More on why we should bury the neoclassical theory of the return on capital: a supplementary note

Roy Grieve[1] [United Kingdom]

Introduction

This note is intended as, in effect, an appendix to the author's recent paper on the deficiencies of the marginal productivity theory of the return on capital[2]. A little extra explanation together with a simple numerical model may help to elucidate matters discussed in that paper. Much was made of the dependence, in the case of a surplus-producing economy, of equilibrium relative values on distribution; there was a passing reference to the "reswitching" phenomenon. For people to see more clearly how such phenomena come about, and appreciate that, however strange they may appear from a neoclassical standpoint, these are entirely natural elements of a classical conception ("classical" meaning in the tradition of Smith, Ricardo and Marx), would be no bad thing.

The background: the differing neoclassical and classical conceptions

In neoclassical or marginalist theory the relative values of goods and services are interpreted as "indices of scarcity" reflecting the balance of demand and supply in the various markets of the economy. This explanation comprehends, along with other values, the prices of "factor services" – i.e. the wages of labour and the rate of interest on capital.[3] These rewards are understood to correspond to the value of the marginal contributions of the factors concerned – that is, to the utility to the consumer of the marginal unit of consumption and to the contribution to production of the marginal worker or marginal unit of capital.

It is this marginalist approach to the theory of distribution that is undermined by the critique - particularly associated with the name of Piero Sraffa – which has been developed in recent years from the old classical perspective. The marginalist analysis was originally constructed to explain consumer behaviour in a context of pure exchange, and, despite subsequent elaboration, authors working in terms of the marginalist paradigm failed to achieve a satisfactory application of their approach to the real world conditions of a surplus-producing economic system. Any real economy *is* a surplus-producing system which, over and above reproducing the producers' goods being used up in the production process, supplies additional (i.e. surplus) output which maintains not only the workforce but also the rest of the community, and which, beyond that, may go to capital accumulation, luxury consumption, or other use[4]. The neoclassical analysis remains grounded in a fairy tale world of exchange and

---

[1] Formerly University of Strathclyde, Glasgow. roygrieve@btinternet.com

[2] Grieve (2012); see also Moseley (2012).

[3] Neoclassical theory frequently focusses on *interest* as the reward to capital, leaving *profit* and its determination neglected in the background.

[4] Surplus output may be defined in alternative ways. The old classical economists viewed the surplus as consisting of the output available for general use after all inputs, *including the maintenance of the labour force*, had been replaced from current output: the wage bill thus counted as a cost rather than as part of the surplus. With reference however to modern conditions when it is not easy to identify what might be considered the necessary subsistence of the workforce, it is preferable to treat the output going to

consumption without getting to grips with the properties of an economic system in which inputs are themselves products of the system, rather than manna from heaven or flotsam picked up on the beach of a desert island.

Neoclassical theorists, generally ignorant of the classical conception of production with a surplus[5], gave no consideration whatever to the fact (of high theoretical importance) that – at least *conceptually* - the surplus product may be divided in different proportions between competing claimants – as between labour and capital. (If wages are increased profits fall, and vice versa.) With respect to the theory of value, the significant implication – appreciated by Smith, Ricardo and Marx – of differences in distributive shares is that equilibrium relative values are affected by the division of the surplus. Other things being equal, relative values will differ according to the rates of wages and profits established. (From a classical angle, it is understood that whatever distribution actually obtains is determined not by factor contributions to production – but may be taken to reflect instead the bargaining power possessed by the rival claimants to shares in net output.)

Equilibrium relative values and the distribution of the surplus

Let us try to explain - as simply as possible – why equilibrium values depend on distribution. As this is a phenomenon completely beyond the neoclassical horizon, it is necessary to investigate the issue from a classical perspective: we employ a very basic Sraffa-type model. In the economic system envisaged production is understood to take place period by period, output in each period not only replacing (for use in the following period) the output used up in the current period, but producing a net surplus over current usage.

