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A neo-Kaleckian - Goodwin model of capitalist economic growth: Monopoly power, managerial pay, labor market conflict, and endogenous technical progress

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Keywords: Neo-Kaleckian growth, Goodwin, managerial pay, unemployment, bargaining.

JEL Classication: E12, O41, O33

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[*]An early version of this paper was presented at the conference honoring Geoff Harcourt's 80th birthday held in Robinson College, Cambridge, June 25 – 26, 2011.

Homage a Geoff Harcourt

For the past fifty years Geoff Harcourt has been a leading contributor to and defender of the Cambridge "Post Keynesian" approach to income distribution and growth. Within that rich school of thought Geoff has championed a Marxist and Kaleckian lens for understanding income distribution and growth in capitalist economies. Such a lens emphasizes the relative power of capital and labor in determining the distribution of income, with the resulting distribution of income impacting the rate of growth. This paper adopts that same lens and I hope Geoff approves.

I Introduction

This paper presents an endogenous growth model with unemployment. The model synthesizes themes in Goodwin's (1967) Marxist approach to distribution and growth with the neo-Kaleckian monopoly power approach. The paper aims to address two limitations in the existing neo-Kaleckian growth model. First, it seeks to distinguish the effect on income distribution of goods market monopoly power and labor market bargaining power, a distinction which current neo-Kaleckian models conflate in the mark-up. Second, it aims to distinguish the effects of capacity utilization from labor market unemployment, which current models implicitly treat as equivalent.

Within the model, monopoly power is identified with the neo-Kaleckian dimension of the analysis and it determines the functional distribution of income. Labor bargaining power is identified with the Goodwin Marxist dimension and it determines the division of the wage bill between managers and workers. Goodwin's (1967) model is a limit cycle model of growth and labor market conditions affect the functional distribution of income by affecting worker bargaining power. The current model is non-cyclical but is

still labeled a Goodwin model because labor market conditions again affect worker bargaining power. However, now, the impact is felt on the division of the wage bill between managers and workers rather than the functional distribution of income.

A major innovation is the introduction of managerial pay into the analysis, with managerial pay being determined through the division of the wage bill into payments to workers and managers.[1] This division of the wage bill serves two functions. First, it provides another channel for income distribution to impact economic activity and growth. Second, it provides a point of entry into the neo-Kaleckian model for Marxist labor market conflict and bargaining power concerns. That is because workers' share of the wage bill depends on their bargaining power.

There are strong empirical reasons for incorporating wage bill division into the analysis. Cambridge Post Keynesian analysis emphasizes the significance of changes of income distribution for explaining economic growth. Within the U.S., the empirical reality is that for much of the past thirty years the functional distribution of income has been fairly constant, whereas the personal distribution has become increasingly unequal owing to worker wage stagnation and rising managerial pay (Saez and Veall, 2005; Mohun, 2006). The implication is if rising income inequality has mattered for growth, then the channel for those effects has been changes in the division of the wage bill that changed the personal distribution of income. That calls for introducing wage bill division into theoretical models. With regard to real world data, workers are identified with

[1] Palley (2005) argues for the importance of the distinction between managerial and worker pay as a way of introducing labor market class conflict into the neo-Kaleckian model. However, the division of the wage bill is exogenously given, the labor market is absent, and the conflict over wage bill division is not modeled. Lavoie (2009) also introduces managerial pay into the neo-Kaleckian model, but his focus is on the cyclical behavior of the mark-up, given target return pricing and fixed managerial costs. He too takes the wage bill division as exogenous and does not model the labor market. The current paper models the labor market, endogenizes the division of the wage bill, and focuses on the AD implications of wage bill division for growth.

production and non-supervisory employees. In the U.S. this group constitutes approximately eighty percent of workers.

Finally, it is worth noting that the current model treats managers' pay as part of the wage bill and firms set prices as a mark-up over total average unit labor costs (i.e. managers' pay affects prices). Kalecki (1970) argued instead for treating managers' pay as a deduction from surplus so that it is not part of the cost structure and does not affect prices. If that treatment were adopted in the current model, there would be no wage bill division problem to solve, and the model would reduce to a standard Kaleckian model but with a deduction from profitability to cover managerial pay. Future research will reconcile these two treatments in a unified model.

III Relation to existing literature

The model that is presented in the next section builds on three different strands of research. The core first strand is the neo-Kaleckian growth model developed by authors such as Rowthorn (1981), Taylor (1983), Dutt (1984), and Lavoie (1995). Growth is driven by capital accumulation which depends positively on the rate of profit and the rate of capacity utilization. Following Palley (2012), capacity utilization is modeled in terms of hours per employed worker. Firms can therefore increase output by increasing hours while holding employment constant. The capital stock is always in use but hours of utilization vary. This contrasts with the conventional neo-Kaleckian model in which low capacity utilization is implicitly identified with having idle capital on hand for use by additional workers.[2] Analytically, the significance of this representation is it breaks the

[2] The neo-Kaleckian assumption of variable capacity utilization is a critical point of contention in Post Keynesian growth theory. It has been criticized by Kurz (1986), Committeri (1986), Dumenil and Levy (1999), Skott (2012, 2010), and Skott and Zipperer (2010) who maintain that equilibrium capacity utilization is not free to vary over the long run and is instead drawn to a normal rate. A defense of the

link between capacity utilization and employment, enabling output to vary while treating employment as a state variable. This is important for analysis of the labor market and the evolution of the unemployment rate, and it contrasts with the conventional model in which output can only increase if employment increases.

