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Distributive and Demand Cycles in the US Economy – A Structuralist Goodwin Model

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Abstract: There are regular counter-clockwise cycles involving capacity utilization u (horizontal axis) and the labor share ψ (vertical axis) in the US economy since 1929. As in Richard Goodwin's cyclical growth model, ψ can be interpreted as a Lotka-Volterra predator variable and u as prey. In a phase diagram, dynamics around the $\dot{u} = 0$ schedule respond to effective demand which econometric estimation (1948-2002) shows to be profit-led. Distributive dynamics around the $\dot{\psi} = 0$ curve demonstrate a long-term profit squeeze. Across cycles, the real wage and labor productivity grow at 0.57% per quarter, holding the wage share broadly stable. Modeling the cycle in the (u, ψ) plane provides a parsimonious description of demand and distributive dynamics, consistent with the macroeconomics embedded in the work of Michal Kalecki, Goodwin, and subsequent followers.

Keywords: Effective Demand, Income Distribution, Structuralist Macroeconomics, Predator Prey Dynamics

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Figures 1 and 2 are capsule descriptions of this paper. The first diagram shows annual observations of the labor share ψ as broadly defined (vertical axis) and capacity utilization u (horizontal axis) for the US economy from 1950 through 2002.[1] To scale u around a value of one (or 100%), capacity utilization is measured relative to potential output.

The trajectories in Figure 1 follow negatively inclined counter-clockwise spirals, with capacity utilization fluctuating by five to seven percentage points over a cycle, and the labor share by two or three points. There is an upward shift in the spirals in the late 1960s, due to the trends in government wages and supplemental labor payments.

Figure 2 presents the longer history beginning in 1929. With much wider fluctuations, the same general pattern holds. The significant exception is the decline in the labor share between 1944 and 1950 as both capacity utilization and wages fall off their wartime peaks.

FIGURES 1 AND 2 HERE

In what follows, we set up a dynamical model to study these oscillations in the (u,ψ) plane. We begin with a theoretical specification and proceed to VAR econometric estimation of effective demand and distributive equations for u and ψ that depend on lagged levels of the two variables. In standard phase diagram fashion, loci along which $\dot{u} = du/dt = 0$ and $\dot{\psi} = 0$ (or $\Delta u = 0$ and $\Delta\psi = 0$ in discrete econometric time) can be interpreted as underlying the cycles.

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[1] The labor share is from the Bureau of Economic Analysis' NIPA Table 1.2. Capacity utilization is based on NIPA Table 1.14 and the Hodrick-Prescott methodology is used to obtain the long-run trend of real GDP. There are numerous payments flowing toward households in the US economy. Just which should be called "wages" is by no means clear. A broad definition of labor payments incorporates wages and salaries paid separately by the private sector and government, along with supplemental labor income (social security, health insurance, and other benefits) paid by both. Government wages tend to vary against the capacity utilization cycle, have an upward oscillating trend between 1950 and 1970 and a downward trend thereafter. Supplemental labor income trends upward from 4% of the total in the 1950s to around 14% in the mid-1990s with most of the growth prior to the mid-1980s. Wages paid by business vary pro-cyclically and the share has a slight downward trend through the early 1980s. When all these contributions are combined, the real wage weakly varies pro-cyclically with *u.*

1. Theory

Long ago, Richard Goodwin (1967) arbitraged mathematical models of species competition from the 1920s (Lotka, 1925; Volterra, 1931) into economics, to set up a "predator-prey" scenario involving distributive conflict between capitalists and workers. The workers, as it turns out, are the predators with economic activity and employment as the prey. A whole econometric literature followed in Goodwin's wake, e.g. Desai (1973), Gordon (1995), and Goldstein (1996). A general finding is that “profit squeeze” cycles exist for the US economy. They are slightly damped and therefore repetitive. These findings are replicated herein.

