

# THE NAIRU, INTEREST RATE AND FINANCE

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**Abstract:** This paper develops a wage-setting/price-setting macroeconomic model that incorporates the impact that financial and monetary factors are likely to have on the determination of the NAIRU (Non-Accelerating Inflation Rate of Unemployment). The model pays particular attention to the way that the wage and price behaviour is modified when the role of the financial structure of consumption and investment expenditures is explicitly considered; based on this modification, it also addresses the influence of monetary policy stance and of banking sector's lending practices on the NAIRU. Further, the 'hysteresis' effects of finance arising from variations in private sector's outstanding debt are explored, in conjunction with the 'hysteresis' effects derived from changes in the size and composition of capital stock. The policy implications drawn from our analysis are briefly discussed with particular emphasis placed on the role that monetary policy is likely to play in the compatibility of the NAIRU with full employment.

**Keywords:** NAIRU; interest rate; debt; finance; monetary policy

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## 1. Introduction

The notion of the Non-Accelerating Inflation Rate of Unemployment (NAIRU) has been one of the most influential concepts in modern macroeconomic theory and policy-making. In conventional literature the NAIRU is conceptualized as a supply-side equilibrium point, basically determined by the operation of the labour market, with demand-side forces having only a limited impact on it (see e.g. Layard *et al.*, 1991; Nickell, 1998; Cahuc and Zylberberg, 2001, ch. 8; Ball and Mankiw, 2002).<sup>1</sup> It appears that reforms in the labour market structure are essential in order for long-run unemployment to be reduced and inflationary pressures to be suppressed (see e.g. Nickell, 1997; Nickell and Layard, 1999; IMF, 1999, 2003; Nickell *et al.*, 2005).

Alternative approaches have pinpointed that the NAIRU is also a function of factors, such as the size and composition of the capital stock and the level of aggregate demand (see e.g. Rowthorn, 1995; Sawyer, 2001, 2002, 2004, 2005, 2006; Arestis and Sawyer, 2004, pp. 77-99, 2005, 2009; Storm and Naastepad, 2007). These considerations dispute that the NAIRU is a ‘strong attractor’ of actual unemployment, calling into question its equilibrium properties hypothesized in the conventional macro-thinking. They also highlight the role of demand management policies in stimulating investment and thereby creating the necessary capacity that facilitates lower unemployment and lower inflation.

Nonetheless, a limitation of both of the above approaches is that no explicit consideration is made, which allows the NAIRU to be a function of the interest rate and of the financial structure of investment expenditures.<sup>2</sup> In this respect, Taylor (2004, pp. 88-89), Hein (2006a), Hein and Stockhammer (2007) and Stockhammer (2008) have recently argued that the interest rate is likely to be a determinant of the NAIRU since it influences the cost of external finance and thereby the price-setting equation in the NAIRU frame.<sup>3</sup>

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<sup>1</sup> See also Stockhammer (2008, pp. 488-493) for a short presentation of this view.

<sup>2</sup> Variations in the interest rate have been allowed to affect only indirectly the NAIRU through the ‘hysteresis’ mechanism (see e.g. Ball, 1999; Logeay and Tober, 2003; Blanchard, 2003; Arestis and Sawyer, 2008).

<sup>3</sup> The assertion that the interest rate is likely to affect the cost of firms and the rate of inflation has been recently formalized in the context of the New Keynesian Phillips curve (see e.g. Christiano *et al.*, 2005; Ravenna and Walsh, 2006; Chowdharry *et al.*, 2006; Rabanal, 2007; Hülsewig *et al.*, 2009).

This paper is intended to augment these recent contributions. We put forward additional channels through which monetary and financial factors are likely to influence the NAIRU. First, we allow the financial obligations of workers, which arise due to consumer borrowing, to influence wage determination. Second, we put forward wage and price-setting equations whereby the monetary channels operate via the burden of debt of workers and firms and not only via the interest rate. Third, we address a new ‘hysteresis’ mechanism through which aggregate demand and actual unemployment can arguably affect the NAIRU; this mechanism relies on the variations that are likely to be generated in private sector’s accumulated debt when fluctuations in the level of economic activity take place.

A further aim of this paper is to explore the interplay between these monetary and financial channels and the effects that endogenous changes in the size and composition of capital stock are likely to have on the determination of the NAIRU. In light of this objective, the model developed in the paper is sketched as an extension of the NAIRU model that has been put forward by Sawyer (2002, 2005, 2006) and Arestis and Sawyer (2004, pp. 73-99, 2005, 2009) -A&S henceforth-, which concentrates particular attention on the link between capital stock and the NAIRU.

The remainder of the paper is organized along the following lines. Section 2 sets out the structure and the basic features of the model. Sections 3 and 4 describe how the debt cash payment commitments (interest plus principal repayments) of workers and firms can be embodied into the wage and price-setting macroeconomic framework. Section 5 analyzes the properties of the NAIRU in a credit/money-using economy and discusses the impact that the interest rate may have on the NAIRU. In section 6 the ‘hysteresis’ effects of finance are introduced and their interplay with the ‘hysteresis’ effects of capital stock is addressed; further, the implications for the compatibility of the NAIRU with full employment are discussed. Section 7 provides some concluding remarks.

## **2. The structure and the basic features of the model**

Our closed economy consists of households, firms, commercial banks and a central bank. Households are subdivided into worker households and rentier households.<sup>4</sup>

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<sup>4</sup> See Hein (2008, ch. 10) and van Treeck (2009) for a similar distinction.

Worker households receive wage bill by participating in the production process. A part of their consumption expenditures is financed by borrowing from commercial banks. Hence, at any point of time they have to comply with cash payment commitments on their outstanding debt (interest plus principal repayments). These are given by the following expression:

$$DCC_w = (r + rep_w) \cdot D_w \quad (1)$$

where  $r$  is the lending interest rate,  $0 < rep_w < 1$  is the fraction of debt that is amortized in each period by worker households and  $D_w$  is the amount of the outstanding consumer debt. It is essential to be noted that, while worker households are portrayed as dissavers in our model, it is possible in some periods their consumption to be lower than their disposable income. At the aggregate level, this is the case when the new amount of borrowing is lower than the repayment of the principal.

The burden of debt of worker households (at the aggregate level) is defined as the ratio of debt cash payment commitments to their wage bill:<sup>5</sup>

$$bur_w = \frac{DCC_w}{WL} \quad (2)$$

where  $W$  is the wage rate and  $L$  is the level of employment.

Rentier households receive only capital income (interest and distributed profits).<sup>6</sup> They do not borrow from banks and save a part of their disposable income in the form of deposits and equities issued by firms and banks.

Firms carry out production activity and take on corporate debt to materialize their investment plans. In similar vein with worker households, their debt cash payment commitments are expressed as:<sup>7</sup>

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<sup>5</sup> See Godley and Lavoie (2007, p. 394) and van Treeck (2009) for a similar definition.

<sup>6</sup> A more realistic assumption would be to allow rentier households to receive both wage and capital income. However, such an assumption would further complicate our model without having something to offer to the main arguments developed in the paper.

<sup>7</sup> See Tymoigne (2006) for a similar definition of the debt cash payment commitments of firms.

$$DCC_F = (r + rep_F)D_F \quad (3)$$

where  $0 < rep_F < 1$  stands for the fraction of debt that is amortized in each period by firms and  $D_F$  designates the amount of the outstanding corporate debt. Note that the lending interest rate is considered for simplicity to be the same for consumer and corporate lending.

The burden of debt of firms at the aggregate level is expressed as:

$$bur_F = \frac{DCC_F}{PQ - WL} \quad (4)$$

where  $Q$  is the total output produced and  $P$  is the price level.

If we write  $Q = nq$ ,  $L = nl$  and  $DCC_F = ndcc_F$  (where  $n$  is the number of identical firms in the economy,  $q$  is the output produced at the firm level,  $l$  is the number of labourers employed in each firm and  $dcc_F$  denotes the debt cash payment commitments of each firm) the burden of debt of each firm is given by:<sup>8</sup>

$$bur_F = \frac{dcc_F}{Pq - Wl} \quad (4')$$

The inflationary process and the NAIRU are modelled in terms of wage and price-setting equations. Wages are settled in a collective bargaining framework (see e.g. Layard *et al.*, 1991, ch. 2; Cahuc and Zylberberg, 2001, ch. 7; Arestis and Sawyer, 2004, pp. 73-99, 2005) and prices are set as a mark-up over the average labour cost in the context of an imperfectly competitive product market (see e.g. Layard *et al.*, 1991, ch. 7; Nickell, 1998; Arestis and Sawyer, 2004, pp. 73-91, 2005; Sawyer, 2005, 2006). The

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<sup>8</sup> Note that expression (4') is derived from expression (4) by dividing the numerator and denominator by  $n$ . This explains why the burden of debt at the aggregate level is equivalent to the burden of debt at the firm level.

lending interest rate is determined by commercial banks as a mark-up ( $m_B$ ) over the discount interest rate ( $r_C$ ) determined by central bank's interest rate policy:<sup>9</sup>

$$r = m_B r_C \quad (5)$$

Note that  $m_B$  is supposed to be basically determined by the degree of competition in banking sector; higher competition drives down  $m_B$ , and *vice versa*. Further, the profits of banks, which are generated by lending worker households and firms, are hypothesized to be all distributed to rentier households.

Money is endogenously created when commercial banks provide loans to creditworthy worker households and firms. The endogeneity of money implies that the real balance effect does not operate in our model; the later could be valid only in the case of an exogenously given nominal money supply.<sup>10</sup> It is also essential to underscore that, as in A&S,<sup>11</sup> the NAIRU (defined as the rate of unemployment at which inflation remains constant) is treated to be time-varying, actual unemployment does not necessarily gravitates towards it (this will explained in more detail below) and 'hysteresis' mechanisms are considered to play a prominent role in its determination.

### 3. Debt cash payment commitments and the wage-setting equation

Our formalization for the wage-setting draws on Arestis and Sawyer (2009, pp. 35-36) whereby the nominal wage growth depends on expected inflation plus and an 'error correction' mechanism.<sup>12</sup> In particular:

$$\dot{w} = \phi \dot{p}^e + \theta_w (\omega_w^T - \omega_{-1}) \quad (6)$$

where  $w$  denotes the log nominal wage rate,  $p$  is the log price level (the subscript  $e$  denotes expectations),  $\phi$  reflects the extent to which expected inflation is passed on to

<sup>9</sup> See e.g. Lima and Meirelles (2003) and Sawyer (2005).

<sup>10</sup> See e.g. Arestis and Sawyer (2004, p. 85; 2009, pp. 43-44).

<sup>11</sup> See, in particular, Arestis and Sawyer (2004, pp. 85-86; 2005, pp. 961; 2009, pp. 41-43).