The second strand of research concerns the supply-side and the endogeneity of technical progress. This line of research stems from the ideas of Verdoorn (1949) and Kaldor (1957) which have become the foundation of Keynesian endogenous growth theory. An early contribution was Palley (1996, 1997) who models technical progress as depending on capacity utilization, the rate of accumulation, and the capital stock per worker. More recent applications include Naastepad (2006), Naastepad and Storm (2007) and Hein and Tarassow (2009) who have technical progress depend on capacity utilization and income distribution. Rada (2007) models a two sector developing economy in which technical progress is impacted by output growth, wage growth and employment growth.

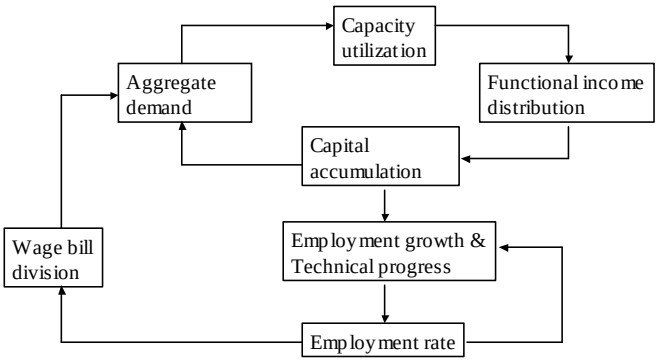
The third and most recent strand comes from Dutt (2006) who introduces labor market balance as a condition of steady state growth. In steady state, employment and the labor force must grow at the same rate to ensure a constant unemployment rate. Dutt accomplishes this by having the rate of labor saving technical progress depend negatively on the rate of change of unemployment so that technical progress (effective labor supply growth) falls as the rate of change of unemployment rises. The current model has the rate of technical progress depend positively on the employment rate so that firms increase the pace of innovation when labor markets are tight. Though similar in spirit and intent to

variable capacity utilization assumption has been offered by Lavoie (1995), Dutt (2006), Dallery and van Treeck (2011) and Hein, Lavoie and van Treeck (2011).

Dutt's formulation, there is an important economic difference. Whereas Dutt's formulation in terms of the rate of change of the unemployment rate leaves the equilibrium unemployment rate indeterminate, the current formulation results in a determinate equilibrium unemployment rate.

The structure of the proposed model is illustrated in Figure 1. The top half of the figure represents the conventional neo-Kaleckian growth model which embodies a causal loop between aggregate demand (AD), capacity utilization, income distribution, and capital accumulation: the bottom half represents the innovations in the paper. The rate of accumulation affects employment growth and technical progress, which affect the employment rate. The employment rate then feeds back to affect the supply-side via impact on technical progress. It also affect affects the demand side via impact on the wage bill division. This latter effect is the Goodwin (1967) Marxist distribution channel.[3]

Figure 1. Structure of the proposed neo-Kaleckian – Goodwin growth and distribution model.



[3] The similarity with Goodwin's (1967) model is attribution to labor market conflict of a role in determining income distribution. Beyond that Goodwin's model is significantly different. First, his model has labor market conflict determine the profit rate, whereas the current model has it determine division of the wage bill. Second, Goodwin's model is cyclical owing to its predator – prey construction of the relation between capital accumulation and the profit rate. The current model is non-cyclical as the profit rate is determined by firms' monopoly power and it is not subject to negative feedbacks from tightened labor market conditions.

IV The Model

The model economy consists of three segments: a production side, a goods market, and a labor market.

IV.A The production side

The production side of the economy is described as follows:

(1) $Y = hMin[\kappa K, A\lambda Min[N, M/\alpha]]$ $\quad 0 < h < h^{Max}$

(2) $M = \alpha N$ $\quad 0 < \alpha < 1$

(3) $g_Y = g_K$

(4) $g_K = g_N + g_a$

(5) $g_a = a(g_K, E, z)$ $\quad a_{gK} > 0, a_E > 0, a_z > 0$

(6) $g_N = g_M$

Y = output, h = hours of utilization, K = capital stock, N = employed workers, M = managers, A = state of technology, κ = productivity of capital (output-capital ratio), λ = worker productivity (output-worker ratio), α = worker-manager ratio, g_Y = output growth, g_K = rate of capital accumulation, g_N = worker employment growth, g_a = rate of labor saving technical progress, E = employment rate, z = exogenous shift factor affecting technical progress, and g_M = managerial employment growth.

Equation (1) is the production function in which output depends on hours of utilization and inputs are capital, workers (measured in effective units), and managers. Equation (2) determines the manager-worker ratio. Equation (3) determines the rate of growth of output which is equal to the rate of capital accumulation. Equation (4) has the rate of capital accumulation equal to the rate of worker employment growth plus the rate

of technical progress. Technical progress is labor augmenting as only this is consistent with steady-state balanced growth (Uzawa, 1961). Equation (5) determines the rate of technical progress via an augmented Kaldor - Verdoorn technical progress function. Technical progress is a positive function of the rate of accumulation, the employment rate, and an exogenous shift factor.[4] Lastly, equation (6) determines the relationship between worker and managerial employment growth.

The production structure is the same as Palley (2012) subject to the addition of managerial employment. An important innovation in that paper was the introduction of a distinction between hours and employment. That distinction enables output to vary via adjustment of hours, even as employment remains constant. If hours are interpreted as a measure of capacity utilization, the hours – employment distinction creates an avenue for distinguishing between effects of capacity utilization and the labor market employment rate.

