Dynamic patterns of accumulation and income distribution

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Abstract

Kaldorian and Robinsonian models have similar steady-growth properties and both traditions offer a unified understanding of trend and cycle. They differ in their treatment of adjustment speeds, and in this paper we (i) analyze the implications of these differences for the cyclical properties of the economy and (ii) evaluate the consistency of the theoretical predictions with empirical evidence for the US.

JEL classification: E12, E32, O41

Key words: growth, business cycles, aggregate demand, instability, income distribution, utilization rate.

1 Introduction

The financial crisis and the severe contraction of real output in 2008-09 have affected the economics profession. The irrelevance of much of contemporary macroeconomics has given new credibility to traditional Keynesian short-run analysis, but the relevance of Keynesian theory for the medium and long run remains controversial, or more accurately, perhaps, is still rejected by the majority. We believe this rejection is unfounded, but Keynesian ideas come in many varieties, and merely claiming relevance for Keynesian theory leaves open most of the critical questions.

This paper examines some theoretical and empirical issues relating to Keynesian models. We focus on models in which (i) the average utilization rate tends to fluctuate around a desired level that is largely independent of aggregate demand, and in which (ii) the fluctuations are seen as at least partly endogenous, arising from the existence of feedback effects that make the balanced growth path locally unstable. These models constitute only a subset of Keynesian long-run theory. Thus, in this paper we disregard the stagnationist / Kaleckian tradition that developed from the work by Rowthorn (1981), Dutt (1984), Taylor (1985) and Marglin and Bhaduri (1990).[1]

At least two distinct strands of models can be identified within our chosen subset: a Marshall-Kaldor strand and a Robinson-Steindl strand. The two strands are almost indistinguishable in terms of their steady growth characteristics but differ with respect to short-run dynamics. Both strands of theory can be developed for dual economies and for mature (labor-constrained) economies. We focus on the mature case since our empirical evidence relates to the US economy and we regard the US as a mature, labor-constrained economy. The analysis builds on Skott (1989, 2005, 2010) but we extend the analysis by examining the short-run dynamics of the theoretical models in greater detail and by evaluating the consistency of the theoretical predictions with empirical evidence for the US.

The paper is in 7 sections. The cyclical patterns of key variables for the US economy are presented in section 2. Sections 3-5 consider the theoretical explanation of these patterns. Section 3 outlines some basic assumptions and discusses the steady-growth implications of goal oriented (profit maximizing) behavior. A Kaldorian version of the dynamic model is described and analyzed in section 4 and a Robinsonian version in section 5. Section 6 considers the empirical evidence on the behavioral equations that characterize the two approaches, and the main conclusions are summarized in section 7.

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[1] In our view this Kaleckian tradition has serious weaknesses, both theoretically and empirically. Some of the criticisms are outlined in, among others, Kurz (1986), Auerbach and Skott (1988) and Skott (2008, 2010); a defense of the Kaleckian tradition has been presented by, among others, Lavoie (1995), Dutt (1997), Dallery and van Treeck (2008) and Hein, Lavoie and van Treeck (2009).

2 Cyclical patterns

2.1 Data

While employment and utilization data are available monthly, the corporate sector profit data are published on a quarterly basis, and unless noted, all data below are quarterly averages. Data are seasonally adjusted by the reporting agency and we assume that these adjustments adequately correct for seasonal effects. The sample begins in the first quarter of 1948, the earliest available employment rates, and ends in the final quarter of 2008, the last full year of available data at the time of writing.[2]

To measure the profit share π, we use the surplus and compensation subcategories of quarterly value added, net of depreciation, in the Bureau of Economics Analysis (BEA) National Income and Product Accounts (NIPA).[3] The largest sector in the NIPA tables for which compensation and operating surplus delineations are available is domestic corporate business. As a share of the total business sector, corporate business net value added rose during 1948-2008, from 57 percent in 1948q1 to 64 percent in 2008q4; as a share of total GDP it remained roughly constant at about 50 percent.[4] Although to some extent dictated by data availability, our use of corporate sector data may be justified by a cleaner application of the theory to corporate than to noncorporate business.

Net value added is fully decomposed into taxes, labor compensation, and operating surplus. We take the profit share to be the sum of the surplus and taxes, divided by value added.[5] Figure 1 shows the actual quarterly evolution of π over 1948-2008 in the US, as well as two Hodrick-Prescott filtered trends. The "short-run" trend aims to smooth some of the extreme peaks in the actual quarterly data. The "long-term" trend emphasizes longer-term variation in the profit share.[6] Because the actual 1948q1 and 2008q4 observations may bias the constructed endpoints of the long-term trend, we restrict the long-term trend

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[2] All data in this paper were collected in September 2009. The national accounts data used include the "final" 2008q4 figures for profits and output, as well as the BEA's July 2009 comprehensive revision

[3] See http://www.bea.gov/national/nipaweb/index.asp

Krueger (1999) evaluates and proposes alternatives to the NIPA compensation data.

[4] See BEA NIPA Tables 1.3.5 and 1.14.

[5] See lines 4, 7, and 8 of NIPA Table 1.14. The treatment of taxes raises questions but for our purposes it seems reasonable to include taxes with profits (the profit maximizing markup on cost is unaffected by a change in the tax rate on profits).

Another question concerns the treatment of executive pay. Executive compensation has increased dramatically and arguably a large part of this increase should be included with profits. Our empirical proxy for the profit share fails to do that. See Krueger (1999) for an evaluation of the NIPA based profit share.

[6] The smoothing procedure used here and later employs the Hodrick-Prescott (1997) filter with smoothing parameters 6.25 and 129,600 for short and long-run trends respectively. While the parameter choice is largely arbitrary – any 'small' and 'large' numbers would be suitable for our descriptive analysis – these specific short- and long-run parameters are recommended by Ravn and Uhlig (2002) for business cycle analysis of annual and monthly data, respectively. Our smaller-than-usual smoothing parameter for the short-run trend is intended to filter out extreme peaks only, leaving considerable quarter-to-quarter variation. Our higher-than-usual smoothing parameter for the long-run trend reflects our effort to describe a long-term variation over decades.

to 1953-2001.[7]

At their peak in the early 1950s, profits accounted for one-third of output. A substantial redistribution towards labor income followed, and the profit share temporarily fell below one-quarter around the onset of the 1980 recession before swinging upwards again in the 1980s and 1990s.

Figures 1-2 about here

We measure the employment rate e as one minus the Bureau of Labor Statistics (BLS) Current Population Survey (CPS) seasonally adjusted unemployment rate.[8] This employment rate definition – the employment to labor-force ratio – avoids complications from historical shifts in the US employment-to-population ratio (for example due to female labor market entry) and is more in line with our later simplifying assumption that labor force growth is roughly constant. As shown in Figure 2, the employment rate peaked at more than 97 percent in the early 1950s and dropped to less than 90 percent during 1982-1983.[9] Over 1948-2008, however, it rarely escaped the 92-96 percent range.

We use the Federal Reserve capacity utilization series for manufacturing. The Federal Reserve also publishes a capacity utilization series for the total industrial sector but this series only exists since 1967, and the manufacturing series may be more reliable.[10] The Federal Reserve series is monthly and seasonally adjusted, and we take quarterly averages for the 1948-2008 period.[11] Over the period, utilization fluctuates strongly with extreme values above 90 percent and below 70 percent (Figure 3). The long term movements are much more modest with a span of 5.7 percentage points between the maximum and minimum values of the long-run Hodrick-Prescott series.

Figures 3 about here

To approximate changes in the capital stock, we use the Federal Reserve industrial capacity index for the manufacturing sector.[12] We use this series partly because capital stock data from the BEA is not available on a quarterly basis. More importantly, however,

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[7] The Hodrick-Prescott filter endpoint bias is well-known. To account for this potential problem, after creating the filtered series, we merely drop the years 1948-1952 and 2002-2008 from the constructed long-term trend, beginning and ending the long-term trend close to the 1953q2 and 2001q1 NBER business cycle peaks.

[8] See http://stats.bls.gov/data/

[9] We ignore the complication that the BLS may increasingly be understating the unemployment rate, around the order of several tenths of a percentage point, as a comparison of US-Census based BLS CPS employment rates suggests in Schmitt and Baker (2006).

[10] See Shapiro (1989) for a review of how the Federal Reserve calculates capacity and utilization.

[11] In January 1986 the Federal Reserve switched from SIC to NAICS industry classification, possibly introducing a discontinuity that may affect statistical analysis. We ignore this complication.

[12] See http://www.federalreserve.gov/releases/G17/caputl.htm
The same 1986 SIC to NAICS industrial classification change mentioned above for the utilization series may also affect the capacity series. We ignore this complication.

the capacity index is more closely related to the theoretical argument in sections 3-5 than the BEA series on net investment: the theoretical argument for accumulation focuses on changes in the desired capacity to produce output, and the capacity index measures the "greatest level of output each plant ... can maintain within the framework of a realistic work schedule".[13]

The capacity series is published monthly. To calculate quarterly capacity changes, $\hat{K}$, we calculate the percent difference between index values three months apart: fourth quarter $\hat{K}$ is the percent difference between December and September values; first quarter $\hat{K}$ is calculated from March's index value and the previous year's December value. The average quarterly growth rate of manufacturing capacity was about 0.9 percent between 1948-2008. The growth rate generally fell over the period, with large peaks in the mid-to-late 1960s and mid-to-late 1990s.