The equilibrium values of the commodities produced must cover the costs incurred in their production, these comprising expenditures on material inputs, on labour and, in addition, a necessary margin of profit, at whatever is the going rate, must be included. Profit is calculated as a mark-up on the outlay (investment cost) on materials[6]. In a given situation these prices are such as to effect a particular division of the surplus between wages and profits.

To reveal fully the nature of these costs of production, Sraffa (1960, Chapter IV) introduces the analytical procedure of "reducing material inputs to dated labour inputs". He notes that material inputs at any particular time are themselves the product, in a previous period of time, of material *and labour* inputs. The point of the procedure is that, by tracing input usage backwards through time, a part of the material element can be progressively replaced as an input component by the earlier labour input which had gone into the production of that material. Thus, by going far enough back in listing the resources used directly and indirectly in the production of a commodity, material inputs come to be replaced by the earlier labour inputs used in producing these materials, so that, eventually, with the material element

---

wages, along with other income shares, as an element of the surplus. That is the convention we adopt in this discussion. That being so, the surplus can therefore be understood as corresponding to the familiar concept of net national income.

[5] While neoclassical economists typically appear to have had no notion of the concept of surplus production, Walras did attempt to bring the phenomenon into his general equilibrium system, but failed to provide a successful treatment; Pareto, his close follower, realized that Walras had got himself into a muddle, and dropped the surplus concept completely from his analysis.

[6] For the sake of simplicity, investment is understood to take the form only of working capital, fixed capital not appearing in the system.

virtually eliminated, we are left with a series of "dated labour inputs" as representing the inputs used over time in producing the commodity in question.

The cost of production of a commodity may thus be interpreted as corresponding to the present value of a particular set of dated labour inputs. In calculating this cost account must be taken not only of direct outlays on wages, but also of the fact that with labour inputs entering into the production of material inputs, the subsequent utilisation of these materials adds a profit mark-up to the labour costs previously incurred. Note that, with compound interest, the impact of the profit factor on the present value depends on the date of application to production of a particular labour input. The present value of the set of dated labour inputs thus depends on the quantity of labour, the date of employment, the rate of wages paid and the going rate of profit.

The present value of each individual dated labour input is represented by the equation $(L_t w)(1 + r)^n$ where L indicates the number of workers, t the date of application of that labour, w the wage rate and n is the compounding factor corresponding to that date. Formally then, the cost of production / equilibrium value p_x of commodity x, made up of the sum of the present values of the several dated labour terms, may be expressed thus:

$$p_x = L_t w + L_{t-1} w(1 + r) + L_{t-2} w(1 + r)^2 + L_{t-3} w (1 + r)^3 \ldots L_{t-n} w(1 + r)^n$$

The present values of the elements of any such series of dated labour terms, and hence the values of the commodities to the production of which they relate, are subject to significant variation according to the particular rates of profit and wages specified. Sraffa (1960, Chapter VI) provides some dramatic examples of the effects of different divisions of the surplus on the values of commodities.

Surplus production and relative values: an illustration

We now introduce a very simple model of a surplus producing economic system. Despite its simplicity it can be used to illustrate phenomena characteristic of such a system, phenomena unrecognized in neoclassical theory.

Our model economy is comprised of a capital goods industry and a consumption goods industry, and produces and uses two commodities, a capital good (k) and a consumer good (c). Capital goods are the "basics" of the system – they are required in the production both of consumption goods and of the capital goods themselves. Our model should be read as being of an elementary input-output system. The structure of the system is shown below (Table 1). p_k and p_c (costs of production / equilibrium values) are the prices of goods k and c respectively; w is the real wage rate (in quantities of c); r the rate of profit, and L quantity of labour (number of workers).