Along Marxist lines (Marglin, 1984), Goodwin assumed a fixed capital-output ratio and savings-determined investment. Since he wrote, a body of structuralist theory dealing with demand and distributive issues has emerged, inspired by the work of Michal Kalecki (1971). It bases the determination of output on effective demand, and distributional dynamics upon social forces. There are three major themes:

First, an effective demand curve exists in the (u,ψ) plane. A positive slope implies that demand is “wage-led,” reflecting the old left Keynesian idea that a powerful way to raise aggregate spending is to engineer a shift in the functional income distribution toward labor (a strategy pursued by Salvador Allende’s government in Chile in the early 1970s, for example). With a strong accelerator response of investment to higher workers’ consumption, output expansion can be shown to be a possible response to the distributional shift.

A negative slope signifies “profit-led” demand, which could result from higher investment stimulated by a bigger profit share and/or more exports due to increased international competitiveness resulting from lower unit labor costs (also indexed by ψ). Econometric evidence (for example, Bowles and Boyer, 1995) suggests that demand in developed economies is profit-led.

Because devaluation cuts real wages and is often associated with output contraction in developing economies, their effective demand may typically be wage-led.[2]

Second, as will be shown below, one can similarly derive a "distributive" curve giving a long-term relationship between the wage share and capacity utilization. Its configuration depends on how real wage and labor productivity growth interact over the cycle. If it has a positive slope, the schedule along which $\dot{\psi} = 0$ could be called "Marxist" or seen as demonstrating a profit squeeze in the sense that the profit share would fall if the level of capacity utilization were to rise in the long run. Subject to stability complications discussed below, a negative slope embodies "forced saving" and could be called "Kaldorian."[3]

Third, the effective demand and distributive curves can be combined to generate a model of cyclical growth, precisely along Goodwin's lines. Because by construction u and ψ vary in limited ranges, they can underlie a pair of differential equations which are generally stationary and thereby straightforward to analyze.

Details follow for one particular specification. We first look at overall capacity utilization as an indicator of effective demand and then real wage and productivity dynamics on the side of distribution. Subsequently we take up behavior of the nominal wage and price levels, and the components of demand.

To model the output cycle as driven from the demand side, we treat capacity utilization u as a continuously differentiable function of time. Let X stand for output and Q for capacity. Then $u = X/Q$ and logarithmic differentiation gives the relationship

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[2] The notions of wage- and profit-led demand trace to papers written independently by Rowthorn (1982) and Dutt (1984), who in turn followed Kalecki's colleague Josef Steindl (1952). Bhaduri and Marglin (1990) expand on their models and Blecker (2002) and Taylor (2003) provide recent literature reviews.

[3] Forced saving involves a distributive shift toward profits to generate saving to finance higher investment as effective demand rises in the long run. This mode of macro adjustment was proposed in the early 19th century or even before, and Kaldor (1956, 1957) was its main post-WWII exponent. Boddy and Crotty (1975) and Bowles, Gordon, and Weisskopf (1990) develop models of the US economy incorporating a profit squeeze.

$$\hat{u} = \hat{X} - \hat{Q} \tag{1}$$

with $\hat{u} = (du/dt)/u = \dot{u}/u$, etc. As will be seen, this specification readily generates cycles, and is consistent with the relatively small changes quarter-by-quarter typically observed in macro time series for aggregate demand and distribution.

Similarly, we have $\psi = \omega/\xi$ as the labor share, where $\omega = W/P$ is the real wage (with *W* and *P* as the nominal wage and price level respectively) and $\xi = X/L$ is labor productivity. The analog to (1) is

$$\hat{\psi} = \hat{\omega} - \hat{\xi}\,. \tag{2}$$

This equation shows that ψ is determined over time by the bargain affecting the nominal wage *W,* pricing behavior by firms which sets *P,* and combined social and technological forces that impinge upon labor productivity growth.

