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Income Distribution in a Monetary Economy: A Ricardo-Keynes Synthesis

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ABSTRACT

The paper provides a novel theory of income distribution and achieves an integration of monetary and value theories along Ricardian lines, extended to a monetary production economy as understood by Keynes. In a monetary economy, capital is a fund that must be maintained. This idea is captured in the circuit of capital as first defined by Marx. We introduce the circuit of fixed capital; this circuit is closed when the present value of prospective returns from employing it is equal to its supply price. In a steady-growth equilibrium with nominal wages and interest rates given, the equation that closes the circuit of fixed capital can be solved for prices, implying a definitive income distribution. Accordingly, the imputation for fixed capital costs is equivalent to that of a money contract of equal length, which is the payment per period that will repay the cost of the fixed asset, together with interest. It follows that if capital assets remain in use for a period longer than is required to amortize them, their earnings beyond that period have an element of pure rent.

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INCOME DISTRIBUTION IN A MONETARY ECONOMY: A RICARDO-KEYNES SYNTHESIS

Income is distributed through the price system and there are basically two broad approaches to price determination. The neoclassical model determines prices as the solution to market clearing equilibrium conditions and the distribution of income is just a by product of this determination. The classical tradition on the other hand, starts with a given distribution of income (the subsistence real wage rate in Ricardo, the rate of profit in Sraffa for example) and solves for the price structure that distributes income according to the stipulated distribution in all lines of production. Post Keynesian approaches to income distribution are in the classical tradition and for our purposes two broad strands can be identified.[1] The Kaldorian approach reverses the causality of Ricardo's dual theory of distribution and growth, and makes investment the determinant of income distribution (Kaldor 1956). The neo-Ricardian approach associated with the work of Pivetti (1985), and also Panico (1985), provides a closing equation for the Sraffian system by setting a direct link between the real rate of interest and the profit rate.

Reformulating the Ricardian model with the aid of "Keynesian apparatus of thought" (Kaldor 1956) has been an indispensible source of inspiration for generations of post Keynesian economists. The Kaldorian approach is aptly described by J. Robinson:

> Whatever the ratio of net investment to the value of the stock capital may be, the level of prices must be such as to make the distribution of income such that net saving per unit of value of capital is equal to it. Thus, given the propensity to save from each type of income (the thriftiness conditions) the rate of profit is determined by the rate of accumulation of capital" (Robinson 1962, p. 11.)

Our starting point is to note that this approach misses important aspects of both the Ricardian and the Keynesian theory. In the Ricardian model income is distributed at the margin where no rents are earned. In the above quotation the phrase "net saving per unit of value of capital" means, on the other hand, that saving out of all non-wage income is involved. The appropriate extension of the Ricardian idea to the Keynesian world should refer to the "marginal plot of capital" or newly installed capital through aggregate investment. It turns out that, and this brings us to the neglected aspect on the Keynesian side, once proper

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[1] Lavoie (1995) provides a very useful summary of various post Keynesian approaches.

consideration is given to the monetary nature of the economy, the determination of the distribution of income at the margin suggests itself naturally.

The total neglect of the monetary nature of capitalist economies is a feature shared by all approaches to distribution theory.[2] Keynesian theory is firmly established around a theory of money and monetary production. Monetary economy is a contractual economy that uses money as the means of contractual settlement. In the words of Davidson (1980 p. 297) "Money is that thing which … permits agents to discharge obligations that are the result of spot and forward contracts. Thus … (1) money is the means of contractual settlement. Money is also (2) capable of serving as an instrument to transport generalized (nonspecific) purchasing power over time …" A non-trivial implication of this is that a monetary economy is a nominal economy. All dealings are in money and parties only observe nominal magnitudes so that income is distributed through a nominal price system. The task of a monetary theory of distribution is thus to determine nominal prices. A set of nominal prices implies a specific pattern of income distribution as a result of the stickiness of fundamental nominal contracts, namely wage and financial contracts, which Keynes believed to be an essential property of money as clearly explained in Lerner (1952 p. 188) and also Brenner (1980). It is noteworthy that in Ricardo's non-monetary world the real wage rate is given, and in Keynes's monetary world the nominal wage rate is given. In the Ricardian model profits are residually determined at the margin. Likewise in our approach the price level will be determined at the margin, in a specific sense to be explained below, given the money wage rate (and the nominal interest rates) implying a real wage rate and the associated income distribution. The proposed approach thus differs in an essential way from all other strands of the classical kind, which having determined a rate of profit go on to calculate the level of prices given the money wage rate.

