Godley and Graziani: Stock-Flow-Consistent Monetary Circuits

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Abstract
In this paper we discuss some issues in the Monetary Theory of Production à la Graziani, such as the "paradox of profits", in the light of the stock-flow-consistent approach pioneered by Wynne Godley, to resolve some apparent inconsistencies and show the common features of the two post-Keynesian approaches.

Keywords: monetary theory of production, circuit theory, stock-flow-consistency, Godley, Graziani

Jel-codes: E12, E44, E52, B50

Introduction and motivation

As a student of Augusto Graziani, I learned about the *Monetary Theory of Production* back in his lectures in 1984. At the time, many researchers in the Department of Economics in Napoli were involved in developing this line of research, under the strong influence of Graziani. I clearly remember some of the puzzles in a monetary circuit that Graziani showed us with very simple models. The simplest puzzle refers to a very simple economy, where firms need to borrow before production takes place, to pay for wages and other production costs. Banks are eager to provide loans, say in the form of overdraft deposit accounts: Graziani clearly showed us how loans create deposits, and not the other way round as mainstream scholars were teaching us, since the loan comes to existence only when firms actually use their overdraft facility to pay wages, say, which we can assume that are immediately deposited in a bank. Any loan generates a deposit somewhere – possibly in the same bank - for the same amount, unless wage earners choose to keep their income in cash form. When a loan is made, money is created, and when the loan is paid back, as firms sell their goods to wage earners, money gets destroyed. The puzzle arises if firms have to pay interest on the loan: in the best case scenario, where firms have recovered from sales all the money paid out in wages, and the initial amount of newly created money gets entirely destroyed, where do firms get

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the cash to pay for interest? And how can they possibly get a monetary profit?

Graziani's lectures were fascinating, but the existence of unresolved puzzles in the theory led me to pursue other avenues of research. Graziani encouraged me to visit Cambridge, and I went to introduce myself to the Head of the Department of Applied Economics, Wynne Godley, who had accepted my application for visiting scholar. On our very first meeting, in 1986, Wynne proposed that we wrote a model using Italian economic data, and that marked the beginning of a long period of collaboration in the U.K. first, Denmark and the Levy Economics Institute in the U.S. later.

I did not follow the evolution of Graziani's Theory of Monetary Profit[1] in great detail until much later, in 2003, when I was asked to discuss a contribution by Louis-Philip Rochon at a conference in honour of Augusto Graziani in Benevento, Italy, on "The Monetary Theory of Production"[2]. Reading Rochon's contribution, I realized that (at least some) *circuitists* knew little about Godley's stock-flow-consistent methodology, which could provide a robust accounting framework for their models, while showing that some of the "puzzles", as the one described above, are only apparent.

Zezza (2004) was an attempt to contribute to the *circuitists*' debate, but I failed to make my point clear enough, and the debate on the *cicuitists* "puzzles" continued. In this chapter I revise my early paper, trying again to show how Godley's approach can provide additional rigour to Graziani's analysis, and pay homage to my two mentors.

More in detail, following Lavoie (2004), and Godley – Lavoie (2007) we investigate the implications for TMC models of laying down the corresponding set of stock-flow accounting, which must imply that every monetary flow comes from somewhere and goes somewhere, so that there are no "black holes"[3]. As the accounting is analysed, it appears that several, if not all, contributors to the TMC fail to take properly into account how banks' profits can be spent in the goods or the financial markets: in several models, interest payments on loans made from firms to banks are not accounted as part of national income, and simply disappear, instead of being treated as a possible source of demand for goods and/or financial assets. By ignoring the accounting and behavioural implications of interest payments, TMC models are usually characterized by a "Paradox of profits": in a pure credit economy and considering a single production period, if firms receive an initial loan M to cover for their current expenditure, by selling goods and financial assets they can at most recover the amount of money M being injected into the economy at the beginning of the period. Firms can therefore pay back the principal to banks at the end of the period, but will

1 See Graziani (2003).
2 Proceedings are in Fontana and Realfonzo (2005). Arena and Salvadori (2004) is the volume of the proceedings from a previous conference in honour of Graziani.
3 Godley (1996).

not possibly have enough liquidity to pay for interests, unless (a) they pay interest in kind, or (b) at the end of the production period they remain indebted with banks, by an amount equal to interest payments. In our view, this result depends on interest payments disappearing from income or stock-flow accounting, and we will show how simple TMC models can be made consistent on this respect. In our approach, the TMC will also be reconciled with the Godley and Cripps (1983) approach, which laid the foundation for Godley's developments in stock-flow consistent modelling in the post-Keynesian tradition.