The short-run operation of the economy is as follows. Actual output equals demand, with output adjusting to meet changes in demand via variation of hours worked. Hours can be viewed as a buffer, analogous to inventory, that adjusts to meet demand fluctuations. Output and hours are jump variables determined by short run forces. Employment, the capital stock, and the state of technology are state variables that evolve slowly in ways to be described.

IV.B The goods market

The goods market is described as follows:

[4] In principle, the rate of labor productivity growth could also be a positive function of hours. Just as a high rate of employment induces firms to look for labor saving innovations, so too might a high rate of capacity utilization as measured by hours. However, for purposes of algebraic simplicity and because it adds little additional analytical insight, this potential hours effect on productivity growth is not included in the current paper.

(7) $Y = D$

(8) $I/K = S/K$

(9) $I/K = g_k = i(\pi, h)$ $\quad i_\pi > 0, i_h > 0$

(10) $S/K = s = [1 - \beta]\{[1 - \theta][1 - \sigma] + \sigma\}Y/K$

$= [1 - \beta]\{[1 - \theta][1 - \sigma] + \sigma\}h\kappa$

$= s(h, \theta, \sigma, \beta, \kappa)$ $\quad 0 < \beta < 1, s_h > 0, s_\theta < 0, s_\sigma > 0, s_\beta < 0, s_\kappa > 0$

(11) $m = m(\psi)$ $\quad m_\psi > 0$

(12) $\sigma = m/[1 + m] = \sigma(\psi)$ $\quad \sigma_\psi > 0$

(13) $\pi = \sigma h\kappa$

β = propensity to consume out of profit and managerial pay, θ = workers' share of the wage bill, σ = profit share, m = firms' mark up over costs, ψ = firms' goods market monopoly power, and π = profit rate.

Equation (7) is firms' production rule. Firms produce to demand which is accommodated by variations in hours of utilization. Equation (8) is the goods market clearing condition which holds at all times and has the rate of accumulation equal to the saving rate. Equation (9) determines the rate of accumulation which is a positive function of the profit rate and hours of utilization. Equation (10) determines the saving rate which is a positive function of hours, the profit share, and the output-capital ratio. It is a negative function of workers' share of the wage bill and the propensity to consume out of profit and managerial pay. Equation (11) determines firms' mark-up which is a positive function of their monopoly power.[5] Equation (12) determines the profit share which, in

[5] In more complicated specifications the mark-up can be a function of hours. It will be a positive function if firms' monopoly pricing power increases with economic activity. It will be a negative function if workers' bargaining power increases with economic activity. Using a game-theoretic model, Rotemberg and Saloner (1986) argue the mark-up may decrease with economic activity as firms try to gain market share.

accordance with Kaleckian mark-up price theory, is a positive function of the mark-up. Equation (13) determines the profit rate.

The saving function assumes workers' propensity to consume is unity. It also assumes managers and capitalists have the same propensity to consume. Interpreted through a class lens this is equivalent to assuming managers and capitalists constitute one class. That renders the model a familiar Cambridge model with capitalists being both owners and managers.[6]

Equations (10) – (13) determine the mark-up, profit share, and profit rate. The functional distribution of income is therefore determined in the goods market by the degree of monopoly power, reflecting the Kaleckian dimension of the model.[7]

IV.C The labor market

The labor market is described by the following equations:

(14) $\theta = \theta(E, \rho)$ $\quad \theta_E > 0, \theta_\rho > 0$

(15) $g_E = g_N - g_L$

E = employment rate, ρ = workers' labor market bargaining power, g_E = rate of change of the employment rate, g_N = employment growth, and g_L = labor force growth.

Empirically, the cyclical behavior of the mark-up is an open issue. These considerations argue for making the mark-up independent of economic activity. They also show that the Kaleckian model is ambiguous with regard to whether the mark-up represents firms' monopoly product market power or workers' bargaining power.

[6] All economic models are simplifications, and macroeconomic models simplify by aggregation. The test is that the insights gained from simplification not come at the cost of distorting the essence of the phenomena under investigation. It is possible to introduce a third class of pure managers with an intermediate propensity to consume. That strategy is not adopted because it adds considerable complexity and other basic issues need to be resolved first. Not only does a three class model add differences in propensities to consume, it also introduces complexities regarding ownership of the capital stock and distribution of profit income since managers save and own part of the stock of wealth. Exactly the same complexity holds when workers save, which is why the Cambridge assumption of a workers having a propensity to consume of unity is so analytically useful.

[7] Based on mark-up pricing firms' pricing rule is $p = [1 + m][1 + \alpha]w/A\lambda$

Equation (14) determines workers' share of the wage bill which is a positive function of the employment rate. Equation (15) is the dynamic equation governing the evolution of the employment rate which is determined by the difference between the rates of employment and labor force growth.

Equation (14) constitutes a wage share curve that can be thought of as the dynamic analogue of the wage curve proposed by Blanchflower and Oswald (1990, 1994). In a static economy the wage level is a positive function of the employment rate: in a dynamic economy in which productivity is growing workers' the wage share is a positive function of the employment rate. Equation (14) embeds a Goodwin (1967) Marxist labor market conflict channel whereby workers' share of the wage bill is positively impacted by worker bargaining power. The bargaining power variable is a catch-all for features such as unionization, minimum wages, employee protections, and social insurance arrangements. It also reflects political characteristics such as the degree of class consciousness and worker solidarity.

