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Interest, debt and capital accumulation - a Kaleckian approach*

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Abstract

In the present paper we explicitly introduce interest payments and debt into a Kaleckian distribution and growth model with an investment function very close to Kalecki's original writings. The effects of interest rate variations on the short-run equilibrium values of capacity utilisation, capital accumulation and the rate of profit are derived, and the long run effects on the equilibrium debt-capital-ratio are also analysed. It is shown, that the effects of interest variations on the endogenously determined equilibrium values of the model do not only depend on the parameter values in the saving and investment functions but also on the interest elasticity of distribution and in some cases on initial conditions with respect to the interest rate and the debt-capital-ratio. If the conditions for short-run 'normal' effects of interest rate variations are given, the economy will be characterised by a long-run unstable debt-capital-ratio and by the macroeconomic 'paradox of debt'. These results are similar to other models and hint to the robustness of Kaleckian 'monetary' models of distribution and growth with respect to the specification of the investment function.

JEL-classification: E12, E22, E25, E44, O42

Keywords: Interest rate, debt, capital accumulation, Kaleckian model

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1. Introduction

The introduction of monetary variables into post-Keynesian models of distribution and growth is an ongoing process, in particular since the late 1980s/early 1990s. In earlier times, however, the impacts of monetary variables have rarely been considered to be relevant for the equilibrium solution in the models built in the tradition of Kaldor (1956, 1957, 1961) and Robinson (1962), on the one hand, and Kalecki (1954) as well as Steindl (1952), on the other.[1] An exception has been Pasinetti's (1974, pp. 139-141) natural rate of growth model in which the normal rate of profit is positively associated with the rate of interest as long as the latter is smaller than the former.[2] Recently post-Keynesians have increasingly taken Keynes's (1933) research programme of a 'monetary theory of production' more and more seriously and have introduced monetary variables into the Kaldorian and Kaleckian variants of the post-Keynesian growth and distribution models.[3] This endeavour has been based on solid foundations of monetary analysis in the work of Kaldor, Robinson and Kalecki themselves.[4]

The attempts to integrate monetary variables in post-Keynesian distribution and growth models usually rely upon the post-Keynesian 'horizontalist' approach to monetary theory: The rate of interest is considered to be an exogenous variable for production and accumulation mainly under the control of the central bank whereas the quantities of credit and money are endogenous to production and accumulation.[5] Integrating this approach into post-Keynesian models of distribution and growth has meant to integrate the rate of interest explicitly into the investment function, in the first place. Lavoie (1995) has shown the results for the basic Kaldorian/Robinsonian and Kaleckian models: Rising interest rates will be associated with

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[1] See Amadeo (1986, 1986a, 1987), Bhaduri/Marglin (1990), Dutt (1984, 1987), Kurz (1994, 1995) and Rowthorn (1981) for modern Kaleckian models, and Lavoie (1992, pp. 282-347) as well as Hein (2004, pp. 149-219) for surveys of Kaldorian/Robinsonian and Kaleckian models of distribution and growth.

[2] In the Pasinetti theorem (Pasinetti (1974, pp. 103-120)) the rate of interest on accumulated workers' savings equals the rate of profit in long run natural growth equilibrium. For a discussion and extension of the Pasinetti theorem including a government sector see Panico (1997). He derives positive effects of both the rate of interest and the real rate of growth on the normal rate of profit.

[3] See, among others, in particular Lavoie (1992, pp. 347-371, 1993, 1995), Lavoie/Godley (2001-2), Lavoie/Rodriguez/Seccareccia (2004), Epstein (1992, 1994), Dutt/Amadeo (1993), Dutt (1989, 1992), Taylor (1985, 2004, pp. 272-278) and Hein (1999, 2004, pp. 221-238). Hein/Ochsen (2003) have used a Kaleckian type model in order to assess the empirical development of interest rates, income shares and capital accumulation in some advanced OECD countries.

[4] See Lavoie (1999), Rochon (1999, pp. 143-150, 2001), Vernengo/Rochon (2001) on Joan Robinson, and Arestis (1996), Dymski (1996) and Sawyer (1985, pp. 88-107, 2001, 2001a) on Michal Kalecki. And, of course, Kaldor (1970, 1982, 1985) has been the founding father of the post-Keynesian 'horizontalist' theory of money (see also Rochon (1999, pp. 99-117, 2000) and Vernengo/Rochon (2001)).

[5] See Kaldor (1970, 1982, 1985), Lavoie (1984, 1992, pp. 149-216, 1996), Moore (1988, 1989), Rochon (1999), and Bertocco (2001) for the post-Keynesian 'horizontalist' approach to monetary theory.

lower rates of capital accumulation in both types of models. In the Kaleckian models with a long run variable rate of capacity utilisation, the equilibrium rate of utilisation will fall when interest rates rise, whereas income distribution determined by mark-up pricing will remain constant. In the Kaldorian/Robinsonian model, however, with a long run normal rate of capacity utilisation and distribution determined by capital accumulation, rising interest rates will be associated with a falling profit share and a decreasing 'normal' rate of profit.

In addition to having directly adverse effects on capital accumulation, changing interest rates also mean a redistribution of income between rentiers and firms with related effects on aggregate saving and on consumption demand. And lasting variations in interest rates may also affect functional income distribution and hence the share of wages and gross profits in total income, as has been proposed by some neo-Ricardian authors,[6] and can as well be found in Joan Robinson's work (Lavoie (1995)) and also in Pasinetti (1974, pp. 139-141). Integrating these effects into models of distribution and growth with endogenous capital accumulation makes the effects of changing interest rates dependent on the parameter values in the investment and the saving functions and on the elasticity of distribution with respect to interest rate variations. For a Kaleckian model, different regimes of accumulation can be derived, ranging from the usually expected adverse effects of interest rate variations on capital accumulation, capacity utilisation and the profit rate to positive effects throughout on the equilibrium values of the system (Lavoie (1993, 1995), Hein (1999), Hein/Ochsen (2003)).

In a further step the effects of debt and debt services which have been highlighted by Kalecki (1937, 1954), Steindl (1952) and Minsky (1975) can be explicitly incorporated into the model. Lavoie (1995) has proposed an attempt to introduce these aspects into a Kaleckian 'Minsky-Steindl-model' of distribution and growth. In Hein (2004a) we have broadened his attempt by endogenously determining the rate of capacity utilisation, instead of simply assuming it to be constant, and by integrating the effects, which interest rate variations have on the distribution of income between wages and gross profits, in the saving and investment function. We have shown that the effects of interest rate variations on the endogenously determined equilibrium values of the model do not only depend on the parameter values in the saving and investment functions but also on the interest elasticity of distribution and on initial conditions with respect to the interest rate and the debt-capital-ratio. It has also been shown that, if the

[6] See Ciccarone (1998), Panico (1985) and Pivetti (1985, 1987, 1991, 2001), among others.

conditions for short-run normal effects of interest rate variations are given, the model-economy will be characterised by a long-run unstable debt-capital-ratio and by the macroeconomic ‘paradox of debt’.

The model in Hein (2004a) includes an accumulation function extending the function proposed by Bhaduri/Marglin (1990) in their non-monetary Kaleckian model: Investment is assumed to be positively affected by capacity utilisation and the profit share, and further on negatively by the interest rate and by the debt-capital-ratio. However, this investment function is only loosely linked to Kalecki’s work on the determinants of investment decisions.[7] And the basic Bhaduri/Marglin function has been criticized by some Kaleckians because of the assumed positive effect of the profit share on investment (Blecker 2002, Mott/Slattery 1994). In the present paper we will therefore substitute the monetary extension of the Bhaduri/Marglin-investment function by an investment function which is closer to Kalecki’s work and which is not liable to the critique put forward against the Bhaduri/Marglin function. We will derive the short and long run results for the otherwise unchanged model. The remainder of the paper is organised as follows. In Section 2 we will describe the basic assumptions and the main characteristics of our model. Section 3 derives the short run equilibrium assuming the debt-capital-ratio to be constant and Section 4 derives the equilibrium in the long run with endogenous determination of the debt-capital-ratio. In Section 5 we discuss the effects variations in the interest rate have on the short and long run behaviour of a simple variant of our model. Section 6 concludes.

