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A note on *Heterodox Macroeconomics* by Blecker and Setterfield

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Blecker and Setterfield's new textbook from 2019 presents an updated discussion of heterodox models of growth and distribution. This note clarifies and elaborates on three important issues discussed in the book. First, the text presents mainly one-sectoral and one-technique models, which is a reasonable set-up to keep things simple but not always enough to discuss some controversial issues. Second, continuous substitution is important but not essential for neoclassical growth theory. Third, the popular Goodwin model presented in the text does not produce 'limit cycles.'

Keywords: *economic growth, income distribution, heterodox macroeconomics*

JEL codes: *B22, B50, E11*

1 INTRODUCTION

Heterodox Macroeconomics (Blecker/Setterfield 2019, henceforth *HM*; unless otherwise stated, all the quotes belong to that text) is a very important contribution. Following the steps of Marglin (1984), Dutt (1990), Lavoie (2014), or Foley et al. (2019), *HM* provides a comprehensive overview of alternative model closures. Specifically, *HM* discusses and reviews models of growth and distribution from the standpoint of classical, Marxian, Robinsonian, Kaldorian, Kaleckian, and Harrodian traditions.

While important topics such as inflation, the balance of payments, or money and finance play a secondary role in the book, the reader looking for 'practical applications' will not be disappointed. For instance, considerable space and attention is devoted to inflation in chapter 5, while the external sector is widely discussed in the last three chapters, where the export-led growth and cumulative causation (ELCC) model and the balance-of-payments-constrained growth (BPCG) model are carefully dissected.

The main strengths of *HM* are its accessible style and the massive number of theoretical approaches that are covered in a reasonably sized text. The models are presented mainly using very simple systems of linear equations and figures, and the intuitions behind the main results are carefully described. The authors' first-hand experience in writing their own heterodox models of growth and distribution is certainly reflected on every single page.

As far as I am aware, *HM* is also the first text to provide an overview of the Harrodian approach and the models from the supermultiplier family. These are currently subject to intense scrutiny and have sparked a stimulating debate (Kurz/Salvadori 2019). A text cannot cover all the schools without becoming excessively boring and long, so the Sraffian and Minskyan traditions get less attention and only appear occasionally in different sections of *HM*.

HM is a must-read to anyone curious about non-mainstream macroeconomics, but also for those who have been taking the alternative approaches more seriously and systematically.

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HM also makes an excellent companion for a one-semester class in undergraduate and graduate macroeconomics. I believe there are (minor) issues that deserve some comments, not necessarily because the text is wrong. In particular, I believe that the text could stress that there is only one dominant technique in the models, could elaborate on the role of smooth production functions in neoclassical theory, and could discuss the nature of cyclical fluctuations in the Goodwin model, clarifying that it does not really produce limit cycles. I will elaborate on these issues and I will provide constructive suggestions and comments in the following three sections.

2 ON THE CHOICE OF TECHNIQUE

HM is mostly based on a simplified model that includes one sector and two social classes. Capitalists and workers have separate claims on income, associated with the production of one good that can be consumed and invested. Technological change is defined by some modifications on the ability to produce the only good, mainly by increasing the efficiency of capital and/or labor inputs.

While this is a standard procedure and a very reasonable way to approach the task at hand, it is never stressed in the text that implicitly only one dominant technique is available and that the ‘wage–profit’ frontier, which is the envelope of all available techniques in the wage–profit space, cannot be non-linear. I do not dispute the usefulness of the approach, but I would like to point out why I think it is important to spell out what is being assumed.

An important reason is that the so-called Cambridge capital controversies established, among other things, that linearity could preclude badly behaved cases from arising (such as reswitching or reverse capital deepening). The controversies evolved around a multi-technique, multi-goods framework, and almost all the participants recognized that the simpler neoclassical parables were wrong outside the linear case, which placed unnecessary restrictions on the individual techniques, in particular that the capital-to-labor ratios were the same for all industries (Samuelson 1966).¹

As a general rule, the wage–profit frontier is downward-sloped, but there are no other meaningful restrictions that can be placed on its shape, at least on non-empirical grounds. The models of *HM* assume *de facto* a linear wage–profit frontier, which may preclude the emergence of the capital paradoxes, but it is an obvious simplification for a text that aims to introduce the reader to heterodox macroeconomics. The level of complexity for instance of Marglin (1984), who did discuss the side effects of assuming a multi-commodity and a multi-technique world, is probably not ideal for an introductory text. Perhaps a few words regarding the capital controversies and the possible ramifications of multi-technique frameworks could shed some light.²

Another reason to stress that there is only one dominant technique is that it may be worth distinguishing between technical progress and the choice of technique. The set-up of *HM* blurs such a distinction. Specifically, technical progress is assumed to take four main

1. What was not clear for all the participants, in particular those from Cambridge Massachusetts, were the implications of the controversies for neoclassical theory. See Petri (2004) for a discussion of problems with the ‘quantity of capital’ (see also Garegnani 1990).

