



**COLLANA DEL  
DIPARTIMENTO DI ECONOMIA**

**JOHN RICHARD HICKS AND THE REHABILITATION  
OF THE WALRASIAN TREATMENT OF CAPITAL**

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**ISSN 2279-6916** Working papers

(Dipartimento di Economia Università degli studi Roma Tre) (online)

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Working Paper n° 150, 2012

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Per ciascuna pubblicazione vengono soddisfatti gli obblighi previsti dall'art. 1 del D.L.L. 31.8.1945, n. 660 e successive modifiche.

Copie della presente pubblicazione possono essere richieste alla Redazione.

esemplare fuori commercio  
ai sensi della legge 14 aprile 2004 n.106

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# John Richard Hicks and the rehabilitation of the Walrasian treatment of capital

## Part I

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*Abstract.* In 1932, Hicks expressed his cautious rejection of Walras's theory of capital. Looking at this theory from the standpoint of the defence of the notion of marginal product, Hicks was led to retrace the difficulties he saw in Walras's theory to the contradiction between Walras's treatment of capital as a set of heterogeneous capital goods on the one side, and the determination of a long period (normal) equilibrium on the other. The paper is conceived as the first part of a larger work aimed at reconstructing Hicks's evolution from his initial rejection of Walras' theory of capital in 1932 to his influential rehabilitation of the Walrasian treatment of capital in 1934.

JEL: B210, B310, D330; D500.

*Keywords:* capital; capital as a single magnitude; capital as a set of heterogeneous goods; normal equilibrium; marginal product; Walras; Hicks.

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I wish to thank Saverio Fratini for his comments on the paper.

# John Richard Hicks and the rehabilitation of the Walrasian treatment of capital

## Part I

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### I

1. In 1932, in the course of a debate around the plausibility of the notion of marginal product, John Richard Hicks expressed his cautious yet firm rejection of the Walrasian theory of capital. ‘I did know’, Hicks for example wrote in reply to Henry Schultz who had accused him of ignoring that theory, ‘that Walras and Pareto had concerned themselves with the problem of capitalisation. Indeed, I had given this part of their work some particular attention. But this attention had convinced me that their theories of capital, suggestive as they are, are the last part of their work which one can consider as final, or accept without the most careful attention’. To which he added: ‘And I am not sure that Pareto would not have agreed with me. For it is surely significant that Walras’ elaborate theory of capitalisation does not reappear in the later work of Pareto, while there is nothing very substantial to take its place’ (Hicks, 1932b, p. 297).

A mere two years later, Hicks’s position appears to change radically. For Hicks still writes that ‘Walras’s theory of capital has not reached [a] happy position. By Pareto it was simply ignored; by Wicksell it was attacked. It has therefore not passed in any “Lausanne” tradition, and is liable to be dismissed as something of an aberration’. But now he adds that ‘in spite of this, *it has its merits*, though there can be no doubt that it needs a good deal of repair *in details* before it can become a usable theory’ (Hicks, 1934, p. 345; my italics).

This change in Hicks’s position on Walras’s theory of capital was destined to mark something more than an important turning-point in his own intellectual development. For, as is well known, the work in which this turning-point was eventually to culminate, *Value and Capital* (1939), was the first comprehensive work written in English to repropound the Walrasian *treatment* of capital as the basis for the general study of value and distribution, and undoubtedly the most influential in this direction, such that it may be said to be at the origin of the more recent reformulation of the orthodox theory along ‘neo-Walrasian’ lines. It will therefore not appear surprising if at a long dis-

tance in time it still seems worthwhile to dwell on that turning-point: for although Hicks's 1932 and 1934 essays have understandably received less attention than *Value and Capital*, they are nonetheless the only works in which he addressed Walras's theory of capital *directly*.

The main result in regard to this theory—the fact that, in general, it is unable to determine a uniform rate of profit—has long been proven and is no longer in doubt<sup>1</sup>. What may be expected from Hicks's writings in the first half of the 1930s is not, then, some new insight into Walras's theory. Nor will we devote, at least directly, much attention to the reasons that led Hicks to change his position. Rather, it will be the aim of the present paper to reconstruct *how* Hicks reached his conclusions in 1932, while a second paper will deal with the way Hicks *presented* his apparently opposite conclusions in 1934. For, as we shall see, this may throw some light on certain relevant aspects pertaining to the *stage of transition* between the traditional and the contemporary versions of the orthodox theory of value and distribution.

## II

2. In order to follow Hicks's argument, it will be convenient first to give the equations in which Walras's theory is expressed and to mention the principal difficulties connected with them<sup>2</sup>.

In the III and the IV section of the *Éléments d'Economie Politique Pure* (1874-77, fourth edition, 1900, English translation 1954), Walras presents the equations regarding production and exchange without capital formation. These consist of the following four groups of equations:

$$\left. \begin{aligned} O_t &= f_t(p_t, p_p, p_k \dots p_b, p_c, p_d \dots) \\ O_p &= f_p(p_t, p_p, p_k \dots p_b, p_c, p_d \dots) \\ O_k &= f_k(p_t, p_p, p_k \dots p_b, p_c, p_d \dots) \\ \dots &\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \end{aligned} \right\} [1]$$

$$\left. \begin{aligned} D_a &= f_a(p_t, p_p, p_k \dots p_b, p_c, p_d \dots) \\ D_b &= f_b(p_t, p_p, p_k \dots p_b, p_c, p_d \dots) \\ D_c &= f_c(p_t, p_p, p_k \dots p_b, p_c, p_d \dots) \\ \dots &\dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \end{aligned} \right\} [2]$$

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<sup>1</sup> See Garegnani (1960, [1962] 2008, 1990); also Eatwell (1987). The main results are set out briefly in §§ 4-5.

<sup>2</sup> The reader wishing to move on directly to the discussion of Hicks's works will find in the subsequent sections the references to the parts of this section relevant to each individual point that will be examined there.



equations therefore reflect the principle, which is distinctive of the marginalist theory, according to which the price of the service of the productive factors, and hence the value of the commodities, are ultimately determined by the *relative scarcity* of those factors.