2. The basic model

Production

In our model we assume a closed economy without economic activity of the state. Technical change is not explicitly considered. Under given conditions of production, there is just one type of commodity produced that can be used for consumption and investment purposes. It is assumed that there is a constant relation between the employed volume of labour (L) and real output (Y), i.e. there is no overhead-labour. The productivity of labour remains therefore constant up to full capacity output and we get a constant labour-output-ratio (l). The capital-potential output-ratio (v) which describes the relation between the real capital stock (K) and potential real output (Y^v) is also supposed to be constant. The capital stock is assumed not to

[7] See Steindl (1981) for an extensive discussion of investment functions in Kalecki’s work.

depreciate. The rate of capacity utilisation (u) is given by the relation between actual real output and potential real output.

Pricing, interest rate and distribution

Functional income distribution is determined by active price setting of firms in incompletely competitive goods markets. Writing w for the nominal wage rate, we assume that firms set prices (p) according to a mark-up (m) on constant unit labour costs up to full capacity output. Following Kalecki (1954, pp. 11-27), we assume that the mark-up in the price equation is mainly determined by the degree of price competition in the goods markets and by the relative powers of capital and labour in the labour market:

$$p = (1 + m)wl, \qquad m > 0. \tag{1}$$

From this we get for the profit share (h), i.e. the proportion of profits (Π) in nominal output (pY):

$$h = \frac{\Pi}{pY} = 1 - \frac{1}{1+m}. \tag{2}$$

The profit rate (r) relates the annual flow of profits to the nominal capital stock. The rate of profit depends on the profit share, the endogenously determined rate of capacity utilisation and the given capital-potential output-ratio:

$$r = \frac{\Pi}{pK} = \frac{\Pi}{Y}\frac{Y}{Y^v}\frac{Y^v}{K} = hu\frac{1}{v}. \tag{3}$$

Introducing monetary variables into the model, we follow the post-Keynesian ‘horizontalist’ monetary view developed by Kaldor (1970, 1982, 1985), Lavoie (1984, 1992, pp. 149-216, 1996) and Moore (1988, 1989) and assume that the monetary interest rate is an exogenous variable for the accumulation process whereas the quantities of credit and money are determined endogenously by economic activity. In this view, the central bank controls the base rate of interest. Commercial banks set the market rate of interest by marking up the base rate and then supply the credit demand of consumers and investors they consider creditworthy at this interest rate. The central bank accommodates the necessary amount of cash. For the sake of simplicity, in what follows we suppose that the central bank's interest rate policy controls the real long-term interest rate, i.e. the long-term nominal interest rate corrected by the inflation rate. The pace of capital accumulation, therefore, has no direct feedback on the interest rate and we follow Pasinetti's recommendation for the treatment of the rate of interest in the theory of effective demand:

> „However important a role liquidity preference may play in Keynes' monetary theory, it is entirely immaterial to his theory of effective demand. What this theory requires, as far as the rate of interest is concerned, is not that the rate of interest is determined by liquidity preference, but that it is determined *exogenously* with respect to the income generation process. Whether, in particular, liquidity preference, or anything else determines it, is entirely immaterial." (Pasinetti (1974, p. 47))

The pace of accumulation is determined by the entrepreneurs' decisions to invest. But investment as the causal force of accumulation has to be financed independently of saving, because investment precedes income and hence saving. In general, long-term investment finance may take place through retained earnings, the issuing of bonds and shares or through long-term credit.[8] Here we shall assume that long-term finance is supplied only by retained earnings or by long-term credit by rentiers' households (directly or through banks). By means of this simplification we do not have to distinguish between creditor households receiving interest income, on the one hand, and shareholder households receiving dividend income, on the other hand, and their different saving propensities.[9]

Introducing interest payments to rentiers' into the model, profit splits into profit of enterprise (Π^n) and rentiers' income (Z).[10] Rentiers' income is determined by the stock of long-term credit (B) granted to firms and the exogenously given rate of interest (i).

$$\Pi = \Pi^n + Z = \Pi^n + iB. \tag{4}$$

[8] The distinction between short-term finance for production purposes and long-term finance for investment purposes, not dealt with in the present paper, can be found in the monetary circuit approach (see, in particular, Graziani (1989, 1994), Lavoie (1992, pp. 151-169), Seccareccia (1996, 2003)).

[9] Of course, our simplification implies that profits net of interest payments are all reinvested into the firm.

[10] In what follows the terms 'profit', 'profit share' and 'profit rate' are related to gross profits as the sum of profit of enterprise and interest.

The debt-capital-ratio (λ) is assumed to be given in the short run but it will vary in the long run:

$$\lambda = \frac{B}{pK}. \qquad (5)$$

The mark-up and the profit share also consist of two parts when interest is introduced, a part that covers profits of enterprise and a part for interest payments. According to Kalecki (1954, p. 18), the degree of monopoly, and hence the mark-up, may but need not increase when overhead costs, including interest costs, increase. Therefore, the profit share may but need not respond to a variation in the interest rate:

$$h = h(i), \qquad \frac{\partial h}{\partial i} \geq 0. \qquad (6)$$

As the successful shifting of variations in interest rates to prices means a change in the mark-up, the ability to enforce a permanent and stable redistribution of income at the expense of labour income by shifting interest rate changes to prices depends on those factors that determine the mark-up, i.e. the intensity of price competition in the goods market and the relative strength of labour unions in the labour market. Considering the distribution effects of interest rate variations we will distinguish two cases below: 1. the case of an interest-inelastic or rigid mark-up and 2. the case of an interest-elastic or flexible mark-up.

Saving and investment

Introducing the interest rate into the saving and accumulation function of the model the following aspects have to be considered. First, interest payments by firms are an income for rentiers‘ households that will affect those households’ expenditures and thus consumption demand and the rate of capacity utilisation. Second, in the case of a flexible mark-up interest rate variations have an impact on real wages and hence on the wage-costs of production, but also on consumption demand out of wages. Third, interest payments are costs for firms and a drain of their internal means of finance which might directly affect their decisions to accumulate.

In order to keep the argument simple, we will assume a classical saving hypothesis, i.e. labourers do not save. The part of profits retained is completely saved by definition. The part of profits distributed to rentiers‘ households, i.e. the interest payment, is used by those households according to their propensity to save (s_Z). Therefore, total saving (S) comprises retained profits (Π-Z) and saving out of interest income (S_Z). Taking equations (3), (4) and (5) into account, we get for the saving rate (σ) which relates total saving to the nominal capital stock:[11]

$$\sigma = \frac{S}{pK} = \frac{\Pi - Z + S_Z}{pK} = h\frac{u}{v} - i\lambda(1 - s_Z), \qquad 0 < s_Z \leq 1. \tag{7}$$

The higher the interest rate at a given rate of profit, a given debt-capital-ratio and a given propensity to save of rentiers‘ households, the lower will be the saving rate, because income is transferred from firms that do not consume to rentiers who consume at least a part of their income. An increasing debt-capital-ratio of firms reduces the saving rate for the same reason.

Integrating interest payments and debt into the investment function of the model is a more difficult task. In Kalecki's work there can be found different investment functions, and until his death he was searching for an appropriate model of entrepreneurs' investment decisions.[12] In an early paper on the trade cycle published in Poland in 1933, Kalecki (1969, pp. 7-10) assumed that entrepreneurs' decisions to invest are affected positively by the expected gross rate of profit and negatively by the rate of interest. Investment decisions are therefore

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[11] This savings function is similar to the one used by Lavoie (1992, p. 365; 1995, p. 160), the only difference being that we explicitly consider the debt-capital-ratio.