2.2 Cycles

This section illustrates three two-dimensional cycles in the employment, profit share, and utilization data.[14] Figure 4 contains two time-connected scatterplots of US employment rates and profit shares. Dots in the top panel are actual quarterly observations in the (e, π)-plane. The bottom panel is a slightly smoothed version using the short-run HP trend described above. Each first-quarter observation is dated with its year. Line segments between the quarterly observations merely help to illustrate the time orientation.

Figure 4 about here

The clockwise loops follow National Bureau of Economic Research (NBER) business cycles.[15] The cycles are most easily distinguished in the bottom panel containing smoothed data, and this panel also shows the long-run variation discussed in the previous subsection. Until the early 1970s the center of the loops shifted vertically as the profit share fell while employment remained above 93 percent. The leftward shift towards higher unemployment over the 1970s and 1980s occurred while the profit share remained below 30 percent. The 1980s began a shift in e and π to the northeast, towards greater employment rates and higher profit shares.

The salient clockwise cycles in the smoothed data are not an artifact of the filtering process. In the actual quarterly data, the profit share moves procyclically: the correlation between it and the employment rate is 0.51, but the correlation between the lags of the profit share and the current employment rate is stronger (for instance, a two year lag of π

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[13] Corrado and Mattey (1997) describe how the Federal Reserve capacity series is constructed. See also Shapiro (1989).

[14] See Barbosa-Filho and Taylor (2006) and Mohun and Veneziani (2008) for related studies of US cycles. These studies use the Goodwin model (Goodwin 1967) as their theoretical framework and neither of them looks at all three variables.

[15] See http://www.nber.org/cycles.html.

has a 0.67 correlation with e). Oscillations in one of these variables therefore necessarily produce clockwise cycles in the (e, π)-plane.

Figure 5 about here

To get a clearer picture of the cyclical element, we follow the approach of Mohun and Veneziani (2008, 2009) and examine the deviations of the actual quarterly observations of (e, π) from their long-run trend. Figure 5 displays these deviations. The separate panels correspond to NBER-dated peak-to-peak business cycles, but we include observations from one year after the second peak to account for (e, π) cycles that 'complete' after the NBER cycle has ended – for example, the cycle in the 1960s. All of the deviation-based cycles are qualitatively well-structured and clockwise-oriented, except for the short cycle starting around the beginning of the 1980q1 recession.

Similar cycles exist in the (e, u)- and (u, π)-planes (see Zipperer and Skott 2009). Thus, there is a pattern of clockwise cycles in all three spaces. The amplitudes (like the period length) differ across cycles; the employment rate and profit shares typically vary by less than 6 percentage points over a cycle, whereas utilization varies by up to 15-20 percentage points.

3 Basic behavioral assumptions

3.1 Properties of a steady-growth path in a mature economy

The steady growth rate cannot exceed the rate of growth of the labor force (adjusted for technical change) in a mature economy, and growth rates below the maximum level permitted by the growth of the labor force would turn the economy into a non-constrained, dual economy. Thus, the growth of output must equal the growth of the labor force, and the employment rate must be constant. Algebraically,

$$\hat{e} = \hat{Y} - n = 0 \tag{1}$$

where e, Y and n are the employment rate, real output and the natural growth rate, respectively, and the 'hat' notation is used to denote growth rates ($\hat{x} = \frac{dx/dt}{x}$). To simplify, we assume a fixed coefficient production function with only two inputs, capital and labor. We also disregard technical change and take the growth of the labor force to be exogenous in the benchmark specification. These assumptions could be relaxed. High employment rates may stimulate the growth of the labor force in several ways, and a simple extension of the model allows the growth of the labor force to depend positively on the employment rate. Immigration is an obvious mechanism in open economies; for a closed economy, changes in participation rates may affect the growth of the labor force in the medium run, and high employment and incipient labor shortages may serve as incentives for labor saving innovation in the long run. This argument can be formalized by assuming that

$n = n(e), n'(e) \geq 0$.[16] Given the purpose of the analysis in this paper, however, little is gained from this extension, and our benchmark model takes n as an exogenous constant.

Firms exhibit goal oriented behavior, and the standard assumption, which we follow in this paper, is that they aim to maximize profits. With minor modifications the argument would go through with an alternative objective (growth maximization subject to profitability constraints, for instance).

Goal oriented behavior implies that in steady growth firms must be satisfied with both their rate of capital utilization and their pricing (markup) decisions. If they were not, they would change their behavior and the steady growth path could not be sustained. Algebraically, these steady-growth conditions can be written

$$u = u^d \tag{2}$$

$$\pi = \pi^d \tag{3}$$

where u^d and π^d denote the rate of utilization and the share of profits that are desired by firms, given the steady growth rate and given their objectives and perceived constraints. A fixed coefficient production function implies that the utilization rate is well-defined, and we use the output-capital ratio as a measure of the utilization rate, $u = Y/K$. It also implies that marginal cost (=average variable cost) is equal to unit wage cost and that there is a simple relation between the (actual) profit share and the (realized) markup on wage cost: $\pi = m/(1+m)$ where m is the markup on unit wage cost.

Consider first the desired utilization rate. Capacity is purely instrumental: it is wanted as a means to produce output and generate profit. A firm may want some amount of excess capacity to deter entry by rival firms, for instance, and to allow it to respond quickly to fluctuations in demand. The desired rate of utilization may therefore depend on structural factors like the degree of competition, the sectoral composition of output and the volatility of demand, and variations in these factors may be reflected in the long-term trends in Figure 3. To simplify the exposition, we disregard shifts of this kind in the theoretical analysis.

Desired utilization may also depend on variables that are endogenous to the model. Firms can experience managerial constraints or other bottlenecks that affect their costs of accumulation, and fast accumulation may be associated with large 'adjustment costs' (this indeed, is a standard assumption in theories of investment). Some bottlenecks are related to the labor market, and low unemployment will tend to exacerbate the bottlenecks and raise the adjustment costs. These considerations suggest that fast accumulation requires strong incentives to invest (that is, a high utilization rate and/or a high profit share) or weak bottlenecks (high unemployment).

The argument can be expressed formally as a long-run relation between desired utiliz-

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[16] This specification has been used by Flaschel and Skott (2006), and induced technical progress along similar lines are discussed by Bhaduri (2003) and Dutt (2005).

ation, the rate of accumulation, the profit share and the employment rate:[17]

$$u^d = \phi(g, \pi, e); \quad \phi_g > 0, \phi_\pi < 0, \phi_e > 0 \tag{4}$$

where g is the rate of accumulation (which is equal to the growth rate of output in steady growth). We expect the partial derivatives of ϕ to be small (in absolute value) within the relevant range of accumulation rates: the cost increases associated with an increase in annual (net) accumulation rates from, say, four to five percent will be small, and the required increase in utilization rates therefore will also be small. Empirical evidence supports these expectations (see Figure 3). There are significant short-run fluctuations in utilization, but the fluctuations take place around a fairly stable long-run level, typically about 80 percent, although this varies somewhat across industries (see Zipperer and Skott 2009 for futher discussion).

Like desired utilization, the desired profit share may be affected by structural shifts - changes in competitive conditions, for instance. The theoretical model abstracts from shifts of this kind, but we need to consider the effects of variables that are endogenous in the model.

The employment rate is a key indicator of conditions in the labor market, and monopsony effects – an effect of aggregate employment on the perceived elasticity of labor supply – can make the profit-maximizing profit share an increasing function of the employment rate.[18] A more general argument for employment effects may draw on traditional Marxian and Kaleckian insights. A sustained increase in employment strengthens workers vis-a-vis management, and as noted by Kalecki (1943), this means that high employment is bad for business: "the self assurance and class consciousness of the working class" will grow and "the social position of the boss" will be undermined (quoted from Kalecki (1971, p. 140-1). Thus, if firms are to maintain any given steady growth rate, g, an increase in the profit share may be required to offset the deterioration of the business climate associated with high employment rates. Analogously, for any given employment rate, an increase in profitability may be needed to induce firms to raise the growth rate.[19]

These considerations suggest a steady-growth relation between the profit share, the employment rate and the growth rate,

$$G(\pi, e, g) = 0; \quad G_\pi < 0, G_e > 0, G_g > 0 \tag{5}$$

This steady-growth condition defines any one of the three variables as an implicit function of the other two. The equation has no direct bearing on causality but, depending on

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[17] Alternatively, the relation can be expressed as

$$F(u^d, g, \pi, e) = 0; \quad F_u < 0, F_g > 0, F_\pi < 0, F_e > 0$$

This equation defines any of the four variables as an implicit function of the other three.

[18] Manning (2003) provides an extended analysis of monopsonistic features of the labor market.