In section 1 we present the simplest possible model of the Monetary Circuit, to recall the major hypothesis and results for this approach, and we show in section 2 how to modify the approach in the literature to deal with interest payments. In section 3 we discuss implications of our approach, and compare our simple TMC model with consistent stock-flow models *a la* Godley. In section 4 we extend the model to an economy with two productive sectors, laying down the "paradox of profits" in greater detail. Section 5 summarizes and concludes.

1. The simplest traditional monetary circuit

Let us consider the simplest possible model of the TMC, namely that of a single production period in a pure credit economy with no government[4]. Only a single good is produced, which is used for both consumption and investment.

At the heart of the TMC is the notion, shared by Godley[5], that production requires time, and that costs of production have to be paid before receipts from sales can be obtained. Monetary wages must therefore be paid in advance, and this requires firms to have enough liquidity before production occurs. Firms as a whole need to obtain an initial loan (L_0), equal to the wage bill (W):

$$L_0 = W \qquad (1$$

Money, in the form of bank deposits, is created[6] as soon as firms pay wage earners.

When production is complete, wage earners may either buy consumption goods (C), or save, increasing their stock of financial assets (V). The budget constraint of households is thus

$$W = C + \Delta V \qquad (2$$

4 See Graziani (2003) for a discussion of the differences among a barter economy, a credit economy and a monetary economy.

5 "...there is a gap in (historical) time between production and sales which generates a systemic need for finance" (Godley, 2004, p. 127).

6 In the TMC, money is created when a loan is made, and it is destroyed when the loan is paid back. Keen (2010) argues that a different characterization can be used through a "revolving fund" where money created by banks is kept, without money destruction. In our view, this approach does not change the functioning of the circuit substantially.

Let us assume that firms finance investment by issuing equities (E).

$$\Delta E^s = I \qquad (3$$

Financial assets are therefore given by bank deposits (D) and equities. It must be the case that

$$\Delta V = \Delta D^d + \Delta E^d = W - C \qquad (4$$

At the end of the production period, firms have to pay back the initial loan, plus interests. Firms receipts are given by sales of consumption goods plus sales of investment goods (I). Firms profits (Π) are thus given by

$$\Pi = C + I - W - r \cdot L \qquad (5$$

where $r \cdot L$ is interests paid on loans. Using (3) and (4) into (5) we obtain

$$\Pi = W - \Delta D^d + (\Delta E^s - \Delta E^d) - W - r \cdot L \qquad (6$$

and therefore, when the supply of new equities from firms equals the demand from households, and assuming that the supply of bank deposits is perfectly elastic

$$\Pi = -\Delta D - r \cdot L \qquad (7$$

The best possible situation for firms is when the demand for new deposits from households is zero, and therefore firms get back the initial loan entirely either by selling consumption goods, or by selling equities. If this is the case, at the end of the production period firms will have enough liquidity to pay back the initial loan, but no liquidity to pay for interests, and there is no room for the realization of profits. This is a simple version of the "profit paradox" of the TMC, which is very close to the "Scheme of Simple Reproduction" in Marx[7]. In Marx terminology, the profit motive in capitalist production is to increase the capitalist amount of money holdings: M-C-M' implies that an initial stock of liquidity M is used to start production (create commodities C) in order to obtain a larger stock of final liquidity M'. While it is straightforward to understand this process for the individual firm, how can firms as a whole recover more money from the production process than the money which has been injected in the system at the beginning of the process?

Proposals for solving the profit paradox have been reviewed in Parguez (2004), but none seemed entirely satisfactory, since more contributions on the same topic continue to appear[8]. Messori and Zazzaro (2003) show that either firms' debt with banks increases without limits, or that a given percentage of firms go bankrupt, and therefore do not reimburse their initial loan, while others earn

7 I am grateful to Anwar Shaikh for several discussions on this issue.

8 Marc Lavoie pointed out to me — in a comment to a previous draft of this paper — that the same topics we are discussing were present in Lavoie (1987).

profits. In Rochon (2005) the solution depends on assuming that part of the initial loan is long-term, and does not require to be repaid in full at the end of the production period.