Table 1: structure of the system

	Physical relationships:	Value relationships:
Capital goods industry:	60k + 75L produce 105k	$60p_k (1 + r) + 75w = 105p_k$
Consumption goods industry:	45k + 25L produce 220c	$45p_k (1 + r) + 25w = 220p_c$
Whole system:	105k + 100L	(net output / surplus = 220c)

The surplus produced is purely in the form of c goods. The k goods produced during each period of time are applied to production in the following period to replace current usage of such goods. The surplus may, in principle, be distributed in different proportions as wages or profits between the rival claimants. Table 2 shows the distributional possibilities in terms of commodity c.

Table 2: profit and wage possibilities

Profit share (in units of c)	Wage share
0	220
20	200
60	160
100	120
140	80
180	40
220	0

Different divisions of the surplus imply different rates of profit and different equilibrium values. The range of profit rates technically feasible in the case of the system modeled can be determined by resort to the notional[7] "standard system", which, representing the technical core of the actual system, reveals the profit-yielding properties of that system. The standard system corresponding to our model economy is

80k + 100L produce 140k; maximum r when w = 0 is 60k/80k = 75%.

The range of profits possible with our actual system is accordingly 0% – 75% (profits zero/wages at maximum – profits maximum share/wages zero).

Let us now see how in the case of our model system the relative values of commodities k and c differ according to the division of the surplus[8]. As explained above, relative values

[7] Logically, such a system is embedded within any actual system. See Sraffa (1960), Chapter IV.

[8] We are not necessarily supposing that such distributional changes are actually occurring. These exercises are in the nature of "thought experiments" intended to reveal what underlies the state of the economy as we see it.

correspond to the present values of the dated labour stream to which the costs of production of each commodity can be reduced. The values of the dated labour streams for commodies k and c are shown below:

For one unit of k:

$$0.714L_tw + 0.408L_{t-1}w(1 + r) + 0.233L_{t-2}w(1 + r)^2 + 0.133L_{t-3}w(1 + r)^3 + 0.076L_{t-4}\,w(1 + r)^4 + 0.043L_{t-5}\,w(1 + r)^5 + 0.025_{t-6}w(1 + r)^6 \ldots 0.00L_{\,t-16}(1 + r)^{16} \ldots ;$$

and for one unit of c:

$$0.114L_tw + 0.146_{t-1}w(1 + r) + 0.084L_{t-2}w(1 + r)^2 + 0.048L_{t-3}w(1 + r)^3 + 0.027L_{t-4}\,w(1 + r)^4 + 0.016L_{t-5}w(1 + r)^5 + 0.009L_{t-6}w(1 + r)^6 \ldots$$

If, for each commodity, we trace these dated labour streams right back, period by period, until the inputs become of negligible magnitude, we should find that the total labour input, summing labour usage over all the dated labour terms, approximates to 1.667L and per unit of output by industry k and 0.450L per unit of output by industry c. When the rate of profit is zero, and costs reduce simply to labour costs, these numbers, multiplied by the wage rate, represent the unit costs of output in the respective industries. In this instance relative values are proportional to "labour embodied"; however, that relationship holds only when all output goes to the workforce: when owners take a share the proportionality between quantities of labour inputs and relative values disappears.

Given the range of values of r possible in our model system, the corresponding values of each commodity may, for any r, be calculated.

Sets of relative values of pk and pc corresponding to various values of r, are reported in Table 3. These values are quoted in terms of wage-units – i.e. the going wage is taken as the numeraire, and used under all circumstances. (Incidentally, both Adam Smith "labour commanded") and Maynard Keynes favoured the wage-unit as a standard of value.)