As is known, in the main part of his exposition Walras assumes that the production coefficients are *given*. Within a marginalist scheme, where the amount produced of each good figures among the unknowns, this is tantamount to supposing not only that in order to produce a determinate amount of each good there is only one method of production, but also that this method does not change with the variation in the level of production of the good itself (constant returns to scale)<sup>3</sup>.

It is possible to show that by means of the budget constraints of the individuals one of the equations [1] – [4] can be obtained from the others. We have therefore  $2m + 2n - 1$  independent equations to determine a like number of unknowns. As is known, however, equations [1] – [4] do not in general admit solutions which are all non-negative, as is instead necessary if they are to be economically significant. For we must contemplate the possibility: *a*) that the demand price of some consumption good will be lower than its production cost even for very low or null amounts produced (non-remunerative consumption goods); and *b*) that even at very low or null prices the supply of the services of some productive factor will exceed the demand for those services (superabundant productive factors). This can be taken into account by replacing the equality sign that appears in equations [3] and [4] with the  $\geq$  and  $\leq$  sign respectively, and adding the condition that the amount produced of a good for which the corresponding condition [3] is satisfied as strict disequality be null, and that the price of a service for which the corresponding condition [4] is satisfied as strict disequality be equal to zero.

As is known, it is proved that in this form (and with the addition of some further assumptions)<sup>4</sup> conditions [1] – [4] admit solutions, that

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<sup>3</sup> When Walras introduces the possibility of more than one method of production for the same good (Walras, [1877] 1954, § 204, p. 240 and lesson XXXVI, pp. 382-392), he implicitly retains the hypothesis of constant returns to scale; he also appears to think that these alternative methods are in general characterized by the employment of the services of the *same* productive factors in different proportions.

<sup>4</sup> Once we admit the possibility that some productive factor may be superabundant, additional assumptions are necessary in order to prevent the excess demand functions from presenting points of discontinuity, which might involve the non-existence of solutions for conditions [1] – [4] (Arrow, Debreu, 1954). It may become for example necessary to assume that each individual possesses: *a*) a positive amount

at this point will all be non-negative by construction. We shall, however, assume this to be true without needing to transform equations [3] – [4] into disequations; i.e. we shall *disregard* the possibility of non-remunerative goods and superabundant factors. We will return later (§ 5, note 11) to discussing to what extent this is justified when the problems arising from Walras’s treatment of capital are dealt with.

3. The consideration of the fact that ‘capital goods proper’  $K, K', K'', \dots$  are *produced* means of production is addressed by Walras only in the V section of the *Elements*.

Walras begins by distinguishing between the gross income that can be derived from the ownership of a capital good and its net income. The first is equal to the price of the service of the capital good in question, which, as we saw, is determined by the equilibrium between the demand and the supply for that service (see equations [4]). We arrive at the second by subtracting from the gross income a fraction  $\mu$  and a fraction  $\nu$  of the price of the capital good to cover amortization and insurance costs<sup>5</sup>.

In this way a first group of  $l$  equations can be added to the equations of production and exchange (where  $l$  is the number of those among the  $n$  productive factors that are ‘capital goods proper’). These equations define the demand price of each capital good as the flow of net income deriving from the ownership of that good capitalized at the prevailing rate of interest:

$$\left. \begin{aligned} P_k &= \frac{p_k}{i + \mu_k + \nu_k} \\ P_{k'} &= \frac{p_{k'}}{i + \mu_{k'} + \nu_{k'}} \\ P_{k''} &= \frac{p_{k''}}{i + \mu_{k''} + \nu_{k''}} \\ \dots &\dots \dots \dots \dots \dots \dots \dots \end{aligned} \right\} [5]$$

where  $P_k, P_{k'}, P_{k''}, \dots$  indicate the price of the  $l$  capital goods  $K, K', K'', \dots$  and  $p_k, p_{k'}, p_{k''}, \dots$  the price of their services, all expressed in terms of the price of good A;  $\mu_k, \mu_{k'}, \mu_{k''}, \dots$  and  $\nu_k, \nu_{k'}, \nu_{k''}, \dots$  indicate the (known) portion of the price of the capital goods  $K, K', K'', \dots$  that must be earmarked for amortization and insurance; and  $i$  indi-

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of each productive factor; or, alternatively, *b*) a positive amount of at least one productive factor that is employed in the production of each consumption good.

<sup>5</sup> As has been noted (Stigler, 1941, p. 248; Garegnani, 1960, p. 93), it is not correct to determine these expenditures independently of the interest rate. The change that would be necessary to take account of this does not however substantially alter Walras’s theory of capital and the problems connected with it.





appropriate for the production of the consumption goods in the proportion in which they are demanded in equilibrium. This inadequacy, so to speak, of the existing fund of capital goods will manifest in the lack of uniformity of the rate of net return that can be obtained on the cost of production of the various capital goods. Under the condition assumed by Walras of the absence of alternative methods of production (or of the sole existence of alternative methods making use of the same capital goods in different proportions), this lack of uniformity necessarily resolves in the incentive to change the *proportion* in which the *existing capital goods* are *reproduced*. In effect, the difference between the individual rates of net return may be such as to encourage the reproduction only of some of the existing capital goods—or even only one of them—while the remaining capital goods, even though utilized in current production and earning, in particular, a positive price for their services (which will be shown by the fact that the corresponding condition [4'] for these services will be satisfied with the sign of equality), *will not be reproduced*.