Bruun and Heyn-Johnsen (2009) again state that "The paradox of monetary profits has been a recurrent theme in macroeconomics since the problem was first formulated by Marx. Capitalists as a whole can at most get from workers, what they already paid out in wages. Marx did not solve this problem, and neither did Keynes" (Bruun – Heyn-Johnsen, 2009, abstract) and they conclude saying that "Economics has not been able to capture what, at least Marx and Keynes, regarded as the most fundamental fact of capitalist economies - that firms produce in order to gain a monetary profit." (ibid., p. 22).

Keen (2010) notes that "The consensus to date has been that it is mathematically impossible for capitalists in the aggregate to make profits" (Kenn, 2010, p. 2) and challenging this consensus suggests that "In brief, "M becomes M+" via the price mechanism, which converts the sale of the physical surplus generated in production into money" (Keen, 2010, p. 2) with a solution very close to what we will adopt in this chapter. Forges-Davanzati and Patalano disagree, stating that "Assuming that workers have a unitary propensity to consume (and do not decide to keep a portion of their savings in the form of liquid balances), it is shown that firms as a whole recoup an amount of money exactly equal to their costs of production for whatever price level, which at the aggregate level equals the money wage bill." (Forges-Davanzati – Patalano, 2011, p. 8). In our view, these authors – who state that "*it is logically impossible to imagine that the closure of the monetary circuit is made possible via banks' expenditure, since banks can spend only in the event firms as a whole have previously gained profits*"[9], which is what we suggest in this chapter and in Zezza (2004), derive their conclusion on the inconsistent hypothesis that firms receipts are equal to money wages[10].

Godley (2004) did not address this problem in his contribution to Graziani's conference, in our view because in his stock-flow-consistent model monetary profits were always possible, as we will try to show in the next section.

2. The simplest consistent monetary circuit

In our view, the basic circuit described in the previous section is incomplete and inconsistent, mainly because interest payments, which constitute the income of bankers, disappear, in that they are not spent on goods or financial assets. This is both an accounting inconsistency and a logical inconsistency, since banks exist because they generate profits for their owners, while such profits

9 Ibid. p. 8-9.
10 Ibid. p. 8, equation [2].

disappear in the simple example described above.

A simple solution to close the circuit can be obtained by treating interest payments consistently. If we want to keep the model within a single production period, the only rationale for banks asking for interest payments is either to pay for their "costs of production," namely wages, or to distribute profits to bank owners, or to cumulate wealth, and since we can rule out that banks cumulate wealth in the form of their own deposits, we can safely assume that any level of undistributed profits obtained by the banking sector is used entirely to purchase equities.

We thus need a "financial period" which is longer than the "production period". The former starts when a loan is made, and money is created, and it ends when the loan is paid back, and money is destroyed. The production period starts immediately after the loan is received, and wages are paid. When production is complete firms can sell the output, and as they recover liquidity from sales, they can pay the interest to banks, which in turn can use this liquidity to purchase goods or equities from firms. If effective demand is equal to output, at the end of the whole (financial) period, firms have received back the entire amount of money they own to the banks, including interest, and the value of their profits will equal the value of investment.

2.1 An economy with only consumption goods

Let us detail this logical sequence by examining how money circulates among firms, workers and the banks in an economy producing only a consumption good, where bankers' income is used to purchase such a good, and profit is the consumption of the capitalist class. A bank loan is made to firms in the form of bank notes printed by the bank, and widely accepted as means of payment.. Assume that the price of goods is equal to 1$, wages are equal to 100$, the interest rate is 10% and the value of production is 150$. This implies, of course, that the (real) value of production is greater than the (real) value of costs (wages plus interest), so that (real) monetary profits correspond to a physical surplus value.

If firms profits are used to purchase consumption goods they will be a simultaneous payment and receipt for the firms sector as a whole, and cancel out in ex-post balance sheets. So let us assume that two firms exist, that workers buy goods from each of them, while the owner of firms A uses profits to purchase goods from firm B and vice versa.

In Table 1 we report the deposit balance of each group at the different stages of the financial cycle. We want the circuit to close by the end of the financial cycle, and the only way this can happen is for income to be entirely spent before the circuit ends. This implies that monetary profits realized by both firms must be spent, as well as interest payments received by banks.