<sup>12</sup> Similar formulations have been presented by Casseti (2003), Setterfield (2009) and Harck (2009). See also Blanchard and Katz (1999), Cahuc and Zylberberg (2001, pp. 482-483) and Ball and Moffitt (2002) for some different wage-setting specifications that embed an 'error correction' term.

nominal wage growth ( $0 < \phi \leq 1$ ),  $\theta_w$  is a positive adjustment coefficient,  $\omega = W / P$  stands for the real wage and  $\omega_w^T$  designates the target real wage of workers in the collective bargaining procedures. The second term in equation (6) captures the ‘error correction’ mechanism and reveals that wage growth increases when the lagged real wage falls short of the target real wage of workers; and *vice versa*.

Before we embark upon the presentation of the factors that influence the target real wage of workers, it is worthy to mention that in our model labour productivity ( $\lambda$ ) is allowed to be affected both by variations in the rate of capacity utilization and in the size of capital stock. In particular, we consider the following formula:

$$\lambda = \Lambda \left( u^{(+,-)}, \lambda_k^{(+)}(k) \right) \quad (7)$$

where  $u$  is the rate of capacity utilization,  $k$  the per firm capital stock and  $\lambda_k$  the capital-determined component of labour productivity. The rate of capacity utilization is given by the ratio  $\frac{q}{v \cdot k}$ , where  $v$  is the potential output ( $q^*$ ) to capital ratio<sup>13</sup> (presumed to be technologically fixed). Following A&S, we assume that there are variable returns to scale; more precisely, we suppose that the increase in capacity utilization triggers a positive effect on labour productivity at low values of capacity utilization (i.e.  $\Lambda'(u) > 0$ ) and a negative one at high values of capacity utilization (i.e.  $\Lambda'(u) < 0$ ). Moreover, the productivity of labour is considered to increase as a result of investment in capital stock.

Equation (8) gives the target real wage of workers:

$$\omega_w^T = w_0 + w_1 E + w_2 \lambda_k + w_3 \omega_{WB} \quad (8)$$

where  $w_i > 0$  ( $i = 0, 1, 2$ );  $w_3 \geq 0$

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<sup>13</sup> Note that  $\frac{q}{k} = \frac{q}{q^*} \cdot \frac{q^*}{k} = u \cdot v$ .

In expression (8),  $w_0$  captures the autonomous wage claims that depend on the institutional setting of labour market; a more rigid (flexible) labour market is associated with higher (lower) wage claims. The term  $w_1 E$  mirrors the positive effect of the rate of employment ( $E$ ) on the bargaining power of labour unions and thereby on their target real wage (see e.g. Dutt, 1992; Casseti, 2002; Lima, 2004; Setterfield, 2007). The term  $w_2 \lambda_k$  reflects the fact that workers are concerned about their income share which implies that changes in the labour productivity may exert a positive impact on their target real wage (see e.g. Setterfield and Lovejoy, 2006, pp. 123).<sup>14</sup> Lastly,  $\omega_W^T$  is assumed to be positively affected by  $\omega_{WB}$ ; the latter is defined as the real wage that, at given debt cash payment commitments and level of employment, makes the actual burden of debt of workers equal to their target one ( $bur_W^{TW}$ );  $w_3$  captures the elasticity of the target real wage with respect to  $\omega_{WB}$ .

In our frame, worker households' target burden of debt is exogenously given. It is presumed to be higher the higher is worker households' urge to consume (which depends on the norms of consumption) and the lower is the perceived degree of uncertainty and financial insecurity. The workers are hypothesized to estimate  $\omega_{WB}$  by using as a reference point the price level of the previous period. Therefore, dividing the numerator and denominator in equation (2) by  $P_{-1}$ , setting  $bur_W = bur_W^T$  and solving for the real wage yields:

$$\omega_{WB} = \frac{DCC_W}{bur_W^{TW} P_{-1} L} \quad (9)$$

Expressions (8) and (9) reveal that the debt cash payment commitments of worker households are likely to positively affect their target real wage. This argument draws on the contributions of Taheri (1995) and Palley (2003), who have claimed the existence of a positive relation between nominal wage demands and workers' financial obligations. More specifically, these scholars assert that the desire of workers to prevent a rise in the burden of their outstanding debt might be a reason that explains the downward nominal

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<sup>14</sup> We assume that workers use as a point of reference only the capital-determined component of labour productivity.

wage rigidity.<sup>15</sup> In our model, workers bargain a higher (lower) real wage the higher (lower) is the real wage that is required to attain their target burden of debt. At this point it is important to be noted that, when the debt cash payment commitments are given, a rise in employment increases the wage bill; this drives down  $\omega_{WB}$  which in turn exerts downward pressures on the target real wage.

We move on to draw the wage-setting curve. We use an equilibrium relationship that equalizes the wage inflation with expected price inflation (i.e.  $\dot{w} = \dot{p}^e$ ) and presume for simplicity that  $\phi = 1$ . Thus, by plugging equation (9) into equation (8), the resulted expression into expression (6) and taking into consideration that  $E = L / LF$  (where  $LF$  stands for the level of full employment-assumed given), the wage-setting equation takes the following form:

$$\left(\frac{W}{P}\right)_{WS} = w_0 + w_1 \frac{L}{LF} + w_2 \lambda_\kappa(k) + w_3 \frac{DCC_w}{bur_w^{TW} \cdot P \cdot L} \quad (10)$$

*Figure 1* depicts the relationship between real wage and employment, as it is captured by equation (10);<sup>16</sup> note that  $FE$  is the full employment vertical line.<sup>17</sup> This curve reveals that the relationship between employment and real wage is a non-linear one with the slope of the curve being negative at low levels of employment and positive at high ones. Intuitively, at low levels of employment the decrease that is triggered in the ratio  $\frac{DCC_w}{bur_w^{TW} \cdot P \cdot L}$  by the increase in the level of employment, overcompensates the positive effect on the real wage arising from the higher bargaining power of workers. The reverse occurs at high levels of employment. The turning point, where the relationship

<sup>15</sup> Taheri (1995) calls this explanation the ‘real debt resistance hypothesis’ and presents econometric evidence that supports its validity.

<sup>16</sup> Note that the curve in *figure 1* corresponds to the facts that, from equation (10):

(i)  $\frac{\partial(W/P)_{WS}}{\partial L} = \frac{w_1}{LF} - \frac{w_3 DCC_w}{bur_w^{TW} \cdot P \cdot L^2}$  which is positive for  $L > L_w$  and negative for  $L < L_w$  ( $L_w$  is defined in expression 11).

(ii)  $\frac{\partial^2(W/P)_{WS}}{\partial L^2} = \frac{2w_3 DCC_w}{bur_w^{TW} \cdot P \cdot L^3} > 0$ .

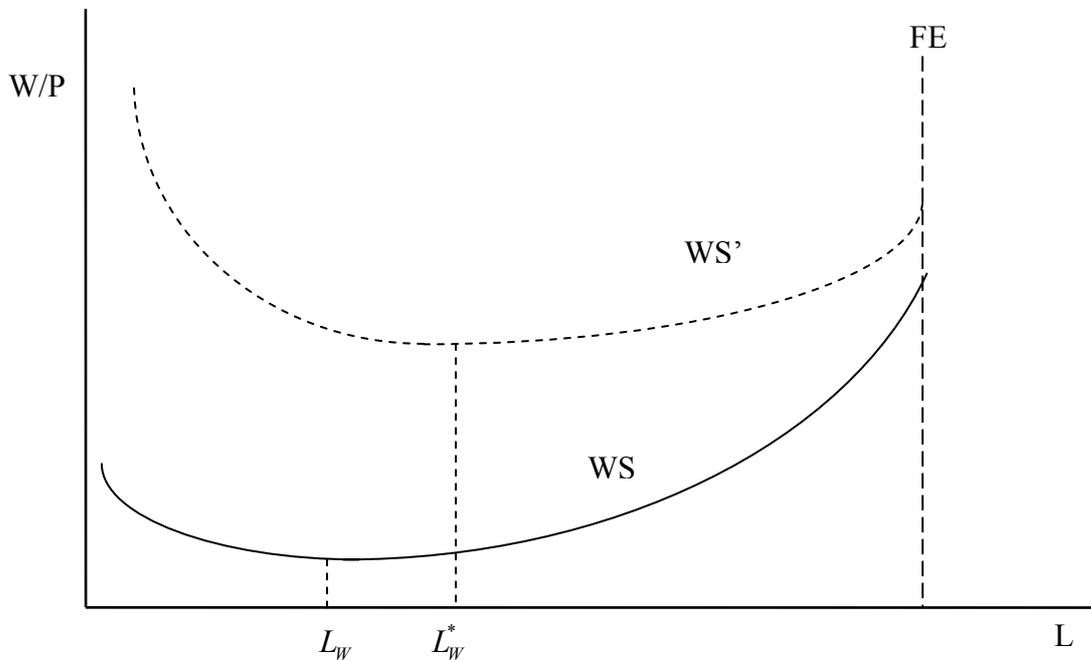
<sup>17</sup> In *figure 1* the wage-setting curve intersects the full employment vertical line. This implies that even at full employment workers are allowed to experience financial and other losses in the case that they loose their jobs. Consequently, real wages determined in the bargaining procedure do not increase without limit when full employment is approached (which is stands in contrast to what is, for instance, implied by the model of Shapiro and Stiglitz, 1984). For a further discussion on this issue see Sawyer (2002, pp. 84-85).

between real wages and employment turns from a negative to a positive one, is given by:<sup>18</sup>

$$L_w = \sqrt{\frac{w_3 \cdot DCC_w \cdot LF}{bur_w^T \cdot P \cdot w_1}} \quad (11)$$

Let us suppose now that there is an exogenous increase in the debt cash payment commitments of worker households. The result is pictured in *figure 1*. The wage setting curve shifts upwards and the turning point moves to the right from  $L_w$  to  $L_w^*$  (see equation 11). Thus, it turns out that a rise in  $DCC_w$  is likely to lead to a higher real wage in the wage bargaining procedures. Furthermore, it is worthy to remark that WS' becomes steeper (flatter) at low (high) levels of employment since variations in employment trigger now more significant changes in the ratio  $\frac{DCC_w}{bur_w^T \cdot P \cdot L}$ .<sup>19</sup>

**Figure 1:** The shift in wage-setting curve triggered by an increase in the debt cash payment commitments of worker households



<sup>18</sup> This is derived by setting  $\frac{\partial(W/P)_{WS}}{\partial L}$  equal to zero.

<sup>19</sup> This is because the absolute value of the slope of the curve increases (decreases) on the left (right) of  $L_w$  (see the first partial derivative in footnote 16).

