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**Article**

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# Invited Article

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## Post-Keynesian growth theory and the supply side: a feminist approach

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*Post-Keynesian macrodynamics is designed to extend the role of demand in the determination of real economic outcomes beyond the short run. The purpose of this paper is to highlight the importance of supply-side considerations in demand-led growth. Building on existing features of the supply side in post-Keynesian growth theory, three new developments are highlighted: human capital accumulation, the social reproduction of labour, and the supply-side link between distribution and growth. These new developments are shown to yield new insights into the established themes of reconciling demand and supply in the theory of long-run growth, and the relationship between distribution and growth. Furthermore, the feminist macro model used to explore the social reproduction of labour is shown to be a potential general framework for synthesizing these insights.*

**Keywords:** demand-led growth, potential rate of growth, technical change, human capital, human capacities, care-giving

**JEL codes:** B54, E11, E12, O41

### 1 INTRODUCTION

Post-Keynesian (PK) macrodynamics is renowned for models of demand-led growth. But the canonical models of growth in this tradition amount to little more than ‘moving IS relationships’ (or moving XM relationships in the case of Kaldorian variants). There are two longstanding internal criticisms of this state of affairs. According to Kregel (1985), the canonical PK models can be likened to ‘Hamlet without the Prince’: they are real-side-only models without monetary or financial foundations. According to Cornwall (1972), meanwhile, these models resemble ‘Say’s law in reverse’, implicitly positing that the supply side is always automatically and fully accommodating of demand-led economic expansion. The concern of this paper is with the second of these criticisms.<sup>1</sup> Its central premise is that the ‘Say’s law in reverse’ postulate in PK macrodynamics is not always appropriate, and even when it is, attention to the supply side can provide important insights. Either way, then, *the supply side merits closer attention in demand-led growth theory.*

There is abundant evidence in the recent PK literature that the supply side is receiving the attention it deserves, and as such it would be easy to compile a catalog of topics based

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1. For monetary and financial extensions of PK growth models, see, for example, Lavoie (1995) and Hein (2012).

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on this literature that pay due attention to the supply side in the context of demand-led macrodynamics.<sup>2</sup> But the purpose of this paper is more specific. Using the model developed by Braunstein et al. (2011) as an exemplar, it argues that feminist macro theory provides a nascent general framework for synthesizing several promising new contributions to the supply-side dynamics of demand-led macrodynamics. Moreover, it suggests that feminist macro theory achieves this end in a manner that not only bears on the longstanding project of reconciling supply and demand in PK growth theory, but also contributes to fundamental debates about the influence of distribution on growth. In so doing (and in the tradition of PK macro modelling critiqued by Kregel (1985)), the discussion in what follows focuses extensively (although not exclusively) on real-side-only macrodynamics, absent explicit monetary and financial considerations. It is also agnostic with respect to the precise influence of distribution on demand formation and growth, drawing attention instead to how the distribution–growth nexus may be altered by supply-side considerations. In short, and in keeping with its theme, the paper abstracts from various issues that are central to the PK project in order to better focus attention on how supply-side considerations – and feminist concerns with the supply side in particular – can contribute to this project.

The remainder of the paper is organized as follows. In Section 2, we begin by briefly reviewing supply-side detail that is already implicit – or explicit – in PK growth models. Section 3 then explores avenues of recent research that advance the integration of supply-side considerations into demand-led macrodynamics. Particular focus is placed on three seemingly unrelated topics – human capital accumulation, the social reproduction of labour, and the supply-side link between distribution and growth – that (*inter alia*) suggest mechanisms that reconcile demand and supply in the theory of long-run growth and provide new insights into the relationship between distribution and growth. Section 4 offers some conclusions, chief among which is that, in light of the pivotal role of the social reproduction of labour in the discussion in Section 3, ‘we should all be feminist macro modellers now’.

## 2 SOME RECEIVED SUPPLY-SIDE WISDOM AND ITS IMPLICATIONS

Despite the ‘Say’s law in reverse’ critique, PK growth theory is no stranger to features of the supply side. It is therefore appropriate to begin with a brief review of received wisdom regarding the supply side in demand-led macrodynamics. As befits the focus of the paper on longer-term, real-side dynamics, the discussion that follows privileges theories of production and technical change. Note, however, that in PK theory, administered prices are a supply-side phenomenon, so that pricing and price dynamics are a supply-side concern – and one that will interact with the theories of production and technical change outlined below. We abstract from these nominal dynamics here, but see, for example, Storm/Naastepad (2007) and Stockhammer (2008, 2011).

### 2.1 Theories of production, potential output growth, and technical change

In PK theory, the ‘workhorse’ production function takes the Leontieff form:

$$Y_p = \min \left[ \frac{K}{v}, \frac{N_{max}}{a} \right] \quad (1)$$

2. Some of this literature is described briefly at the beginning of Section 3.

where  $Y_p$  is potential real output;  $K$  denotes the capital stock;  $v$  and  $a$  represent the full-capacity capital–output ratio and the labour–output ratio, respectively; and  $N_{max} = (1 - U_{min})L$  is ‘full employment’ – the maximum possible level of employment, where  $U_{min}$  denotes the minimum level of unemployment that is attainable given labour market flows and associated ‘frictions’, and  $L$  is the size of the labour force.