In growth rate form, the model can be restated in four equations based upon capacity utilization and the labor share:

$$\hat{X} = \alpha_0 + \alpha_u u + \alpha_\psi \psi\ , \tag{3}$$

$$\hat{Q} = \beta_0 + \beta_u u + \beta_\psi \psi\ , \tag{4}$$

$$\hat{\omega} = \gamma_0 + \gamma_u u + \gamma_\psi \psi\ , \tag{5}$$

and

$$\hat{\xi} = \delta_0 + \delta_u u + \delta_\psi \psi\quad . \tag{6}$$

If we set $\phi_i = \alpha_i - \beta_i$ and $\theta_i = \gamma_i - \delta_i$, then substituting (3)-(4) into (1) and (5)-(6) into (2) gives reduced form equations for u and ψ:

$$\dot{u} = u(\phi_0 + \phi_u u + \phi_\psi \psi) \quad (7)$$

and

$$\dot{\psi} = \psi(\theta_0 + \theta_u u + \theta_\psi \psi) \quad . \quad (8)$$

What can we say about the signs of the coefficients in (7) and (8)?

Beginning with equation (3), evidence presented below and elsewhere suggests that effective demand in the US and other advanced countries is profit-led, so that $\alpha_\psi < 0$. There is a general consensus that the basic Keynesian stability condition $\partial \dot{X} / \partial X < 0$ is satisfied, or $\alpha_u < 0$. In (4), we assume that capacity *Q* is largely determined by the existing capital stock. Capital formation usually responds positively to both the level of economic activity and profitability, so that $\beta_u > 0$ and $\beta_\psi < 0$. It follows immediately that $\phi_u < 0$ so $\partial \dot{u} / \partial u < 0$ in (7) and the differential equation is locally stable in *u*.

Via the multiplier, the overall negative demand effect of a higher value of ψ should outweigh its specific effect on investment, $|\alpha_\psi| > |\beta_\psi|$, so that $\phi_\psi < 0$. In both diagrams in Figure 3, the "Effective demand" schedule along which $\dot{u} = 0$ has a negative slope $d\psi / du = -\phi_u / \phi_\psi$ in the (u, ψ) plane. In the long run, a higher labor share is associated with lower capacity utilization.

FIGURE 3 HERE

The story about the "Distributive" curve along which $\dot{\psi} = 0$ is tangled. In the US the real wage rises in line with productivity across cycles, thereby holding ψ rather stable when it is averaged over long periods. During the course of one cycle, Figures 1 and 2 suggest that $\psi = \omega / \xi$ rises when *u* falls and vice versa. In other words, when *u* swings up productivity growth exceeds real wage growth with the opposite occurring during a downswing in capacity utilization.

The econometric results reported below suggest that the (detrended) price level responds positively to lagged levels of ψ as an indicator of unit labor cost and negatively to lagged *u* via a mildly counter-cyclical aggregate mark-up. Both responses are weak so that *P* is relatively stable over the cycle. In other words, shifts in the real wage ω are largely driven by the (again detrended) money wage *W*. As it turns out, *W* responds positively to both state variables but more strongly to ψ than *u*. so cyclical real wage dynamics are principally driven by money wage reactions to changes in the labor share. The bargaining interpretation would be that at the macro level labor's market power is enhanced when the wage share is high.

Similar observations apply to labor productivity $\xi = X / L$. We know already from the demand side of the model that *X* tends to fall when ψ increases. The econometric results below suggest that ξ reacts positively to lagged values of both *u* and ψ . As with the real wage, the ψ -effect is stronger. It can be positive only if *L* falls more than *X* when ψ rises. This pattern must be interpreted along cyclical lines. During a downswing in *u*, ψ tends to increase. A positive *lagged* response of ξ to ψ is then consistent with a rise in productivity during and after the cyclical trough – the observed pattern.