#### 4. Debt cash payment commitments and the price-setting equation

In this section the relationship between real wages and employment is derived from price determination considerations. The formalization adopted draws on Sawyer (2006, pp. 336-337) and Arestis and Sawyer (2009, p. 37) whereby price inflation depends on expected wage inflation plus the discrepancy between the actual (lagged) real wage and firms' target one. More precisely, we postulate the following relationship:

$$\dot{p} = \dot{w}^e + \theta_p(\omega_{-1} - \omega_F^T) \quad (12)$$

where  $\theta_p$  is a positive adjustment coefficient and  $\omega_F^T$  is the target real wage of firms.

Since firms charge the price of their products as a mark-up ( $M > 1$ ) over the average labour cost, it holds that:<sup>20</sup>

$$P = M \frac{W}{\lambda} \quad (13)$$

Rearranging yields:

$$\frac{W}{P} = \frac{\lambda}{M} \quad (13')$$

The desired real wage of firms can then be seen to be a positive function of labour productivity and a negative function of the mark-up. This leads us to sketch the target real wage of firms by using the following functional form (note that this expression refers to the firm level):

$$\omega_F^T = f_0 - f_1 \left[ u + \frac{u^{*2}}{u} \right] + f_2 \lambda_\kappa + f_3 \omega_{FB} \quad (14)$$

where  $f_i > 0$  ( $i = 0, 1, 2$ );  $f_3 \geq 0$

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<sup>20</sup> Recall that in our model there are no open economy considerations. Hence, no material costs are embodied in our price-setting equation. We also abstract from overheads.

The term  $f_0$  reveals the autonomous profit claims of firms which are related to the degree of competition in the product market; a higher degree of product market competition is associated with a lower  $f_0$ ; and *vice versa*. The second term reveals how variations in capacity utilization affect labour productivity and the mark-up (and thereby the target real wage). As it has been alluded to in the previous section, our model adopts the hypothesis of variables returns to scale. Here, we more precisely assume that  $\Lambda'(u) > 0$  when  $u < u^*$  and  $\Lambda'(u) < 0$  when  $u > u^*$ ;  $u^*$  designates the rate of capacity utilization at which the returns to scale turn from positive to negative. Furthermore, we follow A&S<sup>21</sup> and allow the partial derivative of mark-up with respect to capacity utilization to be negative for low values of capacity utilization and positive for high ones. For the sake of simplicity, we suppose that this change occurs for  $u = u^*$ . The functional form adopted in equation (14) captures these considerations. It can be easily derived that  $\frac{\partial \omega_F^T}{\partial u} > 0$  for  $u < u^*$  and  $\frac{\partial \omega_F^T}{\partial u} < 0$  for  $u > u^*$ .<sup>22</sup> The term  $f_2 \lambda_k$  reflects that an increase (decline) in the capital-component of labour productivity makes lower (higher) the unit labour cost and hence increases (decreases) the willingness of firms to offer a higher real wage.<sup>23</sup>

Lastly, the variable  $\omega_{FB}$  in expression (14) denotes the real wage that is conceived to equalize the actual firms' burden of debt with their target one ( $bur_F^{TF}$ ); note that  $f_3$  stands for the responsiveness of the target real wage to  $\omega_{FB}$ . It should be drawn to attention that firms' target burden of debt is exogenously given and relies on their expectations and state of confidence. By presuming that firms estimate  $\omega_{FB}$  by using as a reference point the price level of the previous period, we can set  $P = P_{-1}$  in expression (4'), divide the numerator and denominator by  $P_{-1}$ , set  $bur_F = bur_F^{TF}$ , utilize the fact that  $q = \lambda_k l$ <sup>24</sup> and solve for the real wage:

<sup>21</sup> See e.g. Arestis and Sawyer (2005, p. 964).

<sup>22</sup> It holds that  $\frac{\partial \omega_F^T}{\partial u} = -f_1 + f_1 \frac{u^{*2}}{u^2}$ . Hence, it follows that  $\frac{\partial \omega_F^T}{\partial u} = 0$  for  $u = u^*$ .

<sup>23</sup> Similarly with worker households, we postulate that firms use as a reference point the capital-determined component of labour productivity.

<sup>24</sup> For reasons of simplicity, in the procedure of mapping out output to employment we abstract from the effects that variations in the level of output may exert on labour productivity.

$$\omega_{FB} = \lambda_{\kappa} - \frac{dcc_F}{bur_F^{TF} \cdot P \cdot l} \quad (15)$$

Expressions (14) and (15) reveal that the higher (lower) are the firms' cash payment commitments on their outstanding debt the higher (lower) is, *ceteris paribus*, the mark-up and the lower (higher) thereby the target real wage. It should be stressed that this proposition is an extension of the contributions of Panico (1988), Moore (1989a, 1989b), Pivetti (1991) and Argitis (2001) who have argued that interest is a part of production cost, which is likely to be passed on to prices.<sup>25</sup> It also draws on the empirical literature that has provided evidence in favour of this assertion (see, among others, Moore, 1989b; Sen and Vaidya, 1995; Hannsgen, 2004; Barth and Ramey, 2001; Chowdhury *et al.*, 2006; Ravenna and Walsh, 2006; Gaiotti and Secchi, 2006; Tillmann, 2008; Hülsewig *et al.*, 2009). A distinct feature of our formalization is that a higher level of employment and output increases, *ceteris paribus*, the real wage that is consistent with the attainment of firms' target burden of debt.

We insert expression (15) into equation (14) and the resulted expression into equation (12). Then, by setting  $\dot{p} = \dot{w}^e$  we obtain:

$$\left(\frac{W}{P}\right)_{PS} = f_0 - f_1 \left[ u + \frac{u^{*2}}{u} \right] + (f_2 + f_3) \lambda_{\kappa}(k) - f_3 \frac{dcc_F}{bur_F^{TF} \cdot P \cdot l} \quad (16)$$

The above expression represents the price-setting at the firm level. The transformation to the aggregate level is attained by writing  $u = \frac{L \lambda_{\kappa}(k) / n}{vk}$ ,  $l = L / n$  and  $dcc_F = DCC_F / n$ . Thus,

$$\left(\frac{W}{P}\right)_{PS} = f_0 - Z_1 \cdot L - Z_2 \frac{1}{L} + (f_2 + f_3) \lambda_{\kappa}(k) \quad (16')$$

where:

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<sup>25</sup> Some price-setting equations that integrate this effect can be found in Dutt (1990-1), Sen and Vaidya (1995), Argitis and Pitelis (2001), Lima and Meirelles (2003), Taylor (2004, pp. 88-90), Hein (2006a, 2006b, 2007), Hein *et al.* (2008) and Lima and Setterfield (2010).

$$Z_1 = \frac{f_1 \cdot \lambda_\kappa(k)}{n \cdot v \cdot k}$$

$$Z_2 = f_1 \frac{u^{*2} n \cdot v \cdot k}{\lambda_\kappa(k)} + f_3 \frac{DCC_F}{bur_F^{TF} \cdot P}$$

Using equation (16') and allowing the level of employment to play the role of the exogenous variable, we can draw the price-setting curve that represents the desired real wage from the perspective of firms. This is portrayed in *figure 2*.<sup>26</sup> At low levels of employment an increase in output (and employment) triggers a positive effect on the real wages that firms are willing to offer. The reason is that at low capacity utilization rates, an increase in employment exerts a positive effect on labour productivity and a negative one on mark-up; meanwhile, there is a decrease in the ratio  $\frac{DCC_F}{bur_F^T \cdot P \cdot L}$ .

On the other hand, at high utilization rates a rise in employment results in a decrease in labour productivity and in an increase in the mark-up. On the right side of  $L_p$  these two effects are strong enough to overwhelm the negative impact that higher employment exerts on mark-up by decreasing the ratio  $\frac{DCC_F}{bur_F^T \cdot P \cdot L}$ . Consequently, the price-setting curve becomes downward-sloping. It should be noted that the turning point is given by the following expression:<sup>27</sup>

It should be noted that the turning point is given by the following expression:<sup>27</sup>

$$L_p = \sqrt{\frac{Z_2}{Z_1}} \quad (17)$$

Supposing an increase in the debt cash payment commitments of firms the price-setting curve will shift from PS to PS' (*figure 2*). The real wage will be lower at every level of

<sup>26</sup> The shape of the price-setting curve is explained by the facts that, from equation (16'):

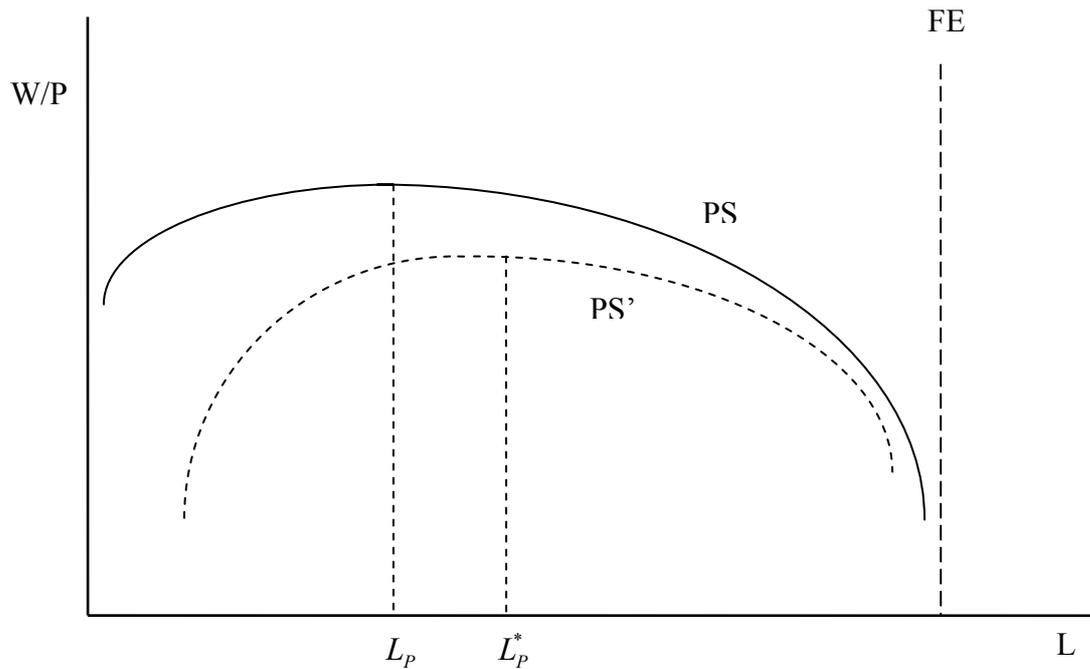
(i)  $\frac{\partial(W/P)_{PS}}{\partial L} = -Z_1 + \frac{1}{Z_2 L^2}$  which is positive for  $L < L_p$  and negative for  $L > L_p$  ( $L_p$  is defined in expression 17).