Lastly, an important feature of the model is that equations (12) and (14) clearly distinguish between the roles of firms' monopoly power and worker bargaining power in determining income distribution. Monopoly power determines the functional distribution of income while bargaining power determines the division of the wage bill.

V Short-run equilibrium

The model has a short run equilibrium and a long run steady state equilibrium. The short run equilibrium determines the instantaneous level of output (Y), hours of utilization (h), profit share (σ), profit rate (π), rate of capital accumulation and growth

(g_K), and saving rate (s). Appropriate substitution enables the short run model to be reduced to two equations given by

(16) $\sigma = \sigma(\psi)$ $\qquad \sigma_\psi > 0$

(17) $i(\sigma(\psi)h\kappa, h) = s(h, \sigma(\psi), \theta(E, \rho), \beta, \kappa)$

$= s(h, \sigma(\psi), E, \rho, \beta, \kappa)$ $\qquad i_\pi > 0, i_h > 0, s_h > 0, s_\psi = s_\sigma\sigma_\psi > 0, s_E = s_\theta\theta_E < 0,$

$s_\rho = s_\theta\theta_\rho < 0, s_\beta < 0, s_\kappa > 0$

The two endogenous variables are σ and h. The slope of the profit function, labeled PP, is given by the

$d\sigma/dh|_{PP} = 0$

The slope of the IS schedule is given by

$d\sigma/dh|_{IS} = [s_h - i_h]/[i_\sigma h\kappa - s_\sigma] \gtrless 0$

The numerator is positive, reflecting the standard Keynesian expenditure multiplier condition that saving be more responsive to income than investment. However, the sign of the denominator is ambiguous and depends on the relative sensitivity of investment and saving to changes in the profit share. If investment is more sensitive, the denominator is positive and the IS schedule is positively sloped. If saving is more sensitive, the denominator is negative and the IS schedule is negatively sloped.

As in all neo-Kaleckian models (Bhaduri and Marglin, 1990) there are three regimes: profit-led, wage-led, and conflictive. In profit-led economies exogenously induced increases in the profit share increase both hours and the rate of capital accumulation so that growth increases. In wage-led economies exogenously induced increases in the profit share reduce hours and the rate of capital accumulation so that growth falls. In conflictive regimes, which are a sub-set of wage-led regimes, a higher

profit share reduces hours but the rate of capital accumulation and growth increases because the positive effect of a higher profit rate dominates the negative effect of lower hours. Table 1 shows the conditions describing profit-led, wage-led, and conflictive regimes.

Table 1. Conditions describing profit-led, wage-led and conflictive regimes.

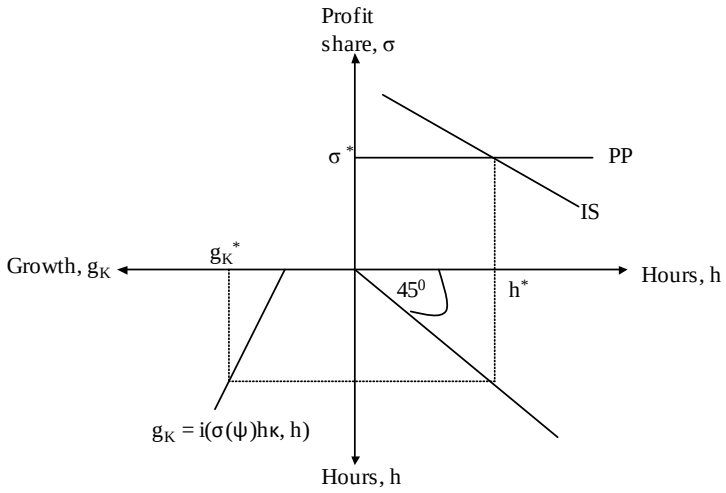
	Hours	**Investment rate**
Profit-led	$h_\psi > 0$	$i_h h_\psi + i_\pi[\pi_h h_\psi + \pi_\psi] > 0$
Wage-led	$h_\psi < 0$	$i_h h_\psi + i_\pi[\pi_h h_\psi + \pi_\psi] < 0$
Conflictive	$h_\psi < 0$	$i_h h_\psi + i_\pi[\pi_h h_\psi + \pi_\psi] > 0$

The distinction between profit-led and wage-led regimes concerns the slope of the IS schedule in [h, σ] space. An economy is profit-led if $dh/d\psi = [i_\sigma h\kappa - s_\sigma]\sigma_\psi > 0$ in which case the slope of the IS schedule is positive. It is wage-led if $dh/d\psi = [i_\sigma h\kappa - s_\sigma]\sigma_\psi < 0$ in which case the slope of the IS schedule is negative.

Figure 2 provides a graphical determination of short run equilibrium. The PP schedule in the northeast quadrant corresponds to equation (16) and determines the profit share which is independent of hours. The IS schedule represents equation (17) and its slope depends on the type of regime. Figure 2 has the IS as negatively sloped, reflecting

the case of a wage-led economy. If the economy is profit-led the IS schedule is positively sloped.[8]

Figure 2. Determination of short run equilibrium in the wage-led case.



Hours and the profit share are determined by the intersection of the IS and PP schedules in the northeast quadrant. That intersection corresponds to a combination of hours and profit share consistent with both goods market equilibrium and firms' mark-up pricing behavior. The southwest quadrant shows the investment function. Mapping from the northeast quadrant into the southwest quadrant then determines the short run rate of capital accumulation and growth.