The most crucial aspect of a monetary economy that motivates the proposed approach is the notion that capital is money. As D. Dillard notes:

> Monetary production means producing and realizing money values. … The task of monetary theory of production is to conceptualize a process that begins with money capital, which is used to purchase materials, capital equipment, and labor; these factors are converted into a product, which is offered for sale; …. Its *(the theory's)* concern is with money as capital and not with money as a medium of exchange. Dillard (1987 p. 1624-1625) (Bracket added)

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[2] As far as the post Keynesian monetary theory and post Keynesian theories of distribution are concerned, there is an obvious lack of integration between the two other than bringing in an exogenously determined interest rate as in various models explored by Lavoie (1995).

This statement has its roots in Marx's famous M – C… [P] …C′ – M′ circuit in which M covers "materials and labor" and other variable expenditures including depreciation.[3] Expenditure on capital equipment or fixed capital on the other hand, clearly has a different dimension and has to be considered in a separate circuit. The circuit of fixed capital starts with the purchase of a capital asset which is then operated through over a period of time and gives rise to a particularly acute valuation problem:

> The use of land, being regarded as a permanency, could be brought in as a regular charge; but the plant and machinery is not expected to last indefinitely, though its use is spread over a time which is longer than the accounting period. … The cost of the machine has to be set against a series of sales, the sales of the outputs to which it contributes, but some of these sales are sales of the present year, some are later and some, maybe, earlier. There is thus a problem of imputation; how much is to be reckoned into the costs of this year, and how much into the costs of other years? It is just the same problem as the allocation of overheads, and to that, as is now well known, there is no firm economic solution. (Hicks 1974, p. 312).

How this imputation problem is addressed determines the distinctive characteristic of a theory of distribution. The central proposition of this paper is that in the absence of uncertainty money and money as capital become indistinguishable and no useful distinction can be drawn between profit and interest. The basis for this point is developed in the next section. The starting point is that the circuits of capital must be closed. The circuit of fixed capital is closed when the sum of money used to purchase the capital goods is recovered with an appropriate rate of return in a present value sense. This gives rise to what we call the amortization equation. The imputation for fixed capital is implicit in the solution of the amortization equation. In Section 2 a simplified one sector model is used to illustrate how the amortization equation may be solved for the price level given the money wage rate and the interest rate structure. Section 3 extends the approach to a simplified two sector model and the "moneyness" of capital becomes clearer. A final section concludes.

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[3] Keynes has also made explicit use of Marx's circuit. He is reported to write: "… C–M–C, i.e. of exchanging commodity (or effort) for money in order to obtain another commodity (or effort). That may be the standpoint of the private consumer. But it is not the attitude of business, which is a case of M–C–M, i.e. of parting with money for commodity (or effort) in order to obtain more money." (Quoted in Bertocco (2005 p. 494 (note 4).) See, also, Dillard (1984), Dillard (1987) and Aoki (2001) for accounts of Keynes' views on Marx and the common threads in their analysis of the monetary nature of capitalist production.

1. Money as Capital

In the already mentioned characteristically clear paper Sir J. Hicks distinguishes between what he calls "Fundist" and "Materialist" conceptions of capital. Accordingly Classical economists were Fundists.

> Classical economics was three-factor economics, and we can now see that the triad had deeper roots than is commonly supposed. Labor is a flow, land is a stock (as stock and flow are used in modern economics); but capital is neither stock nor flow–it is a Fund. Each of the three factors has its own attribute, applicable to itself but to neither of the others. <u>Labor works on land through capital, not on capital nor with capital.</u> The place of each of the factors in the productive process is sharply distinguished. (Hicks 1974 p. 311, underlining added).

It is clear that the only way in which capital can be comprehended as a "fund" is to comprehend it in terms of the general equivalent or money (Foley 1986, p. 18-20). Capital can remain as a fund which is neither flow nor stock but can put labor to work only in the form of money. Now, inherent in the idea of a fund is the property that it must be maintained to be available over and again. It is this nature of capital that the circuits of capital capture.

In the basic $M - C \ldots [P] \ldots C' - M'$ circuit, production starts with money (M) to obtain commodities (C) that go through the production process [P] to become a different set of commodities (C′), which are then sold for more money (M′), and that is how the capitalist sees it, i.e. $M \rightarrow M'$. In other words, the basic circuit is closed when the initial amount advanced returns together with a profit and so the fund is maintained. With proper reckoning of what constitutes cost, the difference $(M' - M)$ is the gross income (non-wage value added) that capitalists derive from the circuit. In careful analysis of Marx's account "constant capital" (C) is understood to be including "... depreciation on fixed capital ... *(and)*... raw materials and other rapidly used inputs to production..." (Foley 1986, p. 45: bracket added) and so should not be confused with long–lived plant and equipment namely fixed capital.