(ii)  $\frac{\partial^2(W/P)_{PS}}{\partial L^2} = -\frac{2}{Z_2 L^3} < 0$ .

<sup>27</sup>  $L_p$  is derived by setting  $\frac{\partial(W/P)_{PS}}{\partial L}$  equal to zero.

employment with the price-setting curve being steeper at low levels of employment and flatter at high ones.<sup>28</sup> Further, the turning point will shift from  $L_p$  to  $L_p^*$ .

**Figure 2:** The shift in price-setting curve arising from an increase in the debt cash payment commitments of firms



### 5. The NAIRU in a money/credit-using economy - the role of the interest rate

Let us now bring together in the same diagram the wage and price-setting curves (*figure 3*). The NAIRU corresponds to the points where the two curves intersect; at these points inflation is constant since the real wages that firms are willing to offer coincide with the real wages determined in the bargaining procedure. Algebraically, these two points are obtained by setting  $(W/P)_{WS} = (W/P)_{PS}$ . Substituting from expressions (10) and (16') yields:

<sup>28</sup> This is because the absolute value of slope of the curve increases (decreases) on the left (right) of  $L_p$  (see the first partial derivative in footnote 26).

$$\left[ \frac{w_1}{LF} + Z_1 \right] L + \left[ \frac{w_3 DCC_W}{P \cdot bur_W^{TW}} + Z_2 \right] \frac{1}{L} + [w_0 - f_0 + (w_2 - f_2 - f_3)\lambda_k] = 0 \quad (18)$$

Equation (18) has two unit roots given by:

$$L_1 = \frac{-[w_0 - f_0 + (w_2 - f_2 - f_3)\lambda_k] + \sqrt{[w_0 - f_0 + (w_2 - f_2 - f_3)\lambda_k]^2 - 4 \left[ \frac{w_1}{LF} + Z_1 \right] \left[ \frac{w_3 DCC_W}{P \cdot bur_W^{TW}} + Z_2 \right]}}{2 \left[ \frac{w_1}{LF} + Z_1 \right]} \quad (19)$$

$$L_2 = \frac{-[w_0 - f_0 + (w_2 - f_2 - f_3)\lambda_k] - \sqrt{[w_0 - f_0 + (w_2 - f_2 - f_3)\lambda_k]^2 - 4 \left[ \frac{w_1}{LF} + Z_1 \right] \left[ \frac{w_3 DCC_W}{P \cdot bur_W^{TW}} + Z_2 \right]}}{2 \left[ \frac{w_1}{LF} + Z_1 \right]} \quad (20)$$

In order for the two curves to intersect at points that exhibit economically meaningful levels of employment it is postulated that:

- (i)  $w_0 - f_0 + (w_2 - f_2 - f_3)\lambda_k < 0$
- (ii)  $[w_0 - f_0 + (w_2 - f_2 - f_3)\lambda_k]^2 - 4 \left[ \frac{w_1}{LF} + Z_1 \right] \left[ \frac{w_3 DCC_W}{P \cdot bur_W^{TW}} + Z_2 \right] > 0$

In *figure 3*, it holds that  $0 < L_2 < L_1 < LF$ ; point A and B have been depicted to correspond to  $L_1$  and  $L_2$  respectively. It turns out that the NAIRU in a money/credit-using economy might not be unique. The NAIRU corresponding to point B exhibits considerable excess capacity and high levels of unemployment; instead, point A corresponds to a NAIRU that is closer to full employment.

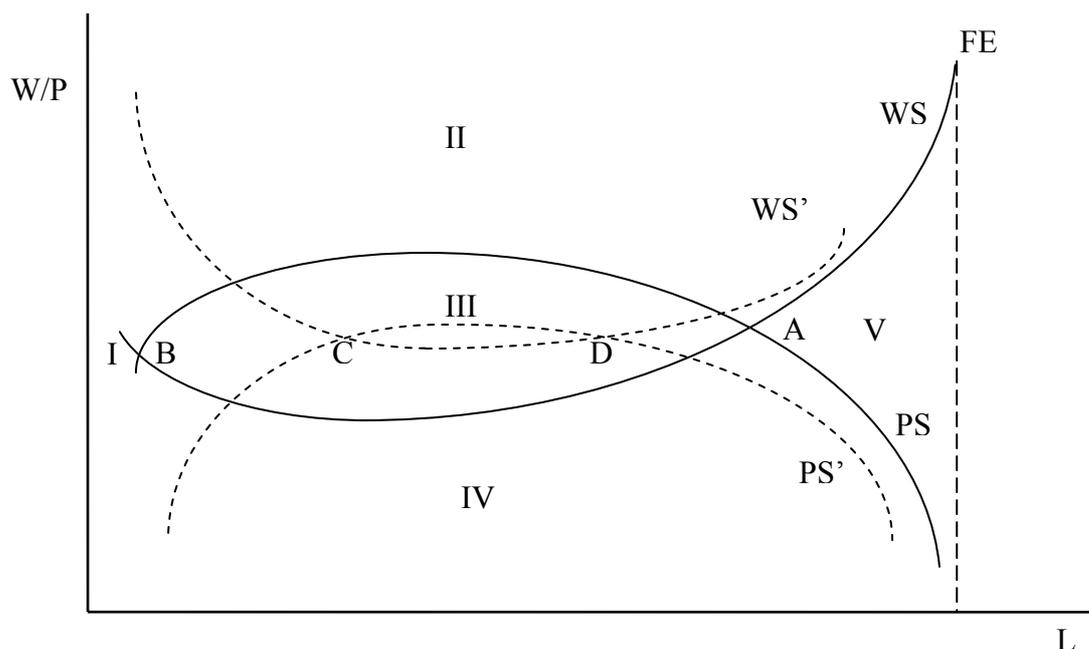
It should be pointed out that, as in A&S (see e.g. Sawyer, 2001, pp. 237-238; Sawyer, 2002, pp. 76-78; Arestis and Sawyer, 2009, pp. 43-44),<sup>29</sup> both NAIRU points are ‘weak attractors’ of actual unemployment and of real wages since it cannot be *a priori* stated that the capital stock in the economy will be adequate to support the corresponding

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<sup>29</sup> See also Sawyer (2004).

levels of output as well as that the aggregate demand and real wage will adjust accordingly. In order to explain in greater detail this ‘non-attractiveness’ of the NAIRU in our model we shall use *figure 3* whereby the wage and price-setting curves divide the space into 5 zones (I, II, III, IV, V).

**Figure 3:** The NAIRU in a money/credit-using economy - the effects of a rise in the lending interest rate



Let us first concentrate attention on the real wage adjustment. In zones I and V wages tend to rise faster than prices from wage determination considerations and prices tend to rise faster than wages from pricing considerations. Hence, these zones involve an inflationary spiral, which implies that a money/credit-using economy can experience increasing inflation both at very low and at very high unemployment rates; meanwhile, the movement of the real wages in these zones depends on the relative size of the wage and price inflation and cannot be, therefore, determined *a priori*. In zone II (IV) wages fall (rise) relative to prices from wage determination considerations and prices rise (fall) relative to wages from price-setting considerations so that real wages tend to fall (rise). Finally, in zone III the economy experiences a disinflationary spiral as the reverse of the situation that characterizes zones I and V applies. Note also that the movement of the real wages is again ambiguous. It becomes, therefore, clear that there is no specific mechanism that safeguards that the real wage will gravitate toward a level, corresponding to either point A or B, irrespective of the initial position of the economy.

We proceed to examine whether aggregate demand adjusts towards a level consistent with the NAIRU points. By adopting a Kaleckian approach it can be argued that aggregate demand is a function of the distribution of income in the economy (see e.g. Sawyer, 1997; Arestis and Sawyer, 2004, pp. 73-91; Stockhammer, 2004, 2008). Thus, the analysis of any adjustment mechanism of aggregate demand should take into consideration the demand regime of the economy. If the economy is characterized by a ‘wage-led’ demand regime, a decrease (rise) in the real wage will lead to a fall (rise) in aggregate demand. The opposite holds in the case of a ‘profit-led’ demand regime.<sup>30</sup> Hence, by combining the ambiguity with respect to the demand regime of an economy with the fact that (as it has been illustrated in the previous paragraph) the direction of the change in real wages is indeterminate, it follows that no adjustment of aggregate demand to points A and B can be *a priori* hypothesized.

The situation becomes even more complicated if one considers the effects that are triggered on aggregate demand when there is a change in the income of rentier households, as a result of variations in the inflation rate. An inflationary spiral is likely to decrease the real interest income of banks and to shift income from rentier households to firms and workers;<sup>31</sup> on the other hand, a deflationary spiral redistributes income in favour of rentier households. Hence, if the decrease in the interest payments is expansionary, the inflationary spiral will be favourable for aggregate demand; the reverse holds if the decline in interest payments is contractionary.<sup>32</sup> One should also take into consideration that inflation is likely to cause a decline in the real value of the accumulated effect with positive feedback effects on consumption and investment expenditures. It seems therefore reasonable to argue that in a money/credit-using economy no automatic forces exist which serve to bring the aggregate demand and unemployment into line with the NAIRU level.<sup>33</sup>

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<sup>30</sup> The distinction between the ‘wage-led’ and the ‘profit-led’ demand regime corresponds to the distinction of Bhaduri and Marglin (1990) and Marglin and Bhaduri (1990) between the ‘stagnationist’ and the ‘exhilarationist’ regime. See also Blecker (2002) and Bhaduri (2008).

<sup>31</sup> Recall that the profits of banks are distributed to rentier households.

<sup>32</sup> In Lavoie (1995) and Hein (2006a, 2006b, 2007) a negative effect of interest payments on aggregate demand is labeled ‘normal’ case and a positive one is termed ‘puzzling’ case. It should be noted, however, that in their models no consideration is made for the interest payments of workers.

<sup>33</sup> See also Hein (2006a) for a more detailed discussion of the stability of the NAIRU when the role of rentiers is taken into consideration.