Table 1 shows the comparative statics for the response of the endogenous short run variables (σ, h, g_K) to changes in the exogenous variables (E, ψ, ρ, β, κ) in different regimes. These comparative statics can be understood by appropriately shifting the IS and PP schedules for wage-led and profit-led regimes. In all regimes increases in the employment rate raise the profit rate, hours, and growth. They do so by increasing

[8] As an economy becomes less wage-led the IS steepens and rotates clockwise. A vertical IS corresponds to an economy that is neither wage-led nor profit-led. Given this transition pattern, the IS schedule for profit-led economies is assumed to be steeper than the PP schedule.

workers' share of the wage bill, which lifts economic activity and the profit rate. The impact of increases in firms' monopoly power varies by regime. In the profit-led regime it raises the profit share, hours and growth. In the wage-led regime it raises the profit share but lowers hours and growth. In the conflictive regime it increases the profit share, lowers hours, but increases the profit rate and growth.

Table 2. Signing of short run comparative statics.

		dE	$d\psi$	$d\beta$	$d\rho$	$d\kappa$
Profit-led	$d\sigma$	0	+	0	0	0
	dh	+	+	+	+	?/+
	dg_K	+	+	+	+	?/+
Wage-led	$d\sigma$	0	+	0	0	0
	dh	+	-	+	+	?/-
	dg_K	+	-	+	+	?/-
Conflictive	$d\sigma$	0	+	0	0	0
	dh	+	-	+	+	?/-
	dg_K	+	+	+	+	?/+

An increase in the output – capital ratio is a little like a sudden jump in productivity and its impact is ambiguous, depending on the relative response of investment and saving. The increase raises the profit rate which increases investment, but it also raises income and saving. In a profit-led regime, investment is highly sensitive to the profit rate and likely dominates so that hours and growth increase. In a wage-led

regime the reverse holds. In a conflictive regime, the increase in the profit rate is sufficient to raise investment but increased saving lowers hours.[9]

The reduced form solutions for the endogenous short run variables in the profit-led regime are:

(18.a) $\pi = \pi(E, \psi, \beta, \rho, \kappa)$ $\quad \pi_E > 0, \pi_\psi > 0, \pi_\beta > 0, \pi_\rho > 0, \pi_\kappa = ?/+$

(18.b) $h = h(E, \psi, \beta, \rho, \kappa)$ $\quad h_E > 0, h_\psi > 0, h_\beta > 0, h_\rho > 0, h_\kappa = ?/+$

(18.c) $g_K = i(E, \psi, \beta, \rho, \kappa)$ $\quad i_E > 0, i_\psi > 0, i_\beta > 0, i_\rho > 0, i_\kappa = ?/+$

The solutions for the wage-led regime are:

(19.a) $\pi = \pi(E, \psi, \beta, \rho, \kappa)$ $\quad \pi_E > 0, \pi_\psi \gtrless 0, \pi_\beta > 0, \pi_\rho > 0, \pi_\kappa = ?/-$

(19.b) $h = h(E, \psi, \beta, \rho, \kappa)$ $\quad h_E > 0, h_\psi < 0, h_\beta > 0, h_\rho > 0, h_\kappa = ?/-$

(19.c) $g_K = i(E, \psi, \beta, \rho, \kappa)$ $\quad i_E > 0, i_\psi < 0, i_\beta > 0, i_\rho > 0, i_\kappa = ?/-$

The solutions for the conflictive regime are:

(20.a) $\pi = \pi(E, \psi, \beta, \rho, \kappa)$ $\quad \pi_E > 0, \pi_\psi > 0, \pi_\beta > 0, \pi_\rho > 0, \pi_\kappa = ?/+$

(20.b) $h = h(E, \psi, \beta, \rho, \kappa)$ $\quad h_E > 0, h_\psi < 0, h_\beta > 0, h_\rho > 0, h_\kappa = ?/-$

(20.c) $g_K = i(E, \psi, \beta, \rho, \kappa)$ $\quad i_E > 0, i_\psi > 0, i_\beta > 0, i_\rho > 0, i_\kappa = ?/+$

The comparative statics with regard to firms' monopoly power (ψ) and worker bargaining power (ρ) reveal an interesting dimension to the model. The standard neo-Kaleckian model distinguishes between profit-led and wage-led regimes. In profit-led regimes increased monopoly power shifts the PP function up, reduces the wage share, and increases economic activity and growth ($dh/d\psi > 0$ and $dg_K/d\psi > 0$). In wage-led regimes the reduction in wage share reduces economic activity and growth ($dh/d\psi < 0$ and $dg_K/d\psi < 0$). As noted in Palley (2005) introducing a Goodwin Marxist styled wage

[9] In terms of Figure 2, in the conflictive regime an increase in the output-capital ratio shifts the IS left, reducing hours. However, it also raises the profit rate, shifting the accumulation function left, which raises growth despite lower hours.

bill division channel means the economy can simultaneously display both profit-led and wage-led characteristics. Thus, the economy can be profit-led with respect to monopoly power but wage-led with respect to worker bargaining power. That is because increases in the worker share of the wage bill due to increased worker bargaining power stimulate economic activity and growth ($dh/d\rho > 0$ and $dg_K/d\rho > 0$). In terms of Figure 2, increased worker bargaining power shifts the IS right while the PP unchanged.