The positive effects of both *u* and ψ on the real wage are stronger than those on productivity. An immediate implication is that $\theta_u = \gamma_u - \delta_u > 0$ and $\partial \dot{\psi} / \partial u < 0$, i.e. there is a short-run profit squeeze. Translating the VAR econometric difference equation presented below into differential equation language, it will also be true that $\partial \dot{\psi} / \partial \psi < 0$ in (8); that equation is locally stable. However, during the period 1955-70 the regression results suggest that $\delta_\psi << 0$, with productivity growth responding strongly to increases in the profit share and making $\theta_\psi > 0$ so that $d\dot{\psi} / d\psi > 0$ as well.

This damped instability case is illustrated in the lower diagram of Figure 3. The slope of the Distributive curve is $d\psi / du = -(\partial \dot{\psi} / \partial u)/(\partial \dot{\psi} / \partial \psi)$ and is negative when $\partial \dot{\psi} / \partial \psi > 0$. For the determinant of the Jacobian of (7) and (8) to be positive (thereby ruling out a saddlepoint), the Distributive curve has to cross the Effective demand curve from above. As shown, starting from a low point for *u* along the Effective demand schedule, the two variables follow a counter-clockwise spiral around the equilibrium point: predator-prey dynamics again.

The upper diagram corresponds to $\partial\dot{\psi}/\partial\psi < 0$. The Distributive curve slopes upward so that there is a profit squeeze. The two-equation system is dynamically stable and can also demonstrate cyclical behavior.[4]

Finally, although it does not appear to be empirically relevant in the US, a stable forced saving/Kaldorian Distributive schedule would have $\partial\dot{\psi}/\partial\psi < 0$ and $\partial\dot{\psi}/\partial u < 0$. The Distributive curve would have a negative slope. A profit-led (negatively sloped) Effective demand schedule would have to cut it from above for the overall system to be stable.

2. Evidence for the United States

To our knowledge, the model just sketched has not been estimated as a full system.[5] Here we present an initial attempt.

For purposes of estimation, it is preferable to work with the labor share of the *business* sector only (instead of the broad measure appearing in Figures 1 and 2), for at least two reasons. The series is reliably stationary, because it does not incorporate the trending elements of supplemental income and government wages. Second, price/quantity data are not readily available for the non-business sector.

Capacity utilization is measured as the ratio of observed to potential business sector product in percentage points. Potential output is calculated using the standard Hodrick-Prescott filter; results are much the same on the CBO definition. The labor share is measured as an index number (1992 = 100), constructed from BLS series on the business sector implicit price deflator, hourly wages, and product per hour. On these definitions, a counter-clockwise cycle persists in the (u, ψ) plane beginning in 1947. Applying the Hodrick-Prescott filter to both variables suggests that movements in

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[4] In the upper diagram, convergence will be oscillatory (the equilibrium point is a "focus") instead of direct (a "node") if the discriminant $(TrJ)^2 - 4DetJ$ of the Jacobian is negative so that the eigenvalues are complex. The (discrete time) econometric results in the following section suggest that this condition is likely to be satisfied.

[5] Gordon (1995) probably came closest, though he used the profit rate as a distributive indicator and did not focus on cyclical patterns.

capacity utilization lead those of the labor share throughout most of the post-World War II period – predator is led by prey.

FIGURE 4 HERE

For decomposition analysis,[6] we can write $u_t = c_t + i_t + n_t + g_t$ at time t, with the four demand components being consumption c_t, investment i_t, net exports n_t, and government spending g_t measured relative to potential GDP. Implicitly, potential GDP and potential business sector GDP are assumed to correlate closely, which they do.