[12] In the introduction to his *Selected Essays on the Dynamics of the Capitalist Economv 1933-1970*, his last book published after he had passed away he wrote: „It is interesting to notice that the theory of effective demand, already clearly formulated in the first papers, remains unchanged in all relevant writings, as do my views on the distribution of national income. However, there is a continuous search for new solutions in the theory of investment decisions, where even the last paper represents - for better or for worse - a novel approach" (Kalecki 1971, p. viii). In the preface to the English translation of his first papers published in Polish in the 1930s, *Studies in the Theory of Business Cycles, 1933-1939*, it says similarly: „The studies also reflect the most essential features of my theory of the business cycle. I modified in my later work only the factors determining investment decisions (...)" (Kalecki 1969, p. 1). For a survey of investment functions in Kalecki's models see Steindl (1981).

positively related to the net profit rate, which is gross profits minus interest payments in relation to the capital stock.[13]

In later work, in particular in Kalecki (1954, pp. 96-108), he considered investment decisions to be mainly determined by the financial resources of the firm and by sales expectations. Internal means of finance have a major impact on the ability to finance investment under the conditions of imperfect capital markets whereas sales expectations affect prospective profits. In his 'principle of increasing risk' Kalecki (1937) had already argued that internal means of finance are a crucial determinant of the firms' access to external finance.[14] In imperfect capital markets, on the one hand, creditors' willingness to supply funds is positively related to debtors' collateral:[15]

> "The access of a firm to the capital market, or in other words the amount of rentier capital it may hope to obtain, is determined to a large extent by the amount of its entrepreneurial capital." (Kalecki (1954, p. 91))

On the other hand, the firms' willingness to borrow depends on its own capital in order to minimize the dangers of income losses and illiquidity in the case business failures:

> „A firm considering expansion must face the fact that, given the amount of the entrepreneurial capital, the risk increases with the amount invested. The greater investment in relation to the entrepreneurial capital, the greater is the reduction of the entrepreneur's income in the event of an unsuccessful business venture." (Kalecki (1954, p. 92))

Contrary to his earlier writings in Kalecki (1937), in Kalecki (1954, pp. 91-92) the firm's willingness to pay higher interest rates cannot compensate for a lack of internal funds or entrepreneurial capital. It rather reinforces the creditors' scepticism with respect to the creditworthiness of the potential debtor.

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[13] As the rate of interest is rather slowly moving, Kalecki simplified the investment function and made the rate of capital accumulation a positive function of the gross profit rate only. And since profits depend on capitalists' expenditure for consumption and investment goods, if a classical saving hypotheses is assumed, and the profit rate is also affected by the capital stock, investment decisions are positively affected by actual investment and negatively by the capital stock. The demand effect of investment stimulates further investment, whereas the lagged capacity effect dampens investment decisions. These contradictory effects of investment can then be used to explain the business cycle (Kalecki 1969).

[14] On Kalecki's „principle of increasing risk" see also Arestis (1996a) und Sawyer (1985, pp. 101-106; 2001).

[15] A similar view was taken by Robinson (1962, p. 86) and Steindl (1952, pp. 107-138).

The investment function applied in our model follows the arguments given above, in particular those by Kalecki (1954), and assumes that investment decisions are positively affected both by expected sales and by retained earnings.[16] Expected sales are determined by the rate of capacity utilisation. Retained earnings, in relation to the capital stock, are given by the difference between the rate of profit and the rate of interest times the debt-capital-ratio. Therefore, the rate of interest and the debt-capital-ratio both have a negative impact on investment because they adversely affect internal funds.[17],[18] Firms, however, can try to maintain internal funds in the face of rising interest rates by increasing the mark-up and hence the profit share. The success of such a reaction, however, depends on the effects on the rate of capacity utilisation, as can be seen in the function for the accumulation rate (g) relating net investment (I) to the capital stock:[19]

$$g = \frac{\Delta K}{K} = \frac{I}{K} = \alpha + \beta u + \tau\left(h\frac{u}{v} - i\lambda\right), \qquad \alpha, \beta, \tau, > 0, \qquad \tau < 1\,. \tag{8}$$

The parameter α stands for the motivation to accumulate which derives from the competition of firms independently of the development of distribution, effective demand, monetary or financial variables. The intensity of the influence of effective demand is indicated by β, whereas τ shows the weight of internal funds which are influenced by distribution and effective demand variables, on the one hand, and by monetary variables, on the other. In what follows we will derive the short and the long run equilibrium positions of the system. Following Lavoie (1995), we take the debt-capital-ratio as a constant in the short run which, however, becomes a variable to be endogenously determined in the long run.

16 In his latest work Kalecki (1971, pp. 169-181) attempted to integrate also technical progress in the investment function. In this case it is profitability of the latest capital vintage incorporating a higher level of technical knowledge than the older vintages which determines investment decisions (see also Steindl (1981)). As our model abstracts from technical progress we do not have to deal with this approach.

17 Although our investment function logically follows from Kalecki's (1954) arguments, the explicit consideration of the interest rate is different from Kalecki's (1954, p. 99) treatment who believed that the long-term rate of interest had no relevant impact on investment because it did not change much in the course of the business cycle. The time horizon, however, of the model we are proposing goes well beyond the business cycle and is related to medium or long run trends in which the real rate of interest in OECD countries has indeed changed significantly over the recent decades (Hein/Ochsen 2003).

18 Recent empirical work has shown that the interest rate has important effects on investment through its impacts on internal funds and hence on the access to external borrowing in imperfect capital markets (see Fazzari/Hubbard/Peterson (1988), Hubbard (1998), Schiantarelli (1996)).

19 This investment function is similar to the one used by Dutt (1992) and Lavoie (1992, p. 364), among others, the difference being that our function explicitly considers the debt-capital-ratio.

3. Short run equilibrium

The short run equilibrium requires the adjustment of production and capacity utilisation to effective demand in the goods market. Therefore, the equilibrium condition is given by:

$$g = \sigma . \tag{9}$$

This equilibrium will be stable, if saving responds more elastically to variations in capacity utilisation then investment:

$$\begin{gathered} \frac{\partial \sigma}{\partial u} - \frac{\partial g}{\partial u} > 0, \\ (1-\tau)\frac{h}{v} - \beta > 0. \end{gathered} \tag{10}$$

From equation (10) it becomes clear that the necessary condition for a stable equilibrium requires $\tau < 1$, which means that the effects of internal funds on investment have to be restricted in order to achieve a stable goods market equilibrium. The equilibrium values (*) for capacity utilisation, capital accumulation and the rate of profit in the short run are as follows:

$$u^* = \frac{i\lambda(1 - s_Z - \tau) + \alpha}{\frac{h}{v}(1-\tau) - \beta}, \tag{11}$$

$$g^* = \frac{i\lambda\left[\beta(1 - s_Z) - \tau\frac{h}{v}s_Z\right] + \alpha\frac{h}{v}}{\frac{h}{v}(1-\tau) - \beta}, \tag{12}$$

$$r^* = \frac{\frac{h}{v}\left[i\lambda(1 - s_Z - \tau) + \alpha\right]}{\frac{h}{v}(1-\tau) - \beta}. \tag{13}$$

With a given debt-capital-ratio in the short run, we get the following reactions of the equilibrium values in the face of changing interest rates:

$$\frac{\partial u}{\partial i}=\frac{\lambda(1-s_Z-\tau)-\frac{\partial h}{\partial i}(1-\tau)\frac{u}{v}}{\frac{h}{v}(1-\tau)-\beta}, \tag{14}$$

$$\frac{\partial g}{\partial i}=\frac{\lambda\left[\beta(1-s_Z)-\tau\frac{h}{v}s_Z\right]-\frac{\partial h}{\partial i}\beta\frac{u}{v}}{\frac{h}{v}(1-\tau)-\beta}, \tag{15}$$

$$\frac{\partial r}{\partial i}=\frac{\frac{h}{v}\lambda(1-s_Z-\tau)-\frac{\partial h}{\partial i}\beta\frac{u}{v}}{\frac{h}{v}(1-\tau)-\beta}. \tag{16}$$

If only stable short run equilibria are considered, also in this model with a more 'Kalecki-like' investment function the short run effects of interest rate variations depend on the interest elasticity of the mark-up (and hence the profit share), on the parameters in the saving and investment functions, i.e. the rentiers' saving propensity and the elasticities of investment with respect to capacity utilisation and internal funds, and may as well be affected by the given debt-capital-ratio (Table 1).