The Leontieff technology treats factor inputs as complements, its zero elasticity of substitution seen as the best first approximation for production processes that, by virtue of their engineering, are characterized by low elasticities of substitution. Changing techniques is thus a discrete process that takes time (and the requisite technological change and investment) – it is not something that can be done continuously (and without limit) at any given point in time, as postulated by continuous production functions.<sup>3</sup> The choice of Leontieff technology is no accident for PK macrodynamics, because of its affinity with two general precepts of PK economics: the importance of *realism* (in this case, the observed history of technology – see Rosenberg 1976); and consistency with *historical time* (in this case, the conception of long-term growth and technical change as historical processes – see Harris 2022).

The solution to equation (1) describes a maximum level of output achievable at any point in time (distinct from the demand-determined actual level of output  $Y \leq Y_p$ ). From (1) we obtain either:

$$Y_p = \frac{K}{v} \tag{2}$$

or:

$$Y_p = \frac{N_{max}}{a} \tag{3}$$

The distinction between these solutions can be thought of in terms of the difference between an underdeveloped Lewis-type ‘dual’ economy (in 2), and a more capital-abundant economy that, were it relieved of the demand constraint that will generally result in  $N < N_{max}$ , will find itself labour-constrained on the supply side (as in 3). The latter, being more representative of advanced capitalism, will be the focus here (see also Skott 2020).

From (3), it follows that:

$$Y_p = \frac{N_{max}}{a} = \frac{(1 - U_{min})LP}{a}$$

where  $P$  denotes total population. Taking logs and differentiating with respect to time, it then follows that:

$$\Rightarrow y_p = -\hat{a} + n = q + n \tag{4}$$

3. As was famously argued by Joan Robinson in the course of the Cambridge capital controversies, movement along a continuous production function confuses movement through space with movement through time – an argument codified by the notion of a ‘fossil’ production function, in which the appearance of continuous substitution possibilities at a point in time is, in fact, the ‘trace’ of discrete transitions between different techniques of production over time (Foley/Michl 1999: 123–138). Even then, within the relevant range of variations in wage and profit rates, the number of viable techniques may be small, creating little opportunity for factor substitution (Kersting/Schefold 2021).

where  $q \equiv -\hat{a}$  is the rate of growth of labour productivity, and both the labour force participation rate ( $L/P$ ) and rate of growth of population ( $n$ ) are assumed constant in the long run. Equation (4) describes the potential rate of growth or what Harrod called the *natural rate of growth* – the maximum rate of growth that can be achieved in the long run. In other words, (4) describes a (long-run) ceiling to the growth rate, derived (in the first instance) independently of the demand-determined equilibrium rate of growth:

$$g = g(\mathbf{Z}) , \quad g' > 0 \quad (5)$$

where  $g$  denotes the equilibrium rate of growth and  $\mathbf{Z}$  denotes a vector of variables, such as animal spirits and the propensity to save, that affect the level and/or rate of growth of aggregate demand.<sup>4</sup> This means that PK growth models are typically characterized by the first Harrod problem: in general, we will observe  $g = g(\mathbf{Z}) \neq q + n = y_p$  or, in other words, *equality of the equilibrium and natural rates of growth is possible but unlikely*.

Two forms of technological change are commonly entertained in PK macrodynamics. The first is associated with the Verdoorn law, stating that:

$$q = \alpha + \beta g \quad (6)$$

where  $0 < \beta < 1$  is the Verdoorn coefficient. The second – classical-induced, factor-biased (CIFB) technical change – posits that:

$$q = \gamma \omega , \quad \gamma > 0 \quad (7)$$

where  $\omega$  denotes the wage share of income. As is evident from inspection of equations (6) and (7), together these theories link technical change to the central foci of PK macrodynamics: *growth* ( $g$ ) and *distribution* (the wage share,  $\omega$ ), respectively.

## 2.2 Path dependency of the potential rate of growth and the first Harrod problem

If technical progress depends on the Verdoorn law, then the natural rate of growth in (4) will be endogenous to the actual rate of growth. Hence combining (4), (5) and (6) yields:

$$y_p = \alpha + n + \beta g(\mathbf{Z}) \quad (8)$$

Indeed, even in the absence of the Verdoorn law, if technical progress occurs through the CIFB mechanism and the distribution of income is determined endogenously together with the growth rate (as in neo-Keynesian models – see, for example, Robinson 1956) – then the natural rate of growth will co-vary with the equilibrium rate of growth because of its endogeneity (via  $\omega$ ) to the structural determinants of  $g$ . This can be seen by writing:

$$\omega = \omega(\mathbf{Z}) \quad (9)$$

and then combining (4), (7) and (9) to yield:

$$y_p = n + \gamma \omega(\mathbf{Z}) \quad (10)$$

4. We assume throughout that the equilibrium rate of growth is stable and overlook disequilibrium outcomes. As such, the equilibrium and actual rates of growth are synonymous in what follows.

As is clear from (10), any variation in  $\mathbf{Z}$  that gives rise to variation in  $g(\mathbf{Z})$  will simultaneously cause variation in  $y_p$ . These results give rise to path dependency in  $y_p$  in the sense of Setterfield (2011), as a result of which the potential rate of growth varies with changes in the actual rate of growth: the independence of  $y_p$  from  $g$  postulated initially in the discussion of (4) no longer holds. Note, however, that path dependency so-defined does not solve the first Harrod problem. Hence as is clear by inspection,  $g = g(\mathbf{Z}) = y_p$  – equality of the actual (equilibrium) and potential rates of growth – will arise only as a special case whether  $y_p$  is determined as in (4), (8), or (10).