VI Steady state equilibrium

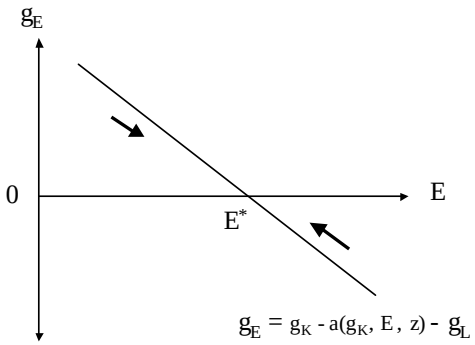
The rate of change of employment is determined by equation (15). Substituting equations (4) and (5) into (15) yields

(21) $g_E = g_K - a(g_K, E, z) - g_L \qquad a_{gK} > 0, a_E > 0, a_z > 0$

Equation (21) is a first-order differential equation and it governs the evolution of the employment rate. That evolution depends on the rate of capital accumulation which determines the growth of actual employment, while the rate of technical progress and labor force growth jointly determine effective labor supply growth. Labor force growth is assumed to be exogenously given. Steady state requires $g_E = 0$ and the condition for stability is $dg_E/dE < 0$. Figure 3 shows the case of a stable adjustment process.

Figure 3. The employment rate adjustment mechanism

$g_E = g_N - g_L$



Substituting for g_K in equation (21) yields

(22) $g_E = i(E, \psi, \beta, \rho, \kappa) - a(i(E, \psi, \beta, \rho, \kappa), E, z) - g_L$

Differentiating with respect to E yields the necessary stability condition:

$dg_E/dE = i_E - a_i i_E - a_E < 0$

Jones (1999) and Taylor (2004, p.188-189) show that the existence of steady state stability requires the endogenous innovation effect from investment be less than unity so that $1 - a_i > 0$. Since $i_E > 0$, the stability condition is $a_E > i_E[1 - a_i] > 0$ or alternatively $a_E + a_i i_E > i_E$. This condition requires that a higher employment rate trigger developments that loosen labor market conditions. Thus, the induced innovation effect from a higher employment rate on effective labor supply growth must exceed the direct employment growth effect from faster capital accumulation. Absent this, a higher employment rate will tighten the labor market, further raising the employment rate and causing an explosive spiral.

The comparative statics of the steady state employment rate for the three regimes with respect to monopoly power (ψ), worker bargaining power (ρ), the propensity to

consume (β), and exogenous labor saving technical progress (z) are shown in Table 2.[10] Increased monopoly power raises the steady state employment rate in the profit-led and conflictive regimes but lowers it in the wage-led regime. Increased worker bargaining power and an increased propensity to consume raise the employment rate in all three regimes because both strengthen AD. An increase in exogenous labor saving productivity growth and actual labor force growth lower the employment regime in all three regimes because they increase effective and actual labor supply growth. This effect of exogenous productivity growth resonates with Alvin Hansen's (1932) theory of technological unemployment which he developed to explain the Great Depression.

Table 2. Signing of long run employment rate comparative statics.

		$d\psi$	$d\rho$	$d\beta$	dz	dg_L
Profit-led	dE	+	+	+	-	-
Wage-led	dE	-	+	+	-	-
Conflictive	dE	+	+	+	-	-

The long run growth rate is determined according to

(23) $g_K = i(\pi(E, \psi, \beta, \rho, \kappa), h(E, \psi, \beta, \rho, \kappa))$

The comparative static effects of changes in the exogenous parameters on steady state growth are as follows:

[10] The comparative statics are obtained by differentiating equation (19) with respect to the exogenous parameters. This yields: $dg_E/d\o = i_\psi - a_i i_\psi \gtrless 0$; $dg_E/d\rho = i_\rho - a_i i_\rho > 0$; $dg_E/d\beta = i_\beta - a_i i_\beta > 0$; $dg_E/dz = - a_i i_z < 0$; $dg_E/dg_L = - 1$.

$dg_K/d\psi = i_\pi \pi_E E_\psi + i_\pi \pi_\psi + i_h h_E E_\psi + i_h h_\psi$

$= i_\pi[\pi_E E_\psi + \pi_\psi] + i_h[h_E E_\psi + h_\psi]$

$dg_K/d\rho = i_\pi[\pi_E E_\rho + \pi_\rho] + i_h[h_E E_\rho + h_\rho]$

$dg_K/d\beta = i_\pi[\pi_E E_\beta + \pi_\beta] + i_h[h_E E_\beta + h_\beta]$

$dg_K/dz = [i_\pi \pi_E + i_h h_E]E_z$

$dg_K/dg_L = [i_\pi \pi_E + i_h h_E]E_{gL}$

Table 3 shows the signs of these comparative static effects in the three different regimes. The direction of change of the steady state growth rate is the same as the direction of change of the steady state employment rate. That means the economy will tend to display a positive correlation between growth and the employment rate. Increases in worker wage share bargaining power (ρ) and the propensity to consume (β) increase growth and the employment rate in all regimes. Redistributing the wage share should therefore be considered a top policy priority. Increases in monopoly power increase growth and the employment rate in the profit-led and conflictive regimes, but decrease them in the wage-led regime. That makes the policy stance toward the functional distribution of income a more complicated matter. Increases in the exogenous rate of technical progress and actual labor force growth lower the steady state growth and employment rate in all regimes. These latter two results are directly contrary to conventional policy wisdom based on neo-classical growth theory. The reason is a more rapid labor supply growth (actual and effective) lowers the employment rate and discourages capital accumulation.