At this point it is important to recall that Walras held that the same variation in the proportion in which the existing capital goods are reproduced, which directly follows from the fact that different rates of profit accrue from them, might be the means by which the economic system could be led to a situation characterized by a uniform rate of profit. It is not hard to see how this idea occurred to Walras. It is, in fact, what we would expect to see in a market economy; and it is what happens in Walras's system with regard to the adjustment in the distribution of the means of production among the sectors producing consumption goods. Walras appears thus to have initially thought that also the adjustment towards a situation characterized by a uniform rate of net return on the supply price of the capital goods could be arrived at thanks to the variation in the price of the services of these goods that would attend a change in their *supply conditions* (i.e. in the variables  $O_{k_0}$ ,  $O_{k_1}$ ,  $O_{k_2}$ , ... that appear on the right-hand side of equations [4'])<sup>7</sup>. In this case, the increase, dictated by competition, in the

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<sup>7</sup> In this connection see in particular the description of the *tâtonnement* that should lead to equilibrium in the case of capitalisation that, in the second and third editions of the *Elements*, ends with the words: 'production and capitalisation can continue but, of course, with the changes entailed by the existence of new capital goods' (Walras [1889 and 1896] 1954, editorial note [f] to lesson 24, p. 590). See also Petri (2006, pp. 35-36) for additional evidence based on Walras's approving comments of Bortkiewicz's review of the second edition of the *Elements*, where the quantities in existence of the different capital goods proper are considered by Bortkiewicz among the *unknowns* of Walras's system.

relative output of the capital goods on which a higher rate of profit is so to speak ‘initially’ obtained, would in fact entail a relative increase in the supply of the services of these goods and hence a decrease in the price of these services, which would thus contribute to lead the different rates of profit to uniformity. However, this is clearly not possible *in Walras’s system* where that set of capital goods is included among the *givens* starting from which the rate of profit must be determined. To allow the available amount of the various capital goods to change would in fact be tantamount to admitting that they cannot be considered among the givens. But in this case, what determines value and distribution in Walras’s theory would remain undecided. Walras acknowledged his error in the fourth edition of the *Elements*<sup>8</sup>. At that point his faith in the fact that the variation in the proportion in which the existing capital goods are reproduced could lead to a uniform rate of profit had therefore to fall back on those variations in the unknowns of his system that result from a variation in the *demand conditions* for the services of these capital goods (recall that the variables  $D_k$ ,  $D_k$ ,  $D_k$ , ... appear on the left-hand side of equations [4]). More precisely, Walras had to pose the whole weight of his argument on the variation *a)* in the prices of the services of the capital goods, and *b)* in their production cost, which result from a variation in the relative output of the new capital goods. However, as Garegnani has shown (in particular, Garegnani, 1960, pp. 110-114, [1962] pp. 7-8, 1990, pp. 16-19), this twofold mechanism is unable, in general, to lead the system towards a situation characterized by a uniform rate of profit.<sup>9</sup>

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<sup>8</sup> In this edition the passage quoted in the previous note disappears and is replaced by a different description of the *tâtonnement* ending as follows: ‘Although the economy is becoming progressive, it remains static because of the fact that the new capital goods play no part in the economy until later in a period subsequent to the one under consideration’ (Walras, [1900] 1954, p. 283). On both passages see the comment in Garegnani (1960, p. 104, note 5).

<sup>9</sup> Analogously with what occurs in a scheme of general equilibrium for any good, an increase in the output of a capital good will always cause an increase in the price of the services that are employed in a relatively high proportion in the production of that good and, in this way, in its production cost. From this point of view, the increase, dictated by competition, in the relative output of the capital goods on which a higher rate of profit is obtained would therefore tend to lead the different rates of profit to uniformity. This effect, however, will be greater the greater is the degree of specialization of the productive factors. But the greater is this degree of specialization, the more likely it becomes that some of these factors will be superabundant and therefore that the price of their service will fall to zero: thus hindering in this other way, insofar as the phenomenon also affects some of the ‘capital goods proper’, the passage to a uniform rate of profit. On the other hand, the effect on the

5. Over and above the strictly formal aspect (the absence, in general, of non-negative solutions for equations [6]), what emerges from the impossibility of Walras's theory to determine a uniform rate of profit is that, once a set of capital goods is introduced as one of the givens of the theory, it is no longer possible to establish a connection between, on the one side, the results that the theory is able to achieve and, on the other, the concrete observations of the economic system in the way which presented itself as the most natural for economic science as much to the classical economists as to the marginalist economists: that is, through the determination of a 'normal' position of the economic system around which it can be expected that the position effectively occupied at each moment by the system 'gravitates': i.e. a position towards which the economic system continually *tends* to move (on this point, see Garegnani, 1976).

For the traditional method was based on the distinction, first established by Adam Smith, between the 'market price' of a commodity—i.e. the price which is actually observable at a given time and place—and its 'natural price' (or 'normal price' as it would be called from Marshall onwards) which is instead the price determined by the theory; and on the possibility to conceive the latter, again according to Smith's expression, as the 'centre' around which the former 'gravitates'. Now, this possibility was ensured by the very fact that the natural price was defined as the price just sufficient to cover at their respective 'natural' or 'average' rates the wages and profits that must be paid to produce the commodity, i.e. by the fact that a uniform rate of profit was assumed in the definition of the position of the economic system determined by the theory. For the market price of a commodity will, in general, be different from its normal price: it will, in particular, be higher whenever the amount of the commodity which is available on the market is lower than the amount that would be absorbed at the normal price; and lower in the opposite case. If, however, this is due to a *disproportion* in the distribution of the means of production

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price of the services of the capital goods of variations in the proportion in which these goods are reproduced may lead towards a diminution of the gap between the rates of profit, as much as towards a widening of the gap. For, whenever the relative output of a capital good increases, the price of its service will tend to diminish in case it is used in a relatively low proportion in its own production, but it will tend to increase in the opposite case; nor does there seem to be any economic reason to persuade us that the first case is more likely than the second. Lastly, we must add that even when the two aforesaid effects move in the 'right' direction, the amount of savings available might not be sufficient to attain a situation characterized by a uniform rate of net return on the supply price of all existing capital goods.

among the various sectors of the economy, it will be in the interest of the owners of the means of production to direct their capital towards the sectors in which the former case occurs (for there a higher than average rate of profit is realized) and to withdraw it from the sectors in which the latter case occurs (for there a lower than average rate of profit is realized): and this will result in driving up the amount of the commodity supplied in the former sectors, and in driving it down in the latter, until the market price returns to its normal level; whereas whenever the divergence between the market price and the normal price of a commodity is due to the influence exercised by accidental forces, such as forecasting errors, delays, etc., on the amount of the commodity that is available on the market or on the amount that would be absorbed at the normal price, the mere passage of time will be sufficient for these influences to cease and, to a great extent, to offset each other in such a way that, with respect to the effective position occupied from time to time by the economic system under the influence of *these* forces, a normal position can emerge as an average<sup>10</sup>.