Table 1. Money holdings at different stages of the financial cycle					
Period	**Firm A**	**Firm B**	**Workers**	**Bankers**	**Firms debt outstanding**
Beginning: a loan is made to both firms	+100$	+100$	0	0	-200$
Wages are paid	0	0	+200$	0	-200$
Production is complete and workers spend 80% of their income	+80$	+80$	+40$	0	-200$
Firms pay interest	+70$	+70$	+40$	+20$	-200$
Owner of firm A purchases goods from firm B	+30$	+110$	+40$	+20$	-200$
Bankers spend their income on consumption goods	+40$	+120$	+40$	0	-200$
Owner of firm B purchases goods from firm A	+80$	+80$	+40$	0	-200$
Workers spend the remaining 20% of their income	+100$	+100$	0	0	-200$
The loan is paid back	0	0	0	0	0

An assumption underlying Table 1, along with the idea that all income is spent, is that firms have perfect foresight on effective demand, so that the whole of production is sold at the current price level.

Assume instead that workers save 10 percent of their income. In this case, workers money holdings at the end of the financial cycle will be equal to 20$, and both firms will be unable to pay back the entire loan, ending the cycle with a debt of 10$ each, and an unexpected increase in inventories of 10 goods each. In our view, this was the main concern of Godley's models. Godley focused on balance sheet accounts at the end of the period, rather than on the need for initial finance, and usually assumed that the change in bank loans outstanding would be equal to the change in inventories valued at costs. The two approaches to finance, Graziani's and Godley's, are therefore entirely compatible[11].

Another issue worth noting from the example in Table 1 is that related to the velocity of circulation. Some authors have suggested that monetary profits can be realized in the TMC only if the velocity of circulation is greater than one. This is indeed the case, since the same bank notes will be used once by wage earners, and a second time by capitalists or bankers. Transactions of bank notes

11 Lavoie (2004) has pursued this point. Cavalieri (2003), adopting a point of view critical of the circuitists approach, states that "In a circuit approach aimed at describing a circular process of creation, utilization and destruction of money, the possibility of using a stock-flow monetary framework … appears problematic."

among workers or firms, on the other hand, will not change the aggregate money holding of each sector. The logical closure of the circuit therefore requires that all income is spent, and this has implications on the velocity of circulation, but assumptions about velocity alone are insufficient to close the circuit by extinguishing the initial loan.

2.2 Stock-flow accounting in a simple consistent model

The ex-post flow accounting for a simple consistent model is reported in Table 2. Table 2 is organized, following Stone (1966), so that monetary payments from a sector are recorded in a column, while rows record receipts. Including a row and a column for transaction on capital account, accounting consistency requires that the total for each row to be equal, ex-post, to the total for the corresponding column, yielding a system of accounting identities, one of which is linearly dependent from the others.

Table 2. Social Accounting Matrix – Model 1: The simplest monetary circuit

	Firms	Households	Banks	Capital Account	Total
1. Firms		C		I	S
2. Households	W		$Wb\ (+r{\cdot}D)$		Yh
3. Banks	$r{\cdot}L$				Yb
4. Capital account	Π	ΔV	Πb		SAV
Total	S	Yh	Yb	I	

Comparing the second row and column in Table 2, households budget constraint is now given by

$$W + Wb = C + \Delta V \qquad (8$$

While banks profits are given, in the third row and column, by[12]

$$\Pi b = r{\cdot}L - Wb \qquad (9$$

Table 3 reports the ex-post flow of funds related to flow accounting in Table 1.

Demand for equities arises from household savings and banks' profits

$$\Delta E^{d} = (\Delta V - \Delta D) + \Pi b \qquad (10$$

12 If we assume that households' demand for bank deposits is positive, households obtain an additional source of income from interest payments on deposits. Such payments will reduce banks' profits by the same amount, so that changes in the interest rate on deposits in this simple model will affect the distribution of final demand between consumption and investment goods, but will not alter the value of liquidity that firms can recover by selling either consumer goods or equities.

If we look at the budget constraint of banks, in the third column of Table 3, we will see that our assumption behind (10) implies that the end-of-period increase in the stock of loans will exactly match the end-of-period increase in the stock of banks deposits. We will turn to this issue later.

