quantity of labour used directly or indirectly, and on the basis of the model, he discovered the properties of the 'natural economy' with structural change. Here 'natural' means 'primary and independent of particular economic systems or institutions (Pasinetti 1981, p.127-128), i.e. 'natural economy' is nothing but 'pure production economy'; and 'structural change' means economic growth with changes in technology and demand structure.

In the natural economy, the contributions to production processes and the benefits are regulated according to the quantity of labour (*ibid.*, p.166), where the price of a product changes at the rate of wage change minus the rate of the increase of the labour productivity of the sector producing that product, and the own-rate of interest of the product becomes equal to the money-rate of interest minus the rate of the price change of the product. There can be systems of the own-rates of interest, among which the system with a money-rate of interest that is equal to the rate of wage change would meet the above mentioned principle of the natural economy; such a money-rate of interest can be referred to as 'natural rate of interest' (*ibid.*, p.194).

According to Pasinetti, the pupils of Keynes were busy developing Keynes' ideas, and did not investigate what the core of the Keynesian revolution nor tried to base it on firm ground. Only Sraffa pursued theoretical consistency of production economy and dedicated himself to strengthening its classical basis (*ibid.*, xix). Sraffa, however, is the most remote from Keynes in respect of the contents of economic works.

Notwithstanding, Pasinetti does not pay attention to chapter 17 nor Sraffa's contribution to it, in spite of the fact this is the only chapter in the *General Theory* where Keynes shows a connection with Sraffa; he says:

The only parts of *The General Theory* that may be directly linked up with Sraffa's ideas are Chapter 16 ('Sundry Observations on the Nature of Capital') and the hints at the 'own rates of interest', explicitly attributed to Sraffa by Keynes. Yet these are secondary aspects, within the theoretical context provided by *The General Theory* or with reference to its immediate policy implications (*ibid.*, p. 164).

Our investigation into the relationship between Sraffa and Keynes on chapter 17 reveals that we can find the core of the Keynesian revolution as interpreted by Pasinetti in the difference between Keynes

and Sraffa. For Sraffa thought of an arbitrage-equilibrium first and then an equilibrium with a unique commodity-rate of interest attainable through production adjustments, whereas Keynes thought that there can be an equilibrium with unemployment and with uneven own-rates of interest, which are accordingly, in general, not equal to the money-rate of interest. The inequality of the own-rates of interest in relation to each other is based on the inequality in the change in the costs of production, which means the inequality in the rates of the change in productivity. In this sense, Keynes' equilibrium reveals a property of the natural economy. Chapter 17 should be paid greater attention, if one pursue the core of the Keynesian revolution along with Pasinetti's vision.

## 11 Concluding Remarks

After rejecting 'Keynes' marginalism' Ranchetti found a common vision between Sraffa and Keynes, namely that the money rate of interest is given outside the system of production. Hishiyama, having reported that Sraffa had told him that the schedule of liquidity-preference has no firm foundation because it depends on individuals' subjective valuations, also remarked that Sraffa's idea concerning the determination of the rate of interest was similar to Wicksel's and also to Keynes' in *A Treatise on Money* (Keynes 1930); i.e. monetary organizations can determine the rate of interest and can keep it for a certain period (Hishiyama 1993, p.117).

Keynes in the *General Theory* introduced the notion of liquidity-preference because he could not neglect factors that depend on convention and are not easily controlled by monetary organizations (Keynes 1936, p. 203). By doing so, he reached the notion of the efficiency of money, i.e. liquidity premium, and then under the broader concept of 'efficiency', he put money on the same ground with other assets and made clear the unique property of money.

Keynes' equilibrium, in which money plays such a peculiar role, is, unlike Sraffa's arbitrage-equilibrium nor production-equilibrium, one that is attained by equilibrating the forces increasing or decreasing employments, where savings and investments are positive, technology and demand structure is changing and prices are altering unequally. That is the core of the Keynesian revolution and chapter 17 was necessary for expressing the properties of such an equilibrium.

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