2. Alternatively, the authors may prefer to claim that real-world wage–profit frontiers are approximately linear (Shaik 2012), or to suggest that the real differences between the heterodox and neoclassical approaches lies elsewhere: ‘The main differences between the Heterodox approaches and the neoclassical model lie in the differences between the three approaches, not in the esoterica of reswitching’ (Marglin 1984: 283, ch. 12).

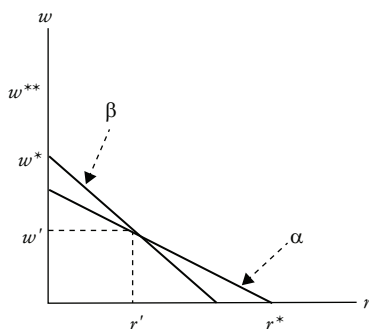
forms, depending on the final impact on the wage–profit frontier: Harrod neutral, Hicks neutral, Solow neutral, and Marx biased. Harrod neutral technical progress raises labor productivity, Hicks neutral technical progress raises both labor and capital productivity, Solow neutral technical progress raises capital productivity, and finally Marx biased technical progress raises labor productivity but decreases capital productivity.

Consider now the claim in chapter 2 that ‘firms will not seek to innovate across the entire spectrum of possible techniques, but instead will focus their (costly) innovative efforts on an economically relevant range of techniques – such as ones that would replace some current workers with machines or robots in countries where wages are high’ (p. 15). This quote suggests that there are multiple techniques available for firms, but somehow contradicts the models of *HM*, which assume that there is only one possible way to combine inputs to produce some output, or at least that all the techniques are combined in a single aggregated construct dubbed ‘production function.’

If there are already two techniques available for firms, things get more complicated. Let us illustrate the point. In Figure 1 there are two techniques (α and β) and one switching point at the real wage w' and the profit rate r' , which means that for such an income distribution, firms are indifferent between the two techniques. The envelope of the two lines represents the wage–profit frontier for a two-technique case. The example presented in *HM* is similar, but there is a slight difference. Instead of assuming that there are two techniques, *HM* suggests that, before the innovation, firms can access only one technique. The innovation creates a new production function that competes with the old one.

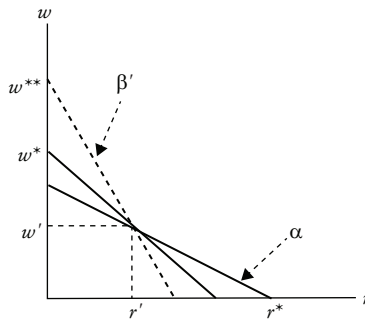
It follows from the figure that one technique will be adopted for a low real wage (and a high rate of profit), while the other will be operative for a high real wage (and a low rate of profit). For wages higher than w' (and profit rates lower than r'), the technique β is adopted, while for wages lower than w' (and profit rates higher than r'), the technique α is operative.

Consider what happens if, once the two techniques are available, there is some form of technological progress, which is depicted by the clockwise rotation of one of the techniques – let us say β rotates and becomes β' , which for simplicity I assume is centered at the same switching point (Figure 2) as in the example used in *HM*. If there were only one technique (β), this modification would be unambiguously classified as a case of Marx biased technical progress.



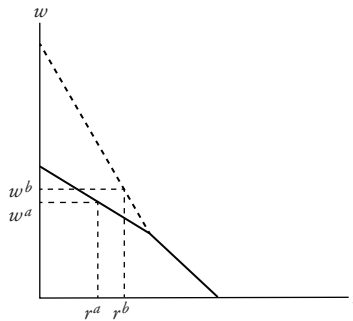
Source: Author's own elaboration.