[19] Behavioral relations between growth and profitability have been discussed by many writers, including Penrose (1959), Wood (1975) and Eichner (1976).

whether firms are seen as price or quantity setters, it may be useful to write it as

$$\pi^d = \pi^d(e, g), \qquad \pi^d_e > 0, \pi^d_g > 0 \tag{6}$$

or

$$g^d = g^d(\pi, e); \qquad g^d_\pi > 0, g^d_e < 0 \tag{7}$$

Equations (4) and (5) define firms' investment and pricing/output decisions in steady growth. If the conditions are satisfied then, by construction, firms are willing to expand their capital and output at the growth rate g and keep their markup at the value that is consistent with the profit share π.

To complete our stripped-down model of a closed, one-sector economy without public sector, we add a saving function and an equilibrium condition for the product market:

$$\begin{aligned} \frac{S}{K} &= su\pi && (8) \\ \frac{S}{K} &= \frac{I}{K} = \hat{K} + \delta = g + \delta && (9) \end{aligned}$$

where δ is the rate of depreciation. The linear specification in (8) with no saving out of wages could the relaxed; the important assumption is differential saving with a higher saving rate out of profit than out of wages. Using (8)-(9) we have

$$su\pi = g + \delta \tag{10}$$

A steady growth solution for the four unknowns u, π, g, e must satisfy equations (1), (4), (5) and (10), and plausible restrictions ensure the existence and uniqueness of a solution. As an example, if (4) simplifies to $u^d = \bar{u}$, the solution for π is given by $\pi = (n + \delta)/s\bar{u}$, and the steady growth solution of e can be found using (5) and $g = n$. The comparative statics are straightforward in this case and show the long-run importance of effective demand. An increase in the saving rate, for instance, is contractionary and reduces the employment rate while an increase in animal spirits (corresponding to a downward shift in the u^d-function in equation (4) and/or an upward shift in the g^d-function in equation (7)) raises employment. By assumption, the natural rate of growth is exogenous and there are no growth effects. If, however, the natural rate is endogenized and $n = n(e)$, shifts in aggregate demand will have both growth and level effects. In this case, the solution for employment is found from the equation

$$n(e) = g^d(\frac{n(e) + \delta}{s\bar{u}}, e) \tag{11}$$

and the condition

$$n' > g^d_\pi \frac{n'}{s\bar{u}} + g^d_e \tag{12}$$

ensures that positive demand shocks raise the employment rate and the rate of growth.

A structurally determined employment rate in the medium and long run (or, equivalently, a NAIRU of natural rate rate of unemployment) emerges as a special case when $g_e^d \to \infty$ at $e = \bar{e}$. There are strong arguments, both empirically and theoretically, against this special case, but a detailed discussion of these issues is beyond the scope of this paper.[20]

3.2 Non-steady growth

Actual economies are not, typically, in steady growth and both utilization and the profit share may deviate from the desired steady-growth levels. Consider first a discrepancy between actual and desired utilization and assume, for concreteness, that firms find themselves with more excess capacity than they think optimal, that is, let $u < u^d$. A profit maximizing firm can be expected to respond to this situation by scaling down its investment plans and/or by reducing its markup to increase its output. The first response is that stressed by Harrod and incorporated into our Kaldorian model; the second is the one favored by Robinson.[21]

The profit share may also deviate from the steady-growth level. Kaldorian firms are quantity setters and the profit share is demand determined. But Kaldorian firms respond to profitability by choosing a high growth rate of output when the profit share is high and a low growth rate when profits are low.[22]

Firms act as price setters in Robinsonian models but adjust their markup (and output) so as to make $u = u^d$. The resulting profit share, however, will influence their accumulation decisions, with accumulation seen as increasing in profitability. Thus, if $\pi > \pi^d(e, n)$ (corresponding to $g^d > n$), the accumulation rate will exceed the natural rate.

These different behavioral patterns will be analyzed in more detail in sections 4-5.

4 Kaldorian models

4.1 The growth function: output adjustment

A Marshall-Kaldor approach assumes that changes in output take time while the adjustment of output prices is 'fast'. These assumptions may seem peculiar in the light of standard Keynesian and Kaleckian models of short-run equilibrium, in which firms set prices and output adjusts instantaneously and costlessly to match demand. The evidence in favour of significant price rigidity is quite weak, however, and output does not adjust

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[20] Some of the empirical issues are addressed by Howell et al. (2007), Akerlof et al. (1996) and Arestis and Sawyer (2005); on the theoretical side, a number of hysteresis mechanisms have been identified by, among others, Blanchard and Summers (1987), Rowthorn (1999) and Skott (1999, 2005a).

[21] Harrod (1939, 1973), Robinson (1956, 1962).

[22] This Marshallian approach is in line with Keynes's analysis in the Treatise on Money (Keynes 1930).

instantaneously.[23] There is a production lag in most lines of production - short in some lines but significant in others - and an increase in production usually requires increased employment which is associated with search, hiring and training costs. Firing or layoffs also involve costs, both explicit costs like redundancy payments and hidden costs like effects on morale and productivity.

Skott (1989, 1989a) formalizes these considerations by taking output as predetermined at any moment. Shocks to aggregate demand are accommodated by movements in prices and profit shares, rather than in output and utilization, but these impact effects are followed by adjustments of output. Mathematically, output becomes a state variable and firms choose the rate of growth of output, rather than the level of output, at each moment.

Profit maximizing firms determine the growth of output so as to balance the costs of changes against the benefits of moving toward a preferred level of output and employment. These expected costs and benefits are determined by the demand and cost signals that firms receive from product and labor markets. The demand signal from product markets is represented by the prevailing profit share. A positive demand shock generates a rise in the profit share, and firms respond to this rise by increasing the growth rate of output.[24] But the extent to which any given demand shock influences growth depends on conditions in input markets, primarily the labor market.

The employment rate influences the costs of changing output through its effects on the availability of labor with the desired qualifications. It is hard for a firm to attract and retain workers when unemployment is low, and high employment rates therefore increase the costs of expansion. Moreover, the quit rate tends to rise when labor markets are tight, and the gross recruitment needs associated with any given rate of expansion increase at a time when low unemployment makes it difficult to attract new workers. A high turnover of the labor force, on the other hand, allows firms to reduce production and employment more rapidly without large adjustment costs when the employment rate is high. These standard microeconomic effects may be reinforced by broader Marxian effects on the social relations of production, as discussed in section 3. Thus, high employment rates tend to put a damper on firms' expansion plans.

Formalizing these arguments, our 'growth function' for a mature economy includes two arguments, the profit share (π) and the employment rate (e):[25]

$$\hat{Y} = h(\pi, e); h_\pi > 0, h_e < 0. \tag{13}$$

We expect the growth function to be non-linear: adjustment costs for output are likely to be convex as a function of $\hat{Y}$, and there may be upper and lower limits on the rate

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[23] Using a dataset covering more than 1000 stores in the US, Eichenbaum et al. (2008) find that the average price has a duration of only two to three weeks.

[24] Demand signals could also be reflected in inventories. For the aggregate economy, however, changes in inventories tend to amplify fluctuations in other demand components over the cycle. Thus, the need for price (and/or output) adjustments would remain, even if inventories were included.

[25] The behavioral foundations of the function are discussed in greater detail in Skott (1989, chapter 4).

of growth, $g^{\min} \leq \hat{Y} \leq g^{\max}$. Thus, the growth rate will be more sensitive to variations in the profit share for intermediate values of the profit share than for very high or very low values. It should be noted that a standard Kaleckian markup equation emerges as a special case of equation (13) when $h_\pi \to \infty$ at $\pi = \bar{\pi}$ and $h_e \equiv 0$. As with a standard markup equation, the sectoral composition of the economy and the degree of competition in the product markets may affect the position and shape of the growth function, and an increase in the flexibility of production may lead to a shift in the growth function.

4.2 Investment

Following a Harrodian approach, we assume that the accumulation rate is predetermined at any moment but that the rate of change of accumulation depends on the difference between a target rate (g^t) and actual accumulation. Algebraically,

$$\dot{g} = \frac{d}{dt}\hat{K} = \lambda[g^t - g] \tag{14}$$

where a dot over a variable denotes the rate of change ($\dot{x} = dx/dt$). Firms want to move towards their desired utilization rate and this determines the target accumulation rate. Adopting a simple formulation we assume that

$$g^t = \chi(u, \hat{Y}) \tag{15}$$

The current growth rate of output enters the $\chi-$function since it indicates the rate of accumulation that is required to keep utilization rates constant. Some fraction of current output growth will be in response to demand shocks that are seen as transitory, and we assume that the partial with respect to $\hat{Y}$ is less than one.

The specification of accumulation in (14)-(15) implies that the short-run Keynesian stability condition is met – there is no immediate impact of changes in aggregate demand on investment – but that long-run accumulation is highly elastic if the partial derivatives of χ are large.

4.3 Steady growth

At a steady growth path we have $g = g^t = \hat{Y} = g^d$. Substituting these conditions into equation (15) we get $g^d = \chi(u, g^d)$ and using the implicit function theorem, this equation defines a steady growth relation $u = \phi(g)$ where $\phi' = \chi_u/(1 - \chi_{\hat{Y}})$.