In a monetary economy there is always another circuit of money, namely the direct circuit

$$M - (1 + i)M,$$

i being the period interest rate. If there is no uncertainty associated with realizing M′ at the end of the production cycle, the two circuits must be perfect substitutes so that we must have

$$i + npe = M'/M - 1$$

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as argued by Pivetti (1985), npe being the normal profit of enterprise or "risk and trouble" of productively employing capital (Pivetti 1985, p. 87). Here "risk and trouble" must refer to factors other than the fundamental or irreducible uncertainty (Davidson 1972) concerning the realization of M′. Under the assumed conditions the interest rate and the rate of profit must be identical up to an accepted margin for the additional toil involved in productive activity because any other difference would be competed away.

Investment in fixed capital, or money tied up in capital equipment, has its own peculiar circuit. A capital asset gives the purchaser "… the right to the series of prospective returns, which he expects to obtain from selling its output, after deducting the running expenses of obtaining that output, during the life of the asset." (Keynes 1973 p. 135) The implied circuit of fixed capital is illustrated in Figure 1 as a cash flow diagram. A monetary outlay of M_K for a fixed asset is made and the asset yields a cash flow of π_t in each period over τ periods. Each cash flow is generated through the relevant basic circuit so that $\pi_t = M_t'$ $- M_t$ in each period. In other words, the circuit of fixed capital consists of a number of basic circuits; with the proviso that M should mean "running expenses of obtaining" the output produced by newly acquired capital asset in each period.
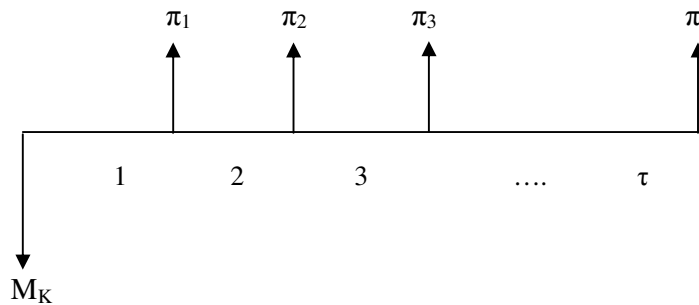

Figure 1. The circuit of fixed capital, $\pi_t = M_t' - M_t$.

The circuit of fixed capital is closed and the fund is maintained when the capital invested is amortized in the sense that it is recovered together with appropriate profit, obviously, in present value terms. The equation that closes the circuit will thus be called the amortization equation. Keynes himself used this closure to define the marginal efficiency of capital as the internal rate of return of the cash flow of Figure 1 with the understanding that M_K is the supply price of capital, that is "…the price which would just induce a manufacturer newly to produce an additional unit of such assets…" (Keynes 1973, p. 135.) In comparison with the interest rate "ascertained from some other source," (ibid. p. 137) the marginal efficiency

was meant to furnish the basis of a theory of investment demand. But while this procedure would make sense for a "price taking" firm taken in isolation, it entails a logical inconsistency in the aggregate as recognized long ago:

> The internal rate of return depends upon present and future prices; present prices reflect future use values through the market place's discounting process, which depends upon the rate of interest. As the interest rate changes, the structure of prices changes, especially the ratio of present prices to future prices. This in turn will affect the internal rate of return. ... In a nutshell, we cannot in full logical consistency draw up a demand curve for investment by varying only the rate of interest (holding all other prices in the impound of ceteris paribus). (Alchian 1955, p. 942)

This circularity argument is conceptually similar to that put forward by Sraffa in the context of a general critique of marginalist approach regarding the interest rate and the determination of the value of capital. The value of capital depends on the interest rate, and therefore cannot be used to determine the interest rate. Likewise the amortization equation cannot be used to determine an internal rate of return to be later compared to the interest rate, given that the prices of commodities including the supply price of capital depend on the interest rate. However, the amortization equation(s) can be solved for the level of price(s) (including the supply price(s) of capital goods) given an interest rate structure and this is the essence of the approach proposed here. The amortization equation(s) will be solved at the margin where capital earns no rent. Here the marginal capital is not the "last unit" of capital employed as in the marginalist theory, but in analogy with Ricardo's marginal plot of land,[4] it is the last "plot" of capital that comes under utilization, namely the capital that becomes available through aggregate investment. The no rent condition is imposed by the nature of the closure of the circuit whereby the discounted sum of "prospective yields" is just enough to cover the supply price of capital together with appropriate interest.