Figure 1 Wage–profit frontier



Source: Author's own elaboration.

Figure 2 Marx biased technological progress



Source: Author's own elaboration.

Figure 3 Modified wage-profit frontier

Before the adoption of the innovation, the maximum real wage and the profit rate are w^* and r^* , respectively. Suppose that real wages were relatively high (for example, above w'); then it make sense for firms to seek to innovate to shed labor costs, as stated in the quote from chapter 2 above. After the adoption of the innovation, the maximum profit rate remains unchanged, but the maximum real wage increases from w^* to w^{**} .

For most purposes, this looks exactly like a Harrod neutral technical progress (which increases labor productivity, but keeps capital productivity intact). Had the real wage remained above the switching point, the part of the envelope below w' would never be observed. Notice that in this scenario it is possible to increase both the real wage and the profit rate (for example, from w^a and r^a to w^b and r^b , as in Figure 3), despite the fact that technical progress was of the Marx biased type. The profit rate can never fall, because in that case the technique α will be adopted.³

3. Furthermore, suppose that after the initial change there is a new technological modification of the Hicks type, that also affects only the technique β , and that such change is so large that now α is no longer profitable for any income distribution. Now the technical progress depicted in Figure 2 will again look like Marx biased.

I do not question the assumptions of *HM*, but I believe that a clarification regarding the number of techniques that are available can greatly reduce the room for misinterpretation of the models. While a full discussion of the multi-goods and multi-techniques case is probably beyond the scope of *HM*, the standpoint on the merits and demerits of assuming that there is only one technique (and for most of the book, one good) is certainly a topic for further discussion. Perhaps a good starting point is to distinguish more precisely between changes in the technique that is operative from technological innovations that create a new blueprint of techniques.

3 ON THE ROLE OF CONTINUOUS SUBSTITUTION

The basic neoclassical growth model does not require factor substitution in order to deliver full employment, something that Solow (1956) himself recognized. However, it is stated in chapter 3 of *HM* that a smooth production function is used to solve Harrod's second problem, namely the equalization of the warranted and the natural rate of growth via the adjustment of the capital-to-labor ratio (p. 121). While this is not the final word of the authors of the text,⁴ the precise role of continuous substitution is often neglected in some heterodox circles, and it may worth exploring this issue.

To see why it would be wrong to claim that continuous substitution is required to obtain full employment in a standard neoclassical growth model, consider the basic dynamic equation which is captured by the following expression:

$$\dot{k} = sf(k) - nk, \quad (1)$$

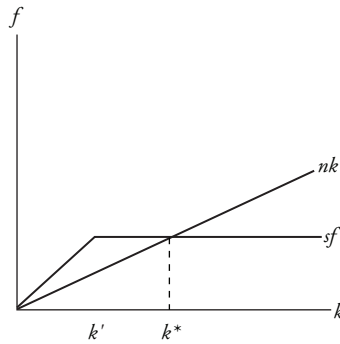
where the derivative of the capital-labor ratio with respect to time \dot{k} depends on the propensity to save s , output per capita (which is some increasing function of the capital-labor ratio $f(k)$), population growth n , and the capital-labor ratio k . Notice that by dividing both sides by k , (1) expresses the fact that the rate of growth of the capital-labor ratio $\hat{k} = \frac{\dot{k}}{k}$ is equal to the rate of capital accumulation $\frac{sf(k)}{k}$ minus population growth.

In equilibrium we should obtain $\dot{k} = 0$ and then $\frac{f(k^*)}{k^*} = \frac{n}{s}$. As is well known, a production function that satisfies the so-called 'Inada conditions',⁵ the best example being the Cobb-Douglas case, ensures that k^* exists and that the dynamic system represented by (1) converges to equilibrium with full employment.

While a Cobb-Douglas production function features a flexible capital-output ratio and is certainly consistent with full employment, provided that factor prices are flexible, it is not the only well-behaved case. Consider for instance a Leontief production function of the form $F = \min\left\{\frac{L}{a_0}, \frac{K}{a_1}\right\}$, where output F is equal to the minimum between the ratio of employment L to the labor-output ratio a_0 and the ratio of capital K to the capital-output ratio a_1 . Because F has constant returns to scale, we can write $f = \frac{F}{L} = \min\left\{\frac{1}{a_0}, \frac{k}{a_1}\right\}$.