Table 1: Responses of the profit share, the rate of capacity utilisation, the rate of accumulation and the rate of profit to a variation in the interest rate: stable short-run equilibria

	$\frac{\partial u}{\partial i}$	$\frac{\partial g}{\partial i}$	$\frac{\partial r}{\partial i}$
$\frac{\partial h}{\partial i}=0$	$\frac{\partial u}{\partial i}>0,\text{if}$ $\lambda(1-s_Z-\tau)>0$	$\frac{\partial g}{\partial i}>0,\text{if}$ $\lambda\left[\beta(1-s_Z)-\tau\frac{h}{v}s_Z\right]>0$	$\frac{\partial r}{\partial i}>0,\text{if}$ $\lambda(1-s_Z-\tau)>0$
$\frac{\partial h}{\partial i}>0$	$\frac{\partial u}{\partial i}>0,\text{if}$ $\lambda(1-s_Z-\tau)$ $-\frac{\partial h}{\partial i}(1-\tau)\frac{u}{v}>0$	$\frac{\partial g}{\partial i}>0,\text{if}$ $\lambda\left[\beta(1-s_Z)-\tau\frac{h}{v}s_Z\right]$ $-\frac{\partial h}{\partial i}\beta\frac{u}{v}>0$	$\frac{\partial r}{\partial i}>0,\text{if}$ $\frac{h}{v}\lambda(1-s_Z-\tau)$ $-\frac{\partial h}{\partial i}\beta\frac{u}{v}>0$

In the case of a rigid mark-up, the reaction of the short run equilibrium values to changes in the interest rate is mainly determined by the rentiers' propensity to save and by the investment elasticity with respect to internal funds (and by the elasticity with respect to capacity utilisation for the equilibrium rate of capital accumulation). If the rentiers' saving propensity is rather high and the internal funds elasticity of investment is high as well (and capacity utilisation does hardly affect investment), rising interest rates will cause falling rates of capacity utilisation, profit and capital accumulation. This is the 'normal' case usually expected in post-Keynesian models. If, however, the propensity to save out of interest income is relatively low and investment is hardly affected by internal funds (and capacity utilisation has a major impact on investment decisions), regimes of accumulation with positive responses throughout the endogenously determined short run equilibrium values may arise. This is what Lavoie (1995) calls the 'puzzling' case. With a rigid mark-up, the debt-capital-ratio does not affect the direction of change of the equilibrium values, but only affects the extent of change: The lower the debt-capital-ratio, the smaller will be the real effects of interest rate variations.

In the case of an interest-elastic mark-up we get an additional effect on the short-run equilibrium values which is negative for each variable in the present model. This result is different from Hein (2004a) and it is due to the more 'underconsumptionist' characteristics of the investment function in the present model. Raising the mark-up and the profit share when interest rates increase will have a positive impact on internal funds but will simultaneously reduce consumption demand, sales and hence capacity utilisation which will negatively feed back on internal funds. Furthermore, lower capacity utilisation will also have a negative impact on investment decisions. That is why, with a flexible mark-up, the probability of a 'normal' case for interest rate effects on the short run equilibrium position will increase. And a 'puzzling' case will become less likely if firms manage to shift varying interest costs to prices.[20] The extent to which the negative impact of a flexible mark-up will be able to (over-)compensate a direct positive effect of interest rate variations will now depend on the given debt-capital-ratio. The higher the debt-capital-ratio the more important will be the (probably positive) direct effects of changing interest rates. The initial debt-capital-ratio may, therefore, under certain circumstances affect the direction of change of the equilibrium position caused by an interest rate variation in the case of an interest-elastic mark-up.

[20] If rising interest rates have a positive effect on the real equilibrium, however, it might be difficult for firms to raise mark-ups because rising mark-ups will require weak unions and hence rising unemployment - and not falling.

4. Long run equilibrium

In the long run, the debt-capital-ratio becomes an endogenous variable which then also has some feedback effects on the other variables of the system. In order to analyse this, we follow the procedure in Lavoie (1995) and Hein (2004a). We start with equation (5) and assume away inflation, i.e. the mark-up may change but not the price level. For the growth rates of the variables it follows:

$$\hat{\lambda} = \hat{B} - \hat{K} = \hat{B} - g. \tag{17}$$

Given our assumptions above, the additional long-term credit granted in each period (ΔB) is equal to rentiers' saving in this period.[21]

$$\Delta B = S_Z = s_Z iB. \tag{18}$$

For the growth rate of debt it follows:

$$\hat{B} = \frac{\Delta B}{B} = s_Z i. \tag{19}$$

In long run equilibrium the endogenously determined debt-capital-ratio has to be constant, i.e. $\hat{\lambda} = 0$. Integrating this condition into equation (17) and making use of equations (12) and (19) we get for the long run equilibrium debt-capital-ratio:

$$\lambda* = \frac{s_z i\left[\frac{h}{v}(1-\tau)-\beta\right]-\alpha\frac{h}{v}}{i\left[\beta(1-s_Z)-\tau\frac{h}{v}s_Z\right]}. \tag{20}$$

[21] This does not imply that rentiers' saving is a precondition for credit and investment. On the contrary, rentiers' saving as well as firms' retained earnings are a result of production of investment and consumption goods initially financed by short-term credit. This has not explicitly been discussed in the present paper but it has been made clear in monetary circuit theory. See Graziani (1989, 1994), Lavoie (1992, pp. 151-169) and Seccareccia (1996, 2003).

This equilibrium will be stable, if $\frac{\partial \hat{\lambda}}{\partial \lambda} < 0$ (Lavoie (1995, p. 168)). Making use of equation (17) and applying equations (12) and (19) yields:

$$\frac{\partial \hat{\lambda}}{\partial \lambda} = \frac{-i\left[\beta(1-s_Z) - \tau \frac{h}{v} s_Z\right]}{\frac{h}{v}(1-\tau) - \beta}. \tag{21}$$

From this it follows for the stability condition:[22]

$$\frac{\partial \hat{\lambda}}{\partial \lambda} < 0, \text{ if}: \beta(1-s_Z) - \tau \frac{h}{v} s_Z > 0. \tag{22}$$

The long run equilibrium tends to be stable, if the rentiers' saving propensity is low and investment decisions are very elastic with respect to changes in capacity utilisation but very inelastic with respect to changes in internal funds. Similar to Lavoie (1995) and Hein (2004a), this is the same parameter constellation which favours a 'puzzling' positive effect of interest rate variations on capacity utilisation, capital accumulation and the profit rate in the short run. If the rentiers' saving propensity is rather high and investment decisions are very inelastic with respect to demand but very elastic with respect to internal funds, the long run equilibrium tends to become unstable. Deviations from equilibrium will generate a long run debt-capital-ratio of either unity or zero. The conditions for long run instability are associated with short run 'normal' negative effects of interest rate hikes on capacity utilisation, capital accumulation and the profit rate.

The effects of interest rate variations on the equilibrium debt-capital-ratio can be derived from equation (20):

$$\frac{\partial \lambda}{\partial i} = \frac{s_Z\left[\frac{h}{v}(1-\tau) - \beta\right] - \lambda\left[\beta(1-s_Z) - \tau \frac{h}{v} s_Z\right] + \frac{\partial h}{\partial i}\frac{1}{v}\{s_Z i[1 - \tau(1+\lambda) - \alpha]\}}{i\left[\beta(1-s_Z) - \tau \frac{h}{v} s_Z\right]}. \tag{23}$$

[22] Note, that the stability of the goods market equilibrium implies (h/v)(1-τ)-β > 0.

First we consider the case of an interest-inelastic mark-up. With the conditions for a stable long run equilibrium given, increasing interest rates will decrease the equilibrium debt-capital-ratio if this ratio is very high in the initial equilibrium, more precisely when $\lambda > \frac{s_Z\left[\frac{h}{v}(1-\tau)-\beta\right]}{\beta(1-s_Z)-\tau\frac{h}{v}s_Z}$ (Appendix A). However, if interest rates increase when the equilibrium debt-capital-ratio is still low, i.e. $\lambda < \frac{s_Z\left[\frac{h}{v}(1-\tau)-\beta\right]}{\beta(1-s_Z)-\tau\frac{h}{v}s_Z}$, this ratio will be rising. When $\lambda = \frac{s_Z\left[\frac{h}{v}(1-\tau)-\beta\right]}{\beta(1-s_Z)-\tau\frac{h}{v}s_Z}$ in the initial equilibrium, variations in the interest rate will not affect the equilibrium debt-capital-ratio. These results are similar to Hein (2004a) but they are different from Lavoie (1995) who gets a uniquely positive relation between the interest rate and the debt-capital-ratio in the case of a stable long run equilibrium. If the parameter constellation in our model implies an unstable long run equilibrium, rising interest rates will always trigger falling equilibrium debt-capital-ratios (Appendix B), as in Hein (2004a) and in Lavoie (1995). In the case of an interest-elastic mark-up our results are slightly modified. The additional effect running through a variation of the mark-up and the profit share may be either negative or positive depending on the values of the parameters α and τ in the investment function, and on the initial debt-capital-ratio. The extent to which this additional effect influences the direction and the magnitude of the total effect of interest rate variations on the debt-capital ratio depends on the initial interest rate.