In addition to the condition $u = \phi(g)$, steady growth requires a constant employment rate (that is, $g = n$), and the growth function (13) and the equilibrium condition (9) imply that $n = h(\pi, e)$ with $\pi = \frac{n+\delta}{s\phi(n)}$. These four equations, which form a special case of the steady growth conditions in section 3, have at most one solution. The solution exists and is meaningful (has $0 < \pi < 1$ and $0 < e < 1$) iff $0 < \frac{n+\delta}{s\phi(n)} < 1$ and $h(\frac{n+\delta}{s\phi(n)}, 0) > n > h(\frac{n+\delta}{s\phi(n)}, 1)$.

The inequalities $0 < \frac{n+\delta}{s\phi(n)} < 1$ are met for all plausible values of the parameters, and if $e = 1$ it is logically impossible for the rate of growth of employment to exceed the rate of growth of the labor force: as e increases it becomes progressively more difficult to expand employment, and the growth function must satisfy the inequality $n > h(\frac{n+\delta}{s\phi(n)}, 1)$. A capitalist economy may not, however, be capable of growth at the natural rate, and the condition $h(\frac{n+\delta}{s\phi(n)}, 0) > n$ need not be satisfied. The likelihood of this outcome increases for low values of the natural rate and high saving rates. As argued by Nakatani and Skott (2007), Japan's stagnation since about 1990 may be related to structural demand problems of this kind: with the exhaustion of hidden unemployment, the growth rate had to come down, but a high saving rate and low natural growth rate precluded a smooth transition to a path with minor fluctuations around a mature steady-growth solution with $g = n$. We ignore these possible complications in this paper, however, and assume that the steady growth equations have a solution with $e > 0$.

4.4 Dynamics

The model produces a three-dimensional dynamic system in (g, u, e):

$$\begin{aligned} \dot{g} &= \lambda(\chi(u, h(\pi, e)) - g) && (16)\\ \dot{u} &= u[h(\pi, e) - g] && (17)\\ \dot{e} &= e[h(\pi, e) - n] && (18) \end{aligned}$$

where $\pi = (g+\delta)/su$. Evaluated at a stationary point the Jacobian of the system takes the form

$$J(g, u, e) = \begin{pmatrix} \lambda[\chi_{\hat{Y}} h_\pi \frac{1}{su} - 1] & \lambda[\chi_u - \chi_{\hat{Y}} h_\pi \frac{n+\delta}{su^2}] & \lambda \chi_{\hat{Y}} h_e \\ u[h_\pi \frac{1}{su} - 1] & -u h_\pi \frac{n+\delta}{su^2} & u h_e \\ e h_\pi \frac{1}{su} & -e h_\pi \frac{n+\delta}{su^2} & e h_e \end{pmatrix} \qquad (19)$$

The necessary and sufficient Routh-Hurwitz conditions for local stability of the linearized system are that

1. $Tr(J) = \lambda[\chi_{\hat{Y}} h_\pi \frac{1}{su} - 1] - u h_\pi \frac{n+\delta}{su^2} + e h_e < 0$
2. $Det(J_1) + Det(J_2) + Det(J_3) = \lambda \chi_u u [1 - h_\pi \frac{1}{su}] + \lambda u h_\pi \frac{n+\delta}{su^2}[1 - \chi_{\hat{Y}}] - \lambda e h_e > 0$
3. $Det(J) = \lambda \chi_u e u h_e < 0$
4. $-Tr(J)[Det(J_1) + Det(J_2) + Det(J_3)] + Det(J) > 0$

Condition 3 is always satisfied but one or more of the other three conditions can easily be violated. Condition 2, for instance, will to fail if χ_u is large, $1 - \chi_{\hat{Y}}$ is small, and output adjustments are fast. These conditions are likely to be met: the high long-run sensitivity of accumulation to variations in utilization was discussed above, and it is a standard assumption in macroeconomics that a boost to investment leads to a short-run increase in the output capital ratio. The latter assumption implies that output adjustments are fast, i.e. that h_π is large. Some destabilizing effects could be offset by a high absolute value of eh_e - a strong "reserve army effect" - but although local stability cannot be ruled out, the economics of the model suggests instability. Bifurcation theory is sometimes used to show the existence of limit cycles in cases like this, but Hopf bifurcations describe local behavior and say little about the existence of meaningful economic cycles. Numerical simulations therefore seem preferable. Our simulations indicate that stable cycles can be generated for plausible functional forms and parameter values. An example is provided in Figure 6 which shows the simulated patterns for $(e, u), (e, \pi)$ and (u, π), respectively.[26]

Figure 6 about here

The robustness of the simulation results receive support from the analysis of a related two dimensional system. The key Harrodian element is the combination of weak short-run effects and strong long-run effects of demand shocks on accumulation. In this Kaldorian setting, the impact effect of changes in aggregate demand falls entirely on prices and the profit share, and the Harrodian combination can be achieved by a static relation between the accumulation rate and the rate of utilization,

$$\hat{K} = \chi(u) \tag{20}$$

With this alternative specification of accumulation, the dynamic system becomes two dimensional, and the presence of limit cycles can be established analytically. The 2D system implies an increasing functional relation between u and π and cannot produce the (u, π)-loops that characterize the 3D system. (and the US data). But the (e, u) and (e, π) cycles of the 2D system closely resemble the simulated patterns for the 3D system (see Skott 1989, 1989a).

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[26] The figure is based on the following specifications

$$\begin{aligned} \chi(u, \hat{Y}) &= 0.3(u - 0.5) + 0.7\hat{Y} \\ \hat{Y} &= h(\pi, e) = \frac{0.4}{1 + \exp(-15(\pi - 0.2 - 0.04(1-e)^{-0.5}))} - 0.17 \\ \lambda &= 1, \quad n = 0.03, \quad s = 0.7, \quad \delta = 0.1 \end{aligned}$$

and initial values

$$u(0) = 0.53, \quad e(0) = 0.9, \quad g(0) = 0.02$$

The logistic specification of the growth function is symmetric around the steady-growth rate, and the parameters imply that $\hat{Y}$ has upper and lower bounds of 23 and -17 percent, respectively. The maximum sensitivity to changes in the profit share (the maximum value of $\partial\hat{Y}/\partial\pi$) is 1.5. The sensitivity with respect to employment goes to infinity as employment approaches one and it may be more informative to look at the transformed variable $E = (1-e)^{-0.5}$; the specification implies a maximum sensitivity with respect to E of -0.06 .

The accumulation function is kept linear, and the parameter values imply a steady-growth sensitivity of $dg/du = 1$ (in steady growth $g = \hat{Y}$ and the specification implies that $g = 0.3(u - 0.5) + 0.7g$).

5 Robinsonian models

5.1 Price adjustment and short-run equilibrium

Robinson assumes that "competition (in the short-period sense) is sufficiently keen to keep prices at the level at which normal capacity output can be sold" (Robinson, 1962, p. 46).[27] Thus, the equalization of actual and desired utilization rates is achieved through adjustments in the markup in Robinson's theory. The adjustments are sluggish and do not keep utilization at the desired rate at all times, but the profit share changes in response to differences between actual and desired capacity utilization. As a simple formalization we assume that

$$\dot{\pi} = \xi(u, \dot{u}) \tag{21}$$

As in the Kaldorian specification of desired accumulation, the variable that targets utilization - in this case the profit share - may depend not just on the current level of utilization but also on relevant rates of change, output growth in the Kaldorian accumulation function and the rate of change of utilization in the Robinsonian markup adjustment.

With slow price adjustment, instantaneous movements in the utilization rate u ensure the equalization of saving and investment in the short run. Thus the adjustment speeds are reversed compared to the Kaldorian specification in section 4, and the equilibrium condition for the product market now determines the rate of utilization.[28] Retaining the saving function (8) and taking the accumulation rate as predetermined in the short run, we get

$$u = \frac{g + \delta}{s\pi} \tag{22}$$

5.2 Investment

Robinson's verbal argument (1962, p. 47) implies that the steady-growth accumulation function takes the form

$$g^d = \frac{I}{K} = f(r^e) \tag{23}$$

where r^e is the expected future rate of profit on new investment and $f' > 0$. This specification, however, is intended for a dual economy without labor constraints. For a mature economy, the state of the labor market needs to be considered too, and arguments analogous to those in section 4 imply that high employment rates (associated with strong workers and a poor business climate) put a damper on accumulation.[29] Formally,

$$g^d = f(r^e, e); \quad f_r > 0, f_e < 0 \tag{24}$$

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[27] Steindl's (1952) argument is close to Robinson's and includes sluggish adjustments in the markup; see Flaschel and Skott (2006).

[28] More complex models in which neither prices nor output are completely flexible have been presented by Chiarella et al. (2005).

[29] This extension finds support in Robinson's discussion of the factors that may hold down accumulation in the 'restrained golden age' (Robinson, 1962, p. 54-55).

In steady growth, expectations are being met and $r^e = r$. Outside steady growth, the distinction between expected and actual profitability in Robinson's argument serves to introduce sluggish adjustments in accumulation. In a continuous-time setting, this can be achieved by a dynamic version of the investment function (24),

$$\dot{g} = \lambda[f(u, \pi, e) - g] \tag{25}$$

where $\lambda > 0$ and $f_u > 0, f_\pi > 0, f_e < 0$, and where the expectational variable r^e has been replaced by the current values of the utilization rate and the profit share.