Figure 4 (based on figure IV from Solow 1956) illustrates this well-behaved case. Between the origin and k' , there is surplus labor, so any addition to the capital stock will expand production and total savings. At the capital-to-labor ratio k' , labor is no longer the scare factor, so the production function becomes a straight line. Intuitively, further

4. *HM* also includes the correct statement. For example, it is often argued that a flexible capital-to-labor ratio is a 'facilitating factor' (p. 122; see also p. 25), but the reason why the system converges to full employment is not given.



Source: Elaborated based on Solow (1956).

Figure 4 The Solow model with fixed coefficients

additions to the capital stock cannot increase output and consequently savings, as capital is now an abundant factor. Where the sf curve crosses the nk curve, other than at the origin, there is an equilibrium with a positive capital-to-labor ratio k^* with full employment. It is clear from the figure that sf should be steeper than nk for low levels of capital per unit of labor, so the well-behaved equilibrium exists. It is straightforward to verify that the equilibrium is stable, as $nk > sf$ implies that the ratio of capital to labor increases, while $nk < sf$ implies that the ratio of capital to labor decreases.⁵

As explained in *HM*, the Solow model does not solve Harrod's first problem (namely the instability of the goods market); rather, the problem is swept under the rug because it is assumed that planned savings equals planned investment, because in the background a fiscal and/or a monetary policy operates which ensures that there is just enough effective demand.⁶

The example with fixed coefficients does not alter the fact that the key difference between heterodox and the neoclassical models is not related to the form of production functions (for example, fixed proportions vs continuous substitution). In principle, both neoclassical models with fixed proportions and heterodox models with continuous substitution can be built. Rather, the distinctive characteristic is the predominance of the assumption that markets clear via price adjustments (in the neoclassical models), at least in the long run, and in particular factor markets. In contrast, market clearing plays a limited role in the heterodox tradition, if any at all.

It may also be worth remembering that Harrod himself did not base his own analysis on a Leontief production function. Rather, Harrod believed that the interest rate may not be flexible enough to ensure full employment. In fact, Harrod (1953) vehemently rejected

5. If capital is the scare factor, $\frac{1}{a_0} > \frac{k}{a_1}$ and then $sf = s\frac{k}{a_1}$. In this case we have $s\frac{k}{a_1} > nk$, and then it follows that $\dot{k} > 0$. As capital accumulates, we should reach an upper bound once labor shortage emerges. Then labor becomes the scare factor, so total savings will be governed by $sf = s\frac{1}{a_0}$. Because nk is continuous and increasing in k , at some point $s\frac{1}{a_0} < nk$ and then $\dot{k} < 0$. Consequently, provided that s is large enough or a_0 and n are small enough, there is a stable equilibrium $k^* = \frac{s}{n} \frac{1}{a_0}$ where labor is fully employed.

6. As Swan (1956: 335) put it: 'Effective demand is so regulated (via the rate of interest or otherwise) that all savings are profitably invested, productive capacity is fully utilized, and the level of employment can never be increased merely by raising the level of spending.'

the model of Pilvin (1953), which relied on factor substitution (a notable forerunner of Solow and Swan) precisely on those grounds:

In my analysis, which only claimed to be a preliminary attempt to lay foundations, I laid no stress on the rate of interest and did not bring it into the foreground as an important determinant. Mr. Pilvin's more optimistic definition of a possible line of growth implies that in appropriate circumstances it is reasonable to suppose that the rate of interest will move in such a way as to change the productive process employed, causing it to move in an appropriate fashion along the curve of the production function. (Harrod 1953: 555)

Harrod's approach seems to be more in line with the idea that the rate of interest is an exogenously given (or at least is not flexible downward) distributive variable. Its adjustment cannot be trusted to ensure full employment.

4 ON LIMIT CYCLES

It is claimed in *HM* that the Goodwin model features 'limit cycles' (p. 97). But the model that appears in chapter 2 produces oscillations of a different sort (that is, a family of closed orbits). The difference may seem minor, and while *HM* uses the term limit cycles between quotes, we should bear in mind that there are subtle modeling issues that we need to keep in mind.