Table 3. Flow of funds for Model 1				
	Firms	**Households**	**Banks**	**Total**
Deposits		$+\Delta D$	$-\Delta D$	*0*
Loans	$-\Delta L$		$+\Delta L$	*0*
Equities	$-\Delta E$	$+\Delta Eh$	$+\Delta Eb$	*0*
Capital	$+I$			$+I$
Total	$+\Pi$	$+\Delta V$	$+\Pi b$	

The value of firms' profits is given by

$$\Pi = C + I - W - r \cdot L \qquad (11$$

And using the identities (8) and (9)

$$\Pi = I - \Delta V - \Pi b \qquad (12$$

Using (10) which defines the demand for equities

$$\Pi = I - \Delta E^{d} - \Delta D \qquad (13$$

which is usually read, looking at the budget constraint of firms in the first column of Table 3, as an ex-post identity stating that investment is financed by profits, new loans from banks or by issuing new equities. In our case, assuming instead that investment is financed by issuing new equities, and that the supply of equities matches demand

$$\Pi = -\Delta D \qquad (14$$

So that, if households' demand for new bank deposits is zero, $\Delta D = 0$, firms' receipts from sales are sufficient to pay back the initial loan *plus* interests, as in our previous example in Table 1. If, on the contrary, households increase their end-of-period stock of deposits, firms will have a positive end-of-period debt with the banking sector.

In this model, loans create deposits, in the sense that in this credit economy money is injected into the system by an initial loan made from banks to firms, and the liquidity transferred from firms to households will generate a stock of deposits which is always equal, in any instant of the production period, to the outstanding stock of loans. But deposits determine loans at the end of the period, since if households decide to keep their savings in the form of bank deposits, rather than purchasing

equities, firms will remain indebted towards banks by an amount which is exactly equal to households desired holdings of bank deposits. In our approach, deposits determine loans in a way which is entirely different from the "conventional" view, where the single bank is allowed to lend money only when it has collected deposits from households. As Graziani (2003) and other circuitists note, while this is true for the single bank, it cannot be true for the banking system as a whole.

In our view, by neglecting a proper representation of the accounting of their model, most circuitists fail to see that interest payments on loans constitute a source of income for banks which will be used in a way consistent with the model. Graziani comes very close to making this point. When analysing the payment of interests on loans he first states that "if the only liquidity in existence originates from bank loans, the firms, by selling commodities and issuing securities, will at best get back the money they have initially spent. This means that firms will be able at best to repay the principal but not the interest on the loans granted them by banks."[13] But immediately afterwards he states "The interest payments that the banks receive from firms are partly used to cover current costs (such as wages and salaries to employees), and partly are net profits to be used for purchasing real goods"[14]. Therefore, interest payments made from firms to banks imply a further monetary payment from banks (or bank owners) to firms for purchasing goods. The payment of interests implies that banks acquire part of firms production, but does not imply that interests are paid "in kind." Graziani does not pursue his own point to its conclusions, as we have suggested in our simple model, and when presenting formal models in his latest contribution he neglects net bank profits when specifying either disposable income or demand for equities.

3. Some further results

On banks' behaviour

Our result about the end of period stock of firms' debt changes if we modify our assumption about banks' behaviour, so that demand for equities from banks is given by bank liquidity, e.g. profits *plus* the increase in banks' deposits[15]. Looking again at banks' budget constraint in Table 3, we can

13 Graziani (2003) pag. 118.

14 Ibidem

15 I am grateful to Marcello Messori for addressing this point in a comment on a previous draft. Messori notes that, if banks are able to obtain goods or equities in exchange for money created by opening a line of credit, they may also create money to acquire any level of equities they desire to hold. In our view, addressing this point properly would require extending our model to define in detail how the market price of equities is determined. We simply note that, in our simpler approach, if we assume that firms finance their investment decisions by obtaining credit from banks, it does not matter whether credit is obtained by opening a line of credit on firms' deposits, or by selling equities to banks, but the amount of money created at the beginning of the circuit should depend on firms' decisions, which may or may not be met by adequate supply of funds from banks, but we don't see how banks can pump more money into the system in excess of the amount which is demanded from firms.

verify that this assumption implies that the end of period stock of loans will always be zero. If this is the case, at the end of the production period firms will always be able to pay back the initial loan plus interests, and money disappears entirely: wealth is cumulated only in the form of equities.

