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Long Term Effects of the Efficiency wage Hypothesis in Goodwin-type Economies: a reply

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In his comment on our paper, Professor Flaschel (F2000 since now on) argues that our model presented in this Journal (Manfredi and Fanti 2000, MF2000), "though quite interesting from a mathematical point of view, cannot be accepted from the economic point of view". The reason of the "economic unacceptability" of our extension of the original Goodwin's model (GM), seems to lie in the chosen formulation of the effort function (see MF2000 for terminology):

$$a = k(\frac{w}{w_0})^b \qquad (1)$$

where a is the average productivity of labour, k an exogenous productivity index, w the real wage, and w_0 a reference wage.

We now try to clarify this point. In our formulation, the reference wage w_0 appearing in (1) is assumed to be either constant or steadily growing. In the latter case it is assumed that its rate of growth cannot exceed the rate of growth (α) of the exogenous component of the productivity of labour. This implies that in the long term the w/w_0 ratio would tend to infinite, a fact which is meaningless for Flaschel. It seems to us that Flaschel overemphasises the role played by w_0 in our model. The basic productivity-wage relationship used is (see MF1999):

$$a = kw^b \qquad (2)$$

This formulation is common in the literature and defines an effort function with constant elasticity (i.e. Lindbeck-Snower, 1991)[1]. In (2) k is usually to be interpreted as an index of the state of technology which may be time-dependent (as it is the case in all growth models with exogenous technological progress). Being an index it does not have a physical dimension: it is a pure number. There is an alternative possibility: k could be interpreted as a measure of productivity (for instance a

[1] In the literature on Goodwin's model a formulation of this type was adopted by Chooi (1995). As known, this function does not respect the efficiency condition of Solow (1979), according to which the elasticity would be of unit value in a

baseline productivity level corresponding to some "normal" level of the wage). In this latter case a problem of "dimensional inconsistency" arises in (2), unless we replace the wage with a non-dimensional measure of the wage itself, such as, for instance, a normalised wage, as done in (1). In MF (2000), with the purpose of preserving this second interpretation of k, we have extended the formulation (2), by writing (1), in order to make (2) "dimensionally correct". The quantity w_0 is to be intended, therefore, as a pure normalising factor, needed to make (2) "dimensionally correct". That is, the quantity w_0 by no means represents a postulated behavioural relationship between economic variables, as Flaschel suggests. For this reason we made on w_0 the simplest assumption, i.e. that w_0 is exogenously determined (constant or steadily growing). It is then easy to show (see the Appendix in MF2000) that equation 2 remains true, with the only consequence that the term k has to be redefined to take w_0 into account. This re-definition has no relevant qualitative effects on the main results (static and dynamical) of the paper.

We acknowledge that when one aims to explicitly model the reference wage, then Flaschel's formulation[2]:

$$a = kV^h \qquad (3)$$

where $V=w/a$ is the labour share, seems to be the most straightforward one having the merit "*to avoid that the measure with which workers compare themselves becomes more and more unimportant in the course of the time*" (Flaschel 2000).

As a more general remark on the modelling of the efficiency wage effect within Goodwin's model, our opinion is that Flaschel's equation and ours are different formulations which lead to quite different economic outcomes. To illustrate this point, let us consider both formulations:

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profit –maximizing equilbrium, but can be justified by assuming that, for instance, the presence of trade unions can push firms to pay wages higher than those emerging by the sole efficiency considerations.

[2] The formulation of the Efficiency Wage hypothesis adopted by Flaschel represents a theory of the worker behaviour which, though legitimate, is broadly different from the textbook formulations by Solow and Lindbeck-Snower adopted here.

$$\frac{\dot{a}}{a}=\frac{\dot{k}}{k}+b\frac{\dot{V}}{V}=\alpha+b\frac{\dot{V}}{V} \quad (F2000) \qquad \frac{\dot{a}}{a}=\frac{\dot{k}}{k}+b\frac{\dot{w}}{w}=\alpha+b\frac{\dot{w}}{w} \quad (MF2000) \quad (4a,b)$$

where α is the rate of change of the exogenous productivity index. In (F2000) $\frac{\dot{a}}{a}\geq\alpha$ if $\frac{\dot{V}}{V}\geq 0$, i.e. the rate of change of the average productivity of labour exceeds that of the exogenous productivity index, in (and only in) those phases of the cycle in which the labour share is increasing. This implies that in Flaschel's formulation there is no effect of the efficiency wage on the long term growth of the economy. On the other side, in our model $\frac{\dot{a}}{a}\geq\alpha$ if $\frac{\dot{w}}{w}\geq 0$, i.e. the rate of change of the productivity of labour exceeds that of the exogenous productivity index, in (and only in) those phases of the cycle in which the real wage is increasing. Since Goodwin-type models exhibit steadily increasing wages in the long term regime, a true effect of the wage on long term productivity is observed implying a persistent efficiency wage effect, contrary to Flaschel's model. To our mind, our formulation thereby contains a substantive idea, namely that the worker could positively react, by increasing his effort, when the economy is in the positive phase of the cycle (or, in other words, when the wage is rising). Moreover, despite Flaschel's opinion, our model contains a true comparison criterion for the choice of the worker's effort, and this criterion is the cycle itself, measured via the cyclical dynamics of the wage.

Finally, a further justification to our formulation (2) is the following. Let us suppose one wants to explicitly consider a behavioural relationship for w_0 based on basic literature. For instance in Akerlof 's model (1982), in which a single firm chooses the optimal wage and employment in a context of "partial gift exchange", the reference wage is assumed to be

$$w_0(t) = w^o(t)^{U(t)} z^{1-U(t)} \qquad (5)$$

where w° is the wage paid by other firms and z is the level of the unemployment benefit. Since the firm in question is the typical firm, its wage is the same as the wage of other firms, i.e. w°=w. By assuming that z is endogenously determined as a fraction of the current wage: z=hw, where 0<h<1, the formulation (5) would, once introduced in (1), leads to:

$$a(t) = k(t)\frac{(w(t))^b}{(w(t))^{U(t)}(hw(t))^{1-U(t)}} = \frac{k(t)}{(h)^{1-U(t)}}(w(t))^b \qquad (6)$$

The formulation (6), at least at equilibrium, is equivalent to our basic formulation (2). One could of course study the overall dynamics of the Goodwin-type model embedding (6). In this case we get a more general 3-dimensional formulation (with state variables (U,V,w)) of the model MF2000. A preliminary analysis of this model, not presented here, confirms that even under a full endogenising of the reference wage such as (5), the efficiency wage parameter b preserves a crucial role in determining the dynamics of the system which goes well beyond the "purely stabilizing" role which is played under Flaschel's formulation. This again suggests that the efficiency wage hypothesis actually enriches the spectrum of the dynamical outcomes of the GM and hence the analysis of the GM suitably extended to incorporate modern theories of wage determination seems to be a still open and stimulating research problem.

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