If now we look to Walras's theory, we may see that, when the analysis does not take into account the fact that 'capital goods proper' are produced means of production (that is, when the analysis is confined to conditions [1] – [4]), the position of the economic system that the theory determines has the character of a normal position; whereas it loses this character when we move to the complete system. For, in the first case, the equations do not describe the situation of the economic system that we might expect to observe at any one moment, but a situation in which the distribution of the means of production among the various sectors has had time to adjust itself to the demand structure. It is therefore the position towards which the economic system will *tend* to move. In the words of Walras:

Equilibrium in production, like equilibrium in exchange, is an ideal and not a real state. It never happens in the real world that the selling price of any given product is absolutely equal to the cost of the productive services that enter into that product, or that the effective demand and supply of services or products are absolutely equal. Yet equilibrium is the normal state, in the sense that it is the state towards which things spontaneously tend under a régime of free competition in exchange and production (Walras, [1874] 1954, § 188, p. 224).

The same does not occur for the complete system, which, as a result of the failure to satisfy equations [6], would show the curious and in

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<sup>10</sup> For a detailed analysis of the relation between market prices and normal prices, see Vianello (1989) and Ciccone (1999).

fact hybrid case of an economy that, as far as the production of consumption goods is concerned, has reached that ‘ideal state towards which things tend’, while it has not reached such a state as regards the production of capital goods. Even leaving aside possible changes in technique or tastes—whether entirely exogenous or the natural consequence of capital accumulation—we have here a situation in which the producers of the capital goods will be incentivated to shift their capital from the production of certain goods to that of certain others. Towards this position the economic system will therefore exhibit no tendency to move; nor will it display any degree of persistence with respect to the effect of accidental disturbances.<sup>11</sup>

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<sup>11</sup> Before concluding this section, we must return to discuss how far it is legitimate to assume that conditions [3] and [4] are satisfied as equations when the difficulties that arise in connection with Walras’s theory of capital are discussed. For it must be noted that, exactly as in the case of these equations, a solution to the problem concerning the possibility of solving equations [6] can be sought at a formal level in their transformation into an equal number of *disequations*, with the caveat that the capital goods for which the corresponding condition [6] would be satisfied as strict disequation would not be reproduced (Morishima, 1960). It could be suspected, then, that the source of the problems connected with the Walrasian treatment of capital is no different from the source of the problems connected with the possibility of ‘non-remunerative’ goods and of ‘superabundant’ factors; and, above all, that the choice these problems may determine regarding the form of conditions [6] may not affect the significance of the theory in any different way from the choice determined by these latter problems as regards the form of conditions [3] and [4].

If we look at the transformation of equations [3] into disequations, we will however easily see that, taken in itself, it is perfectly *compatible* with the determination of an ‘ideal state’ of the economic system ‘towards which things tend’. The consumption goods that in this case would not be produced do not in fact appear among the *givens* of the theory. Their non-production would therefore have to be attributed mainly to the nature of those goods; and, what is more, it would not involve any tendency to change those givens nor, therefore, the position of the economic system (Garegnani, [1962] 2008, p. 14). The same cannot be said in the case of the *non-reproduction* of certain capital goods that would ensue from the transformation of equations [6] into disequations when those capital goods have been included among the givens of the theory. In this case the non-production of some capital goods does not so much depend on the nature of these goods but on the fact that the existing quantity of them is not adjusted to the other givens; and, above all, it involves the tendency to a change in the givens and thus to a move away from the position that the theory would have determined starting from those same givens.

Less simple is the question regarding how the difficulties in the treatment of capital relate to the transformation into disequations of equations [4]. For, here, two aspects of the problem must be kept separate. If for the moment we disregard the need to reproduce the productive factors—i.e. if we concentrate on the equations that refer to the services of ‘land’ and ‘personal’ capital goods for which this is, at

### III

6. As we mentioned at the beginning, Hicks's interest in Walras's theory of capital was initially manifested in the context of a debate that arose around the notion of marginal product. More precisely, in 1932 Hicks seems to have looked at Walras's theory in order to find the most solid basis for the objections that, starting from the extreme specialization that, as a rule, must be held to characterize individual capital goods and which makes them scarcely substitutable among

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least in a first approximation, possible—their transformation into disequations does not raise problems at the level of method: in this case, too, such transformation would not lead to a change in the givens of the system and would thus be *compatible* with the determination of a normal position. The fact that the contrary may appear to be true reflects in reality a problem concerning the way this position is determined. For when marginalist theory is conceived without reference to the existence of alternative production methods, the price of the service of each productive factor appears to be sensitive to the available quantity of that factor in such a way as to make income distribution substantially indeterminate (indeed the difficulties that arise in connection with equations [4] have been initially discussed as a problem pertaining to the marginalist *theory*, rather than to the possibility of applying the traditional *method*; see Wieser, 1889; Valk, 1928; Robertson, 1931; Neisser, 1932; Stackelberg, 1933). If, instead, we take into consideration the problem of the reproduction of the productive factors—and therefore we concentrate on the equations that refer to the services of the ‘capital goods proper’—we must recognize that their transformation into disequations, involving the possibility that some capital goods included among the givens are not reproduced, will be *incompatible* with the determination of a normal position. But this would represent a manifestation *in a particularly acute form* of the same difficulties in the treatment of capital that will *in any case* manifest in the non-solution of conditions [6] as equations.