5.3 Steady growth

As in section 4, we get a three dimensional system of differential equations, but the state variables are different. Instead of g, u, e, we now get a system in g, π, k where the new state variable k describes the ratio of the capital stock to the labor force. The ratio k is definitionally related to employment and utilization, and - normalizing units so that labor productivity is equal to one - we have

$$e = uk \tag{26}$$

Using this definition of k, the dynamic system can be written

$$\begin{aligned} \dot{g} &= \lambda[f(u, \pi, e) - g]; \qquad f_u > 0, f_\pi > 0, f_e < 0 && (27) \\ \dot{\pi} &= \xi(u, \hat{u}) && (28) \\ \hat{k} &= g - n && (29) \end{aligned}$$

Equations (27)-(29) imply that a stationary solution satisfies

$$\begin{aligned} f(u, \pi, e) &= g && (30) \\ \xi(u, 0) &= 0 && (31) \\ g &= n && (32) \end{aligned}$$

Equation (31) provides a unique stationary solution for u, and using $u = (n + \delta)/s\pi$ we get a solution for π. Equation (30) can now be used to derive the solution for e (and using (26) for k).

5.4 Dynamics

The local stability properties of the stationary solution are determined by the Jacobian. As in the Kaldorian case, the conditions for local stability will not be met in general and limit cycles may emerge. An example is illustrated in Figure 7. To facilitate comparison with the Kaldorian model and the stylized facts in section 2, the figure shows the simulation results for $(e, u), (e, \pi)$ and (u, π).[30]

Figure 7 about here

The model uses a 'dynamic' specification of the investment function in equation (27). As in the Kaldorian case, it is straightforward to set up a two-dimensional version of the model with a 'static' investment function.[31]

6 Evidence

6.1 Cyclical patterns

Both the Robinsonian and Kaldorian formulations in sections 3-5 have utilization at the desired rate in steady growth and both versions endogenize the profit share. The steady-growth equality between desired and actual utilization is based on pricing/output behavior in Robinson and on accumulation in Kaldor; to get a steady-growth relation between growth and profitability, conversely, the Robinsonian model uses capital accumulation instead of output growth, as in the Kaldorian version. But from a steady-growth perspective these changes in the assignment of pricing and accumulation make no difference.

The reversal of the relative adjustment speeds for output and prices does affect the short-run dynamics of the models but, perhaps surprisingly, with a suitable choice of parameter values the resulting cyclical patterns for employment, utilization and the profit share are qualitatively quite similar and broadly in line with the empirical evidence in section 2.

The amplitude of fluctuations in the employment rate (relative to the amplitude of the fluctuations in utilization) is lower in the data than in the simulated cycles. Okun's law provides a simple explanation for this discrepancy. The models assume a constant

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[30] The functional forms, parameters and initial values are:

$$\begin{aligned} f(u, \pi, e) &= \frac{0.4}{1 + \exp(-10(\pi - 0.1(1-e)^{-0.5})} - 0.1 \\ \xi(u, \dot{u}) &= 10(u - 0.5 + 0.7\dot{u}/u) \\ \lambda &= 2, \quad s = 0.7, \quad \delta = 0.1, \quad n = 0.03 \\ g(0) &= 0.04, \quad \pi(0) = 0.4, \quad k(0) = 1.7 \end{aligned}$$

[31] Let

$$\dot{\pi} = \nu(u - u^d) \tag{33}$$

$$\hat{k} = \hat{K} - n = f(u, \pi, e) - n \tag{34}$$

where $e = uk$ and $u = \frac{f(u,\pi,e)+\delta}{s\pi}$, and assume that the short-run Keynesian stability condition is met (i.e. that $(f_u + kf_e)/s\pi < 1$).

labor productivity (or a constant rate of growth of labor productivity) while actual labor productivity is strongly procyclical as a result of variations in the utilization of labor (including labor hoarding). To incorporate this empirical regularity, the dynamic equation for the employment rate could be respecified as

$$\begin{aligned} \hat{e} &= \hat{L} - n \\ &= [\lambda(\hat{Y} - n) + n] - n; \qquad \lambda < 1 \end{aligned} \tag{35}$$

Simulations with this modified equation reduce the amplitude of the employment cycle.

The amplitude of profit cycle is also too high in the simulations. This discrepancy is not surprising either. The model treats investment as the only source of autonomous demand in the short run whereas both the foreign and public sectors are important in the US economy. A significant part of foreign and public demand is independent of the level of output in the short run, and demand originating from these sectors affects the equilibrium condition for the product market and the determination of the profit share. If, as a simple example, all foreign and public demand is proportional to the capital stock, the determination of the profit share in the Kaldorian model – $\pi = (g+\delta)/su$ – is replaced by

$$\pi = \frac{g + \delta + a}{su}; \qquad a > 0 \tag{36}$$

where a is the ratio of foreign and public demand to capital. Simulations show that this modification reduces the amplitude of the profit cycle relative to the amplitude of utilization.

A possible problem with the Robinsonian model, finally, is the failure of our simulations to reproduce clockwise cycles in the (u, π) space. This failure has an intuitive explanation: a positive relation between the change in π and the level of u produces a tendency toward counter clockwise cycles, and adding the rate of change of u as a (linear) influence on $\dot{\pi}$ does not remove this tendency. The significance of this shortcoming of the Robinsonian model relative to the Kaldorian formulation should not be exaggerated. It may well be possible to achieve clockwise cycles with relatively minor modifications of the Robinsonian model, and it should be noted also that the orientation of the (u, π) cycle is reversed in the Kaldorian model if the effect of output growth is excluded from the accumulation function. The qualitative properties of the (e, u) and (e, π) cycles, by contrast, are quite robust.

Overall, the successful reproduction by the models of some of the striking empirical patterns is promising. But as pointed out by critics of the calibration approach, the ability of a calibrated model to simulate selected empirical patterns provides a weak test of the model. Furthermore, the similarity of the reduced-form dynamics does not mean that the underlying behavioral equations of Kaldorian and Robinsonian specifications perform equally well empirically.

6.2 Output and pricing

We first look at output and pricing. The Kaldorian model assumes that output growth responds to profitability and employment while the Robinsonian argument relates changes in the profit share to the rate of utilization, and these contrasting views on the determinants of pricing and output can be examined econometrically.

Table 1 presents the results of a Kaldorian regression with output growth as the dependent variable. Output growth is calculated as the quarterly growth rate of real net (of depreciation) value added for the corporate business sector. Quarterly net value added is the sum of the surplus, defined above, and labor compensation. To adjust for inflation, we use the deflator implied by the BEA series on real and nominal output of the nonfinancial business sector.[32] This measure of quarterly real output growth averaged 0.9 percent over 1948-2008, varying widely until the 1960s, after which it mostly remained within the range of -2 to 4 percent.

The regressors in the first column are the deviation of the profit share from its long-term trend and the deviation of a non-linear indicator of labor market conditions, $E = (1-e)^{-0.5}$, from its long-term trend. This specification is a linearized version of the one used in the simulations (which assumed that output growth was a function of $\pi - a - b(1-e)^{-0.5}$).[33] Both the profit share and the labor market indicator have the expected signs and are significant at the 1% level, but the regression shows signs of autocorrelation in the error terms.

The autocorrelation problem is alleviated and the fit is improved in columns two and three, which include the lagged dependent variable as a regressor. The coefficients on π and E keep their signs and statistical significance in these regressions. The impact effect of changes in profitability or employment is slightly reduced, but the long-term effect is roughly the same as in column one: a one percentage point increase in the profit share raises the quarterly growth rate of output by about 0.25-0.4 percentage point (corresponding to an increase in the annual growth rate of about 1-1.6 percentage points); an increase in the labor market indicator of one percentage point reduces the annual growth rate by about 0.04-0.06 percentage point. The parameters in the simulations of the Kaldorian system in Figure 6 are in line with these estimates. The growth equation is nonlinear but evaluated at the steady growth path (where the sensitivity of growth to changes in π and E at at its maximum), the derivatives of the simulated equation are given by $\partial\hat{Y}/\partial\pi = 1.5$ and $\partial\hat{Y}/dE = -0.06$.

To check robustness, we tried several specifications that included the utilization rate as an explanatory variable. Utilization was uniformly insignificant, however. Column four gives an example.

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[32] See NIPA Table 1.14, lines 19 and 42. BEA does not publish real output or a deflator for the overall corporate sector.

[33] We ran regressions using other functional forms for the labor market indicator, and the empirical results were insensitive to these changes in the precise specification.

Tables 1-2 about here.

The results for the Robinsonian regression are given in Table 2. Column one includes only the current and lagged deviations of utilization rates from their long-term trend, corresponding to the theoretical specification in equation (21). The coefficient on the rate of utilization is statistically significant but both coefficients have the wrong sign. The lagged dependent variable is included as a regressor in column two but this changes little. Column 3 shows the results of a more general specification which includes also the levels of the profit share and the labor market indicator. Only the labor market indicator is statistically significant in this regression; the negative sign of the coefficient is what one would expect, given the empirically observed clockwise cycles in (e, π).

Overall, the regressions in Table 2 fail to support the Robinsonian mechanism.