Let us suppose now that an increase in the lending interest rate occurs. The reason might be either a policy-induced increase in the discount rate of the Central Bank ( $r_{CB}$ ) and/or an exogenous increase in the degree of the oligopoly structure in the commercial banking sector, which is likely to lead to a higher  $m_B$ . A direct result is that the debt cash payment commitments of both workers and firms increase (see expressions 1 and 3), which in turn implies that the price-setting curve shifts downwards to  $PS'$  and the wage-setting curve shifts upwards to  $WS'$ , as it is portrayed in *figure 3*. The new NAIRU points are C and D. Although point C is now closer to full employment (compared to point B) point D is located at a greater distance from it (compared to point A).<sup>34</sup>

The above result reveals an interesting policy implication. Suppose that the initial level of employment is on the right of point A and within zone V. Suppose further that the central bank focuses on price stability and, following a ‘Taylor-rule’ type monetary policy,<sup>35</sup> manipulates the interest rate in the pursuit of suppressing the inflationary pressures. This implies that, since inflation increases, the central bank is likely to respond by decreasing the discount interest rate with the intention to trigger a fall in aggregate demand and thereby in inflation. According to the ‘new consensus macroeconomics’ (see e.g. Allsopp and Vines, 2000; Romer, 2000; Meyer, 2001; McCallum, 2001; Woodford, 2003; Goodfriend, 2007; Galí and Gertler, 2007) such a policy response is sufficient to lead the economy to a rate of unemployment consistent with the NAIRU. In our model, however, an increase in the interest rate makes the NAIRU corresponding to point A move leftwards (e.g. at point D). Hence, if the decrease in the unemployment rate is not power enough to counterbalance the initial discrepancy between the unemployment rate and the NAIRU as well as the difference between the initial and the new NAIRU, the above monetary policy intervention will be unable to suppress the initial inflationary pressures. It is also worthy to pinpoint that, given the aforementioned impact of the interest rate on the NAIRU, a restrictive monetary policy response entails the danger to increase the disinflation costs associated with any attempt to tame inflation by increasing the rate of unemployment.

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<sup>34</sup> This result can be easily derived from equations (19) and (20).

<sup>35</sup> See Taylor (1993).

Consider also the case of the economy being within zone I. Inside this zone inflation increases. Observing this inflationary spiral the monetary authorities are likely to respond by increasing the interest rate. This policy reaction, however, triggers two effects which, in contrast to the purposes of the central bank, both reinforce the inflationary pressures. The first is that the NAIRU will move closer to full employment (e.g. at point C) resulting in much higher inflationary pressures into region I. The second is that unemployment will probably increase making higher the discrepancy between the actual unemployment and the NAIRU; this in turn implies that the economy will arguably experience a much more important inflationary spiral.

The foregoing analysis casts, therefore, some doubts on the capacity of the ‘Taylor-rule’ type monetary policies to control changes in the inflation rate. By relying on a theoretical framework that does not account of the ‘burden of debt’ effects of interest rate variations as well as the monetary channels through which aggregate demand and employment may affect upon inflation (which in our model are reflected on the ratios  $\omega_{WB}$  and  $\omega_{FB}$ ), these policies are likely to be self-defeating and to fail in stabilizing inflation in a money/credit-using economy.<sup>36</sup>

Let us proceed by making some additional points with regard to the relationship between the interest rate and the NAIRU. *First*, it ought to be emphasized that the impact of the interest rate on the NAIRU depends crucially on the elasticities  $w_3$  and  $f_3$  of target real wages with respect to  $\omega_{WB}$  and  $\omega_{FB}$  respectively. Following Argitis (2001), Argitis and Pitelis (2001) and Hein (2007), it can be asserted that, when  $\omega_{WB}$  and  $\omega_{FB}$  are on the increase,  $w_3$  and  $f_3$  are more likely to be high in the case of rigid labour market structure and low product market competition. On the other hand, when  $\omega_{WB}$  and  $\omega_{FB}$  decrease, rigidity in labour market and low competition in product market are more likely to be associated with low values of  $w_3$  and  $f_3$ .

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<sup>36</sup> Taylor (2004, p. 89), Hein (2006a) and Lima and Setterfield (2010) have made a similar discussion on this issue. Furthermore, Ravenna and Walsh (2006), Surico (2008) and Llosa and Tuesta (2009) have recently identified and explored various problems (indeterminacy, instability etc.) that are likely to emerge with regard to the optimal monetary policy when a cost-channel of monetary policy is assumed to exist (that is when the discount interest rate is treated to affect the cost of production).

*Second*, an issue, which is linked to the above remark, is whether points C and D in *figure 3* exhibit a higher or a lower real wage compared to points B and A respectively. This seems to depend to a significant extent on the institutional structure of product and labour markets. If the degree of competition in product market and the degree of flexibility in labour market are high, a rise in the lending interest rate will result in a slight upward shift of the wage-setting curve and a slight downward shift of the price-setting curve. Consequently, it cannot be *a priori* determined whether the new NAIRU points exhibit a lower or a higher real wage. The same ambiguity seems to apply if both the conditions of a rigid labour market and an oligopolistic product market prevail. On the other hand, when the price competition in the product market is relatively low and the labour unions are not strong enough, the downward shift of the price-setting curve is more likely to outweigh the upward movement of the wage-setting curve. Hence, the real wage that corresponds to the new NAIRU points is expected to be lower. The reverse of the above situation holds, if the price competition in the product market is intensive and the strength of labour unions is high.

Furthermore, it should be called to attention that the relative shifts in wage and price-setting curves, which are generated from an increase in the lending interest rate, are also a function of the accumulated debt of worker households and firms. The higher is the magnitude of the outstanding debt the more important are, *ceteris paribus*, the shifts in the wage and price-setting curves as a response to a rise in the interest rate. Consequently, the prior knowledge of the institutional and debt structure of an economy is essential in order to assess the impact that changes in monetary policy stance and/or in the degree of competition in the banking sector are likely to have on the real wage that corresponds to a rate of unemployment consistent with the NAIRU.

*Third*, the structure of our model indicates that, *ceteris paribus*, a decrease in the lending interest rate may lead point A to move closer to full employment and point B to lift closer to zero employment (see *figure 3* and equations 19 and 20). This would increase the possibility for the economy to be positioned within zone III and enjoy a disinflationary spiral for a considerable range of employment levels. Hence, in contrast to the conventional wisdom, a reduction in  $r_{CB}$  and/or in  $m_b$  is likely to contribute to the suppression of the inflationary pressures instead of exaggerating them, at least in the short-run.

*Fourth*, it is interesting to note that in the medium to long-run, a change in the lending interest rate may have some further indirect impacts on the NAIRU. In particular, two ‘hysteresis’ effects of the interest rate are likely to emerge. The first has been pinpointed recently in the related literature (see e.g. Ball, 1999; Logeay and Tober, 2003; Blanchard, 2003; Arestis and Sawyer, 2008; Stockhammer and Sturn, 2008) and is associated with the feedback effects of the interest rate on capital accumulation. Following A&S, a decrease in the interest rate would lead to a shift in the position of the price-setting curve which in turn would affect the NAIRU. The second is related to the influence that the interest rate might exert on the new amount of borrowing. It can be argued that a lower (higher) interest rate increases (decreases) the demand and the supply for loans<sup>37</sup> leading in this way to a higher (lower) accumulation of debt in the subsequent periods. This, according to our model, would cause a shift in both the wage and the price-setting curves, affecting in this way the NAIRU of the economy. Note that the above ‘hysteresis’ effects of interest rate operate to the opposite direction; the first one implies a decrease in the NAIRU of point A when the interest rate decreases, whereas the second one indicates an upward pressure on this NAIRU as a result of a lower interest rate. The reverse is more likely to hold for the NAIRU that corresponds to point B.

In view of the arguments advanced above, it can therefore be demonstrated that, when the elasticity of borrowing with respect to the interest rate is low, or when the private sector exhibits a considerable amount of accumulated debt, or when the elasticity of investment with respect to the interest rate is high, a decrease in the lending interest rate might trigger a substantial fall in the NAIRU (that is closer to full employment), even in the long-run.

The assertion for a positive association between the interest rate and the NAIRU has recently been supported by various empirical studies which, within different analytical and theoretical frameworks, have found evidence in favour of an ‘interest rate-affected’ NAIRU. Logeay and Tober (2003) have utilized data for twelve European countries during the period between 1973 and 2002 and have found that the real interest rates

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<sup>37</sup> A lower interest rate might increase the demand for loans due to the decrease that it triggers on the cost of borrowing and in the burden of debt of borrowers. Furthermore, it is likely to increase the supply of credit by increasing the borrowers’ income net of interest payments and thereby their creditworthiness. The opposite holds when the interest rate goes up (see e.g. Wolfson, 1996; Lavoie, 2006, p. 70).

explain a quarter of the increase in the NAIRU between 1980 and 1995. Their results have also shown that ‘[a] change in short-term real interest rates by 1 percentage point leads to a change in the NAIRU by 0.3 percentage points’ (*ibid.*, p. 16). Semmler and Zhang (2006) have tested the impact of the real interest rate on the NAIRU by using data for Germany, France, U.K. and U.S. for the period 1982 to the end of the 1990s. Their results support the proposition for a positive relationship between interest rate and the NAIRU.<sup>38</sup> In another empirical study, Gianella *et al.* (2008) have investigated the determinants of the NAIRU for 23 OECD countries. The econometric evidence suggests that the high interest rates were a key determinant of the increase in the NAIRU that took place in 1980s. The authors also point out that: ‘the steady decline in the real interest rates over the most recent period is found to have contributed significantly to the decline in the estimated NAIRUs for most of the countries in the sample’ (*ibid.*, p. 32).<sup>39</sup> Besides, Stockhammer and Sturn (2008) find evidence for a statistically significant effect of the change in the interest rate on the variation in the NAIRU in OECD countries the period between 1980 and 2003.

## **6. The ‘hysteresis’ effects of finance and the compatibility of the NAIRU with full employment**

In the NAIRU literature two basic types of ‘hysteresis’ mechanisms have so far been put forward through which past unemployment (and aggregate demand) may exert impact on the NAIRU. The first mechanism is associated with the operation of the labour market and, in particular, with the ‘insider-outsider’ effects (Lindbeck and Snower, 1986) and the relationship between short-term and long-term unemployed (Layard and Nickell, 1986; Blanchard and Summers, 1988). The second mechanism, which has been especially emphasized by A&S, is linked to the favourable (unfavourable) effect that a higher (lower) level of aggregate demand might exert on capital stock and thereby on the NAIRU. In this section we assert that a third type of ‘hysteresis’ mechanism might

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<sup>38</sup>The theoretical justification that Logeay and Tober (2003) and Semmler and Zhang (2006) provide for their results relies on the ‘hysteresis’ explanation. In particular, it is argued that the interest rate variations during the periods under examination affected actual unemployment, which in turn influenced the NAIRU through the ‘hysteresis’ effects in the labor market and/or capital formation. Our model suggests a further more direct mechanism through which this observed correlation between interest rate and NAIRU might be explained.

<sup>39</sup>In this study the real interest rate that is utilized is the long-term one and is used as a proxy for the real user cost of capital; the latter is incorporated into the price-setting equation to capture the impact that the cost of capital may exert on the production cost and thereby on prices and the NAIRU.

exist; this mechanism is related to the role that the external finance is likely to play in boosting aggregate demand.