### 2.3 Overcoming the first Harrod problem: reconciling demand and supply in long-run growth theory

As noted, the path dependency of  $y_p$  does not in and of itself reconcile the actual (equilibrium) and potential rates of growth. This persistence of the first Harrod problem can spell trouble for PK macrodynamics. To see this, first, note that:

$$\begin{aligned} Y &= \frac{Y}{N}N \\ \Rightarrow g &= q + e \\ \Rightarrow e &= g(\mathbf{Z}) - q \end{aligned} \tag{11}$$

where  $e$  denotes the rate of growth of employment. Now note that:

$$\begin{aligned} \eta &= \frac{N}{L} \\ \Rightarrow \hat{\eta} &= e - n \\ \Rightarrow e &= n \end{aligned} \tag{12}$$

since, because the rate of employment  $\eta$  is a bounded variable ( $0 \leq \eta \leq 1$ ), we must observe  $\hat{\eta} = 0$  in the steady state. Hence substituting (11) into (12) and re-arranging, we obtain:

$$g(\mathbf{Z}) = q + n \Rightarrow g = y_p$$

This is precisely the outcome that, as previously noted, will *not*, in general, be observed in PK growth models.

There are two possible solutions to this apparent dilemma. The first involves abandoning the steady-state framework, or else assuming that economies are all of the Lewis-type. But it has already been suggested that advanced economies do not conform to the labour-abundant conditions typical of a dual economy. And while non-steady-state analysis has its merits, equilibrium methodology is pervasive in economic theory and the comparative static (dynamic) analysis that it supports is arguably too useful to surrender completely. The second solution is to seek mechanisms capable of reconciling  $g$  and  $y_p$ , and that will ultimately give rise to a constant (but indeterminate) value of  $\eta$  consistent with  $e = 0$  (see, for example, Palley (2002), Dutt (2006a) and Setterfield (2006)). One approach involves accepting the value of the potential rate of growth, and postulating that:

$$\dot{\mathbf{Z}} = -\gamma(g - y_p) \tag{13}$$

This means that if, for example,  $g(\mathbf{Z}) > y_p$ , the determinants of the actual rate of growth adjust so as to reconcile  $g$  with the supply-determined  $y_p$ . For example, in the context of a Kaldorian model, Palley (2002) argues that increases in  $\eta$  associated with  $g(\mathbf{Z}) > y_p$  induce sectoral bottlenecks that encourage expenditure switching towards imports, thus raising the income elasticity of demand for imports and so lowering  $g(\mathbf{Z})$  (by diminishing the balance-of-payments-constrained growth rate) until  $g(\mathbf{Z}) = y_p$ . In this approach, the final steady-state growth rate is determined on the supply-side by  $y_p$ , so the first Harrod problem is solved but at a cost: the long-run rate of growth is no longer demand-determined.

The alternative approach involves accepting the value of the equilibrium rate of growth, and postulating that:

$$\dot{q} = \delta(g - y_p) \quad (14)$$

and/or:

$$\dot{n} = \phi(g - y_p) \quad (15)$$

This means that if, for example,  $g(\mathbf{Z}) > y_p$ , the determinants of the potential rate of growth adjust so as to reconcile  $y_p$  with the demand-determined  $g$ . For example, and again in the context of a Kaldorian model, Setterfield (2006) argues that the propensity of any given rate of growth to induce productivity-enhancing technical change via the Verdoorn law depends on the accompanying degree of macroeconomic ‘slack’, so that increases in  $\eta$  associated with  $g(\mathbf{Z}) > y_p$  induce increases in  $\beta$  as firms switch from ‘defensive’ (capacity maintaining) investment to ‘enterprise’ investment (R&D and/or investment embodying technical change) (Lamfalussy 1961, 1963).<sup>5</sup> In this approach, the final steady-state growth rate is determined on the demand-side by  $g(\mathbf{Z})$  thanks to the mechanism in (14).<sup>6</sup> The first Harrod problem is once again solved but this time without sacrificing the demand-led character of the long-run growth rate. Of course, the mechanisms postulated in equations (13), (14), and (15) need not be treated as mutually exclusive and empirical evidence (see, for example, Soukiazis et al. 2017; Cordeiro/Romero 2023; Ozelik 2022) suggests they are not.

### 3 THREE NEW DEVELOPMENTS

Various literatures build on the foundations outlined in the previous section and in so doing, extend and enrich analysis of the supply side in demand-led macrodynamics. For example, drawing on a prominent theme in neoclassical endogenous growth theory, Tavani/Zamparelli (2015) argue that technical change does not simply materialize ‘out of thin air’, but must be conceived as the output of a process of production that requires resource inputs. This demands a model of the production function that gives rise to technical change. Elsewhere, Marglin (2017) draws attention to the distinction between capital widening and capital deepening, suggesting that the *purpose* of capital accumulation (at the point of production) can affect the relationship between distribution and growth.<sup>7</sup>

5. This mechanism is consistent with equation (14) and will raise the value of  $y_p$  in equation (8) until  $g(\mathbf{Z}) = y_p$ .

6. The mechanism in (15) is of much older pedigree, postulating that the labour-force-active population adjusts to labour market conditions through mechanisms such as migration. This idea is discussed in classical political economy. For more recent discussion in the context of PK macrodynamics see, for example, Cornwall (1977) and Porcile/Lima (2010).

Hence even if a profit squeeze reduces investment devoted to capital widening, it may *increase* investment devoted to capital deepening as a result of equation (7), according to which a profit squeeze motivates labour-saving technical change.