The direct circuit of money comparable to the circuit of fixed capital involves lending out the sum M_K against τ equal payments so that the present value of the payment series at an appropriate discount rate is equal to the initial sum. That is, the direct circuit is closed when the initial sum is recovered together with a rate of return equal to the discount rate. The required equal payment must be so determined as to make this possible. In the case of fixed capital the payment series is the cash flow (π_t) from operating activities and depends on prices. In the absence of any uncertainty associated with the realization of the circuit of

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[4] See Pasinetti (1960).

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fixed capital the two circuits must again be identical. This means that the implicit imputation for fixed capital in solving the amortization equation for prices must be the capital recovery cost defined as the payment per period that will repay the cost of the fixed asset over τ periods and provide the necessary rate of return on the investment.

2. A One Sector Model

The economy produces a malleable good using labor (L) and capital (K) according to

$$Q = K/\sigma = L/\lambda, \quad \sigma, \lambda > 0, \tag{1}$$

it being understood that $L = \lambda K/\sigma$.[5] The economy is in a steady growth equilibrium with investment (I) being a constant fraction (α) of output, $I = \alpha Q$.[6] In addition perfect foresight is assumed so that all future prices are expected to remain equal to current prices. All future quantities are known along the growth path and there is no uncertainty in this respect. As a result "prospective returns" from investment are known and are realized as expected. Investment has a gestation period of one year, and that it takes τ years to amortize newly acquired capital assets. Here "τ" is not necessarily the "life" of the asset, but is another variable "ascertained from some other source" that will be seen to be crucial in the determination of prices and the distribution of income. Finally, the money wage rate (w) and short and long term nominal interest rates are all assumed to be given.

The only "movement" in this economy is at the margin where capitalists invest an amount of money pI (p being the current and expected future prices of output) in capital assets in exchange for a prospective return of $\pi = pI/\sigma - (1 + i)w\lambda I/\sigma$ in each period "which they expect to obtain from selling its output ($M' = pI/\sigma$), after deducting the running expenses ($M = (1 + i)w\lambda I/\sigma$) of obtaining that output." The wage cost per unit of output is $w\lambda$ and $(1 + i)w\lambda$ is the cost of labor inclusive of the (opportunity) cost of money tied up in the wage bill over a single period. The rate "i" is the period or the short term nominal interest

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[5] To assume such a "production function" is perfectly consistent with the Fundist perspective: "… the rethinking of capital theory and of growth theory, which followed from Keynes, and from Harrod on Keynes, led to a revival of Fundism. If the Production Function is a hallmark of Materialism, the capital-output ratio is a hallmark of modern Fundism." (Hicks 1974, p. 309).

[6] This means that the economy is growing at the rate $g = \alpha/\sigma - d$, d being the rate of depreciation of the capital stock; and that α happens to be equal to the propensity to save. We shall ignore time subscripts so long as there is no danger of confusion.

rate and is the cost of money as capital in the basic circuit.[7] There is no depreciation charge as part of the cost in the present formulation. We should only recognize as cost any actual depreciation of capital that results in a fall in the average capital productivity (σ) during the amortization period. We can do this either by using the appropriate productivity coefficient (σ_i, $i = 1 \ldots \tau$) in each period; or by adding the actual cash expenses required to maintain the productivity of capital constant. Any other depreciation charge would result in "double amortization," as we are set out to find the price that would amortize the sum invested in newly produced and installed capital goods. As we are here assuming that the average capital productivity of newly installed equipment remains constant during the amortization period, there is no depreciation cost to be included in M.

 With this information the amortization equation is:

$$pI = \sum_{j=1}^{\tau} \frac{pI/\sigma - (1+i)w\lambda I/\sigma}{(1+i_n^*)^j}. \tag{2}$$

Here i_n^* is the nominal rate of discount, or the long term nominal interest rate plus any necessary provision for the normal rate of profit of enterprise, again assumed to be given. The only unknown in this equation is the price of output and we get:

$$p\sigma = [p - (1+i)w\lambda]PV(i^*, \tau), \tag{3}$$

$$\text{where } PV(i^*, \tau) = \sum_{j=1}^{\tau} \frac{1}{(1+i^*)^j} \tag{4}$$

is the present value factor corresponding to a particular real discount rate (i^*) and amortization period.[8] We see that for (3) to yield a positive solution for the price the condition

$$PV(i^*, \tau) > \sigma \tag{5}$$

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[7] This idea can be traced back to Marx, who considered it as the secondary distribution of the surplus between money-capitalists and the industrial capitalists, as explored in Panico (1980 p. 365-366).