6.3 Investment functions

Table 3 presents the investment regressions.[34] Column 1 corresponds to the theoretical specifications in equations (14) and (25). The signs are as expected and all the coefficients are statistically significant at the 1 percent level, but the equation shows signs of autocorrelation in the residuals.[35] These problems disappear when extra lags of the dependent variable are included in column 2. The coefficients all keep the expected signs and remain statistically significant. The implied long-run sensitivity to changes in utilization, profitability and employment also stay essentially unchanged: a one percentage point increase in u, π and $E(= (1-e)^{-0.5})$ generates a change in the steady growth value of the annual accumulation rate of about 0.8 to 1.2, 1.5 to 1.8 and -0.06 to -0.1 percentage points, respectively.

Table 3 about here

Changes in capital capacity are related to utilization, profitability and employment in both the Kaldorian and Robinsonian models, and the estimated investment function provides no clear test of the two theories against each other. The results, however, are relevant for an evaluation of Kaldorian/Robinsonian models relative to the Kaleckian models that currently seem to dominate post Keynesian economics.

Both the Kaldorian and Robinsonian approach regard the desired utilization rate as structurally determined. This structural determination can be seen as a straightforward

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[34] We shall refer to the equation as an investment or accumulation equation. Strictly speaking, however, it is not a standard investment function. The derivation of the accumulation equations in sections 3-5 assumed a fixed coefficient prodiction function and a constant rate of depreciation. If these assumptions are relaxed, the simple relation investment and changes in capacity needs to be modified. Our use of the Federal reserve data sidesteps this problem by focusing directly on the relevant variable: changes in capacity.

[35] The reported standard errors have been adjusted using the automatic lag selection procedure described in Newey and West (1994).

implication of goal oriented behavior and therefore should not be controversial. Yet, it is rejected by Kaleckian models which take the utilization rate as an *accommodating* variable and which imply that small shifts in aggregate demand can have large, long-run effects on utilization (see Skott (2008)). The large long-run effects on utilization follow from the extension of a "Keynesian stability condition" to the long run: it is assumed that accumulation is less sensitive than the saving-capital ratio to variations in the utilization rate, not just in the short run but also in the long run. This Kaleckian assumption finds no support in the regressions. The estimated accumulation function has a very low short-run sensitivity to changes in u - thus satisfying the short-run stability condition - but a long-run sensitivity that greatly exceeds any plausible value of the sensitivity of the long-run saving-capital ratio.

7 Conclusion

Macroeconomic variables exhibit fluctuations around their long-term trends. Most analytical work segregates these two aspects and views cycles as the result of stochastic shocks whose effects on output and employment are then mediated by some propagation mechanism. This is the approach of new classical (RBC) and new Keynesian theory, and it is also, perhaps surprisingly, the implication of Kaleckian growth models that assume stability of the steady growth path. Our approach in this paper is different. We concur with Kaldor (1954) that a piecemeal combination of separate models of growth and fluctuations may miss crucial feedback mechanisms by which both cycles and trend are generated endogenously. Needless to say, endogenous cycles do not preclude the existence of random shocks, and random shocks will leave their mark on the fluctuations.

The simulations of the Kaldorian and Robinsonian models in this paper successfully reproduce some of the key patterns in the US data. Clearly, it is not a perfect fit. The models did not include any stochastic shocks and therefore cannot reproduce the irregularity of the empirical cycles in terms of periodicity and amplitude. We also deliberately left out the public and foreign sectors in order to simplify the analysis and focus on the dynamics of a pure capitalist system, and from an empirical perspective this is a serious omission. The equilibrium condition for the product market – and thus the market clearing solution for the profit share in the Kaldorian model and the utilization rate in the Robinsonian model – are affected by the foreign and public sectors, and the behavior of these sectors may influence both short-run fluctuations and long-term trends in the data.

The absence in the theoretical model of the public and foreign sectors and of short-term shocks to aggregate demand does not, however, invalidate the reasoning behind the behavioral equations. These equations summarize how signals from input and output markets affect firms' investment, pricing and output decisions, and as long as firms operate within a stable environment there is no reason for these behavioral equations to shift.

The latter condition may seem questionable, especially since the environment can be influenced by changes in the foreign and public sectors. As a result, firms' interpretation of the signals they receive may be affected and the behavioral functions may not be stable. Trends in international competition, for instance, can influence the desired markup and generate a shift in the Kaldorian growth function, and changes in the policy regime may also lead to shifts in the behavioral equations.[36] We have tried to address this concern by looking at the deviations of variables from their long-term trend, as measured by the HP filter. This, admittedly, is a crude and imperfect correction but the correction does, we believe, solve some of the problems. In the Kaldorian growth function, for instance, firms respond to the deviation of actual profit margins from the desired levels, and the HP filter may provide a proxy for the desired level.

To conclude, the empirical evidence gives tentative support to the Kaldorian approach. Using empirically reasonable parameter values, model simulations reproduce key stylized facts, and the estimation of the Kaldorian growth function gives plausible coefficients. By contrast, our regressions fail to support Robinsonian specifications of changes in the profit share, and the estimated investment functions violate the assumptions underlying the Kaleckian growth model. These econometric results should be regarded as preliminary. The Kaldorian growth equation function performed well econometrically, but we are not aware of other econometric work on this relation, and our conclusions may not be robust. The accumulation function may be subject to more serious problems. Investment decisions are notoriously difficult to model. Pervasive uncertainty makes long-term investment subject to shifts in 'animal spirits', and our benchmark models paid attention to neither monetary policy nor the effects of broader changes in the financial environment.[37]

The theoretical model also needs to be extended. The omission of public and foreign sectors has already been commented on, and we left out financial stocks and the influence of financial variables on both household consumption and firms' investment decisions. Some work has been done in this direction but much more is needed.[38] First and foremost, however, there is a need for theoretically informed, empirical work.

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[36] The dependence of behavioral equations on the policy regime is usually associated with the Lucas critique. Long before Lucas, however, it had been pointed out by Keynesians that a government commitment to countercyclical demand policies could have an immediate effect on instability through its effects on firms' expectations.

[37] A large literature discusses the 'financialization' of the US and other economies; see e.g. Crotty (2005), Epstein (2005), Krippner (2005), Palley (2007), Stockhammer (2004).

[38] A recent post Keynesian literature has focused on stock-flow consistent modeling (e.g. Godley and Lavoie (2001-02, 2007) and Dos Santos and Zezza (2008)). This is not a new idea, however, and Skott (1989) presents a stock-flow consistent version of the basic Kaldorian model. Skott and Ryoo (2008) consider the long-run implications of changes in financial behavior, and Ryoo (2009) analyzes a stock-flow consistent Kaldorian model with long waves of Minskian financial instability.

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VARIABLES	(1) yhat	(2) yhat	(3) yhat	(4) yhat
pi_dev	0.390***	0.196**	0.265***	0.302***
	(2.27e-07)	(0.0279)	(0.00389)	(0.00233)
E_dev	-0.0136***	-0.0120***	-0.0104***	-0.00752**
	(4.26e-09)	(1.28e-07)	(6.55e-06)	(0.0378)
L.yhat		0.280***	0.254***	0.262***
		(0.000344)	(0.00103)	(0.000765)
L4.yhat			-0.174***	-0.161**
			(0.00777)	(0.0157)
u_dev				-0.0432
				(0.316)
Constant	0.00952***	0.00682***	0.00875***	0.00860***
	(0)	(2.97e-08)	(1.10e-09)	(2.46e-09)
Observations	196	196	196	196
Adj. R-Squared	0.225	0.272	0.295	0.295

p-values in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 1: Regression equations for the quarterly growth rate of output

	(1)	(2)	(3)	(4)
VARIABLES	pi_devdot	pi_devdot	pi_devdot	pi_devdot
u_dev	-0.0590***	-0.0558***	0.000457	-0.0204
	(1.59e-08)	(5.04e-07)	(0.980)	(0.172)
L.u_devdot	-0.00949	-0.0214	-0.0454	
	(0.689)	(0.444)	(0.122)	
pi_dev			-0.0329	
			(0.390)	
E_dev			-0.00611***	-0.00471***
			(0.000109)	(0.000745)
L.pi_devdot		0.0646	0.0396	
		(0.420)	(0.618)	
Constant	-6.77e-05	-7.10e-05	-0.000135	-6.43e-05
	(0.862)	(0.856)	(0.720)	(0.864)
Observations	194	194	194	195
Adj. R-Squared	0.155	0.154	0.210	0.206

p-values in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 2: Regression equations for the rate of change of the profit share

VARIABLES	(1) khat	(2) khat
u_dev	0.0138***	0.00810***
	(6.92e-07)	(0.000301)
pi_dev	0.0196***	0.0128***
	(0.000379)	(0.00249)
E_dev	-0.00115***	-0.000652***
	(2.61e-06)	(0.00104)
L.khat	0.956***	1.663***
	(0)	(0)
L2.khat		-0.871***
		(0)
L4.khat		0.174***
		(3.43e-07)
Constant	0.000395**	0.000306**
	(0.0196)	(0.0229)
Observations	196	196
Adj. R-Squared	0.961	0.977

p-values in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3: Regression equations for the rate of growth of capital capacity