To impose a linear decomposition of ψ into its components, regression equations have to be specified for $\ln\psi$ to obtain the determinants of the distributive curve. More precisely, define $f(\psi_t) = \ln\psi_t - \ln\overline{\psi}$ where ψ_t is the wage share at time t and $\overline{\psi}$ is its sample mean. For sample values close to the mean, we have

$$\ln\psi_t - \ln\overline{\psi} \approx f(\overline{\psi}) + (1/\overline{\psi})(\psi_t - \overline{\psi}) = (\psi_t/\overline{\psi}) - 1\,.$$

This is an approximate linear relationship between ψ and $\ln\psi$, which in turn decomposes as $\ln\psi = \ln W - \ln P - \ln\xi$, parallel to the additive breakdown of aggregate demand into its components presented above.

Measured in index number form, variations in ψ slightly exceed those of u over cycles. Both series are stationary at the 1% level of significance on Augmented Dickey-Fuller tests.[7]

To have the explanatory variables expressed in the same functional forms, the regression equations were estimated for u and ψ to analyze the demand curve, and for $\ln u$ and $\ln\psi$ to analyze

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[6] The appendix presents the methodology to decompose the aggregated VAR coefficients, estimated for the dynamics of u and ψ, into their distributive and demand components. For a detailed description, see Barbosa-Filho (2003).

[7] The ADF tests were done with zero to seven lagged differences and no trend in the estimated equations for both variables. To have the same sample for all lag specifications, the tests were run for the 1949-2002 sample. At 1% and 5% of statistical significance, respectively, the unit-root null is rejected for u and ψ in all lag specifications.

the distributive curve.[8] In both cases the distributive-demand dynamics were studied using an off-the-shelf vector autoregressive (VAR) model of the form

$$\mathbf{y_t} = \boldsymbol{\mu} + \boldsymbol{\eta}\mathbf{t} + \sum_{\mathbf{j=1}}^{\mathbf{L}} \boldsymbol{\Phi}_\mathbf{j}\mathbf{y}_{\mathbf{t-j}} + \boldsymbol{\varepsilon}_t$$

where $\mathbf{y}_t = [\psi_t \; u_t]'$ in the "demand" VAR and $[\ln\psi_t \; \ln u_t]'$ in the "distributive" VAR, $\boldsymbol{\mu}$, $\boldsymbol{\eta}$ and $\boldsymbol{\Phi}_j$, are coefficient matrices of appropriate dimensions and, by construction, $\boldsymbol{\varepsilon}_t$ is vector of white-noise disturbances.[9]

To define the lag structure of the model, we set eight as the maximum length and computed Akaike and Schwarz information criteria for all specifications. The results indicated that two is the best lag length.[10]

Table 1 summarizes results of the distributive and demand VAR models for the period 1948-2001. The wage, price, and productivity variables increase over time so all equations were estimated including trends. All coefficients were jointly significant according to the standard tests and the capacity utilization and labor share equations had adjusted R-squares of 0.75 and 0.83 respectively.[11]

TABLE 1 HERE

Through the lags, capacity utilization responds positively to its own past values and negatively to the wage share. From the first row in Table 1, the equation for *u* can be rewritten as

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[8] The linear approximation around the sample means allows us to map the level results into the log-level results and vice versa.

[9] The path from the data generating process of the state variables to the estimable VAR model involves four methodological assumptions, namely: (i) we can work with the marginal density function of the variables under study; (ii) such a function can be approximated by a linear function; (iii) the parameters of such a function are time invariant; and (iv) the derived disturbances are normally distributed.

[10] The Akaike and Schwarz information criteria were calculated for 1949-2002 to have the same sample in each of each lag specification. The lowest Schwarz criterion is obtained with two lags, whereas the Akaike criteria with two and three lags are practically the same and lower than in all other lag specifications.

[11] Wald tests indicate that we can reject the null that the coefficients on the first and second lagged values of the state variables are jointly equal to zero.

$$u_t - u_{t-1} = 37.4275 + (1.2042 - 1)u_{t-1} - 0.4862u_{t-2} + 0.3031\psi_{t-1} - 0.3931\psi_{t-2}$$

so that Δu_t has an overall negative response of $(1.2042 - 1) - 0.4862 = -0.282$ to the two lagged values of *u*. The implied long-run multiplier of $1/0.282 = 3.546$ has a plausible magnitude.