As previously noted, the purpose of this paper is to show how feminist insights provide a nascent general framework for integrating three new and important literatures bearing on the treatment of the supply side in demand-led macrodynamics. In what follows, then, we outline each of these three new developments in turn, focusing on their contribution to the project of reconciling demand and supply in long-run growth. In the process, attention will be drawn to the potentially central role that feminist insights can play in integrating these otherwise seemingly unrelated literatures.

### 3.1 Human capital formation

Lima et al. (2021) and Serra (2021) investigate human capital formation in a PK framework.<sup>8</sup> This is an important development in and of itself, because since Lucas (1988), human capital theory has been closely associated with neoclassical growth theory. In the PK context, however, investment in human capital constitutes both a source of productive capacity on the supply-side (where it increases the size of the labour force in efficiency units) *and* an autonomous, non-*physical*-capacity-creating expenditure that contributes to demand formation.<sup>9</sup> Beginning with the former, and after Lima et al. (2021) and Serra (2021), we can re-write the production function in (1) as:

$$Y_p = \min \left[ \frac{K}{v}, \frac{N_{max}}{(1 - U_{min})} \frac{h}{a_H} \right] \tag{16}$$

where  $a_H = \frac{H}{Y}$  is the (constant) human capital ( $H$ ) to output ratio, and  $h = \frac{H}{L}$  denotes human capital per worker. Then:

$$Y_p = \frac{N_{max}}{(1 - U_{min})} \frac{h}{a_H} = \frac{(1 - U_{min})L}{(1 - U_{min})} \frac{h}{a_H} = \frac{Lh}{a_H} \tag{17}$$

$$\Rightarrow y_p = g_b + n$$

where  $g_b \equiv \widehat{h}$ . Since:

$$g_b = g_H - n$$

(where  $g_H \equiv \widehat{H}$ ), it follows that:

$$y_p = g_H \tag{18}$$

Meanwhile, we can write:

$$g_H = \frac{\dot{H}}{H} = \frac{I_H}{H}$$

7. See also Marglin (2021: chs. 10, 18).

8. For similar developments in a Classical-Marxian context, see Dutt/Veneziani (2018, 2020).

9. Notice the subtle but important distinction here between human capital accumulation and the non-capacity-creating expenditures emphasized in Sraffian supermultiplier models.



This brings us to investment in human capital ( $I_H$ ) and so to the *demand side* of the model. Lima et al. (2021) and Serra (2021) provide different descriptions of who invests in human capital (and thus generates aggregate demand) and how their expenditure is financed. In Lima et al. (2021),  $I_H$  is publicly funded by a proportional income tax ( $\tau$ ), so that:

$$\begin{aligned} I_H &= \tau Y \\ \Rightarrow g_H &= \frac{\tau Y}{H} = \frac{\tau}{a_H} \end{aligned} \quad (19)$$

Meanwhile, Serra (2021) describes  $I_H$  as a private (household) expenditure, partly funded by a portion ( $\mu$ ) of wage income, and partly financed by a portion ( $\theta$ ) of household debt accumulation, so that:<sup>10</sup>

$$I_H = \theta \dot{D} + \mu \omega Y$$

where  $\dot{D}$  is household borrowing (the rate of change of household debt,  $D$ ) and  $\omega$  is the wage share of income. It follows that:

$$\begin{aligned} g_H &= \theta \frac{\dot{D}}{K} \frac{K}{K_u} \frac{K_u}{Y} \frac{Y}{H} + \mu \omega \frac{Y}{H} \\ \Rightarrow g_H &= \frac{\theta \nu}{a_H u K} \dot{D} + \frac{\mu \omega}{a_H} \end{aligned}$$

where  $K_u = uK$  is the share of the capital stock used to produce current output and  $u$  is the rate of capacity utilization. Meanwhile, following Dutt (2006b):

$$\begin{aligned} \dot{D} &= \lambda(\omega Y - iD) \\ \Rightarrow \frac{\dot{D}}{K} &= \lambda \left( \frac{\omega u}{\nu} - id \right) \end{aligned}$$

Hence upon substitution:

$$\begin{aligned} g_H &= \frac{\theta \nu \lambda}{a_H u} \left( \frac{\omega u}{\nu} - id \right) + \frac{\mu \omega}{a_H} \\ \Rightarrow g_H &= \frac{\omega}{a_H} (\theta \lambda + \mu) - \frac{\theta \nu \lambda}{a_H u} id \end{aligned} \quad (20)$$

The demand-side differences reflected in equations (19) and (20) matter. In Lima et al. (2021), human capital is publicly funded by taxation according to a balanced-budget

10. See Serra (2021) for extensions to this basic framework, in which ‘high’ and ‘low’ skill workers accumulate ‘primary’ and ‘secondary’ human capital in a segmented education market, and ‘low’ skill workers’ investment is motivated (in part) by the wage gap, so that they accumulate human capital in an effort to ‘keep up with the high-skill Joneses’. See also de Carvalho et al. (2023), who treat human capital accumulation as a private, debt-financed expense. The description of household borrowing in de Carvalho et al. (2023) differs from that below, but the precise specification of borrowing and debt dynamics is not the focus in what follows.

principle, thus having no implications for public debt accumulation. However, fiscal policy becomes a cause for concern: raising taxes to fund human capital accumulation is shown to have ambiguous effects on the employment rate because contrary to neoclassical theory, raising the supply of highly-educated workers does not automatically create demand for these workers. In Serra (2021), meanwhile, investment in human capital is financed by workers borrowing from rentiers, so that the financial fragility of the household sector becomes an issue. Student debt relief is now an important policy concern. Serra (2021) shows that while student loan cancellation has desirable short-term macroeconomic effects, a reduction in student loan interest rates is required for such effects to persist in the long term.