In order to explain the procedure through which the ‘hysteresis’ mechanism of finance is likely to emerge, it is essential to make some clarifications with regard to the way that the dynamics of debt are portrayed in our frame. So far in our presentation it has been pinpointed that both worker households and firms assign a target with respect to their burden of debt. In similar vein, it can be asserted that banks also set a target with respect to both consumer and corporate burden of debt. Let us denote by  $bur_W^{TB}$  the banks’ target burden of worker households’ debt and by  $bur_W^{TF}$  their target with respect to firms’ burden of debt. Both  $bur_W^{TB}$  and  $bur_W^{TF}$  depend on the confidence of banks, their liquidity preference and lending practices as well as on various institutional settings, which determine the degree of financial intermediation, securitization etc.

The most plausible scenario is  $bur_W^{TW} > bur_W^{TB}$  and  $bur_F^{TF} > bur_F^{TB}$ , which implies that banks desire to lend less than what their customers are willing to borrow; in this case credit rationing occurs. In our analysis for the ‘hysteresis’ effects of finance we will confine our attention to this most plausible scenario. We will assume that for some exogenous reasons (institutional changes, new lending practices, higher degree of confidence etc.) both  $bur_W^{TB}$  and  $bur_F^{TB}$  increase, that is banks become more willing to lend worker households and firms.<sup>40</sup> This implies that the outstanding debt (and thereby the debt cash payment commitments) of worker households and firms will increase in the subsequent periods. Assuming that  $bur_W^{TB}$  and  $bur_F^{TB}$  will remain unchanged, there will be a tendency for the wage-setting curve to shift upwards and for the price-setting curve to shift downwards (see respectively *figure 1* and *figure 2*). Since the amount of new borrowing will increase there will also be a boost in aggregate demand and economic activity (at least in the subsequent periods). Therefore, the decline in the rate of unemployment will be combined with feedback effects on the NAIRU associated with the rise in the outstanding debt of the private sector.

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<sup>40</sup> The alternative scenario would be to assume that  $bur_W^{TW} < bur_W^{TB}$  and/or  $bur_F^{TF} < bur_F^{TB}$ . In this case, the ‘hysteresis’ effects of finance could potentially emerge if there was an increase in  $bur_W^{TW}$  and/or  $bur_F^{TF}$ .

Let us now examine how the aforementioned ‘hysteresis’ effects of finance are likely to interact with the ‘hysteresis’ effects arising from the adjustment in the size and composition of the capital stock.<sup>41</sup> In order to do this we will confine our analysis to two alternative scenarios with regard to the way that investment takes place (see Sawyer, 2002 and Arestis and Sawyer, 2005). According to the *first scenario* investment is capacity-replacing (and productivity-enhancing) and is undertaken only by existing firms. The result of this type of investment is an increase in capital stock per firm ( $k$ ). In the *second scenario*, investment is capacity-enhancing which means that it takes the form of new firms (i.e.  $n$  increases).

Starting from the *first scenario*, we consider the following sequence of events. At a first stage, there is a finance-led increase in consumption and investment expenditures as a result of a rise in  $bur_w^{TB}$  and  $bur_F^{TB}$ . This triggers an increase in workers’ and firms’ accumulated debt, which in turn tends to shift the wage-setting curve upwards and the price-setting curve downwards; note that the turning points move leftwards. Meanwhile, the higher investment in capital stock will lead to an increase in capital intensity ( $k$ ). This is likely to affect the position of both the wage and the price-setting curves. On the one hand, since  $\lambda_k$  increases, there will be a further pressure for an upward shift in the wage-setting curve (see equation 10). On the other hand, by using expression (16’) and postulating that the increase in the capital-determined component of labour productivity will just be offset by the rise in capital stock,<sup>42</sup> it can be inferred that the price-setting curve will also have a tendency to shift upwards. Consequently, the wage-setting curve will shift upwards with the direction of the shift in the price-setting curve being, however, ambiguous (since both upward and downward pressures are placed).

At a second stage, higher aggregate demand motivates firms to further invest in capital stock. By postulating that this investment is, at least partly, debt-financed, the outstanding debt of firms is expected to further increase and this will be combined with

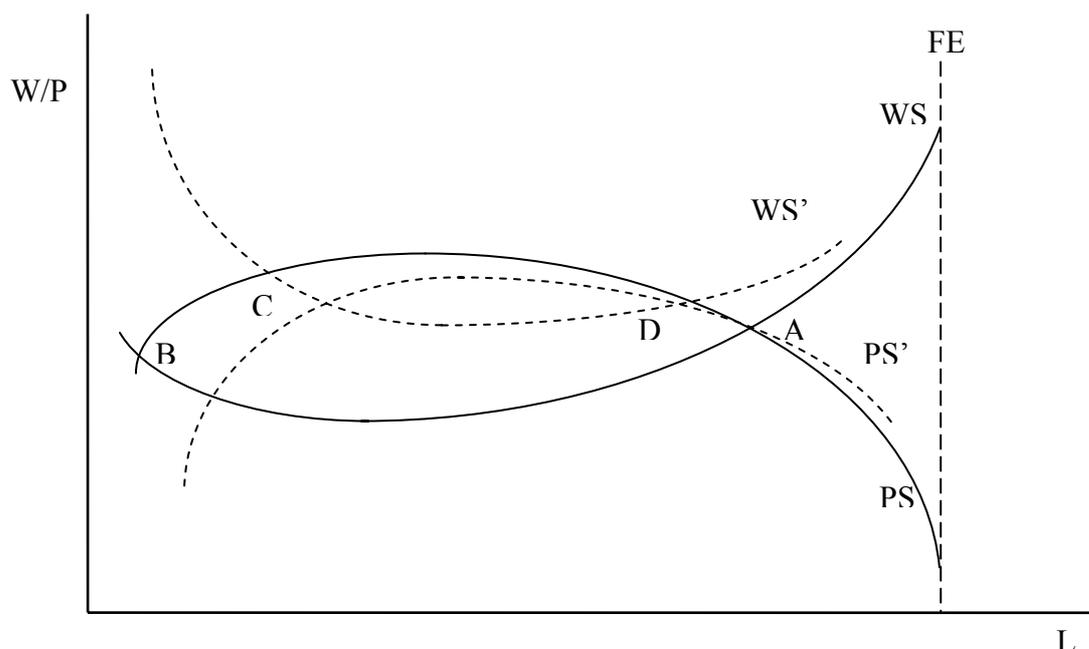
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<sup>41</sup> In order to focus on the central points which we are seeking to make in this section we assume away the ‘hysteresis’ effects arising from the operation of the labour market.

<sup>42</sup> This implies that the ratio  $\lambda(k)/k$  in equation (16’) remains unchanged and thereby that the capacity utilization is the same at every level of employment (note that  $u = [\lambda_k(k)/vk] \cdot l$ ). It is worthy to remark that, if it is presumed that  $\lambda_k$  increases more than  $k$  (i.e. capacity utilization becomes higher at every level of employment), there will be a pressure for  $L_p$  to shift leftwards; and *vice versa*.

an additional increase in  $k$ . Hence, the direction of the shift in the price-setting cannot even in this stage be unambiguously determined.

**Figure 4:** The ‘hysteresis’ effects of a finance-led increase in aggregate demand in the case of capacity-replacing (and productivity-enhancing) investment (*scenario 1*)



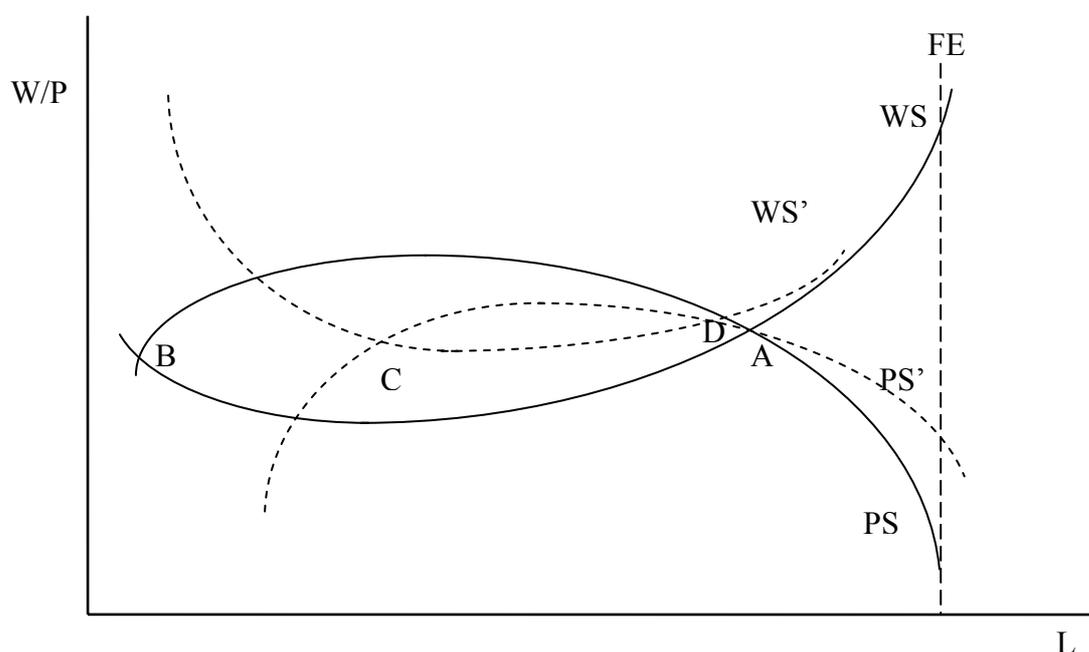
In *figure 4* we sketch the ‘hysteresis’ effects associated with the first scenario. It has been postulated that the effect from the increase in the outstanding debt of firms almost outweighs the impact of the rise in capital intensity. This implies that there is only a slight change in the slope of the price-setting curve; its position will be almost at the same level. As it can be observed, the NAIRU point that exhibits a higher level of unemployment (point B) moves closer to full employment (point C), while the opposite is true for the NAIRU point A (which moves on the left, to point D).

In the *second scenario*, the sequence of events is similar. However, investment at both the first and at the second stage takes the form of more firms. This implies that investment leads to a higher  $n$  which, according to equation (16'), suggests an outward shift in the price-setting curve.<sup>43</sup> This, in conjunction with the increase in the

<sup>43</sup> The reason is that  $Z_1$  declines and  $Z_2$  increases at a given level of employment. As a result,  $L_p$  tends to shift rightwards. On the left of  $L_p$  the increase in  $Z_2$  outweighs the decline in  $Z_1$  and the real wage is lower. The reverse occurs on the right of  $L_p$ .

accumulated debt of firms, makes the price-setting curve move rightwards down. The wage-setting curve shifts upwards, as in the previous scenario.<sup>44</sup> In *figure 5* the ‘hysteresis’ effects connected with the second scenario are depicted. In similar vein with scenario 1, the distance between the two NAIRU points tends to decline.