Figure 1: Profit share; US corporate business

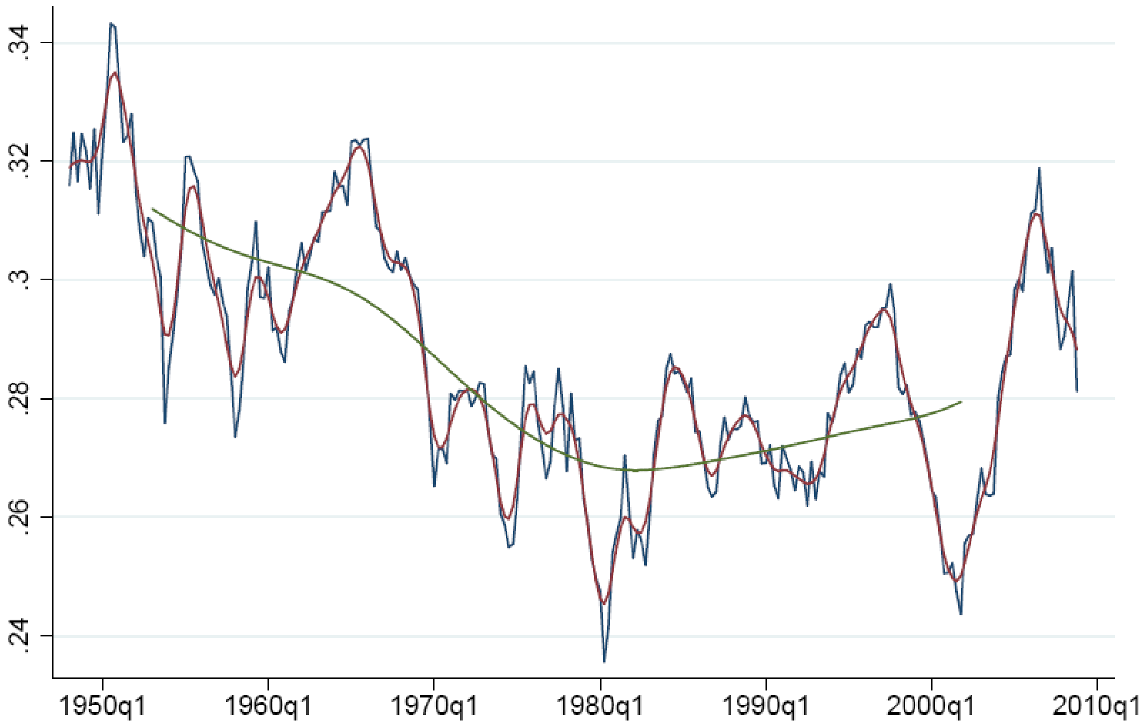


Figure 2: Employment rate

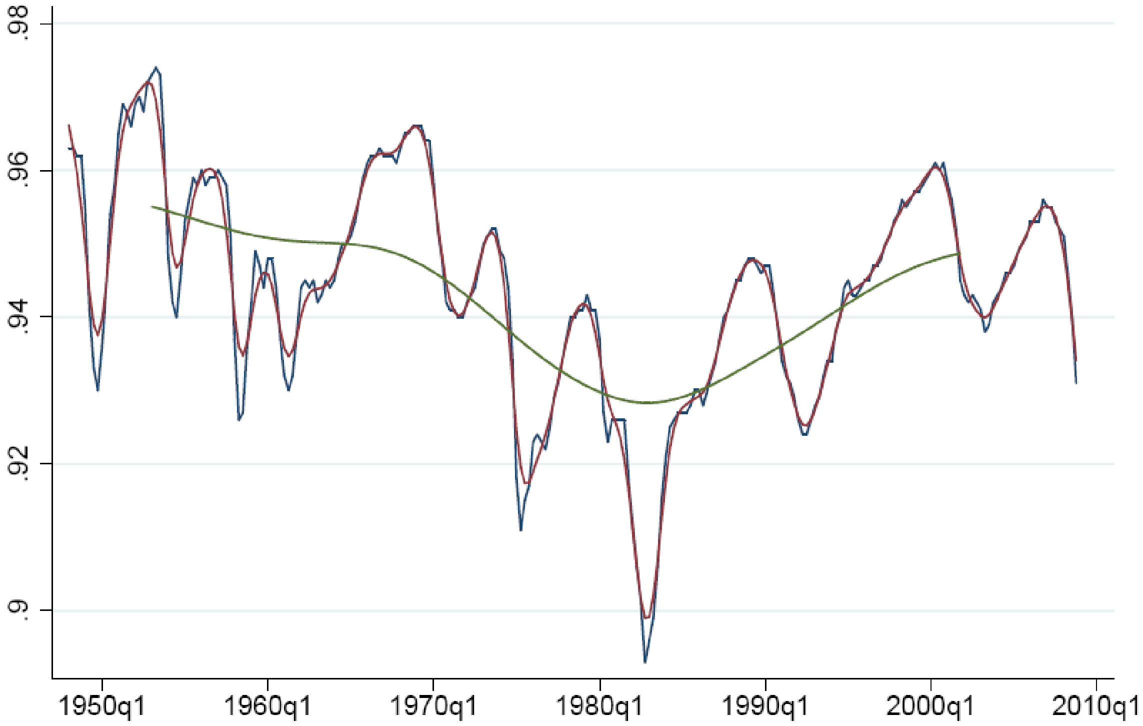


Figure 3: Utilization rates; US manufacturing

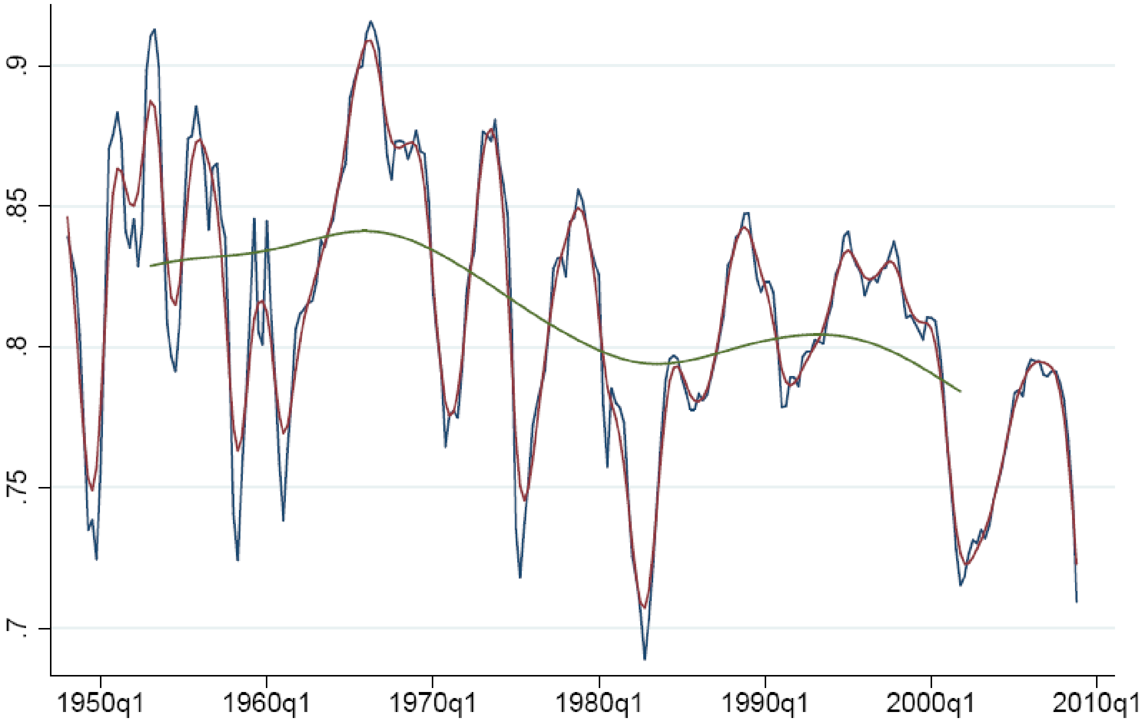


Figure 4: Scatterplots of employment rate and profit share