This leads us to a last consideration. If it is true that, taken in itself, the substitution of equations [3] and [4] with a number of disequations appears to be *compatible* with the determination of a normal position, it is also true that those problems regarding the inclusion among the givens of a set of heterogeneous capital goods, which manifest in the impossibility to solve conditions [6] as equations, will tend to make themselves felt in every part of the system; and, in particular, that they will make that same transformation for equations [3] and [4] no longer merely possible, but *necessary*. For that treatment of capital may increase the probability that phenomena of superabundance among the productive factors will emerge. Moreover, when the composition of the capital endowment is not free to adjust to the other givens of the system, *each* consumption good may in principle be ‘non-remunerative’. The exposition of Walras's theory under the assumption that conditions [3] and [4] are always solved as equations is therefore only justified, on the one hand, by the fact that, in their pure form, the problems concerning the solution of equations [3], [4] and [6] spring from different sources; and, on the other, by the fact that it is only the non-solution of equations [6], whether or not *associated* with the non-solution of equations [3] or [4], that renders the theory unable to determine a normal position.

them and with labour and land, were levelled also by marginalist economists—and, among these, especially by Pareto and Cassel—at the plausibility of that notion, which is instead based precisely on the possibility to substitute one ‘productive factor’ with another. For, as we saw, among the founders of the marginalist theory Walras was the only one to have based his whole theory on the treatment of capital as a set of heterogeneous goods and therefore to have provided a basis for those objections within marginalism itself<sup>12</sup>.

The point on which all of Hicks’s criticism turns is the following. Even if it were possible to solve the equations in which Walras’s theory is expressed, in Hicks’s opinion the theory would in general remain incapable of determining an equilibrium. ‘It is perfectly possible to conceive of a community’, Hicks writes referring through the name of Pareto to Walras’s theory of capital,

in which all Pareto’s equations are satisfied but which is not in equilibrium (Hicks, 1932a, p. 85).

Though moving from the apparently specific question of the plausibility of the notion of marginal product, Hicks thus seems to reach a conclusion regarding Walras’s theory of capital that is very close to the one we have seen in § 5. At the same time, he seems to argue, differently from what we saw in § 4, that this conclusion does not manifest in the impossibility of solving Walras’s equations; or, at least, that it is

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<sup>12</sup> This is true even though Walras himself as from 1895 expressed approval of the notion of marginal product. In this case it was Walras who was not faithful to his own way of treating capital. This can be appreciated if we return to conditions [3] (§ 3, note 6), which, as we there saw, represent one of the ways for incorporating in the Walrasian system the choice of the productive methods, and noting that, to the extent that it is assumed (as Walras implicitly does) that they do not entail a choice regarding the type of capital goods, they postulate in reality the existence of a marginal product of the individual ‘capital goods proper’ that is clearly devoid of any plausibility. Walras was probably aware of this contradiction, as witnessed by the fact that, in illustrating the possibility of alternative production methods, he never refers to the possibility of substituting ‘capital goods proper’ among themselves or with labour, but always to the possibility of substituting ‘land’ capital goods on the one side, with ‘personal’ capital goods and ‘capital goods proper’ on the other (‘in making a product, it is possible to employ more or less of some productive services, say land services, provided that correspondingly less or more of other productive services, say labour or capital services, are employed’, Walras, [1877] 1954, § 204, p. 240); and indeed by the fact that he generally refers to this possibility only in the discussion of the secular evolution of the economic system where we should expect to observe changes in the technical conditions of production, and where there is accordingly no reason to expect those ‘non-land’ capital goods to remain the same (Walras, [1896], lesson xxxvi, pp. 382-392).

*conceivable* that those equations find a solution, without this being in itself sufficient to determine an equilibrium.

7. If for the moment we leave aside this last problem (to which we shall return in § 9) and ask why, according to Hicks, Walras's equations would in general be incapable of determining an equilibrium, we will see that the reason lies in the fact that, in his opinion, these equations leave in existence an incentive to move away from the position that they themselves determine. For, according to Hicks,

so long as the  $n$  commodities which are being produced are *arbitrarily given commodities*, each individual may have reached his preferred position within that charmed circle, but he may still have the incentive to move outside it (Hicks, 1932a, p. 85; my italics).

In particular, Hicks argues,

It would be possible for the *machine*-makers, say, to *modify* slightly the character of the goods they produce, so as to meet the needs of their customers more exactly. By so doing, it would be possible for them to sell their new goods at a price which would yield them a *greater profit* than they had earned before; while on the other hand their customers would be better satisfied, for they in turn would also earn larger profits (Hicks, 1932a, p. 86; my italics).

It is clear then that in 1932 Hicks viewed Walras's theory starting out from a case which, as we saw (§ 2), is not contemplated in that theory, but that he hold to be immediately relevant for discussing the notion of marginal product: the case of an economic system in which alternative methods of production are known and in which these methods generally feature the employment of capital goods of different *type*. For Hicks insisted that the objections levelled at the notion of marginal product on account of the specificity of the individual capital goods must be answered by showing how the substitutability that is at the basis of that notion should be referred, not to labour, land and such individual capital goods, but to labour, land and the 'factor of production' capital: for when capital is treated as a single magnitude, it becomes 'capable of transference from one form into the other' (Hicks, 1932b, p. 298)<sup>13</sup>.