[8] Suppose there is a constant steady state rate of inflation (inf) so that $p_t = p(1 + inf)^t$, $w_t = w(1 + inf)^t$. When p and w are factored out, we are left with the $(1 + inf)^t/(1 + i_n^*)^t = 1/(1 + i^*)^t$ term inside the summation given that $1 + i^* = (1 + i_n^*)/(1 + inf)$.

must be satisfied.[9] We can then define

$$r = \frac{1}{PV(i^*, \tau)} \tag{6}$$

and rearrange (3) as:

$$p = (1 + i)w\lambda + rp\sigma. \tag{7}$$

Note first that this can be solved directly for the price in nominal terms as $p = (1 + i)w\lambda/(1 - r\sigma)$, which is well defined since (5) means $(1 - r\sigma) > 0$. The right hand side of (7) has the same form as the standard (in the sense of being cost minimizing) unit cost function associated with the fixed coefficient production function, given the nominal wage rate and "r" as in (6), with the added feature of an short-term interest charge on working capital. The rp term would normally be identified as the rental rate of capital. On this interpretation $rp\sigma$ is per unit profit and so "r" is the rate of profit because the $p\sigma$ is the value of per unit capital requirement. This interpretation, while acceptable, may be misleading in some instances as will appear below. It is better to think of "r" as the capital recovery cost per unit of capital. Along the growth path with perfect foresight and no uncertainty relating to realizing the sales revenue from new investment, the circuit of fixed capital and direct circuit of money must be identical. It follows that a dollar of capital in either circuit is earning just i_n^*pI in each period, sufficient provision having been made for the normal profit of enterprise.[10] This point will prove to be crucial in the two sector extension of the model in the next section.

It is interesting to note that the capital recovery cost (profit) rate is distinct from the real rate of interest. In particular a positive capital recovery cost rate does not require a positive interest rate structure, since with $i^* = i = 0$, we have $PV(0, \tau) = \tau$ and $r = 1/\tau$. In this case "r" recovers the capital invested in equal installments without any rate of return. The rate "r" is readily seen to be independent of the short term interest rate, increasing in the real rate i^* and decreasing in τ. Thus, the higher must be the capital recovery cost, the shorter is the amortization period and the higher is the real discount rate. As for the price level, it is clear

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[9] Rearranging (3) we have $(1 + i)w\lambda PV = p(PV - \sigma) > 0$, the left-hand side being positive.

[10] The capital recovery cost in the direct circuit of money is calculated as $A = pI/PV(i_n^*, \tau)$, given the interest rate i_n^*. In our case $A = \pi = pI/\sigma - (1 + i)w\lambda I/\sigma$ so that $p = (1 + i)w\lambda + A/(I/\sigma) =$ per unit wage cost + per unit capital recovery cost $= (1 + i)w\lambda + p\sigma/PV(i_n^*, \tau)$ as in the text. After the first payment an amount $A - i_n^*pI$ of the initial sum is recovered. Over the next period the investor can earn $i_n^*(A - i_n^*pI)$ on the recovered sum and will earn $i_n^*[(pI - (A - i_n^*pI)]$ on the remaining balance the total being i_n^*pI and this is true in each period.

that it is increasing in w, i and i*, and is decreasing in τ. While these are valid inferences in the strictest sense of comparative statics, it is altogether a different matter to set out clearly the transitional dynamics of how an economy may settle in the final equilibrium after a change. Under plausible scenarios the actual outcome may be quite different from that indicated by the ceteris paribus comparative static results. Pursuing these issues any further is beyond the scope of this paper. Nevertheless, it has to be pointed out that the course of nominal wages contracts in response to increases in interest rates or the possible interaction between short and long term interest rates may render the ceteris paribus results practically meaningless.