In the present model, the relation between the interest rate and the equilibrium debt-capital-ratio, therefore, does not only depend on the parameters of the saving and the investment function, but also on initial conditions, i.e. on the debt-capital-ratio in the initial equilibrium in the case of a stable long run equilibrium and also on the level from which interest rates start to change in the case of an interest-elastic mark-up. These path-dependence features are absent from Lavoie's (1995) 'Minsky-Steindl-model' but they are similar to those derived in Hein (2004a).

From the analysis so far it has become clear that the short run and long run effects of interest rate policies in our model may depend on the rentiers' propensity to save, the elasticities of investment with respect to capacity utilisation and to internal funds, and on initial values of the interest rate and the equilibrium debt-capital-ratio. This is summarised in equations (23)-(26) which display the long run effects of interest rate variations on the endogenous variables of the model:

$$\frac{\partial u}{\partial i} = \frac{\left(\lambda + i\frac{\partial \lambda}{\partial i}\right)(1 - s_Z - \tau) - \frac{\partial h}{\partial i}(1-\tau)\frac{u}{v}}{\frac{h}{v}(1-\tau) - \beta}, \tag{24}$$

$$\frac{\partial g}{\partial i} = \frac{\left(\lambda + i\frac{\partial \lambda}{\partial i}\right)\left[\beta(1 - s_Z) - \tau\frac{h}{v}s_Z\right] - \frac{\partial h}{\partial i}\beta\frac{u}{v}}{\frac{h}{v}(1-\tau) - \beta}, \tag{25}$$

$$\frac{\partial r}{\partial i} = \frac{\left(\lambda + i\frac{\partial \lambda}{\partial i}\right)\frac{h}{v}(1 - s_Z - \tau) - \frac{\partial h}{\partial i}\beta\frac{u}{v}}{\frac{h}{v}(1-\tau) - \beta}. \tag{26}$$

5. Model behaviour when interest rates change: a simple case

In what follows, we will trace the short and long run effects of changing interest rates through the model. Only stable goods market equilibria will be considered, but potential long run instability in the debt-capital-ratio is taken into account. For the sake of simplicity, our analysis of the effects on real variables is confined to the accumulation rate, and only the case of an interest-inelastic mark-up is explicitly discussed. The chosen simplifications make our results directly comparable to those derived by Lavoie (1995) and Hein (2004a). They have the additional advantage that the model behaviour following interest rate variations only depends on the rentiers' propensity to save (s_Z), the investment elasticities with respect to capacity utilisation (β) and to internal funds (τ), and on the initial equilibrium debt-capital-ratio (Table 2).

Table 2: Effects of interest rate variations with an interest-inelastic mark-up			
		$\beta(1-s_Z)-\tau\frac{h}{v}s_Z$	
		+	–
1. Interest rate and equilibrium accumulation rate in the short run	$\frac{\partial g}{\partial i}$, λ constant, equation (15)	+	–
2. Interest rate and long run equilibrium debt-capital-ratio	$\frac{\partial \lambda}{\partial i}$, equation (23)	–, if λ > 0, if λ = $\frac{s_Z\left[\frac{h}{v}(1-\tau)-\beta\right]}{\beta(1-s_Z)-\tau\frac{h}{v}s_Z}$ +, if λ <	–
3. Debt-capital-ratio and accumulation rate	$\frac{\partial g}{\partial \lambda}$, i constant, Appendix C	+	–
4. Interest rate and equilibrium accumulation rate in the long run	$\frac{\partial g}{\partial i}$, λ variable, equation (25)	+	+
5. Stability of long run equilibrium debt-capital-ratio	$\frac{\partial \hat{\lambda}}{\partial \lambda}$, i constant, equation (21)	– (stable)	+ (unstable)

If $\beta(1-s_Z)-\tau\frac{h}{v}s_Z > 0$, the long run equilibrium debt-capital-ratio will be stable. This requires that the rentiers' propensity to save is rather low and that investment is very responsive to capacity utilisation but very inelastic with respect to internal funds. These conditions imply, firstly, an equal distribution of financial wealth across the economy. Assuming that the propensity to consume declines with rising income, a more equal distribution of financial wealth - and hence yields from financial wealth - will amount to a lower average propensity to save. Secondly, a stable long run equilibrium implies stable conditions of finance for firms, so that in the face of variations in internal funds, triggered by changes in the interest rate or in the debt-capital-ratio, creditors do not change their willingness to long-term finance and debtors do not change their willingness to invest very much. If this is the case, the 'principle of increasing risk' and hence internal funds will only have little effect on investment. Decisions to invest are rather determined by sales expectations of firms than by the risks associated with increasing debt finance. We may expect that these conditions rather prevail in a bank-based financial system than in a capital-market based system. Bank-based systems are characterised by long-term relations between firms and creditors which are more stable than the short-term relations dominating in capital-market based systems (Grabel (1997)). Thirdly, conditions for a stable long run equilibrium can also be assumed to prevail in periods of rapid and stable capital accumulation with stable sales expectations having a high weight for investment decisions rather than in periods of stagnation with uncertain sales and profit expectations.

When the interest rate rises in a constellation with a long run stable debt-capital-ratio, in the short run, with a given debt-capital-ratio, the rate of capital accumulation will increase. In the long run, the debt-capital-ratio will vary as well with the direction of variation depending on the initial debt-capital-ratio. The rate of accumulation in the long run stable constellation moves in the same direction as the debt-capital-ratio (Appendix C). Taking the direct and indirect effects of changing interest rates - via changing debt-capital-ratios - into account, the equilibrium rate of capital accumulation will rise in the long run (Appendix A).

If $\beta(1-s_Z)-\tau\frac{h}{v}s_Z<0$, the long run equilibrium will be unstable. This constellation requires a high rentiers' propensity to save, a low elasticity of investment with respect to capacity utilisation and an elastic responsiveness to changes in internal funds. These conditions will be given, if financial wealth and the yields from financial assets are unequally distributed across the economy and if fragile relations between the financial sector and non-financial business dominate. Variations in interest rates, and hence in internal funds, then have significant effects on the willingness to finance and the willingness to invest. The 'principle of increasing risk' has a dominant effect on investment whereas changes in capacity utilisation are of minor importance. We may expect these conditions to prevail in capital market based financial systems (Grabel (1997)). Prolonged periods of economic stagnation with uncertain sales and profit expectations should also be conducive to this constellation.

If interest rates increase in a parameter constellation yielding a long run unstable debt-capital-ratio, in the short run, with a given debt-capital-ratio, capital accumulation will decrease. The long run equilibrium debt-capital-ratio will also go down (Appendix B). A falling equilibrium debt-capital-ratio should then have a stimulating effect on the equilibrium accumulation rate countervailing the short-run effect (Appendix C). In the long run, the equilibrium rate of capital accumulation will rise, also in the unstable case (Appendix B).