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<sup>13</sup> The intention here is not to suggest that this position *separates* Hicks from the majority of marginalist economists of the time. Hicks's two writings of 1932—together with the work by Robertson quoted in note 11 above to which Hicks directly refers—are indeed notable precisely because they show with a clarity not easily found elsewhere that one of the reasons why marginalist economists *generally* relied on the treatment of capital as a single magnitude lay in the fact that this treatment of capital alone can lend plausibility to the notion of marginal product—and more in

What according to Hicks would emerge from Walras's theory would seem then to be a system of equations that would show the convenience of *not* reproducing the existing capital goods, but rather of producing capital goods *of a different type*, owing to the fact that on these 'alternative' capital goods a higher rate of profit could be obtained. But, as in Walras's system the type of capital goods cannot change simply because it is *assumed* that only one method of production for each good is known—or, at most, that alternative methods are known, but are characterized by the employment of the same capital goods in different proportions (§ 3 and note 6)—all would appear to reduce to a different evaluation, by Walras and Pareto on the one hand, and by the supporters of the theory of marginal productivity on the other, in regard to the flexibility of the productive process; or, even more simply, to the presence in the Walrasian system of an assumption that could be removed as easily as it was introduced. Hicks himself seems at times to incline towards this reductive interpretation (see § 9 further on). At bottom, however, he appears convinced that the absence of 'alternative' capital goods merely reflects a deeper constraint imposed on Walras's system by the analytical formulation he has adopted. It is for 'mathematical convenience', Hicks remarks, and not for its 'economic significance' that Walras has to impose that 'the only goods with which the market need be concerned are those goods which are actually being produced' (Hicks, 1932a, p. 85; the judgement is reiterated in Hicks, 1932b, p. 298); and, in his view, all the difficulties connected with Walras's theory of capital stem from this single circumstance.

8. What is the precise origin of this constraint that Hicks finds at work in Walras's theory he seems not clearly to grasp. It is evident, however, that it would not be able by itself to produce the results that Hicks ascribes to it. As Hicks himself had noted, in order to do this it is in fact necessary that the 'goods which are actually being produced', to the consideration of which the Walrasian system would find itself confined, be also 'arbitrarily chosen'. Now, this cannot happen for consumption goods: for, as we have seen (§§ 2 and 5, note 11), Walras's system may be modified in such a way as to make the type of consumption goods 'actually produced' a result of the process that leads to equilibrium. But this is indeed the case, in Walras's theory, of *capital goods*: for in this case by 'goods which are actually being produced' we must understand the goods included among the givens of

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general to the substitutability among productive factors—upon which the marginalist theory of distribution rests. On this point, see Trabucchi (2011).

the theory. It does not in fact appear possible to interpret Hicks's expression 'goods that are actually produced' in the light of the distinction, which belongs to the modern notion of temporary equilibrium, between the capital goods existing at the beginning of a determinate period (that are taken into consideration only from the point of view of their utilization) and the capital goods produced during that period (considered solely from the point of view of their production). The lapse of time to which the traditional notion of equilibrium implicitly refers is indeed such that it is not possible to abstract from the perishability of the capital goods: if these are to be currently utilized, they must also be currently replaced<sup>14</sup>. It is, then, undoubtedly significant that, while Hicks's formulation of the constraint that would operate in Walras's theory regards both consumption and capital goods indifferently<sup>15</sup>, he makes use of the latter alone to illustrate his argument ('It would be possible for the *machine-makers...*', see p. 15 above). And that the root of the problem must be sought in the fact that by treating capital as a set of heterogeneous goods Walras had actually included among the *givens* of the theory—that cannot be but arbitrarily chosen—what should instead be one of the *results* of the process leading to equilibrium, this Hicks seems very near to acknowledging fully when, in reply to certain objections by Schultz, he counters Walras's theory with the traditional treatment of capital in terms of a 'productive factor', and writes:

any particular set of prices of the *factors* of production determines, not merely the quantities of factors demanded, and the quantities of intermediate and final products produced, but also the *kinds* of intermediate and final products (Hicks, 1932b, p. 299).

9. At a certain point Hicks remarks that in order to incorporate in Walras's scheme the choice of which consumption goods and which capital goods it would be convenient to produce, 'we should need to introduce, as well as  $n$  [in our case  $n + m$ ] commodities, intermediate

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<sup>14</sup> Note that Hicks sidesteps this difficulty in a particular way. It will be recalled that he did not write that Walras's equations show that different capital goods from those in use are actually produced, but only that it is convenient to do so. In other words, it is as though Hicks had, so to speak, *frozen* the Walrasian system *before* the effect of that convenience of varying the production of the capital goods makes itself felt: in this way capital goods 'actually produced' and actually in use continue to coincide.

<sup>15</sup> See the quotation on p. 16 above ('the only goods with which the market...') referring generically to 'goods'; see also Hicks's statement, quoted below at the beginning of § 9, referring explicitly to 'intermediate' and 'final' goods. I owe this point to an anonymous referee on an earlier version of this paper.

and final, which are actually produced, a much larger number of possible commodities, which are not produced, because something else is preferred to them, at the lowest prices at which they could be offered' (Hicks, 1932b, p. 299).

Hicks himself did not take the path he indicated. In this way, with the oscillation in his judgement that we mentioned above, he seemed to leave open the possibility that, by the simple integration of Walras's equations with the new conditions regarding the choice of 'intermediate and final' goods to produce, Walras's theory could be made acceptable. In reality, even without materially writing the new conditions, Hicks's suggestion contained elements sufficient to see how the deeper result he had reached—the impossibility of determining an equilibrium with the Walrasian treatment of capital—was fundamentally sound; even though this would have meant for Hicks having to revise his idea regarding the independence of this result from the problem of the solvability of Walras's equations.

For it is clear that nothing prevents us from adding further conditions to Walras's equations in such a way as to contemplate the possibility of 'alternative' consumption and capital goods. The problem arises when we discover that while the 'expanded' equations can effectively represent the process by which the consumption goods that are 'actually produced' are chosen, this is not the case, with Walras's treatment of capital, for capital goods: for capital goods in existence—and thus, according to what was specified before, also in production—are in fact already established, and all that the 'expanded' equations can do in this case is to indicate the convenience of producing different ones, thereby certifying the state of disequilibrium in which the system finds itself.