Table 3. Signing of long run growth rate comparative statics.

		$d\psi$	$d\rho$	$d\beta$	dz	dg_L
Profit-led	dg_K	+	+	+	-	-
Wage-led	dg_K	-	+	+	-	-
Conflictive	dg_K	+	+	+	-	-

VII A Keynesian employment rate channel

So far the employment rate has been restricted to impact economic outcomes via its impact on technical progress and the division of the wage share. However, it may also impact aggregate demand via its impact on inflation. Tobin (1965) argues that inflation increases the portfolio demand for capital as agents shift away from monetary assets. That tends to increase demand for hard assets, and it also increases stock market values which can increase capital accumulation through the Tobin q channel (Brainard and Tobin, 1977).

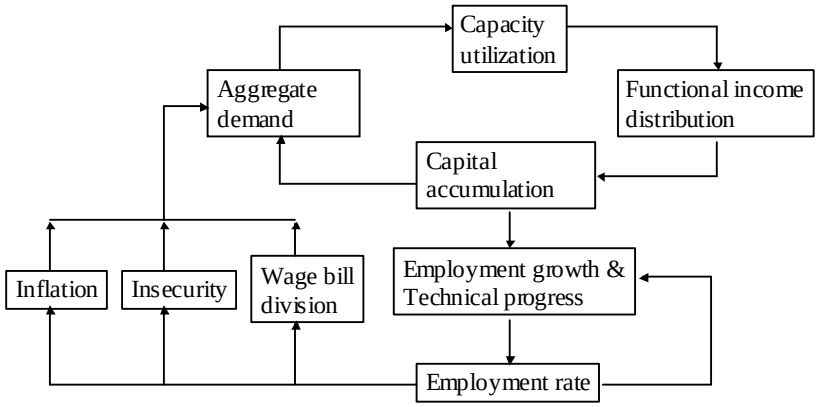
Additionally, inflation causes households and business to accelerate their expenditure (Neary and Stiglitz, 1983; Palley, 2011b) to avoid future higher prices. That expenditure acceleration effect increases investment spending and lowers saving.

Lastly, the employment rate may impact households' sense of economic security and that can impact saving behavior. Leland (1968) shows an increase in perceived future income uncertainty, holding expected income constant, leads to an increase in

precautionary saving. That is because increased future income uncertainty increases the marginal utility of future income. Carrol (1992) makes a similar argument using the unemployment rate (one minus the employment rate) as a proxy for income certainty and provides evidence of such an effect

Including these expenditure and uncertainty effects alters the structure of the model as shown in Figure 4. Now, there are two additional channels of effect out of the labor market into the goods market, which can be labeled the Keynesian employment rate channel, whereby increases in the employment rate (i.e. decreases in the unemployment rate) positively affect AD.

Figure 4. Structure of the neo-Kaleckian - Goodwin growth and distribution model with a Keynesian employment rate channel.



These inflation and economic insecurity effects are readily incorporated in the model by adding an inflation process and modifying the saving and investment equations as follows:

(24) $\Pi = \Pi(E) - g_a + \gamma\Pi^e$ $\Pi_E > 0, 0 < \gamma < 1$

(25) $\Pi^e = \Pi$

(26) $I/K = g_k = i(\pi, h, \Pi^e)$ $\quad i_\Pi > 0, i_h > 0, i_{\Pi e} > 0$

(27) $S/K = s = [1 - \beta(E, \Pi^e)]\{[1 - \theta][1 - \sigma] + \sigma\}Y/K$

$= [1 - \beta(E, \Pi^e)]\{[1 - \theta][1 - \sigma] + \sigma\}h\kappa \quad 0 < \beta(E, \Pi^e) < 1, \beta_E > 0, \beta_{\Pi e} > 0$

$= s(E, h, \Pi^e, \psi, \rho, \kappa) \quad s_E < 0, s_h > 0, s_{\Pi e} < 0, s_\psi > 0, s_\rho < 0, s_\kappa > 0$

Equation (24) is a standard expectations augmented Phillips curve in which the inflation rate is a positive function of the employment rate. The Kaleckian model is a mark-up pricing model in which price inflation is determined by the rate of growth of unit labor costs.[11] Equation (25) has inflation expectations equal to actual inflation.[12] Equation (26) determines the rate of capital accumulation which is augmented to include an inflation expenditure acceleration effect. Finally, equation (27) determines the saving rate which is augmented to include both an employment rate insecurity effect and an inflation expenditure acceleration effect.

Equation (27) makes the propensity to consume endogenous and it now depends positively on the employment rate (E) and expected inflation (Π^e). The direct partial effect of employment on saving is negative ($s_E < 0$) but the total effect will be positive if the income effect dominates the uncertainty and inflation effects ($ds/dE = s_E + s_\pi\pi_E + s_h h_E + s_{\Pi e}\Pi^e{}_\Pi\Pi_E$).

Substituting for g_a and Π_e into equation (24) then yields an expression for the instantaneous rate of inflation given by

(28) $\Pi = [\Pi(E) - a(i(E, \psi, \beta, \rho, \kappa), E , z)]/[1 - \gamma]$

[11] The price inflation Phillips curve is derived from the wage inflation Phillips curve as follows. The rate of price inflation follows from the mark-up pricing rule and is given by $\Pi = w - g_a$ where w = nominal wage inflation. The rate of nominal wage inflation is given by $w = \Pi(E) + \gamma\Pi^e$. Combining the two then yields $\Pi = \Pi(E) - g_a + \gamma\Pi^e$.