However, the interpretation of the effects of rising interest rates under the conditions of an unstable long run equilibrium has to take into account that changing interest rates will trigger an unstable disequilibrium process, so that the new equilibrium will not be reached. Starting from a long run equilibrium position, rising interest rates cause falling short run equilibrium accumulation rates and a falling equilibrium debt-capital-ratio in the long run. Since the actual debt-capital-ratio then exceeds the new long run equilibrium ratio, instability of this equilibrium means cumulative deviation of the actual from the equilibrium debt-capital-ratio. Therefore, the actual debt-capital-ratio will increase and finally approach unity. This unstable disequilibrium process is hence characterised by falling accumulation rates and rising debt-capital-ratios, both triggered by an increasing interest rate. Therefore, we get a macroeconomic 'paradox of debt':[23] Because of increasing interest rates, and hence decreasing internal funds, firms cut down investment in order to reduce debt-capital-ratios and interest payments. The macroeconomic effect of this individual behaviour, however, is such that the actual debt-capital-ratios and hence interest payments will increase, internal funds will decrease inducing firms to further cut down investment etc.[24] When interest rates fall, the cumulative disequilibrium process is in the opposite direction: Falling interest rates induce rising short run equilibrium rates of capital accumulation and falling actual debt-capital-ratios. When the 'paradox of debt' prevails, Kalecki's 'principle of increasing risk', i.e. a co-movement of investment and indebtedness finally setting a limit to accumulation, is irrelevant at the macroeconomic level, as was already noted by Kalecki (1937) himself.[25] The results with respect to long run instability and the macroeconomic 'paradox of debt' derived here are the same as in Lavoie (1995) and in Hein (2004a) although we have changed the accumulation function significantly.

6. Conclusions

The introduction of monetary variables into post-Keynesian models of distribution and growth is an ongoing process. Lavoie (1995) in his Kaleckian 'Minsky-Steindl-model' incorporating

[23] On the ‚paradox of debt' see, in particular, Steindl (1952, pp. 113-122), Dutt (1995) and Lavoie (1995).

[24] This process may be reinforced if commercial banks - in the face of rising indebtedness of firms - start to increase market rates beyond the initial increase in the central bank's base rate.

[25] This ‚paradox of debt' also invalidates the macroeconomic relevance of Minsky's (1975) 'financial instability hypothesis' in so far as it is related to the financing of real investment. It has to rely on a co-movement of investment and debt finally leading to a breakdown in investment due to increasing financial fragility. Our results for the unstable case also question those post-Keynesian views by Minsky (1986), Palley (1996), Rousseas, (1998) and Wray (1990) arguing for commercial banks endogenously increasing interest rates because of increasing indebtedness of firms when investment *rises* (for a critique see also Lavoie (1995, 1996)). From our analysis it rather follows that commercial banks might increase lending rates in the face of rising debt-capital-ratios and *falling* investment!

the effects of debt and debt services on capital accumulation has shown that the short run effects of interest rate variations on capital accumulation depend on the parameters in the saving and investment function allowing for negative ('normal') as well as positive ('puzzling') effects. Long run stability of the debt-capital-ratio is associated with a short run 'puzzling' case, and long run instability with the short run 'normal' case. Long run instability yields the macroeconomic 'paradox of debt'. In Hein (2004a) we have extended this analysis and have endogenously determined the rate of capacity utilisation, on the one hand. On the other, we have taken account of the effects interest rate variations might have on the distribution between wages and gross profits, using a monetary extension of the investment function proposed by Bhaduri/Marglin (1990). Our results have been quite similar to those by Lavoie (1995), but in our paper there has been some path dependence with respect to the effects of interest rate variations on the short and the long run equilibrium. The short run effects of interest variations do not only depend on the parameters in the savings and investment function but may also be affected by the debt-capital-ratio given in the short run, in the case of an interest elastic mark-up. Long run equilibrium effects of interest rate changes on the debt-capital ratio will also be influenced by the debt-capital-ratio in initial equilibrium if the long run equilibrium is stable and further on by the initial interest rate if the mark-up is interest-elastic. Long run stability is again associated with the short run 'puzzling' case, and the short run 'normal' case with long run instability. And long run instability also yields the macroeconomic 'paradox of debt'.

In the present paper we have only changed the accumulation function compared to Hein (2004a) in a way that it becomes closer to Kalecki's original writing and is also no longer liable to the critique put forward against the introduction of the profit share as an independent determinant of investment in the basic Bhaduri/Marglin investment function. Basically, however, the results in Hein (2004a) can be maintained: Short run equilibrium effects of interest rate variations on capacity utilisation, capital accumulation and the rate of profit depend on the parameters in the saving and investment function, and on the given debt-capital-ratio in the case of an interest-elastic mark-up. However, in the present paper the 'normal' case for the effects of interest rate variations on the real equilibrium becomes generally more likely, if the mark-up is interest elastic. This is due to the more 'underconsumptionist' feature of the investment function in the present model. Again we get that long run stability is associated with the short run 'puzzling' case and we have some path dependence of interest rate effects on the equilibrium debt-capital-ratio in this case. The short run 'normal' case is associated with long run instability which again yields the macroeconomic 'paradox of debt'. We can therefore conclude that the results of Kaleckian 'monetary' models of distribution and growth related to the long run instability of the debt-capital-ratio and to the 'paradox of debt' seem to be quite robust with respect to the specification of the investment function of the model.

References

Amadeo E.J. (1986): 'Notes on capacity utilisation, distribution and accumulation', *Contributions to Political Economy*, 5, pp. 83-94.

Amadeo E.J. (1986a): 'The role of capacity utilization in long period analysis', *Political Economy*, 2, pp. 147-160.

Amadeo E.J. (1987): 'Expectations in a steady-state model of capacity utilization', *Political Economy*, 3, pp. 75-89.

Arestis P. (1996): 'Kaleckis's role in post Keynesian economics: an overview', in King J.E. (ed.): *An Alternative Macroeconomic Theory: The Kaleckian Model and Post-Keynesian Economics*, Kluiwer, Boston.

Arestis P. (1996a): 'Kaleckis's role in post Keynesian economics: An overview', in King, J.E. (ed.): *An Alternative Macroeconomic Theory: The Kaleckian Model and Post-Keynesian Economics*, Kluiwer, Boston.

Bertocco G. (2001): 'Is Kaldor's theory of money supply endogeneity still relevant?', *Metroeconomica*, 52, pp. 95-120.

Bhaduri A., Marglin S. (1990): 'Unemployment and the real wage: the economic basis for contesting political ideologies', *Cambridge Journal of Economics*, 14, pp. 375-393.

Blecker, R. (2002): 'Distribution, demand and growth in neo-Kaleckian macro-models', in Setterfield M. (ed.): *The Economics of Demand-led Growth*, Edward Elgar, Cheltenham.

Ciccarone G. (1998): 'Prices and distribution in a Sraffian credit economy', *Review of Political Economy*, 10, pp. 399-413.

Dutt A.K. (1984): 'Stagnation, income distribution and monopoly power', *Cambridge Journal of Economics*, 8, pp. 25-40.

Dutt A.K. (1987): 'Alternative closures again: A comment on 'growth, distribution and inflation'', *Cambridge Journal of Economics*, 11, pp. 75-82.

Dutt A.K. (1989): 'Accumulation, distribution and inflation in a Marxian/post-Keynesian model with a rentier class', *Review of Radical Political Economics*, 21 (3), pp. 18-26.

Dutt A.K. (1992): 'Rentiers in post-Keynesian models', in Arestis P., Chick V. (eds.): *Recent Developments in Post-Keynesian Economics*, Edward Elgar, Aldershot.

Dutt A.K. (1995): 'Internal finance and monopoly power in capitalist economies: A reformulation of Steindl's growth model', *Metroeconomica*, 46, pp. 16-34.

Dutt A.K., Amadeo E.J. (1993): 'A post-Keynesian theory of growth, interest and money', in Baranzini M., Harcourt G. (eds.): *The Dynamics of the Wealth of Nations*, Macmillan, London.

Dymski G.A. (1996): 'Kalecki's monetary economics', in King J.E. (ed.): *An Alternative Macroeconomic Theory: The Kaleckian Model and Post-Keynesian Economics*, Kluiwer, Boston.

Epstein G.A. (1992): ‘Political economy and comparative central banking’, *Review of Radical Political Economics*, 24, pp. 1-30.

Epstein G.A. (1994): ‘A political economy model of comparative central banking’, in Dymski G., Pollin R. (eds): New Perspectives in Monetary Macroeconomics, University of Michigan Press, Ann Arbor.

Fazzari S.M., Hubbard R.G., Petersen B.C. (1988): ‘Financing constraints and corporate investment’, *Brooking Papers on Economic Activity*, 1, pp. 141-195.