**Figure 5:** The ‘hysteresis’ effects of a finance-led increase in aggregate demand in the case of capacity-enhancing investment (*scenario 2*)



The above analysis brings to the forefront that in the case of a finance-led increase in aggregate demand the potential rise in the accumulated debt of workers and firms may prevent the NAIRU to coincide with (or, at least, to approach) full employment. However, we argue that this problem might be overcome if an adequate monetary policy reaction is implemented. In particular, if the Central Bank decreases the discount interest rate in response to an increase in private sector’s outstanding debt, the rise in the debt cash payments commitments of workers and firms may be, at least partially, offset. Consequently, the wage-setting curve will remain almost unchanged and the price-setting curve will be allowed to shift upwards and/or outwards making it possible for the NAIRU to converge to full employment. It should also be emphasized that such a monetary policy could be augmented by interventions in the legal and institutional

<sup>44</sup> Note, however, that the shift in the wage-setting curve is now smaller.

framework of the banking sector, which should aim at the decrease of the banking mark-up when a finance-led boom takes place.

At this point, however, one should also take into account the ‘hysteresis’ effects that may emerge from the decrease in the lending interest rate. Recall that a fall in the interest rate may lead to further investment in capital stock as well as to further increase in the accumulated debt of the private sector in the long-run. For the movement of the NAIRU towards full employment not to be prevented, it may therefore be essential to restrict the increase in the amount of borrowing as a response to a fall in the lending interest rate. This may be especially the case for the consumer borrowing which does not contribute, at least directly, to the enhancement of the economy’s capacity.

Given this role of the interest rate, a policy proposal could be for the banking sector to be regulated so as for the expansion of consumer loans to be restricted whenever the economy experiences a substantial decrease in the lending interest rate. Towards this direction, Palley’s (2004) recommendation for asset-based reserve requirements could be adopted. More specifically, policy makers could combine the decrease in the lending interest rate with a rise in consumer loan reserve requirements. The latter would lead to the increase in the cost of consumer loans for banks;<sup>45</sup> this would discourage the exaggerated expansion of consumer lending keeping in this way under control workers’ accumulated debt.

In our viewpoint, the above arguments shed some new light on the basic assertion of A&S for the role of capital stock in the compatibility of the NAIRU with full employment. A&S claim that, except under very specific conditions (see e.g. Sawyer, 2002, pp. 83-88), the stimulation of investment that occurs in an expansionary environment is arguably sufficient to suppress the inflationary pressures that arise from the increase in aggregate demand and employment. According, however, to the preceding discussion, this is valid only if the expansion is not finance-led. If this is not the case, the boom will be probably combined with an increase in private sector’s accumulated debt, which may not allow the NAIRU to lift to the full employment level. Nonetheless, if the monetary policy and the regulation in the banking sector react in the

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<sup>45</sup> In our frame such a policy response might restrict the rise in  $bur_w^{TB}$ .

way that has been suggested above, the increase in worker households' and firms' debt cash payment commitments is likely to be mitigated and the inflationary pressures that arise from the higher outstanding debt might be prevented. In this case, the arguments of A&S are likely to be still valid even within the context of a finance-led expansionary environment.

## **7. Concluding remarks**

This paper has developed a wage-setting/price-setting macroeconomic model and has attempted to explore the potential links between monetary and financial factors and the NAIRU. It has been illustrated that, under certain circumstances, variations in the debt cash payment commitments of worker households and firms are likely to exert considerable pressures on the NAIRU. Furthermore, the paper has argued in favour of an 'interest rate-affected' NAIRU and has discussed potential implications for the conduct of monetary policy. Particular attention has been paid to the 'hysteresis' effects of finance, which have been asserted to arise in the case of a finance-led increase in consumption and investment expenditures, as a result of changes in the lending behaviour of banks. The implications of these effects have also been explored in conjunction with the capital stock 'hysteresis' mechanism.

In terms of policy implications, two basic points have been outlined. *First*, it has been shown that a monetary policy that seeks to tame inflation by raising the discount interest rate may well cause the NAIRU to shift towards a direction that reinforces inflationary pressures. *Second*, it has been suggested that, if the NAIRU is to coincide with full employment, monetary policy should arguably respond by decreasing the discount interest rate whenever the economy experiences a finance-led expansionary environment. The compatibility of the NAIRU with full employment becomes even more possible if this response is to be combined with adequate interventions in the lending behaviour and institutional setting of the commercial banking sector.

## References

- Allsopp, C., Vines, D. (2000). 'The assessment: macroeconomic policy', *Oxford Review of Economic Policy*, 16 (4), pp. 1-32.
- Arestis, P., Sawyer, M. (2004). *Re-examining Monetary and Fiscal Policy for the 21<sup>st</sup> Century*, Cheltenham, Edward Elgar.
- Arestis, P., Sawyer, M. (2005). 'Aggregate demand, conflict and capacity in the inflationary process', *Cambridge Journal of Economics*, 29, pp. 959-974.
- Arestis, P., Sawyer, M. (2008). 'A critical reconsideration of the foundations of monetary policy in the new consensus macroeconomics framework', *Cambridge Journal of Economics*, 32, pp. 761-779.
- Arestis, P., Sawyer, M. (2009). 'Price and wage determination and the inflation barrier: moving beyond the Phillips curve', in Gnos, C., Rochon, L.-P. (eds), *Monetary Policy and Financial Stability: A Post-Keynesian Agenda*, Cheltenham, Edward Elgar.
- Argitis, G. (2001). 'Intra-capitalist conflicts, monetary policy and income distribution', *Review of Political Economy*, 13 (4), pp. 453-470.
- Argitis, G., Pitelis, C. (2001). 'Monetary policy and distribution of income: Evidence for the United States and the United Kingdom', *Journal of Post Keynesian Economics*, 23 (4), pp. 617-638.
- Ball, L. (1999). 'Aggregate demand and long-run unemployment', *Brookings Paper on Economic Activity*, 1999(2), pp. 189-251.
- Ball, L., Mankiw, G. (2002). 'The NAIRU in theory and practice', *Journal of Economic Perspectives*, 16 (4), pp. 115-136.
- Ball, L., Moffitt, R. (2002). 'Productivity growth and the Phillips Curve', in Krueger, A., Solow, R. (eds), *The Roaring Nineties. Can Full Employment Be Sustainable?*, New York, Russel Sage Foundation.
- Barth, M. J., Ramey, V.A. (2001). 'The cost channel effect of monetary transmission', in Bernanke, B., Rogoff, K. (eds), *NBER Macroeconomics Annual 2001*, Cambridge, MIT Press.
- Bhaduri, A. (2008). 'On the dynamics of profit-led and wage-led growth', *Cambridge Journal of Economics*, 32, pp. 147-160.

- Bhaduri, A., Marglin, S. (1990). 'Unemployment and the real wage: The Economic basis for contesting political ideologies', *Cambridge Journal of Economics*, 14(4), pp. 375-393.
- Blanchard, O. (2003). 'Monetary policy and unemployment', remarks at the conference 'Monetary policy and the labor market', in honour of James Tobin, held at the New School University, New York.
- Blanchard, O., Katz, L. (1999). 'Wage dynamics: reconciling theory and evidence', *American Economic Review Papers*, 89 (2), pp. 69-74.
- Blanchard, O., Summers, L. (1988). 'Beyond the natural rate hypothesis', *American Economic Review*, 78 (2), pp. 182-187.
- Blecker, R. (2002). 'Distribution, demand and growth in neo-Kaleckian macro-models', in Setterfield, M. (eds), *The Economics of Demand-led Growth: Challenging the Supply-Side Vision of the Long Run*, Aldershot, Edward Elgar.
- Cahuc, P., Zylberberg, A. (2001). *Labor Economics*, Cambridge, Massachusetts, The MIT Press.
- Cassetti, M. (2002). 'Conflict, inflation, distribution and terms of trade in the Kaleckian model', in Setterfield, M. (eds), *The Economics of Demand-led Growth: Challenging the Supply-Side Vision of the Long Run*, Aldershot, Edward Elgar.
- Cassetti, M. (2003). 'Bargaining power, effective demand and technical progress: a Kaleckian model of growth', *Cambridge Journal of Economics*, 27 (3), pp. 449-464.
- Chowdhury, I., Hoffman, M., Schabert, A. (2006). 'Inflation dynamics and the cost channel of monetary transmission', *European Economic Review*, 50, pp. 995-1016.
- Christiano, L. J., Eichenbaum, M., Evans, C. (2005). 'Nominal rigidities and the dynamic effects of a shock to monetary policy', *Journal of Political Economy*, 113, pp. 1-45.
- Dutt, A. K. (1990-91). 'Interest rate policy in LDCs: a Post Keynesian view', *Journal of Post Keynesian Economics*, 13 (2), pp. 210-232.
- Dutt, A. K. (1992). 'Conflict inflation, distribution, cyclical accumulation and crises', *European Journal of Political Economy*, 8, pp. 579-597.
- Galí, J., Gertler, M. (2007). 'Macroeconomic modelling for monetary policy evaluation', *Journal of Economic Perspectives*, 21 (4), pp. 25-45.