[12] This corresponds to agents having perfect foresight with respect to inflation so that inflation misperceptions play no role.

$= \Pi(E, \psi, \beta, \rho, \kappa, , z, \gamma)$ $\quad \Pi_E > 0, \Pi_\psi < 0, \Pi_\beta < 0, \Pi_\rho < 0, \Pi_\kappa \gtrless 0, \Pi_z < 0, \Pi_\gamma > 0$

Inflation is a state variable dependent on the rate of employment, and it is assumed to be positively related to the employment rate ($\Pi_E > 0$). Theoretically there could be a negative relation between the employment rate and inflation if the employment rate had very strong effect on productivity growth ($a_i i_E + a_E > 0$). Increased firms' bargaining power lowers inflation ($\Pi_\psi < 0$) because it raises investment and induced productivity growth. The same economic logic explains the effect of a higher propensity to consume ($\Pi_\beta < 0$) and increased worker wage bill division bargaining power ($\Pi_\rho < 0$), both of which increase investment by increasing demand. Faster autonomous productivity growth lowers inflation ($\Pi_z < 0$), while an increase in the coefficient of inflation expectations raises inflation ($\Pi_\gamma > 0$).

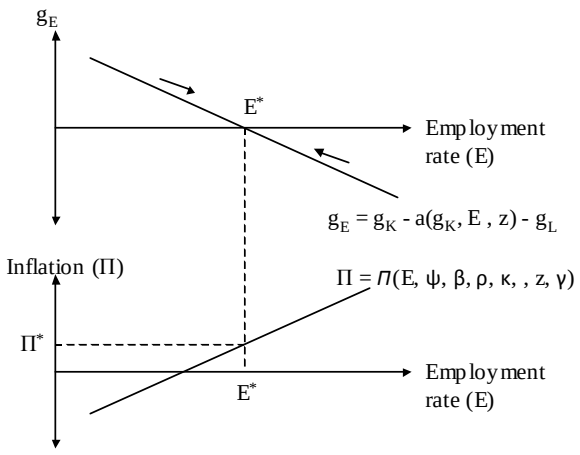
The functional form of the short-run equilibrium solutions and signings of derivatives for each regime is identical to that shown by equation (18.a) – (18.c), (19.a) – (19.c), and (20.a) – (20.c). However, the magnitude of the derivatives $d\pi/dE$, dh/dE and dg_K/dE are increased because of the inflation expenditure acceleration and economic insecurity effects.

The long run steady state remains governed by the first order differential equation given by equation (22) and the stability condition is again $dg_E/dE = i_E[1 - a_i] - a_E < 0$. However, it is now more likely that the economy is unstable because the magnitude of i_E is increased. Keynesian models are always theoretically prone to multiplier instability resulting from excessive positive feedbacks between demand and income. The Keynesian employment rate channel exposes demand driven growth models to analogue instability. That is because increases in the employment rate have a stronger impact on AD and

capital accumulation, which in turn generates faster employment growth. If strong enough, this feedback loop can become unstable.

Figure 5 shows the determination of the steady state employment and inflation rates for the stable case. Equation (22), the equation of motion determining the evolution of the employment rate, determines the steady state employment rate. That in turn determines the inflation rate.

Figure 5. Steady state employment and inflation rates.



The relation between the steady state inflation and employment rates is complicated. Increases in firms' bargaining power (ψ) increases the employment rate by increasing the rate of accumulation, but it also shifts the Phillips curve down by increasing productivity growth. Inflation can therefore rise or fall. The same patterns hold for increases in the propensity to spend (β) and workers' wage bill division bargaining power (ρ). Increases in autonomous productivity growth (z) lower the employment rate by increasing productivity and effective labor supply growth, and they also shift the Phillips curve down. Inflation therefore falls unambiguously. Increases in the coefficient

of inflation expectations (γ) increase the steady state employment rate by raising accumulation and shift the Phillips curve up. Inflation therefore rises unambiguously.

Finally, the comparative statics regarding steady state growth are unchanged in sign. However, the magnitudes are larger because capital accumulation is more sensitive to changes in the employment rate caused by changes in exogenous variables owing to the addition of the Keynesian inflation rate channel.

VIII Conclusion

This paper has combined the neo-Kaleckian and Goodwin approaches to growth and distribution to produce a synthetic model of capitalist economic growth. The key innovation was introduction of managerial pay. The Kaleckian tradition emphasizes monopoly power as the determinant of income distribution. The Goodwin approach emphasizes Marxist styled labor market conflict and bargaining power. The paper combined these two approaches, with Kaleckian monopoly power determining the functional distribution of income and Marxist labor bargaining power determining the division of the wage bill between workers and managers.

Cambridge Keynesian growth theory emphasizes the role of income distribution in explaining growth patterns. The model helps explain growth outcomes over the past thirty years, a period when growth slowed. For much of this period the functional distribution of income was relatively constant, but income inequality increased because the wage bill shifted from workers to managers. The model explains how that shift negatively impacted growth and the employment rate.

Finally, the inclusion of a wage bill division effect shows why economies can simultaneously display wage-led and profit-led characteristics. That is because the

economy can be profit-led with respect to the functional distribution of income but wage-led regarding the distribution of the wage bill between workers and managers.

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