The model presented is a very useful device to illustrate the mechanics of the original models, but it may fail to produce systematic oscillations under a more general set-up. Specifically, the simplified model of Goodwin (1967) is linear system that combines two dynamic equations for the profit share and employment. The first equation governs functional income distribution:

$$\hat{\psi} = -(q + \gamma) + \xi e, \quad (2)$$

where $\hat{\psi}$ is the rate of growth of the labor share, q is the rate of growth of labor productivity, and e is the rate of employment, with $\gamma > 0$ and $\xi > 0$. Notice that (2) can also be expressed as $\hat{\psi} = \hat{w} - q = -\gamma + \xi e$ where \hat{w} is real wage growth.

Employment growth is a function of the difference between the rate of growth of capital g minus the rate of growth of labor in efficiency units (population growth plus labor productivity) $n + q$. The rate of capital accumulation is given by $\frac{1-\psi}{a_1}$, which is assumed to be equal to the profit rate, defined as the profit share $1 - \psi$, over the capital-output ratio a_1 . Employment growth is thus defined by:

$$\hat{e} = \frac{1-\psi}{a_1} - (n + q). \quad (3)$$

The dynamic system has an equilibrium when $\hat{\psi} = \hat{e} = 0$ which, barring the degenerate case where $e = \psi = 0$, implies that employment is given by $e^* = \frac{q+\gamma}{\xi}$ and the wage share by $\psi^* = 1 - a_1(n + q)$. The associated Jacobian matrix is:

$$\mathbf{J} = \begin{bmatrix} 0 & \xi \\ -1/a_1 & 0 \end{bmatrix}, \quad (4)$$

with $TR[\mathbf{J}] = 0$ and $DET[\mathbf{J}] = \frac{\xi}{a_1} > 0$. The system has two complex roots with a zero real part, which in practical terms means that there is an entire family of closed orbits around

e^* and ψ^* , but not a limit cycle as stated. A limit cycle should not be close to other cyclical trajectories.

If we modify the Goodwin model slightly, cyclical behavior may disappear, as is recognized in *HM* (see p. 96). More precisely, if for some reason the level of employment or the wage share affect their own rates of change, which is reasonable for instance if the adjustment involves lags, the dynamics may become non-oscillatory (or oscillatory around a stable or an unstable equilibrium).

To clarify how slight modifications in the adjusting mechanism may eliminate systematic oscillations altogether, consider a more generalized system of the form:

$$\hat{\psi} = H(\psi, e) \tag{5}$$

$$\hat{e} = G(\psi, e), \tag{6}$$

where H and G are some continuous functions of employment and the labor share, with $H_e > 0$ and $G_\psi < 0$ as in the Goodwin model, but for instance $H_\psi < 0$ and/or $G_e < 0$, so there is a stabilizing feedback from the level of the wage share and employment to their rates of change.

For instance, consider the functions $\dot{\psi} = \psi\alpha_1(\psi^* - \psi)$ and $\dot{e} = e\alpha_2(e^* - e)$, with positive speeds of adjustment towards equilibrium $\alpha_1 > 0$ and $\alpha_2 > 0$. Now $DET[\mathbf{J}] > 0$ and $TR[\mathbf{J}] < 0$, so the system no longer oscillates around the equilibrium defined previously, except possibly during the disequilibrium phase.⁷

What is the main take-home point? While the Goodwin model is a very nice pedagogical device and certainly suits the level of complexity of *HM*, it has a very limited ability to produce non-convergent oscillation under more general conditions and it does not produce a limit cycle (there are multiple of trajectories of employment and the profit share that are associated with different initial conditions).

For instance, the model proposed by Skott (1989) discussed in chapter 6 of *HM* has similar implications (that is, employment and the profit share display a clockwise cycle when the profit share is located on the y axis and employment in the x axis), but after a change in the initial conditions (which does not change the basic structure of the model), the employment rate and the profit share will converge to the same cyclical trajectory. This cannot happen in the Goodwin model: the variables will jump into a different closed orbit after the shock.

5 CONCLUSIONS

HM is the most up-to-date review of heterodox models of growth and distribution written so far. It is a must-read and the details discussed in the previous pages should not distract the reader from the content of a truly great text.

While I would prefer that the main merits and demerits of one-good and one-technique models, the role of smooth production functions in neoclassical and heterodox models, and the nature of cyclical fluctuations had been discussed differently, I think that the authors' framing choices are hard to question, especially for a text that aims to keep things simple while maintaining rigor.

7. See for instance the model proposed by Barbosa-Filho/Taylor (2006), discussed in chapter 5 of *HM*.

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