This being said, however, it becomes evident how the problem identified by Hicks in Walras's theory and concerning the choice of the *type* of capital goods to be produced in equilibrium is of the *same nature* as the one, regarding only their *relative quantity*, that we saw in § 4 and that Hicks, instead, was led to disregard. For, following the rewriting suggested by Hicks, it becomes clear how both problems must be retraced to the possible inconsistency between, on the one side, what we might call the 'qualitative' and 'quantitative' composition of investment and, on the other, the 'qualitative' and 'quantitative' composition of the capital endowment, when the latter is fixed *before* equilibrium is reached; which is indeed what happens when, as with Walras, a set of heterogeneous capital goods is included among the givens of the theory. And it is this very fact that leads one to rule out that, in

general, the first problem may present itself as entirely separate from the second<sup>16</sup>.

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<sup>16</sup> As we have seen (§§ 2 and 5, note 11), to follow a suggestion like that of Hicks (to introduce, along with the goods that are produced, a number of goods that are *not* produced), it is not sufficient to add new *equations* to Walras's system. Rather, we must transform some of the existing equations into a larger number of *disequations*. It must also be considered that the problem presents itself in appreciably different terms according to whether these 'goods that are not produced' are consumption goods or capital goods. Some considerations on the latter case may help us to understand Hicks's position better.

The choice among alternative capital goods arises when alternative production methods are known and when these are not characterized, as Walras seems to think, by the employment of the same capital goods in different proportions, but by the employment of capital goods of different *type*. This holds good, of course, as much for the production methods of the consumption goods as for those of the capital goods themselves. To avoid excessive complications, we shall however continue to assume that for each capital good only one production method is known. Let us then assume that along with the  $l$  capital goods that we have already introduced (§ 3),  $l'$  'alternative' capital goods are known in our system. As we saw (§ 3 note 6), in order to take into consideration the existence of alternative production methods it will firstly be necessary to transform the  $m$  equations [3] into a much larger number of *disequations*. Equations [3] will then take the following form:

$$\sum_{ijq_i} p_j a_{jq_i} \geq P_i \quad \begin{array}{l} i = 1, 2, \dots, m \\ j = 1, 2, \dots, n, \dots, (n + l') \\ q_i = 1, 2, \dots, Q_i \end{array} \quad [3'']$$

where, as in conditions [3'], the generic term  $a_{jq_i}$  indicates the quantity of the  $j$ -th capital good required to produce one unit of the  $i$ -th good with the  $q$ -th method available for the production of that good: the difference with those disequations being limited: *a*) to the number of 'capital goods proper', which can now be considerably increased; and *b*) to the fact that the condition, which we set in regard to those disequations, on the basis of which the service of each capital good must be required by all the productive methods of at least one consumption good, has no further reason to be posed. It will indeed be convenient to simplify in the opposite direction and assume that the service of each capital good is required *at most* by one production method for each good.

When alternative production methods are characterized by the employment of capital goods of different *type*, the transformation of equations [3] will, however, also entail the transformation of equations [6]. For, not only will we have to make space here also for the  $l'$  'alternative' capital goods; we must also take account of the fact that, for capital goods that are only employed in production methods that in equilibrium are not chosen, the demand price will have to be lower than the supply price:

$$\sum_{jk_l} p_j a_{jk_l} \geq P_{k_l} \quad \begin{array}{l} l = 1, 2, \dots, m \\ j = 1, 2, \dots, n, \dots, (n + l') \end{array} \quad [6']$$

Note now that, in the case of conditions [6], their transformation into a (larger) number of disequations *does not entail* the abandonment of the condition of a uniform rate of profit, but is part of the *reformulation* of that condition that becomes

10. Now that Hicks's argument has been shown to be relevant in order to discuss the validity of Walras's theory even though it makes reference to a problem, such as the choice of the type of capital goods, that is not directly contemplated in that theory, one could still, however, suspect that the criterion to which Hicks refers in order to conclude that Walras's equations are unable to determine an equilibrium was too restrictive. It might seem in other terms that Hicks tended to consider in equilibrium only a situation in which *any* incentive to move away from it was absent: i.e. that he judged to be in equilibrium only a situation in which the givens can be seen as *constant*. Since the problem will re-emerge in Hicks's 1934 paper, it will be as well to pause here and clarify this doubt. For such constancy in the givens does not appear to be a requisite of the traditional method

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necessary when alternative production methods are known. To see this, consider that, our original equations being given, one of the following *four* cases may present itself. If we call  $r$  the highest rate of return obtainable on the supply price of the 'alternative' capital goods, the rate of return on the supply price of the existing capital goods may be: *a*) uniform and greater than  $r$ ; *b*) non-uniform but with the lowest among these rates higher than  $r$ ; *c*) non-uniform and with at least the lowest among these rates lower than  $r$ ; *d*) uniform and lower than  $r$ . Now, clearly only in case (a) would the system find itself in a 'normal' position. But even in case (d) the rate of return on the supply price of the existing capital goods is uniform. In order to determine a normal position it is then necessary to add as a *further* condition that the rate of profit on the existing capital goods, as well as being uniform, is also *higher* than that which could be obtained on 'alternative' capital goods.

This being said, it is clear that, if the existing capital goods are those that have been included among the givens of the theory, only by chance may the system find itself in situation (a). In general, it will find itself either in situation (b), and in this case the inconsistency will be between the proportion in which certain capital goods are available and the proportion in which *those same* capital goods are required in order to produce the consumption goods in the proportions in which these are demanded in equilibrium (i.e. we will be in front of the same inconsistency as the one we find in Walras's original system where alternative production methods are not contemplated); or in situations (c) or (d), and therefore the inconsistency will be, respectively, also, or solely, between the *type* of the existing capital goods and the *type* of the capital goods that would be required in equilibrium. It is clear, however, that the *nature* of the inconsistency is the same, inasmuch as it refers back in both cases to the fact that, with the Walrasian treatment of capital, what should emerge as a *result* of the process leading to equilibrium has been included among the *givens*. Lastly, we can see how the case discussed by Hicks must be likened to our case (d). It appears immediately clear how it is an absolutely particular case (having fixed a set of capital goods, we would indeed always expect to observe the system in situation c). But it is not an arbitrary case. For there is surely a sense in which the choice of the type of capital goods precedes (logically) the choice of their relative quantity.

which, as we saw in § 5, is based on the possibility of determining a position towards which the economic system continually *tends*.