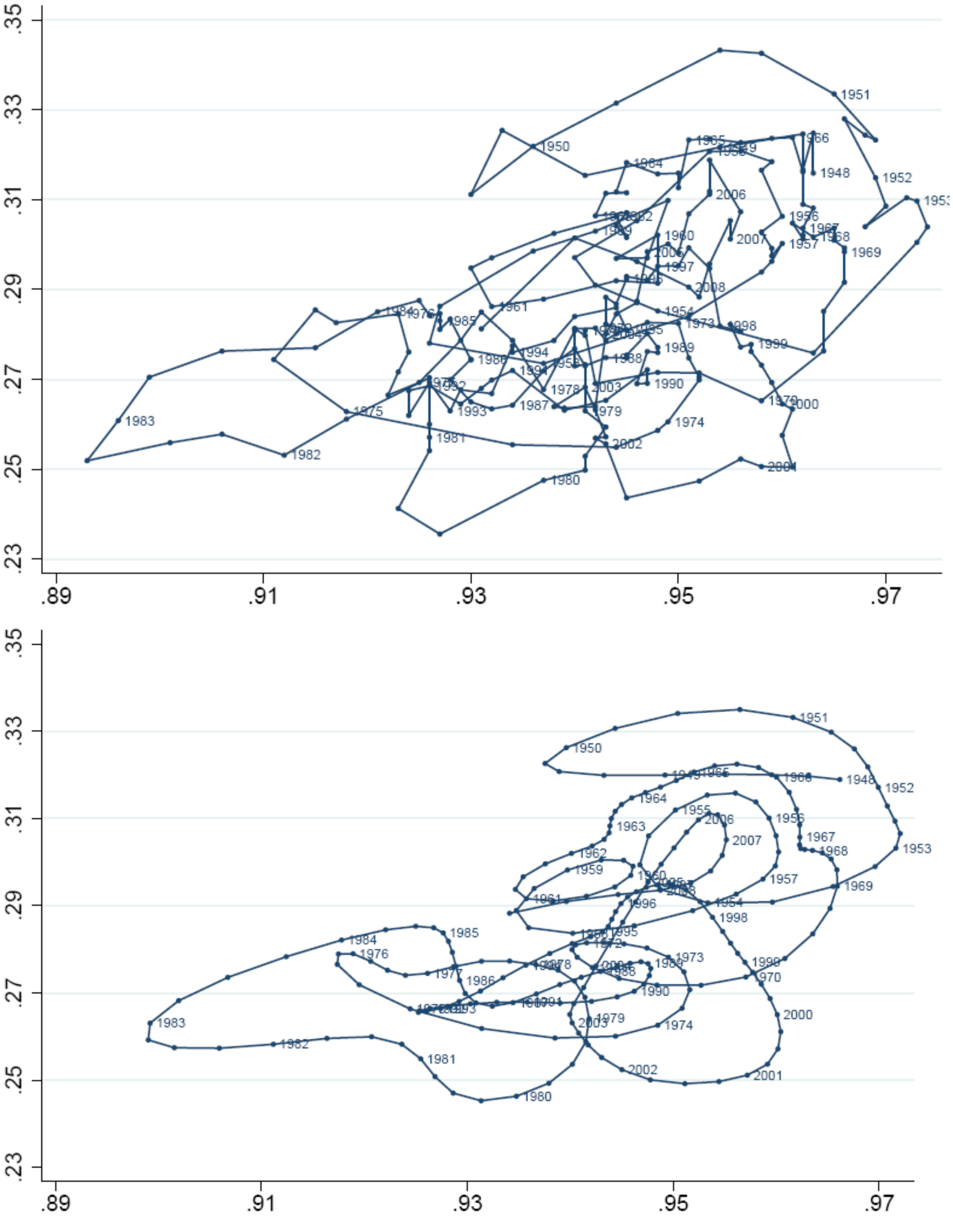
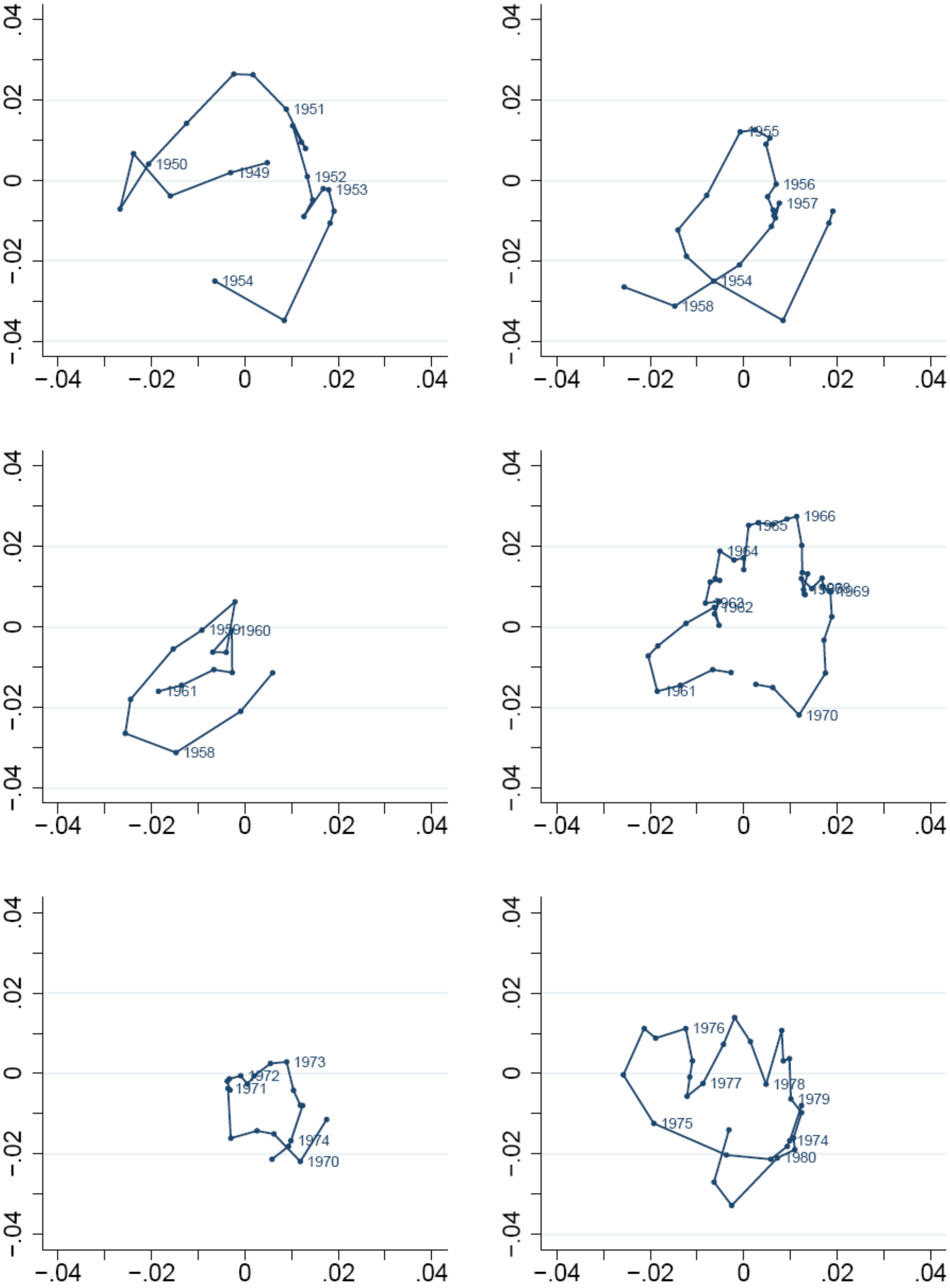


Figure 5: Deviations from long-run trend: employment rate - profit share



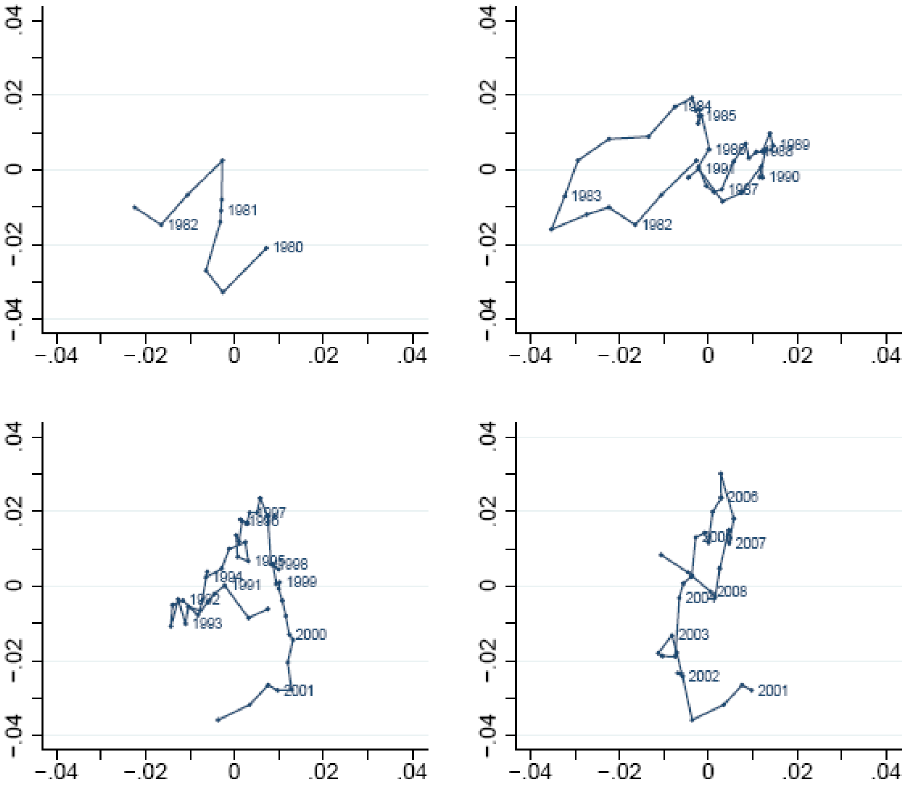

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Figure 6: Kaldorian dynamics

Figure 7: Robinsonian dynamics