On households' behaviour

In our simple model, we implicitly adopted that consumption and savings decisions are based on current income. However, the only possible rationale for an increase in households' holdings of bank deposits is given by an increase in future consumption. If this is the case, consistency would require that current consumption decisions be based both on current income and on past cumulated savings. This would alleviate the finance problem for firms, since in each period they will recover at least part of the liquidity which was "missing" in previous periods of production.

Moreover, we believe that even when modelling a single production period, it should be assumed an initial stock of wealth for some sectors, such as land or "capital" owned by firms, or "gold". By providing loans to firms, banks will therefore be able to appropriate either part of the current production of goods, or part of the existing stock of wealth.

Using a single period of production may be appropriate to outline the basic principles of the TMC, but proper models for monetary economies should be developed in a dynamic context.

A Post-Keynesian Version

It would be reasonably simple to modify our model along post-Keynesian lines, splitting the households sector into wage earners, who spend all of their income, and firms' owners, who have a positive propensity to save. Results would not change as far as the paradox of profits is concerned, provided that interest payments on bank deposits, and banks' distributed profits, are properly taken into account in determining households disposable income.

TMC, Say's Law and the Keynesian approach

At a first look, the TMC outlined here may resemble the neoclassical approach, where it is savings decision to determine investment, rather than the Keynesian approach of effective demand, where investment decisions determine the level of output. As shown in our accounting in Tables 2 and 3, investment needs to be financed by issuing equities, and demand for equities ultimately arises from savings, so it may seem that saving decisions ultimately determine investment.

Even though we consistently used the assumption that supply equals demand, we believe TMC to be compatible with a Keynesian approach: assuming that firms have excess capacity, an increase in

investment will stimulate an equal increase in the production of capital goods. This will in turn require an increase in the wage bill for the capital goods sector, and an equivalent increase in loans demanded by this sector. The increase in the wage bill will stimulate production in the consumption goods sector, following the standard multiplier effect. TMC is thus entirely Keynesian in spirit, but stresses that increases in production, generated by a rise in effective demand, may be constrained by credit rationing, if firms pay real wages in advance.

4. A two sector model

To enrich our discussion of investment and the determination of profits in the TMC, we now move to a Neo-Kaleckian approach, according to the taxonomy proposed by Parguez (2004). Namely, we split firms into a sector producing consumption goods, and a sector producing investment goods. We begin our analysis following the model in Rochon (2005), namely that firms do not issue equities, and finance investment only through profits, but we modify Rochon's model to treat interest payments on loans consistently as in our simpler model.

Table 4. Social Accounting Matrix – Model 2: A two sectors model

	Firms		**Households**		**Banks**	**Capital account**	**Total**
	Cons. goods	**Inv. goods**	**Wage earners**	**Bank owners**			
1. Cons. goods			*C*				*C*
2. Inv. goods						*Ic + Ii*	*I*
3. Wage earners	*Wc*	*Wi*					*W*
4. Bank owners					*Fb*		*Yhb*
5. Banks	*r·Lc*	*r·Li*					*Yb*
6. Capital account	*Πc*	*Πi*	*Sh*		*Πb*		*Sav*
Total	*Yc*	*Yi*	*Yh*		*Yb*	*I*	

Table 5. Flow of funds for Model 2

	Firms		**Households**	**Banks**	**Total**
	Cons. goods	**Inv. goods**			
Deposits			*+ΔD*	*-ΔD*	*0*
Loans	*-ΔLc*	*-ΔLi*		*+ΔL*	*0*
Equities	*-ΔEc*	*-ΔEi*	*+ΔEh*	*+ΔEb*	*0*
Capital	*+Ic*	*+Ii*			*+I*
Total	*Πc*	*Πi*	*Sh*	*Πb*	

Model accounting is now summarized in Table 4 for flows, and Table 5 shows the corresponding allocation of savings to financial assets and physical capital. To make our analysis as close as possible to that in Rochon (2005), let us assume first that firms do not issue equities, and that banks distribute all of their profits. Households' savings will therefore take the form of an increase in the stock of banks deposits.