- Gaiotti, E., Secchi, A. (2006). 'Is there a cost channel of monetary policy transmission? An investigation into the pricing behavior of 2,000 firms', *Journal of Money, Credit and Banking*, 38, pp. 2013-2037.
- Gianella C., Koske I., Rusticelli E., Chatal O. (2008). 'What drives the NAIRU? Evidence from a panel of OECD countries', *OECD Economics Department Working Paper No. 649*.
- Godley, W., Lavoie, M. (2007). *Monetary Economics: An Integrated Approach to Credit, Money, production and Wealth*, Basingstone, Palgrave Macmillan.
- Goodfriend, M. (2007). 'How the world achieved consensus on monetary policy', *Journal of Economic Perspectives*, 21 (4), pp. 47-68.
- Hanssgen, G. (2004). 'Gibson's paradox, monetary policy and the emergence of cycles', *Levy Economics Institute of Bard College*, working paper no. 410, July 2004.
- Harck, S. (2009). 'A Phillips curve interpretation of error-correction models of the wage and price dynamics', *Cambridge Journal of Economics*, 33, pp. 95-112.
- Hein, E. (2006a). 'Wage bargaining and monetary policy in a Kaleckian monetary distribution and growth model: trying to make sense of the NAIRU', *Intervention. Journal of Economics*, 3 (2), pp. 302-329.
- Hein, E. (2006b). 'Interest, debt and capital accumulation – a Kaleckian approach', *International Review of Applied Economics*, 20 (3), pp. 337-352.
- Hein, E. (2007). 'Interest rate, debt, distribution and capital accumulation in a Post-Keynesian model', *Metroeconomica*, 58 (2), pp. 310-399.
- Hein, E. (2008). *Money, Distribution Conflict and Capital Accumulation. Contributions to 'Monetary Analysis*, Basingstone, Palgrave Macmillan.
- Hein, E., Lavoie M., van Treeck, T. (2008). 'Some (in)stability puzzles in Kaleckian models of growth and distribution: a critical survey', IMK Working Paper, 19/2008.
- Hein, E., Stockhammer, E. (2007). 'Macroeconomic policy mix, employment and inflation in a Post-Keynesian alternative to the New Consensus model', Working Paper no. 110, Vienna University of Economics and B.A.
- Hülsewig, O, Mayer, E., Wollmershaeuser, T. (2009). 'Bank behaviour, incomplete interest rate pass-through and the cost channel of monetary policy transmission', *Economic Modelling*, 26, pp. 1310-1327.
- International Monetary Fund (1999). 'Chronic unemployment in the Euro area: causes and cures', *World Economic Outlook*, Chapter IV, Washington, DC: International Monetary Fund, pp. 88-121

- International Monetary Fund (2003). 'Unemployment and labor market institutions', *World Economic Outlook*, Chapter IV, Washington, DC: International Monetary Fund, pp. 129-150.
- Lavoie, M. (1995). 'Interest rates in Post-Keynesian models of growth and distribution', *Metroeconomica*, 46 (2), pp. 146-177.
- Lavoie, M. (2006). *Introduction to Post-Keynesian Economics*, New York, Pgrave Macmillan
- Layard, R., Nickell S. (1986). 'Unemployment in Britain', *Economica*, 53, pp. S121-S169.
- Layard R., Nickell S., Jackman R. (1991). *Unemployment: Macroeconomic Performance and the Labor Market*, Oxford, Oxford University Press.
- Lima, G.T. (2004). 'Endogenous technological innovation, capital accumulation and distributional dynamics', *Metroeconomica*, 55 (4), pp. 386-408.
- Lima, G. T., Meirelles, A. J. (2003). 'Endogenous banking markup, distributional conflict and capacity utilization', *Metroeconomica*, 54 (2 & 3), pp. 366-384.
- Lima, G.T., Setterfield, M. (2010). 'Pricing behaviour and the cost-push channel of monetary policy', *Review of Political Economy*, 22 (1), pp. 19-40.
- Lindbeck, A., Snower D. (1986). 'Wage setting, unemployment and insider-outsider relation", *The American Economic Review*, 76 (2), pp. 235-239.
- Llosa, L.-G., Tuesta, V. (2009). 'Learning about the monetary policy rules when the cost-channel matters', *Journal of Economic Dynamics & Control*, 33, pp. 1880-1896.
- Logeay, C., Tober, S. (2003). 'Time-varying NAIRU and real interest rates in the Euro area', European Network of European Policy Research Institutes, working paper no. 24.
- Marglin, S., Bhaduri, A. (1990). 'Profit squeeze and Keynesian theory', in Marglin S., Schor J. (eds), *The Golden Age of Capitalism*, Oxford, Oxford University Press.
- McCallum, B. T. (2001). 'Monetary policy analysis in models without money', *Federal Reserve Bank of St. Louis Review*, 83 (4), pp. 145-160.
- Meyer, L. (2001). 'Does Money Matter?', *Federal Reserve Bank of St. Louis*, 13 (4), pp. 1-15.
- Moore, B. (1989a). 'The endogeneity of credit money', *Review of Political Economy*, 1 (1), pp. 65-93.

- Moore, B. (1989b). 'The effects of monetary policy on income distribution', in Davidson, P., Kregel, J. (eds), *Macroeconomic Problems and Policies of Income Distribution*, Aldershot, Edward Elgar.
- Nickell, S. (1997). "Unemployment and labour market rigidities: Europe versus North America", *Journal of Economic Perspectives*, 11 (3), pp. 55–74.
- Nickell, S. (1998). 'Unemployment: questions and some answers', *The Economic Journal*, 108, pp. S802-S816.
- Nickell S., Layard R. (1999). 'Labor market institutions and economic performance', in Ashenfelter, O., Card, D. (eds), *Handbook of Labor Economics*, Volume 3C. Amsterdam: Elsevier, pp. 3029-3084.
- Nickell, S., Nunziata, L., Ochel, W. (2005). 'Unemployment in the OECD since the 1960s. What do we know?', *The Economic Journal*, 115, pp. 1-27.
- Palley, T. I. (2003). 'The backward-bending Phillips curve and the minimum unemployment rate of inflation: wage adjustment with opportunistic firms', *The Manchester School*, 71 (1), pp. 35-30.
- Palley, T. I. (2004). 'Asset-based reserve requirements: reasserting domestic monetary control in the era of financial innovation and instability', *Review of Political Economy*, 16 (1), pp. 43-58.
- Panico, C. (1988). *Interest and Profit in the Theories of Value and Distribution*, London, Macmillan.
- Pivetti, M. (1991). *An Essay on Money and Distribution*, London, Macmillan.
- Pivetti, M. (2001). 'Money Endogeneity and Monetary non-Neutrality: a Sraffian Perspective', in: Rochon L.-P. and Vernengo M. (eds), *Credit, Interest Rates and the Open Economy: Essays on Horizontalism*, Cheltenham: Edward Elgar, pp. 104-119.
- Rabanal, P. (2007). 'Does inflation increase after a monetary policy tightening? Answers based on an estimated DSGE model', *Journal of Economic Dynamics & Control*, 31, pp. 906-937.
- Ravenna, F., Walsh, C. (2006). 'Optimal monetary policy with the cost channel', *Journal of Monetary Economics*, 53, pp. 199-216.
- Romer, D. (2000). 'Keynesian macroeconomics without the LM Curve', *Journal of Economic Perspectives*, 14 (2), pp. 149-169.
- Rowthorn, R. (1995). 'Capital formation and unemployment', *Oxford Review of Economic Policy*, 11 (1), pp. 26–39.

- Sawyer, M. (1997). "Income distribution, macroeconomic analysis and barriers to full employment", *Journal of Income Distribution*, 7 (2), pp. 147-160.
- Sawyer, M. (2001). 'The NAIRU: a critical appraisal', in Arestis, P. and Sawyer, M. (eds), *Money, Finance and Capitalist Development*, Aldershot, Edward Elgar
- Sawyer, M. (2002). 'The NAIRU, Aggregate Demand and Investment', *Metroeconomica*, 53 (1), pp. 66-94.
- Sawyer, M. (2004). 'The NAIRU, labour market 'flexibility' and full employment', in Stanford, J. and Vosko, L. (eds), *Challenging the Market: The Struggle to Regulate Work and Income*, Montreal's McGill-Queen's University Press.
- Sawyer, M. (2005). 'Towards a simple macroeconomic model incorporating the key heterodox propositions', mimeo, University of Leeds, October 2005.
- Sawyer, M. (2006). 'A Kaleckian analysis of monetary policy', *Intervention. Journal of Economics*, 3 (2), pp. 331-349.
- Semmler, W., Zhang, W. (2006). 'Nonlinear Phillips curve, endogenous NAIRU and monetary policy', in Chiarella C., Franke R., Flascel P and Semmler W. (eds), *Quantitative and Empirical Analysis of Nonlinear Dynamic Macromodels*, Elsevier.
- Sen, K., Vaidya, R. (1995). 'The determination of industrial prices in India: a Post Keynesian approach', *Journal of Post Keynesian Economics*, 18 (1), pp. 29-52.
- Setterfield, M. (2007). 'The rise, decline and rise of incomes policies in the US during the post-war era: an institutional-analytical explanation of inflation and the functional distribution of income', *Journal of Institutional Economics*, 3 (2), pp. 127-146.
- Setterfield, M. (2009). 'Macroeconomics without the LM curve: An alternative view', *Cambridge Journal of Economics*, 33 (2), pp. 273-293.
- Setterfield, M., Lovejoy, T. (2006). 'Aspirations, bargaining power and macroeconomic performance', *Journal of Post Keynesian Economics*, 29 (1), pp. 117-148.
- Shapiro, C., Stiglitz, J. (1984). 'Equilibrium unemployment as a worker discipline device', *American Economic Review*, 74, pp. 433-444.
- Stockhammer, E. (2004). 'Is there an equilibrium rate of unemployment in the long run?', *Review of Political Economy*, 16 (1), pp. 59-77.
- Stockhammer, E. (2008). 'Is the NAIRU theory a Monetarist, New Keynesian, Post Keynesian or Marxist theory?', *Metroeconomica*, 59 (3), pp. 479-510.

- Stockhammer, E., Sturn, S. (2008). 'The impact of monetary policy on unemployment hysteresis', IMK Working Paper 15/2008, Duesseldorf: Macroeconomic Policy Institute (IMK) at Hans Boeckler Foundation.
- Storm, S., Naastepad, C.W.M. (2007). 'It is high time to ditch the NAIRU', *Journal of Post Keynesian economics*, 29 (4), pp.531-554.
- Surico, P. (2008). 'The cost channel of monetary policy and indeterminacy', *Macroeconomic Dynamics*, 12, pp. 724-735.
- Taheri, J. (1995). 'On the persistence of high unemployment in the OECD countries: the real debt resistance hypothesis', *Journal of Post Keynesian Economics*, 17 (4), pp. 481-502.
- Taylor, J. (1993). 'Discretion versus policy rules in practice', *Carnegie-Rochester Conference Series on Public Policy*, December, pp. 195-214.
- Taylor, L. (2004). *Reconstructing Macroeconomics: Structuralist Proposals and Critiques of the Mainstream*, Cambridge Massachusetts, Harvard University Press.
- Tillmann, P. (2008). 'Do interest rates drive inflation dynamics? An analysis of the cost channel of monetary transmission', *Journal of Economics Dynamics & Control*, 32, pp. 2723-2744.
- Tymoigne, E. (2006). 'The Minskyan system, part III: System dynamics modeling of a stock flow-consistent Minskyan model', Working Paper no. 455, The Levy Economics Institute of Bard College.
- van Treeck, T. (2009). 'A synthetic, stock-flow consistent macroeconomic model of 'financialization'', *Cambridge Journal of Economics*, 33, pp. 467-493.
- Wolfson, M. (1996). 'A Post Keynesian theory of credit rationing', *Journal of Post Keynesian Economics*, 18 (3), pp. 443-470.
- Woodford, M. (2003). *Interest and Prices: Foundations of a Theory of Monetary Policy*, Princeton, NJ, Princeton University Press.