These differences aside, however, both models give rise to descriptions of the potential and equilibrium (actual) rates of growth that can be summarized as:

$$y_p = g_H \quad (18)$$

and:

$$g = g(g_H, \mathbf{Z}) \quad (21)$$

Inspection of (18) and (21) reveals that in this class of models, human capital accumulation contributes to the determination of both the demand-led equilibrium rate of growth and the potential rate of growth. In principle, then, variation in  $g_H$  might bring about *reconciliation* of  $g$  and  $y_p$  of the sort contemplated in subsection 2.3. In fact, as is formally demonstrated by Serra (2021),  $g_H$  can play precisely this role. Hence in addition to its intrinsic importance in PK macrodynamics as demonstrated by Lima et al. (2021) and Serra (2021), human capital accumulation presents a mechanism capable of solving the first Harrod problem in demand-led growth models.

### 3.2 Social reproduction of the household

In both Lima et al. (2021) and Serra (2021), human capital is narrowly defined as formal education and training. Investment in human capital so-defined, together with the provision of *care services* (Elson 1995), contributes to the stock of *human capacities*: ‘features that make human beings more economically effective (such as emotional maturity, patience, self-confidence, and the ability to work well with others, as well as standard human capital measures such as skills and education)’ (Braunstein et al. 2011: 9–10). Simply put, human capacities are ‘individual attributes that improve productive contributions’ (Heintz/Folbre 2022: 150). So-defined, human capacities are acquired rather than innate and are equivalent to conventional conceptions of human capital *broadly defined*, as acquired attributes of individuals that enhance their (marginal) productivity. Crucially, however, by distinguishing between human capital (narrowly defined) and care services – which are provided through both market processes (for example, day spa services) and non-market processes (for example, caring for a sick relative) – the concept of human capacities draws explicit attention to *unpaid care in the home*, which is closely related to the Marxist-Feminist concept of the *social reproduction of labour* (Folbre 1994). Ultimately, then, focus on human capacities draws attention to the fact that such capacities are accumulated through processes that are *gendered* (Braunstein et al. 2011: 8).

PK contributions to the nascent field of feminist macroeconomics have demonstrated the capacity of gender to contribute to demand formation through a variety of channels, including the size of the marginal propensity to consume and the trade balance (Seguino 2010; Seguino/Setterfield 2010; Onaran et al. 2022a, 2022b, 2023). However, as first

demonstrated by Braunstein et al. (2011) and more recently by Onaran et al. (2022a), the particular value of focusing on human capacities accumulation in the context of PK macrodynamics is that it has important implications for both aggregate demand *and* supply.<sup>11</sup> Potentially, as will be argued below, it also has implications for the reconciliation of the actual (equilibrium) and potential rates of growth required to solve the first Harrod problem.

In the Braunstein et al. (2011) model, investment spending on marketed services that create human capacities ( $I_{H_c}$ ) contributes directly to demand formation, where:

$$I_{H_c} = I_{H_c} \left( \sigma^e(\pi, u) \right), \quad I'_{H_c} > 0 \quad (22)$$

and  $\sigma^e(\cdot)$  denotes expected opportunities, with  $\sigma^e_\pi < 0$ ,  $\sigma^e_u > 0$ . The *size* of  $I'_{H_c} > 0$  depends on ‘caring spirits’, which are assumed to be greater in altruistic societies than in selfish societies. The key results in Braunstein et al. (2011) emanate from this distinction,<sup>12</sup> the general importance of which is evident from the fact that, from (22):

$$dI_{H_c} = I'_{H_c} (\sigma^e_\pi d\pi + \sigma^e_u du).$$

Given  $I'_{H_c}, \sigma^e_u > 0$  and that the size of  $I'_{H_c}$  depends on caring spirits, it follows that the *size of the accelerator effect on total investment* ( $I$ ) in this model,  $dI = I_{K_u} du + I'_{H_c} \sigma^e_u du$  where  $I_K$  denotes investment in physical capacity and  $I_{K_u} = \frac{dI_K}{du}$ , depends on caring spirits. The importance of this observation for PK macrodynamics is twofold. First, as is evident from the debate between Harrodians and Kaleckians, the size of the accelerator effect influences the stability of the steady state in PK growth theory. Second, per Bhaduri/Marglin (1990) and Marglin/Bhaduri (1990), the size of the accelerator effect influences the character of the demand regime (specifically, whether it is wage- or profit-led).<sup>13</sup> In other words – and as is emphasized by Braunstein et al. (2011: 14–15) – regardless of the character of the demand regime otherwise, the inclusion of human capacities in demand formation as in (22) inclines the demand regime towards being wage-led.

Meanwhile, the contribution of unpaid care-giving (the social reproduction of labour) in the household enters on the supply-side of the Braunstein et al. (2011) model, where:

$$H_c = H_c \left( f(u), m(u) \right) \quad (23)$$

In equation (23),  $f(u)$  and  $m(u)$  denote the female and male wage rate, respectively, where  $m' > f' > 0$  and  $H_{c_m} < H_{c_f} < 0$ . Hence wages are increasing in the level of economic activity but at different rates, reflecting the assumption that men have more bargaining power due to gender segmentation of the labour market. Meanwhile, the production of human capacities is decreasing in wage rates, capturing the idea that higher wages attract both men and women towards the paid labour market and thus reduce time devoted to the unpaid (re)production of human capacities in the household. Moreover, the negative effect of wages on unpaid care-giving is greater for men due to

11. See also Braunstein et al. (2020, 2021), Onaran et al. (2022b, 2023), and Oyvat/Onaran (2022) for empirical counterparts to the theoretical literature discussed in this subsection.