Returning to income distribution implications of equation (7) we can write:

$$1/\lambda = v(1 + i) + rk. \hspace{4cm} (8)$$

Here $v = w/p$ is the real wage rate and $k = \sigma/\lambda$ = capital per worker. This equation shows the distribution of output per worker between competing claims. The two terms correspond to the two circuits of capital. The $(1 + i)v$ term is what is recovered in the per unit basic circuit together with appropriate interest. The second, on the other hand, is the capital recovery cost and represents the per unit imputation to cover fixed capital cost per period. This brings us to the novel feature of the present formulation. When output produced with capital that has already been amortized and has a useful life longer than the amortization period is valued at this price, the (rk) component yields pure rent. Thus the rate "r" becomes the "rate of rent" when the amortized stock of capital is considered as shown in Figure 2.
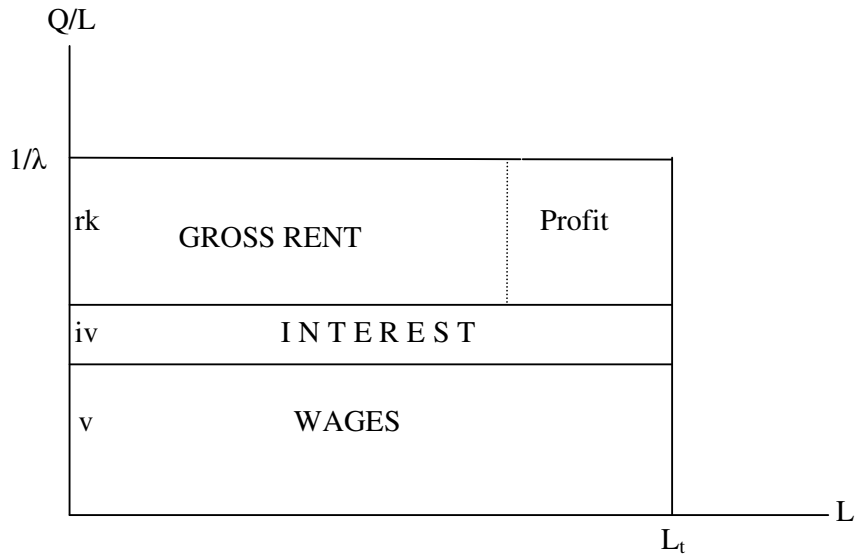
Figure 2: Distribution of Income

In the figure the productivity of labor is assumed to be the same on both new and old capital assets. The area (GROSS RENT + Profit) is given by $rkL_t = rK_t$. The residual area denoted by GROSS RENT corresponds to the income accruing to the capital stock that has already been amortized. Therefore, the part of it that cannot be assigned to a cost of producing output is rent proper. Depreciation in the national income accounting sense and manufacturing overhead costs are obvious candidates for items to be accounted as cost to be covered in gross rent. There must also be an allowance for non-manufacturing or "administrative overhead" costs, excluding any "bonus" payments in cash or in kind.[11] Thus unless all of it can be assigned to production related costs, there is a pure rent component in Gross Rent, and in Keynes' words (see below) these assets "… yield during their lives services having an aggregate value greater than their initial supply price ...". Clearly the existence of rent depends on the length of the amortization period relative to the useful life of capital goods. Since investments that have a shorter life than a viable amortization period would never be undertaken, the amortization period can either be equal to or shorter than the life of a capital asset. If the two are equal, the asset is discarded as soon as it is amortized and so cannot earn any rent. This is possible for some capital goods in certain industries. But this cannot be a general state of affairs as we do observe vintages of the same type of capital equipment be-

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[11] Such payments may be seen as taking share in rents. There is some ambiguity as to how to ascertain relevant administrative overhead costs to be included as cost of producing output.

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ing "profitably" employed at the same time.[12] The current model suggests that what appears to be "profitable" in the case of older capital assets is in fact a reflection of their rent earning potential. In fact the price of an older fixed asset is simply the present value of its rent earning potential. A newly produced asset has a supply price and the price of output that can be produced with it is so determined as to amortize the asset leading to a definite income distribution. An older asset has no supply price and the price of output that can be produced with it having been determined at the margin, the price of the asset accommodates to its earning potential. In this way in equilibrium a dollar invested in a fixed asset of any age and money has the same rate of return, provisions having been made for the normal profit of capital assets.

Finally, we show how gross rent is related to model parameters. In any period investment undertaken in the previous τ periods is being amortized and each "shot" of investment is earning $\pi_{-j} = rpI_{-j}$ ($j = 1, 2, \ldots, \tau$) per period.[13] But because $I_{-j} = \alpha Q_{-j}$ and output is growing at the constant rate g, we can write

$$\pi_{-j} = rp\alpha Q_{-j} = \frac{rp\alpha Q_t}{(1+g)^j},$$

so that total current nominal profit in terms of current output is given by:

$$\Pi_t = \sum_1^\tau \pi_{-j} = rp\alpha Q_t \sum_1^\tau \frac{1}{(1+g)^j} = \alpha\psi pQ_t = \psi I_t, \tag{9}$$

where $\psi = \sum_1^\tau \frac{(1+i^*)^j}{(1+g)^j}$, in view of (6). This says that total (nominal) profits is just proportional to current (nominal) investment (αpQ_t), the factor of proportionality (ψ) being the ratio of the two present value factors. In other words, the pricing rule implies a modified version of the usual maxim which can be stated as "what capitalists earn as profits is proportional to