Table 3: relative values

r	p_k	p_c	w	p_c/p_k
0	1.67	0.45	1	0.27
10	1.92	0.54	1	0.28
20	2.27	0.68	1	0.30
30	2.78	0.86	1	0.31
40	3.57	1.14	1	0.32
50	5.00	1.65	1	0.33
60	8.33	2.83	1	0.34

Our model thus captures a phenomenon overlooked in neoclassical theory, the dependence of equilibrium values on the division of the surplus. The relative values of goods k and c do vary, if not to a dramatic extent, but what is particularly interesting is how the value of the capital good, (and consequently, the value of the capital stock, when measured in wage-units, does vary dramatically according to the distribution of the surplus (see Table 4). It may be noted that if, alternatively, a unit of good c (representing a basket of consumption goods) is taken as the numeraire, the value of the stock of k goods used in production is again seen to vary with distribution - but in a different direction, falling rather than rising with increases in r! *It is evident that a given stock of real capital equipment does not have a unique value independent of the return on capital.*

The value of capital per worker across the economy varies with altered rates of wages and profits as shown in Table 4. Columns 2 and 4 indicate that the "quantity of capital" installed in this economy, when measured in value terms, varies significantly according to distribution of the surplus (and according to the standard chosen). Measuring values in wage-units, the system is apparently operating with a higher capital-labour ratio when wages are low than when they are high, but when commodity c is taken as the standard of value, the ratio rises as wages rise. But, of course, regardless of the different values of capital under different circumstances, the stock of real capital is exactly the same in its physical form and properties.

Table 4: value of capital installed

r	value of capital stock (105k x p_k) / w (in wage-units)	value of capital per unit of L (in wage-units)	value of capital stock (105k x p_k) / p_c (c as numeraire)	value of capital per unit of L (c as numeraire)
0	175	1.75	390	3.90
10	202	2.02	374	3.74
20	238	2.38	351	3.51
30	292	2.92	339	3.39
40	375	3.75	329	3.29
50	525	5.25	318	3.18
60	875	8.75	309	3.09

We see therefore that produced capital goods take on different relative values according to how the surplus is distributed. That that is so creates a serious difficulty for the neoclassical theory of distribution which, as we know, attempts to explain the return on capital (the value of r) by reference to the quantity of capital measured in value terms. But, as illustrated in Table 4, *unless a particular value of r has been specified, the value of capital is indeterminate*. Consequently, the impasse facing the neoclassical theorist seeking to account for the value of r is that while it is essential to know the value of the existing stock of capital, a unique value can be attached to that set of real items only when the answer to the question being asked is known. *This state of affairs leaves the neoclassical theory of distribution in an impossible situation.*

Reswitching

The principle purpose of this exercise has been to demonstrate how, in the case of a surplus-producing economic system, the value of real capital goods is not independent of the distribution of the surplus, a fact which undermines the neoclassical explanation of the return on capital in terms of the abundance or scarcity of the existing stock of capital. Having achieved our initial objective, let us extend this explanatory exercise a step further by demonstrating how the dependence of values on distribution gives rise to the phenomenon – paradoxical from the neoclassical perspective – known in the literature as "reswitching".

Reswitching relates to choice of production technique. Neoclassical theory supposes the existence of a regular relationship between relative abundance or scarcity of factors, low or high factor prices and the factor intensity of technique chosen. Thus the expectation would be

that, in moving between economies with different resource "endowments"[9], we would find labour-intensive techniques in use in a labour- abundant, low wage economy (economy A), capital-intensive methods being employed where capital was plentiful and labour relatively scarce and dear (economy C), and "in-between" techniques favoured in economy B, where labour was less scarce than in C, but capital more abundant than in A. What we would not expect to see would be that a technique adopted as appropriate to conditions in A, and rejected in B as unsuitable, is selected again as appropriate in C. This unexpected appearance of the same technique under quite different economic conditions is what is referred to as "reswitching".[10] Imagine an entrepreneur transferring his operations from economy A to economy B and in doing so switching from a labour intensive technology to a more capital intensive one, but, in making a further move to economy C, switching back to the technology which had been used in economy A. From a neoclassical perspective that would seem very odd – how could a technique appropriate to a low wage, high interest economy become optimal in a high wage, low interest one?

To model the circumstances under which this could happen, we introduce alongside the simple model system with which we have been working, another similar system (call it "system 2"). See Table 5 for the specification of that system. It is similar in structure to our previous model economy ("system 1") in that it consists of a capital goods sector together with a consumer goods sector; we suppose that the consumer good is the same good c as produced in system 1, but that the capital good k' is different in technical properties from the capital good k of System 1. Sets of relative values implicit in system 2 according to distribution are reported in Table 6.