12. For example, raising the female wage rate is shown to have different effects in selfish as opposed to altruistic societies.

13. Note that the fact that  $I'_{H_c} > 0$  and  $\sigma^e_\pi < 0$  will only serve to reinforce the effects of human capacities accumulation on the character of the demand regime as described here.

the gendered structure of the social reproduction of labour. Drawing on (23), Braunstein et al. (2011) then write:<sup>14</sup>

$$Q = \frac{1}{a} = Q[f(u), m(u), H_c(f(u), m(u))] \tag{24}$$

where  $Q_f, Q_m, Q_{H_c} > 0$ . In other words, output per worker increases in response to both CIFB technical change ( $Q_f, Q_m > 0$ ) and hours devoted to unpaid care-giving in the household ( $Q_{H_c} > 0$ ). Note that, as a result of the specification of the wage- and unpaid-care-giving functions in (23), it follows from (24) that an increase in economic activity and hence wages will have both positive ‘direct’ effects *and* negative ‘indirect’ effects (via the human capacities production function in equation (23)) on  $Q$ .<sup>15</sup>

Braunstein et al. (2011) do not postulate an explicit production function, but based on (1) and (24) we can write:

$$Y_p = \min\left[\frac{K}{v}, N_{max}Q[f(u), m(u), H_c(f(u), m(u))]\right] \tag{25}$$

$$\Rightarrow Y_p = (1 - U_{min})LQ[f(u), m(u), H_c(f(u), m(u))] \tag{26}$$

It follows that:

$$y_p = q(\cdot) + n \tag{27}$$

Derivation of  $q(\cdot)$  from the implicit function  $Q[\cdot]$  stated in (24) requires further thought here.<sup>16</sup> Furthermore, the precise specification of  $q(\cdot)$  in (27) will, in the long term, be affected by  $g_{H_c} = \frac{I_{H_c}}{H_c}$  as a result of equation (22), as the stock of human capacities responds to the flow of investment in marketed services associated with the development of human capacities.<sup>17</sup> These important theoretical issues notwithstanding, it would appear that there clearly is (or can be) *some* appropriate expression for  $q$  such that

14. In Onaran et al. (2022a), unpaid care in the home enters directly into the determination of the (log) level of output per worker, together with (*inter alia*) the CIFB mechanism *and* a Verdoorn effect, in what therefore constitutes an extension of (24).

15. Note that in Braunstein et al. (2011),  $H_c$  is independent of  $I_{H_c}$ , because of the assumed short-run structure of model, while  $H_c$  is modelled exclusively in terms of labour inputs (requiring no marketed goods or services). As a result, unpaid care-giving affects  $H_c$  and hence  $Q$  but without generating demand for output, while investment in marketed services that (ultimately) contribute to human capacities generates demand for output without affecting  $H_c$  and hence  $Q$ . In short, the structure of the model means that care services as conceived by Elson (1995) have demand- and supply-side effects that are independent of one another. The independence of  $H_c$  and  $I_{H_c}$  would inevitably be relaxed beyond the short run. Assuming that marketed outputs are required as factor inputs complementary to unpaid labour in the domestic production of  $H_c$ , which would make demand formation dependent on (*inter alia*) the scale of unpaid care-giving in the home, might represent an interesting extension of the Braunstein et al. (2011) model.

16. The same applies to the extended model of output per worker in Onaran et al. (2022a). In both cases, the capacity for long-run growth in domestic care-giving *per capita* must be reconciled with the time constraint faced by the household. One possibility, of course, is that the productivity of domestic care giving itself need not be constant.

17. Note that this last problem is ‘solved’ in the neoclassical model of Heintz/Folbre (2022), but by treating  $H_c$  and  $g_{H_c}$  as exogenously given. In the neoclassical literature generally, the inter-generational reproduction of labour (the value of  $n$ ) has captured attention, owing to declining fertility rates in advanced economies coupled with the importance of  $n$  for the determination of  $y_p$  and hence  $y$  in

$q = q(g_{H_c}, \mathbf{X})$ , where  $\mathbf{X}$  is a vector of other influences on  $q$  including unpaid care-giving in the household. This, in turn, suggests that we can (or should eventually be able to) write:

$$y_p = q(g_{H_c}, \mathbf{X}) + n \quad (28)$$

and (recalling structure of demand side):

$$g = g(g_{H_c}, \mathbf{Z}) \quad (29)$$

We now have expressions analogous to equations (18) and (21) derived from the human capital literature surveyed in the previous subsection, in which human capacity accumulation contributes to the determination of both the demand-led actual (equilibrium) rate of growth and the potential rate of growth. The key difference, of course, is that human capital accumulation (narrowly defined) is but a subset of human capacities accumulation, which includes services derived from gendered, unpaid care-giving in the household. In other words, equations (28) and (29) can be thought of as *generalizing* equations (18) and (21). Otherwise, and by appeal to the discussion in the previous subsection and in particular, the results of Serra (2021), the prospect now arises that variation in the accumulation of human capacities may reconcile the equilibrium and potential rates of growth and thus provide a mechanism capable of solving the first Harrod problem.<sup>18</sup>