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[12] According to Godden (2001) the simple payback period is common as an investment appraisal method in the British industry, especially among smaller firms, at least as one of the methods that firms use in conjunction with discount methods. The average payback period turns out to be 2.7 years in 1994 and 3.6 years in 2001 for the firms included in the sample of the surveys conducted by the Confederation of British Industry. A small number of firms (less than 5% of the sample in 2001) report 10-11 years of payback period. Thus the payback period seems to depend on the type of industry. If payback period is a rough guide to the parameter "τ", then it appears that the amortization period is not very long.

[13] $\pi_{-j} = pI_{-j}/\sigma - (1 + i)w\lambda I_{-j}/\sigma = I_{-j}/\sigma(p - (1 + i)\ w\lambda) = (I_{-j}/\sigma)rp\sigma$, in view of (7).

what they spend as investment." It will be recognized however that in the Kaleckian "macroeconomic" theory of distribution (Asimakopulos 1975, p. 321-onwards) profits refer to total non-wage income, while here it is only part of it. The share of profits in income is given by $\Pi_t/pQ_t = \alpha\psi$. It follows that

$$GR = rK_t - \psi I_t, \tag{10}$$

so that the share of gross rent in income is $r\sigma - \alpha\psi$. It is shown in Appendix 1 that for reasonable parameter values the share of profits is positively related to α. As a result the share of gross rent in income would be lower with a higher rate of investment in proportion to output.

3. A Two Sector Model

We now briefly consider a two sector extension of the model to illustrate how the solution based on closing the circuit of fixed capital may be applied in general. There are two sectors producing consumption (C) and investment goods (I). Production functions are given by $Q_z = K_z/\sigma_z = L_z/\lambda_z$, $z = C, I$. We assume as before that along the growth path newly invested capital in each sector is expected to be and is fully utilized. Allowing for differences in the amortization periods in the two industries the amortization equations are:

$$p_I I_C = \sum_{j=1}^{\tau_C} \frac{p_C I_C/\sigma_C - (1+i)w\lambda_C I_C/\sigma_C}{(1+i_n^*)^j}$$

$$p_I I_I = \sum_{j=1}^{\tau_I} \frac{p_I I_I/\sigma_I - (1+i)w\lambda_I I_I/\sigma_I}{(1+i_n^*)^j}. \tag{11}$$

From these we obtain in the same way as we did in deriving (7), the following price equations in each industry:

$$p_c = (1+i)w\lambda_c + r_c p_I \sigma_c \tag{12}$$

$$p_I = (1+i)w\lambda_I + r_I p_I \sigma_I \tag{13}$$

where $r_z = 1/PV_z(i^*, \tau_z)$ and $PV_z(i^*, \tau_z) = \sum_{j=1}^{\tau_z} \dfrac{1}{(1+i^*)^j} =$ present value factor in the industry z

$= C, I$. These nominal prices at which incremental capitals in the respective industry are amortized are fully determined for a given constellation of the parameters $(w, i, i^*, \tau_c, \tau_I)$. As the focus of the paper is to establish the general nature of the approach we shall not pursue the solution any more than that provided in Appendix 2. With these prices new investment in each industry has the same marginal efficiency and the monetary equilibrium condition implicit in the Chapter 17 of the General Theory is satisfied (see Panico 1985).

We now see that if "r" is interpreted to be the rate of profit, equations (12) and (13) cannot be equilibrium relations given that profit rates are not equalized across industries. However, equations (12) and (13) are equilibrium relations in the sense that if they hold, there is nothing to be gained by shifting capital from one industry to the other. When equations (12) and (13) are satisfied a dollar invested in either industry is just earning i_n^* and it makes no difference if the money invested in one sector is recovered earlier. Because a dollar can only earn i_n^* whether it is recovered or it's in the process of being recovered (see note 10) so long as there is no uncertainty associated with realization of $rp\sigma$ in the respective industry, as we assuming throughout. If uncertainty becomes an issue, liquidity preference may change in favor of money, pushing the system out of equilibrium as the identity between the two circuits of money no longer holds. But that is a concern of a theory of investment and income determination and not that of a theory of long run theory of income distribution where a state of tranquility is assumed.