Grabel I. (1997): ‘Savings, investment and functional efficiency: a comparative examination of national financial complexes’, in Pollin R. (ed.): *The Macroeconomics of Saving, Finance, and Investment*, University of Michigan Press, Ann Arbor.

Graziani A. (1989): ‘The theory of the monetary circuit’, *Thames Papers in Political Economy*, Spring.

Graziani A. (1994): ‘Monetary circuits’, in Arestis P., Sawyer M. (eds.): *The Elgar Companion to Radical Political Economy*, Edward Elgar, Aldershot.

Hein E. (1999): ‘Interest rates, income shares and investment in a Kaleckian model’, *Political Economy. Review of Political Economy and Social Sciences*, 5, pp. 5-22.

Hein E. (2004): *Verteilung und Wachstum. Eine paradigmenorientierte Einführung unter besonderer Berücksichtigung der post-keynesianischen Theorie*, Metropolis, Marburg.

Hein, E. (2004a): Interest rate, debt, distribution and capital accumulation in a post-Kaleckian model, *WSI Discussion Paper*, No. 133, WSI in der Hans-Böckler-Stiftung, Düsseldorf.

Hein E., Ochsen C. (2003): ‘Regimes of interest rates, income shares, savings, and investment: A Kaleckian model and empirical estimations for some advanced OECD-economies’, *Metroeconomica*, 54, pp. 404-433.

Hubbard R.G. (1998): ‘Capital-market-imperfections and investment’, *Journal of Economic Literature*, 36, pp. 193-225.

Kaldor N. (1956): ‘Alternative theories of distribution’, *The Review of Economic Studies*, 23, pp. 83-100.

Kaldor N. (1957): ‘A model of economic growth’, *The Economic Journal*, 67, pp. 591-624.

Kaldor N. (1961): ‘Capital accumulation and economic growth’, in Lutz F.A., Hague D.C. (eds.): *The Theory of Capital*, Macmillan, London.

Kaldor N. (1970): ‘The new monetarism’, *Lloyds Bank Review*, 97, July, pp. 1-17.

Kaldor N. (1982): *The Scourge of Monetarism*, Oxford University Press, Oxford.

Kaldor N. (1985): ‘How monetarism failed’, *Challenge*, May/June, pp. 4-13.

Kalecki M. (1937): ‘The principle of increasing risk’, *Economica*, 4, pp. 440-447.

Kalecki M. (1954): *Theory of Economic Dynamics*, George Allen, London.

Kalecki M. (1969): *Studies in the Theory of Business Cycles, 1933 - 1939*, Basil Blackwell, London.

Kalecki M. (1971): *Selected Essays on the Dynamics of the Capitalist Economy, 1933-70*, Cambridge University Press, Cambridge.

Keynes J.M. (1933): ‘A monetary theory of production’, in *The Collected Writings of J.M. Keynes*, Vol. XIII, Macmillan, London, 1987.

Kurz H.D. (1994): ‘Growth and distribution’, *Review of Political Economy*, 6, pp. 393-420.

Kurz H.D. (1995): ‘The Keynesian project: Tom Asimakopulos and ‘the other point of view’’, in Harcourt G.C., Roncaglia A., Rowley T. (eds.): *Income and Employment in Theory and Practice. Essays in Memory of Athanasios Asimakopulos,* St. Martin’s Press, New York.

Lavoie M. (1984): ‘The endogenous flow of credit and the post-Keynesian theory of money’, *Journal of Economic Issues*, 18, pp. 771-797.

Lavoie M. (1992): *Foundations of Post Keynesian Economic Analysis*, Edward Elgar, Aldershot.

Lavoie M. (1993): ‘A post-classical view of money, interest, growth and distribution’, in Mongiovi G., Rühl C. (eds.): *Macroeconomic Theory: Diversity and Convergence*, Cambridge University Press, Cambridge.

Lavoie M. (1995): ‘Interest rates in post-Keynesian models of growth and distribution’, *Metroeconomica*, 46, pp. 146-177.

Lavoie M. (1996): ‘Horizontalism, structuralism, liquidity preference and the principle of increasing risk’, *Scottish Journal of Political Economy*, 43, pp. 275-300.

Lavoie M. (1999): ‘The credit-led supply of deposits and the demand for money: Kaldor’s reflux mechanism as previously endorsed by Joan Robinson’, *Cambridge Journal of Economics*, 23, pp. 103-113.

Lavoie M., Godley W. (2001-2): ‘Kaleckian models of growth in a coherent stock-flow monetary framework: a Kaldorian view’, *Journal of Post Keynesian Economics*, 22, pp. 277-311.

Lavoie M., Rodriguez G., Seccareccia M. (2004): ‘Transformational growth, interest rates, and the golden rule’, in Argyros G., Forstater M., Mongiovi G. (eds.): *Growth, Distribution, and Effective Demand*, M.E. Sharpe, Armonk, New York.

Minsky H.P. (1975): *John Maynard Keynes*, Macmillan, London.

Minsky H.P. (1986): *Stabilizing an Unstable Economy*, Yale University Press, New Haven.

Moore B.J. (1988): *Horizontalists and Verticalists: The Macroeconomics of Credit Money*, Cambridge University Press, Cambridge.

Moore B.J. (1989): ‘The endogeneity of credit money’, *Review of Political Economy*, 1, pp. 65-93.

Mott T., Slattery E. (1994): The influence of changes in income distribution on aggregate demand in a Kaleckian model: stagnation vs. exhilaration reconsidered, in Davidson P., Kregel J. (eds.): *Employment, Growth and Finance*, Edward Elgar, Aldershot.

Palley T.I. (1996): ‘Accomodationism versus structuralism: time for an accommodation’, *Journal of Post Keynesian Economics*, 18, pp. 585-594.

Panico C. (1985): ‘Market forces and the relation between the rate of interest and profit’, *Contributions to Political Economy*, 4, pp. 37-60.

Panico C. (1997): ‘Government deficits in post-Keynesian theories of growth and distribution’, *Contributions to Political Economy*, 16, pp. 61-86.

Pasinetti L.L. (1974): *Growth and Income Distribution*, Cambridge University Press, Cambridge.

Pivetti M. (1985): ‘On the monetary explanation of distribution’, *Political Economy*, 1, pp. 73-103.

Pivetti M. (1987): ‘Interest and profit in Smith, Ricardo and Marx’, *Political Economy*, 3, pp. 63-74.

Pivetti M. (1991): *An Essay on Money and Distribution*, Macmillan, London.

Pivetti M. (2001): ‘Money endogeneity and monetary non-neutrality: A Sraffian perspective’, in Rochon L.-P., Vernengo M. (eds.): *Credit, Interest Rates and the Open Economy. Essays in Horizontalism*, Edward Elgar, Cheltenham.

Robinson J. (1962): *Essays in the Theory of Economic Growth*, Macmillan, London.

Rochon L.-P. (1999): *Credit, Money and Production. An Alternative Post-Keynesian Approach*, Edward Elgar, Cheltenham.

Rochon L.-P. (2000): ‘1939 - 1958: Was Kaldor an endogenist?’, *Metroeconomica*, 51, pp. 191-220.

Rochon L.-P. (2001): ‘Cambridge’s contribution to endogenous money: Robinson and Kahn on credit and money’, *Review of Political Economy*, 12, pp. 287-307.

Rousseas S. (1998): *Post Keynesian Monetary Economics*, 3rd. edition, Macmillan, London.

Rowthorn R. (1981): ‘Demand, real wages and economic growth’, *Thames Papers in Political Economy*, Autumn.

Sawyer M. (1985): *The Economics of Michal Kalecki*, M.E. Sharpe, Armonk, New York.

Sawyer M. (2001): 'Kalecki on money and finance', *European Journal of the History of Economic Thought*, 8, pp. 487-508.

Sawyer M. (2001a): 'Kalecki on imperfect competition, inflation and money', *Cambridge Journal of Economics*, 25, pp. 245-261.

Schiantarelli F. (1996): 'Financial constraints and investment: methodological issues and international evidence', *Oxford Review of Economic Policy*, 12, pp. 70-89.

Seccareccia M. (1996): 'Post Keynesian fundism and monetary circulation', in Deleplace G., Nell E. (eds.): *Money in Motion*, Macmillan, London.