### 3.3 Distribution and potential output growth again

As was demonstrated in subsection 2.2, technical change can connect distribution to the determinants of the potential rate of growth. Although this does not *automatically* solve the first Harrod problem, if  $y_p$  is affected by distribution and  $g = y_p$  is observed in the steady state, then distribution can be said to affect the *actual* (equilibrium) rate of growth – but through supply-side channels, rather than the demand-side channels traditionally emphasized in PK macrodynamics (Petach/Tavani 2020; Luzuriaga/Tavani 2021; Rada et al. 2021, 2022; Michl/Tavani 2021). Further to all this, as is demonstrated by Rada et al. (2021), in a model in which distribution affects both the actual and (via technical change) potential rates of growth, redistribution of income may provide a mechanism capable of reconciling the equilibrium and potential rates of growth and thus solving the first Harrod problem. Indeed, this mechanism may even transform a profit-led medium run growth regime into one that is wage-led in the long-run steady state.<sup>19</sup>

the neoclassical tradition (see, for example, Jones 2022). But neither the social reproduction of labour nor the gendered nature of either the inter-generational or social reproduction processes are prominent themes.

18. There are, of course, other ways in which the human capital and human capacities literatures might gain from cross-fertilization. For example, Lima et al. (2021) and Serra (2021) show that the financing of accumulation matters, as does (*contra* Braunstein et al. 2011: EN 5) the interest rate. Perhaps most importantly, the human capital literature already makes a ‘tight’ connection between demand and supply, as a result of which any expenditure on human capital augments the stock of human capital available on the supply side. This formulation might assist with the precise specification of  $q(\cdot)$  as discussed above.

19. Of course, there is no need to begin with a medium-run growth regime that is profit-led when integrating technical change into PK macrodynamics and then considering the interaction of distribution and growth. See, for example, Rochon/Setterfield (2012) and Storm/Naastepad (2017) for wage-led models featuring the CIFB mechanism found in Rada et al. (2021) and/or the Verdoorn law. In what

To see all this, consider a demand-led growth regime of the form:<sup>20</sup>

$$g = g(\pi, \mathbf{Z}), \quad g_\pi > 0 \tag{30}$$

$$\pi = 1 - \omega = 1 - wa \tag{31}$$

where  $\pi$  is the profit share of income and  $w$  is the real wage. In equations (30) and (31), an increase in  $w$  will increase  $\omega = wa$  (*ceteris paribus*) and thus reduce  $\pi$  (in (31)) and  $g$  (in (30)). In other words, the demand-led growth regime in (30) is (by hypothesis) unambiguously profit-led.

Now suppose that:

$$y_p = -\hat{a} + n = q + n \tag{4}$$

$$q = \gamma\omega \tag{7}$$

$$\hat{w} = q + \delta(g - y_p) \tag{32}$$

where (32) captures a ‘Phillips’ or ‘reserve army’ mechanism, according to which increases in the rate of employment (as a result of  $g > y_p$ ) cause increases in the rate of growth of real wages. In the model above, steady state conditions arise if  $g = y_p$  so that, in addition to a constant rate of employment, we observe  $\hat{w} = q = -\hat{a}$  in (32), which renders the wage- and profit-shares of income constant in (31). But any occurrence of the first Harrod problem  $g \neq y_p$  will cause the real wage to grow at a rate that differs from the rate of productivity growth (see equation (32)), altering the functional distribution of income and hence (*ceteris paribus*) raising the rate of productivity growth in (7) and the potential rate of growth in (4).

The implications of all this are illustrated in Figure 1. Suppose that we begin with  $\pi^* = 1 - \omega^*$  which, given the growth schedule  $g_1$ , is consistent with steady-state conditions at  $g^* = y_p^*$ . Now assume that a change in the vector  $\mathbf{Z}$  causes the growth schedule  $g_1$  to rotate to  $g_2$ , raising the rate of growth observed at  $\pi^* = 1 - \omega^*$  to  $g' > y_p^*$  initially. This will imply that  $\hat{w} > q = -\hat{a}$  in (32), resulting in an increase in  $\omega$  and corresponding decrease in  $\pi$  in (31). The resulting redistribution of income towards wages will now have two effects. First, it will reduce the medium-run rate of growth,  $g$ , as a result of the latter being profit-led ( $g_\pi > 0$ ). Second, it will stimulate productivity growth and hence raise the potential rate of growth,  $y_p$ , as a result of CIFB technical change. The end result of these processes will be the restoration of steady-state equilibrium at  $g'' = y_p'$  (consistent with  $\pi' = 1 - \omega'$ ), such that  $g' > g'' = y_p' > y_p^* = g^*$ . In other words, despite the fact that growth is profit-led in the medium run ( $g'' < g'$  due to the increase in the wage share), the steady-state rate of growth *increases* ( $g'' = y_p' > y_p^* = g^*$ ). In short, the long-term steady-state rate of growth is wage-led, principally as a result of the positive effects of the wage share on  $y_p$  working through the supply-side of the economy.<sup>21</sup>

follows, the purpose of privileging the Rada et al. (2021) model is that it helps to illustrate the potentially *transformative* effects of supply-side dynamics on the distribution-growth nexus – specifically, the transformation of an initially profit-led growth regime into one that is wage-led.

20. The model developed by Rada et al. (2021) involves endogenous cycles in the medium run. The presentation is simplified here, by focusing on the properties of the medium-run equilibrium rate of growth.