4. Conclusions

The main result of this paper may be neatly summarized by rephrasing Robinson: "Whatever the ratio of net investment to the value of the stock capital may be, the level of prices must be such as to make the distribution of income such that the present value of the flow of net profits per unit of value of newly invested capital is equal to it." This and any other result in this paper, in turn, ultimately depends on the idea that in a monetary economy money and capital are perfect substitutes in the absence of uncertainty. This is because capital as a fund can exist only as money and this gives rise to two circuits: the direct circuit of money and the circuit of money as capital. If there is no uncertainty regarding the closure of the circuits, equilibrium will obtain only when nothing can be gained by shifting a dollar from the direct circuit to the other. It follows that the imputation for fixed capital must be the capital recov-

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ery cost as obtained from the direct circuit of money adjusted for the normal rate of profit. Capital recovery cost cannot in general be the same across industries because the component of it that accounts for recovering the capital is in general different given different amortization periods. But in equilibrium when all circuits are identical to the direct circuit of money marginal efficiencies of all assets are equal adjusted for differences in normal rates of profit and there is no incentive to shift capital in and out of any sector.

Money as an investment fund is truly the Widow's Cruse of modern times. Prices are so determined as to replenish the cruse over a time period that is characteristically shorter than the useful life of the capital assets that the fund is used to purchase. The modern Widow's Cruse is thus more miraculous in that having been fully recovered together with the appropriate reward, it can go onto repeat the cycle and thus maintain the growth of the economy, while at the same time the capital assets that were amortized in the process of replenishing it, accumulate in the form of a rent earning stock of specific capital assets. Moreover, as Keynes has shown, money as an investment fund determines the rate at which the accumulated stock can be utilized through the multiplier. This is truly a fantastic yet fragile process because in its other role money itself may become the "object of desire" (Keynes 1973 p. 235) and be hoarded. In this case the magic breaks down, the cruse fails to be replenished in full and a slower pace of economic activity is imposed on the economy.

Appendix 1:

The share of profits in income is $\Pi_t/pQ_t = \alpha\psi = \alpha r \sum_1^\tau \dfrac{1}{(1+g)^j}$. It is seen that an increase in α has conflicting effects on the share of profits, because ψ falls as the growth rate increases with α. Differentiating $\alpha\psi$ with respect to α we get:

$$d(\alpha\psi)/d\alpha = \psi + \alpha r \sum_1^\tau \frac{-j(1+g)^{j-1}g'}{(1+g)^{2j}} = \psi - \alpha rg' \sum_1^\tau \frac{j}{(1+g)^{j+1}}$$

$$= r \sum_1^\tau \frac{1}{(1+g)^j} - \frac{r(g+d)}{1+g} \sum_1^\tau \frac{j}{(1+g)^j}.$$

The last equality follows from observing that $g = \alpha/\sigma - d$, so that $g' = 1/\sigma$ and $\alpha g' = g + d$, d being the rate of depreciation. Clearly if τ is large enough, this expression can be negative. For example, with $g = 5\%$ and $d = 2\%$, the expression is negative for $\tau = 44$. Thus, it is safe to consider the effect to be positive for the range of values of τ as suggested in footnote 9.

Appendix 2:

From (13) we get

$$p_I = \frac{(1+i)\lambda_I}{1 - r_I \sigma_I} w$$

which is meaningful so long as the denominator is positive as in the one sector model. Using this in (12) we can solve for p_C in nominal terms as:

$$p_C = (1+i)w(\lambda_C + \frac{r_C \sigma_C}{1 - r_I \sigma_I}\lambda_I)$$

This implies the following expression for the real wage rate in terms of the consumption good:

$$w/p_C = \frac{1}{(1+i)(\lambda_C + \frac{r_C \sigma_C}{1 - r_I \sigma_I}\lambda_I)}$$

This means that the short term interest rate, the usual tool of monetary policy, has a potential to put downward pressure on the real wage. From this we can solve for the relative price p_I/p_C as:

$$p_I/p_C = \frac{\lambda_I}{1 - r_I \sigma_I} \frac{1}{(\lambda_C + \frac{r_C \sigma_C}{1 - r_I \sigma_I}\lambda_I)} = \frac{1}{\frac{\lambda_C}{\lambda_I} + r_C k_C - r_I k_I}$$

where $r_C k_C = r_C \sigma_C/\lambda_C$ and $r_I k_I = r_I \sigma_I/\lambda_I$. It follows, for example, that $p_I/p_C = \lambda_I/\lambda_C$, iff the capital recovery cost is the same in both industries. Note moreover that the relative price is independent of the short term interest rate.

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