We treat the two systems as constituting alternative techniques of producing commodity c and we suppose that entrepreneurs will chose which of the two techniques, under whatever conditions prevail, is the more profitable. (We may refer to them as "systems 1 and 2" or, alternatively, as techniques 1 and 2: no matter – here "system" and "technique" signify the same thing.)

Table 5: structure of system 2

Physical relationships:	Value relationships:
48k' + 40L produce 80k'	$48p_{k'}(1 + r) + 40w = 80p_{k'}$
32k' + 60L produce 200c	$32p_{k'}(1 + r) + 60w = 200p_c$
80k' + 100L	

[9] We are adopting Joan Robinson's procedure of supposing the different techniques of production to be employed in "isolated islands of equilibrium".

[10] As to how the reswitching issue arose, see Harman (1996).

Table 6: relative values, system 2

r	$p_{k'}$	p_c	w	$p_c/p_{k'}$
0	1.25	0.50	1	0.40
10	1.47	0.56	1	0.38
20	1.79	0.64	1	0.36
30	2.27	0.77	1	0.34
40	3.12	1.00	1	0.32
50	5.00	1.50	1	0.30
60	12.50	3.50	1	0.28

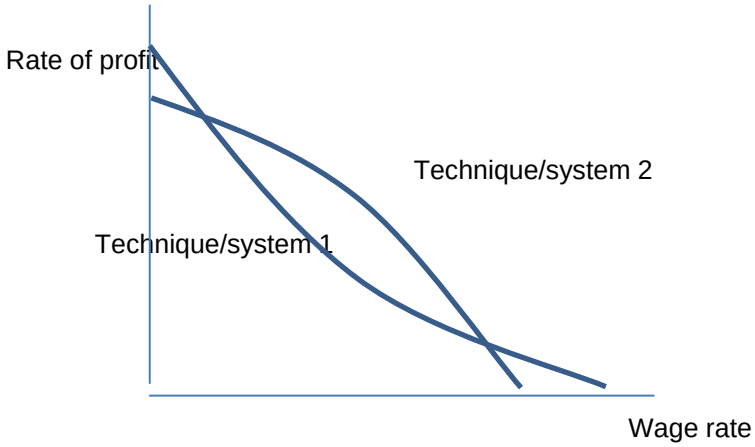
With respect to choice of technique it is relevant to compare the capital-labour ratios associated with the two techniques. Again we encounter a state of affairs unrecognised and inexplicable in a neoclassical world. Table 7 shows how the capital/labour ratios (value of equipment per worker) of the two techniques do not stay constant in relation to each other, but vary with the distribution of income. Thus we cannot say, without knowing distribution and relative values, which technique is the more "capital intensive". At lower rates of profit 1 is more capital intensive than 2, but at high rates the situation is reversed, with the value of capital per worker higher in 2 than in 1. It is this variability in the relation to each other of the two capital/labour ratios that underlies the reswitching which, as we are about to show, can occur between the two techniques.

Table 7: capital/labour ratios

r (%)	Capital/labour ratio technique 1 (Value of capital in wage units, per unit of labour)	Capital/labour ratio technique 2
0	1.75 : 1	1 : 1
20	2.38 : 1	1.43 : 1
50	5.25 : 1	4 : 1
60	8.75 : 1	10 : 1

Given the availability of these alternative techniques for the production of consumer good c, entrepreneurs will select whichever technique is the more profitable under the particular conditions (with regard to distribution of the surplus) that happen to obtain. The relative profitability of the two techniques depends on the going rates of profit and wages. How their respective profitabilities vary as wage levels alter is shown in Figure 1.

Figure 1: Wage-profit frontiers



The figure depicts "wage-profit frontiers" indicating feasible wage and profit combinations associated with each technique. With these "frontiers" set against each each other and the rate of profit yielded by each technique compared at various wage rates, it is evident which technique will be favoured in particular distributional situations.