21. Note the consistency of this result with Blecker (2016), according to whom growth is more likely to be wage-led in long run.

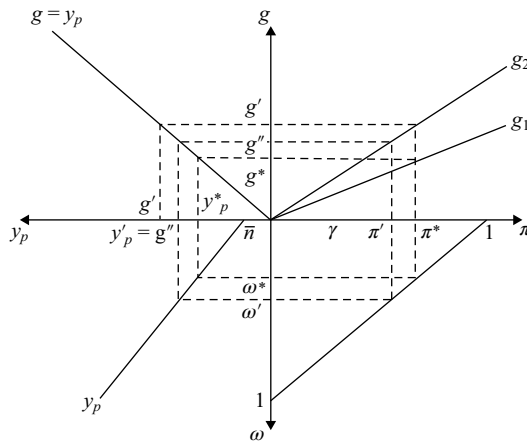


Figure 1 Wage-led growth via the supply side

Various complications might intrude on the result just described. In particular, technical change through the Verdoorn channel in equation (6) would mean that *ceteris paribus*, a fall in the actual rate of growth induced by a rise in  $\omega$  above  $\omega^*$  would *retard* productivity growth and so *reduce* the natural rate of growth. As a result, the natural rate of growth may experience a *net decline* in value when the countervailing effects on  $q$  of both the Verdoorn law and CIFB technical change are taken into account. If so, then with both the actual and the natural rates of growth now falling as  $\omega$  rises, the system as a whole may become unstable if reductions in  $y_p$  exceed those in  $g$ . Even if stability holds, the steady-state equilibrium growth rate will now be profit-led, since  $g$  and  $y_p$  will converge to a value below that of the original steady-state growth rate. In sum, the controversy in PK macrodynamics concerning wage- versus profit-led growth will reappear in a model of this type that is augmented by the Verdoorn law, with the *supply-side* now established as the ‘battleground’ between competing views.

These complications aside, another look at the model sketched above reveals clear links to the human capacities (and hence human capital) literatures previously surveyed. Hence in Rada et al. (2021), any change in the distribution of income affects realized growth outcomes via both the actual *and* potential rates of growth (the values of which are eventually reconciled). In the models of Braunstein et al. (2011) and Onaran et al. (2022a), the same result can potentially emerge, with important embellishments provided by their consideration of the effects on output per worker of the (re)production of human capacities in the household. We have already seen that in a model of this type, the accumulation of human capacities is (following Serra 2021) suggestive of a ‘servo-mechanism’ capable of reconciling the actual and natural rates of growth. Meanwhile, the accumulation of these capacities is profoundly affected by income redistribution (the focus of attention in Rada et al. 2021). First, income redistribution will affect the demand side of the model outlined in subsection 3.2 through its ‘traditional’ effects on consumption and investment in physical capital, *and* through its effects on investment spending on human capacities in equation (22). Second, income redistribution will affect  $Q = Q[.]$  in equation (24) on the supply side, both through the ‘traditional’ channel of CIFB technical change, *and* as a result of variation in the quantity of unpaid care-giving in the home.

Indeed with respect to this final channel, any change in the functional distribution of income will affect  $Q$  in equation (24) to varying degrees, depending on the extent to which changes in wage income affect male as opposed to female wages. This is, of course, because of the *gendered* structure of unpaid care giving in the household, as captured by the assumption  $m' > f' > 0$  in equation (23). The upshot of these considerations is that feminist macro models of the type developed by Braunstein et al. (2011) and Onaran et al. (2022a) can be thought of as nascent extensions of Rada et al. (2021) – nascent, of course, because a model of the type sketched in subsection 3.2 is a short-run model, whereas Rada et al. (2021) is a fully-specified model of both medium- and long-run (steady-state) growth dynamics.

#### 4 CONCLUSIONS

This paper has focused on both ‘received wisdom’ and various new developments that concern modelling of the supply side in PK macrodynamics. On the face of it, three new developments that have been explored – human capital accumulation, the social reproduction of labour, and the supply-side link between distribution and growth – concern topics that, while important in their own right, are unrelated. On closer inspection, however, this turns out not to be the case. First, quite apart from the *primary* topics of interest in these three new literatures, all three serve an important *secondary* purpose: they relate back to the established theme of reconciling aggregate demand and aggregate supply in PK growth theory, by suggesting (or even demonstrating) new adjustment mechanisms through which we might come to observe equality between the actual (equilibrium) and potential rates of growth. In the process, they also provide new insights into another well-established theme in PK macrodynamics – the debate as to whether growth is wage- or profit-led.

Second, the themes of all three literatures – at least as they relate to reconciling the actual and potential rates of growth, and further exploring the relationship between distribution and growth – have been shown to intersect in the demand-led feminist macro model developed by Braunstein et al. (2011) and Onaran et al. (2022a). This suggests that feminist macro theory can be seen as a nascent general framework for further (and integrated) exploration of the themes developed in Lima et al. (2021), Serra (2021), and Rada et al. (2021). Consistent with the role of feminist economic theory recently envisaged by Folbre (2023),<sup>22</sup> feminist considerations would thus appear to be central to further development of PK macrodynamics – suggesting that ‘we should all be feminist macro modellers now’.

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22. Essentially, Folbre (2023) argues that quite apart from its (obvious) focus on gender and sexuality as a source of inequality, feminist economics should permeate all micro- and macro-theoretic arguments, because of the breadth and generality of its insights into matters pertaining to both structure and agency in the economic sphere.



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