Seccareccia M. (2003): 'Pricing, investment and the financing of production within the framework of the monetary circuit: some preliminary evidence', in Rochon L.-P., Rossi S. (eds.): *Modern Theories of Money*, Edward Elgar, Cheltenham.

Steindl J. (1952): *Maturity and Stagnation in American Capitalism*, 2nd. edition, Monthly Review Press, New York, London, 1976.

Steindl J. (1981): Some comments on the three versions of Kalecki's theory of the trade cycle, in: Lois, J. (Hg.), *Studies in Economic Theory and Practice*, Amsterdam u.a., S. 125-133.

Taylor L. (1985): 'A stagnationist model of economic growth', *Cambridge Journal of Economics*, 9, pp. 383-403.

Taylor L. (2004): *Reconstructing Macroeconomics. Structuralists Proposals and Critiques of the Mainstream*, Harvard University Press, Cambridge/Mass, London.

Vernengo M., Rochon L.-P. (2001): 'Kaldor and Robinson on money and growth', *European Journal of the History of Economic Thought*, 8, pp. 75-103.

Wray L.R. (1990): *Money and Credit in Capitalist Economies: The Endogeneous Money Approach*, Edward Elgar, Aldershot.

Appendix A: Effects of interest rate variations with an interest-inelastic mark-up: stable long run equilibrium

Starting from equations (23) and (25), assuming a stable short run goods market equilibrium as well as a stable long run debt-capital-ratio and an interest-inelastic mark-up, the signs of $\frac{\partial \lambda}{\partial i}$ and $\frac{\partial g}{\partial i}$ have to be determined. An interest-inelastic mark-up, i.e. $\frac{\partial h}{\partial i} = 0$, reduces (23) and (25) to:

$$\frac{\partial \lambda}{\partial i} = \frac{s_Z\left[\frac{h}{v}(1-\tau)-\beta\right]-\lambda\left[\beta(1-s_Z)-\tau\frac{h}{v}s_Z\right]}{i\left[\beta(1-s_Z)-\tau\frac{h}{v}s_Z\right]} \tag{23'}$$

and

$$\frac{\partial g}{\partial i} = \frac{\left(\lambda + i\frac{\partial \lambda}{\partial i}\right)\left[\beta(1-s_Z)-\tau\frac{h}{v}s_Z\right]}{\frac{h}{v}(1-\tau)-\beta}. \tag{25'}$$

The assumptions with respect to stability imply $\frac{h}{v}(1-\tau)-\beta > 0$ and $\beta(1-s_Z)-\tau\frac{h}{v}s_Z > 0$. Given these assumptions, the sign of $\frac{\partial \lambda}{\partial i}$ from equation (23') depends on the value of λ, because (23') can be rearranged:

$$\frac{\partial \lambda}{\partial i} = \frac{1}{i}\left\{\frac{s_Z\left[\frac{h}{v}(1-\tau)-\beta\right]}{\beta(1-s_Z)-\tau\frac{h}{v}s_Z} - \lambda\right\}. \tag{23''}$$

From this it follows:

$$\frac{\partial\lambda}{\partial i} < 0 \text{, if } \lambda > \frac{s_Z\left[\frac{h}{v}(1-\tau)-\beta\right]}{\beta(1-s_Z)-\tau\frac{h}{v}s_Z},$$

$$\frac{\partial\lambda}{\partial i} = 0 \text{, if } \lambda = \frac{s_Z\left[\frac{h}{v}(1-\tau)-\beta\right]}{\beta(1-s_Z)-\tau\frac{h}{v}s_Z}, \tag{23'''}$$

$$\frac{\partial\lambda}{\partial i} > 0 \text{, if } \lambda < \frac{s_Z\left[\frac{h}{v}(1-\tau)-\beta\right]}{\beta(1-s_Z)-\tau\frac{h}{v}s_Z}.$$

Inserting (23'') into (25') yields:

$$\frac{\partial g}{\partial i} = s_Z > 0. \tag{25''}$$

In the stable long run, rising rates of interest always have a positive effect on the equilibrium rate of capital accumulation. The same result follows from equations (17) and (19) and the assumption that $\hat{\lambda} = 0$ in long run equilibrium. Therefore, it also applies to the case of an interest-elastic mark-up.

Appendix B: Effects of interest rate variations with an interest-inelastic mark-up: unstable long run equilibrium

Again starting from equations (23) and (25) assuming a stable short run goods market equilibrium, but an unstable long run debt-capital-ratio and an interest-inelastic mark-up, the signs of $\frac{\partial\lambda}{\partial i}$ and $\frac{\partial g}{\partial i}$ have to be determined. An interest-inelastic mark-up, i.e. $\frac{\partial h}{\partial i} = 0$, reduces (23) and (25) to:

$$\frac{\partial\lambda}{\partial i} = \frac{s_Z\left[\frac{h}{v}(1-\tau)-\beta\right]-\lambda\left[\beta(1-s_Z)-\tau\frac{h}{v}s_Z\right]}{i\left[\beta(1-s_Z)-\tau\frac{h}{v}s_Z\right]} \tag{23'}$$

and

$$\frac{\partial g}{\partial i}=\frac{\left(\lambda+i\frac{\partial\lambda}{\partial i}\right)\left[\beta(1-s_Z)-\tau\frac{h}{v}s_Z\right]}{\frac{h}{v}(1-\tau)-\beta}. \tag{25'}$$

The assumptions with respect to stability imply $\frac{h}{v}(1-\tau)-\beta>0$ and $\beta(1-s_Z)-\tau\frac{h}{v}s_Z<0$. Taking these assumption into account and rearranging equation (23') always yields:

$$\frac{\partial\lambda}{\partial i}=\frac{1}{i}\left\{\frac{s_Z\left[\frac{h}{v}(1-\tau)-\beta\right]}{\beta(1-s_Z)-\tau\frac{h}{v}s_Z}-\lambda\right\}<0. \tag{23''}$$

Inserting (23'') into (25') gives:

$$\frac{\partial g}{\partial i}=s_Z>0. \tag{25''}$$

Also in the unstable long run equilibrium, rising rates of interest always have a positive effect on the equilibrium rate of capital accumulation. Again, the same result follows from equations (17) and (19) and the assumption that $\hat{\lambda}=0$ in long run equilibrium. Therefore, here it also applies to the case of an interest-elastic mark-up.

Appendix C: Feedback effects of changing debt-capital-ratios on the short-run equilibrium rates of capacity utilisation, capital accumulation and profit

Starting from equations (11), (12) and (13) feedback effects of changing long run debt-capital-ratios on the equilibrium rates of capacity utilisation, capital accumulation and profit have to be determined. We assume that changing debt-capital-ratios, for the reasons given in the text, will have no direct feedback effects on the interest rate or on the mark-up. Variations in indebtedness will hence only affect the distribution of profits between retained earnings and rentiers' income. This will in turn affect rentiers' consumption demand and firms' investment. From equations (11) - (13) we get:

$$\frac{\partial u}{\partial \lambda} = \frac{i(1 - s_Z - \tau)}{\frac{h}{v}(1-\tau) - \beta}, \tag{11'}$$

$$\frac{\partial g}{\partial \lambda} = \frac{i\left[\beta(1 - s_Z) - \tau \frac{h}{v} s_Z\right]}{\frac{h}{v}(1-\tau) - \beta}, \tag{12'}$$

$$\frac{\partial r}{\partial \lambda} = \frac{\frac{h}{v} i(1 - s_Z - \tau)}{\frac{h}{v}(1-\tau) - \beta}. \tag{13'}$$

If only stable equilibria are considered ($\frac{h}{v}(1-\tau) - \beta > 0$) and a positive rate of interest is assumed, we get the conditions displayed in Table C1:

Table C1: Responses of the profit share, the rate of capacity utilisation, the rate of accumulation and the rate of profit to a variation in the debt-capital-ratio: stable equilibria
$\frac{\partial u}{\partial \lambda} > 0$, if : $1 - s_Z - \tau > 0$
$\frac{\partial g}{\partial \lambda} > 0$, if : $\beta(1 - s_Z) - \tau \frac{h}{v} s_Z > 0$
$\frac{\partial r}{\partial \lambda} > 0$, if : $1 - s_Z - \tau > 0$

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