If banks distribute all of their profits ($\Pi b = 0$), distributed profits will be given by row and column 5 in Table 3:

$$Fb = r \cdot Lc + r \cdot Li \quad (15$$

Assuming that wage earners and bank owners have the same propensity to save we can consolidate rows 3 & 4, and the corresponding columns, to obtain demand for consumption goods:

$$C = Wc + Wi + Fb - Sh \quad (16$$

Profits in the consumption and investment sector will be given by rows and columns 1 & 2, respectively:

$$\Pi c = C - r \cdot Lc - Wc \quad (17$$

$$\Pi i = Ic + Ii - r \cdot Li - Wi \quad (18$$

Using (15) and (16) in (17) we obtain

$$\Pi c = Wi + r \cdot Li - Sh \quad (19$$

The hypothesis in Rochon that firms investment is given by profits implies

$$Ic = \Pi c \quad (20$$

$$Ii = \Pi i \quad (21$$

Using (19) and (20) in (18) we get

$$\Pi i = - Sh + Ii \quad (22$$

If households spend all of their income ($Sh = 0$), at the end of the production period firms in the consumer goods sector will recover enough liquidity to pay back the initial loan plus interests, and will have positive profits to cover for investment. Demand for capital goods from this sector will have a value exactly equal to costs of production in the investment goods sector, which will be able to pay back its initial loan. However, comparing (21) and (22) it becomes apparent that investment in the capital goods sector remains undetermined: the assumption that firms in this sector invest all of their profits is inappropriate, since profits in this sector are ultimately given by investment in the

same sector, so that the equations hold for any level of investment. We must drop equation (21), and keep investment in this sector as exogenous, to determine profits in this sector.

$$Ii = Ii^* \qquad (21'$$

If households' saving is positive, profits in the consumer goods sector will be lower by an amount equal to saving, and profits will however be positive as long as

$$Sh < Wi + r \cdot Li$$

Sales of investment goods will be lower, and the capital goods sector will not be able to recover enough liquidity to reimburse the initial loan. At the end of the production period the increase in the stock of banks deposits will equal the increase in the outstanding debt of firms, as in our simpler model.

Let us now allow firms to issue equities to finance investment. Equations (20) and (21')[16] need to be changed into

$$Ic = \Pi c + \Delta Ec \qquad (20'$$

$$\Delta Ei = Ii^* \qquad (21''$$

We may also assume that banks distribute only a share γ of their profits, and cumulate wealth by acquiring equities. We will have

$$Fb = \gamma \cdot (r \cdot Lc + r \cdot Li) \qquad (15'$$

$$\Delta Eb = (1-\gamma) \cdot (r \cdot Lc + r \cdot Li) \qquad (23$$

The model may now be closed with appropriate assumptions on households and banks demand for financial assets, given their relative rate of return.

It remains true, as in our simpler model, that, if households' demand for banks deposits increases, firms will not recover the initial loan plus interests from sales in the goods or the financial market, unless we modify our equation (23) for banks behaviour, allowing banks to convert any increase in deposits to an increase in their demand for equities.

A more complex model including a central bank and the government sector, which we believe to be entirely compatible with this approach, can be developed along the lines in Zezza and Dos Santos (2004), where it is shown that the major features of the TCM approach, and in particular the

16 We still need to keep investment in the capital goods sector to be exogenous: if we revert to equation (21) investment and profits in this sector will still be undetermined with the addition of equities.

endogeneity of money, are maintained.

5. Conclusions

In this paper we have addressed some puzzles in the Monetary Theory of Production, or Monetary Circuit, namely the determination of aggregate profits within a single period of production when firms have to pay interests on an initial bank loan.

We have shown that the "profit paradox" disappears when bankers income arising from interest payments is treated consistently as a source of either demand for goods or demand for financial equities issued by another sector. Our assumption is required for consistent modelling of the banking sector: if interest payments are obtained, they must be used before the end of the financial period, and this in turn implies that the overall time period for the circuit, which starts when the initial loan is made, and ends when the loan is paid back, is longer than the production period.

We have examined the implications of our approach to TMC: a first major point is that, if households' have a positive demand for bank deposits, this implies that consumption and saving decisions must depend on cumulated wealth, and that the analysis of a single production period becomes inappropriate. We also showed how the TMC approach may be reconciled with Keynesian and Kaldorian approaches, and we have shown the similarities with the stock-flow approach adopted, among others, by Godley. In particular, while Godley focuses on the end-of-period stock of loans outstanding, the TMC focuses on the beginning-of-the-period initial finance, but the two approaches are entirely compatible.

We have finally extended our results to a two sectors model, showing that some hypothesis on investment decisions proposed in the TMC literature may be inappropriate.

We hope our contribution will help the development of robust post-Keynesian models compatible with the TMC approach.

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