In order to establish, in a first stage of the analysis, whether a given economic system shows a tendency to move towards the position determined by theory, it appears legitimate to assume that we observe the system in the absence of those exogenous changes in the givens that, in fact to some extent always present, contribute to explaining why the observations do not in general coincide with the theoretical position. The same cannot be done with regard to possible *endogenous* changes; since these are determined by the same theory whose connection with observations one is seeking to ascertain, they must be taken as an integral part of the problem under discussion. Now, there would of course be no problem if these endogenous changes were completely absent: if, that is, the givens from which the theoretical position was determined could be considered as constant. But this is not generally the case in a capitalist economy, which is normally characterized by capital accumulation and thus by all those changes—in technique, in consumption, in institutions—which are connected with it. However, the tendency of the economic system to move towards the normal position will be effective even when the givens are only *persistent*, i.e. in the case where, net of the exogenous changes, the endogenous ones are slow with respect to the movement of the system itself towards the theoretical position.

And that the problem for Hicks was indeed that of the lack of persistency of some of the givens of Walras's theory and not the mere fact that these givens are bound to change with the passage of time—i.e. the fact that they cannot be taken as constant—is witnessed by his reply to another of Schultz's objections. 'Hicks' fundamental error', wrote Schultz, 'lies in his belief [...] that in the Walras-Pareto equations [...] the total supply of each factor is taken as given' (Schultz, 1932, p. 285). 'The central issue of Marginal Productivity', Hicks replied,

is an issue of economic statics—in Clark's sense—and this, it seems to me, is as true in the Lausanne system as in any developed economic theory. The conditions which give rise (or do not give rise) to the Marginal Productivity law are [...] similar in form whatever assumption we make about saving. It is thus perfectly natural, when one is discussing marginal productivity, to assume constant supplies of the factors [...]' (Hicks, 1932b, p. 297).

This exchange between the two economists may contain an element of incomprehension concerning the meaning to attribute to the ex-

pression ‘supply of a factor of production’: for if this refers to the supply of the services of the factor of production, this may of course be elastic to the price system (as shown in equations [1]) even while the available quantity of each factor remains given<sup>17</sup>. But, over and above this question, what Hicks emphasized was that the static *method* enables us to take *as given* quantities that in reality are slowly changing; in particular, that this method can be employed to study value and distribution in an economic system in which there is net capital accumulation, i.e. a system where one of the magnitudes included by the marginalist theory among the givens is indeed changing endogenously, but at a relatively slow rate.

#### IV

11. To conclude this first part we can say then that in 1932 Hicks harboured two levels of awareness of the difficulties present in Walras’s theory of capital. At the first and, in a sense, more superficial level the limits of the theory would stem simply from the fact that it does not consider the problem of choosing the type of capital goods that, in equilibrium, should be used and produced; so that it might even appear that, according to Hicks, all that needs to be done to make the theory acceptable is to integrate it with the conditions he himself suggests and that we have seen in § 9. The limits of the theory would directly derive then from the partial understanding of Walras himself of the notion of marginal product and, in particular, from his incomprehension of the need to consider the type of capital goods employed as variable, if the notion is not to be accused of implausibility. In clarifying the bases that underpin the notion of marginal product Hicks was however continually led towards a second, deeper level of awareness regarding Walras’s theory: namely, that this theory did not merely disregard the problem of the choice of the type of capital goods, but would find the problem impossible to posit, since the type of capital goods is already fixed in the givens of the theory. And it

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<sup>17</sup> Apart from this possible source of misunderstanding, it appears that Schultz may have shared Bortkiewicz’s (and, as we have seen, initially Walras’s) error consisting in considering the *endowment* of the individual capital goods as variable in Walras’s theory (see § 4, and notes 7-8 above). For in his objection to Hicks, after correctly stating that in Walras’s system the supply of the services of the various capital goods is variable (as stated by equations [1] which express the amount of the services of the *existing* factors of production that will be supplied at different prices), he seems to suggest that it is the object of ‘the equations of capitalisation’, i.e. equations [5]-[7], to determine ‘the quantity of capital that will be supplied’ (Schultz, 1932, p. 287).

seems to be this deeper level of awareness, that Hicks never expresses in a sufficiently precise form, that underlies his conviction on the basis of which, also in the absence of an in-depth discussion of the problem of the solvability of Walras's equations, one must conclude that they do not determine a genuine equilibrium.

That Hicks left the question of the relation between what we have called the two levels of his awareness of the difficulties in Walras's theory unresolved will not appear strange when we consider, on the one hand, that both of these led him, though with different degrees of distinction, to reject the theory; and, on the other, that since Hicks at the time saw no reason to doubt that capital could be treated as a single magnitude, he was not inclined to seek an alternative within marginalist theory to what was then its dominant version. Rather, it may be useful to note how the particular point of view adopted by Hicks in 1932 prevented him from considering an important aspect of Walras's original argument. As we have seen (§ 4), Walras had maintained that the variation in the relative output of new capital goods, that follows directly from the fact that different rates of profit are obtained on the supply price of the various capital goods, could represent the mechanism by virtue of which the system could be led towards a situation featuring a uniform rate of profit. Now, over and above the limits of this adjustment mechanism (§ 4, note 9), it is clear that it can be taken into consideration only when, thanks to the hypothesis that for each good there exists only one production method, the argument is confined, as in Walras's *Elements*, to the question of the *relative quantity* in which the existing capital goods are reproduced. When, instead, as Hicks does in dealing with the notion of marginal product, the question regarding the *type* of the capital goods also arises, the mechanism cannot evidently even be considered.

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