Consider what these choices will be. Start with the situation that wages (in both systems) are at a very high level. Initially we find that technique 1 offers the higher rate of profit, and will therefore be the preferred method of production. At lower wages, profits will be higher in both systems, but, as wages are reduced, the rate of profit in system 2 will rise by more than that in 1, and technique 2 will accordingly come into favour. (The reason for this technological "switch" is that at high wage levels, technique 1 is more capital intensive than technique 2, implying that a given income transfer from workers to owners raises the rate of return to greater extent in 2 than in 1. Further wage reductions, over a considerable range, increase the return on capital in both systems without inducing a change in technique; but when wages fall to very low levels, another switch in technique is predicted, from 2 back to 1. Note what is happening in the case of this latter switch: as before, entrepreneurs have switched from the more capital-intensive technique to the relatively labour-intensive one, again for the reason that the given reduction in wages has a larger impact on profits in the latter than the former system.

The inexplicable oddity here from the neoclassical perspective is that the former switch from a more capital intensive to a less capital intensive one was from technique 1 to technique 2; in the latter instance the switch from a technique of higher capital intensity to one of lower capital-intensity is from technique 2 to 1. The explanation, of course, is that alteration of the relative capital intensities of the two techniques (see Table 7) has made the switch back from 2 to 1 advantageous for the same reason as was the switch from 1 to 2.

Reswitching, that is to say, occurs because of the dependence in these systems of relative values on the division of the surplus: in consequence the two techniques cannot be uniquely ranked (as in a neoclassical world they would be) in terms of capital intensity.

Conclusion

The marginalist or neoclassical theory is seen to run into difficulties in respect both of explaining the determination of the rate of return on capital and in understanding the possibilities that exist as regards choice of technique. These difficulties result from the neoclassical presumption of a constant one-to-one relationship between the *values* placed on commodities produced within the economy and the *quantities* of real physical "stuff" (measured in appropriate terms) of which they are comprised. But, a given commodity or given collection of commodities (such as a set of capital goods) has, in the real world context of production with a surplus, no unique value, independent of the division of the surplus, relative to other goods or sets of goods. The neoclassical theory is led into error by failure to appreciate that the value of a specific stock of capital goods depends on the going rate of return on capital; it is baffled by the possible implications of the fact that the ranking of techniques of production in terms of capital or labour intensity (with technical specifications unaltered) is likewise dependent on the distributional situation.

The fundamental reason for all this theoretical muddling is that the neoclassical analysis, having failed to escape from Walras's desert island, remains applicable only to a notional exchange-and-consumption world, and necessarily finds itself in difficulty when faced with explaining the working of a real world economy characterized by production with a surplus.

References

Grieve, R H (2012), 'The marginal productivity theory of the price of capital. An historical perspective on the origins of the codswallop', *real-world economics review*, 60, pp. 138-149.
http://www.paecon.net/PAEReview/issue60/Grieve60.pdf

Harman, C (1966), 'The Crisis of Bourgeois Economics', *International Socialism*, 71; available at http://pubs.socialistreviewindex.org.uk/isj71/harman.htm

Moseley, F (2012), "A Critique of the Marginal Productivity Theory of the Price of Capital", *real-world economics review*, 59, pp.131-137.

Sraffa, P (1960), *Production of Commodities by Means of Commodities*. Cambridge: Cambridge University Press.

Author contact: roygrieve@btinternet.com

SUGGESTED CITATION:
Roy Grieve, "More on why we should bury the neoclassical theory of the return on capital: a supplementary note", *real-world economics review*, issue no. 61, 26 September 2012, pp. 137-146,
http://www.paecon.net/PAEReview/issue61/Grieve61.pdf

You may post and read comments on this paper at http://rwer.wordpress.com/2012/09/26/rwer-issue-61

WEA 3-year plan