In formal terms, one of the necessary stability criteria for an autoregressive (AR) model with two lags is that the absolute value of the sum of coefficients on lagged values must be less than one.[12] From Table 1, this requirement is satisfied for the *u* process: 1.2042 – 0.4862 = 0.718 < 1. Perhaps more intuitively, at a steady state it will be true that $u_t = u_{t-1} = u_{t-2}$ and $\psi_t = \psi_{t-1} = \psi_{t-2}$, so that $u_t - u_{t-1} = 0$,. The implied slope of the steady state effective demand curve is $d\psi / du = (1 - 1.2042 + 0.4862)/(0.3031 - 0.3931) = -3.1334$, as shown in the table.

Over the sample period, effective demand is profit-led. With both u and ψ normalized around unity, a three percentage point decrease in the index for the wage share over the long run would result in a rise of about one point in capacity utilization.

The wage share responds positively to past values of capacity utilization and itself. The overall response of $\Delta \ln \psi_t$ to $\ln \psi_{t-1}$ and $\ln \psi_{t-2}$ is $(-1 + 0.7128 + 0.1919) = -0.0953$, so the difference equation for $\ln \psi$ is locally stable. The steady state slope of the distributive curve $d(\ln \psi)/d(\ln u)$ is 1.9166, signaling a profit squeeze. A one percentage point increase in capacity utilization over the long term would lead the profit share to fall by two points.

Figure 5 gives a feel for the overall dynamics of the system. With the trivial time trend in *u* shown in Table 1 eliminated[13], steady state values of the variables are $u = 99.14$ and $\psi = 103.99$. In the diagram, a once-off -3% shock is applied to steady state *u* and +3% to steady state ψ , to approximate the bottom of a normal cycle. The phase diagram shows the expected counterclockwise

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[12] Let ϕ_{u1} and ϕ_{u2} be respectively the coefficients on the first and second lagged values, the necessary and sufficient stability condition is that the two AR coefficients lay in the “stability triangle” defined by the inequalities $\phi_{u1} + \phi_{u2} < 1$, $\phi_{u1} - \phi_{u2} > -1$ and $\phi_{u2} > -2$.

[13] The trend is due to the sharp increase in consumption from 1970 through 1985 and will probably die out as the sample grows longer.

pattern. The state variables return close to the steady state after eight quarters (and cycle in the vicinity thereafter).

FIGURE 5 HERE

Table 2 presents the slopes of the effective demand and distributive curves for the "Golden Age" period that began after WWII and ended in the early 1970s, and thereafter. A convenient breakpoint is the year 1970, which contained the trough of an NBER business cycle. The initial year is alternatively 1948 or 1954 (the latter a trough year which omits the immediate post-WWII and Korean War periods).

TABLE 2 HERE

Over both 1948-2001 and 1954-2001, demand is profit-led and there is a profit squeeze. Pre-1970, the demand effect is stronger (a two percentage point decrease in ψ would make u increase by one point or more in the long run), and weakens during 1971-2001. Further sample splits suggest that demand may have shifted to being wage-led during the 1970s but was profit-led in the preceding and following decades.[14] However, the number of observations per decade is too low to make a solid case.

During 1954-1970, the distributive curve takes a negative slope and the difference equation for $\ln\psi$ is locally unstable as in the lower diagram of Figure 3.

Otherwise, the qualitative characteristics of the economy are described by the upper diagram in Figure 3. It follows that "permanent" distributive shocks favorable to labor (upward shifts of the distributive curve) lead to an increase in the labor share at the expense of a reduction in capacity utilization; and that permanent positive demand shocks (upward shifts of the demand curve) lead to increases in capacity utilization and the labor share. Along the lines of Figure 5, convergence to a "new" long run intersection of the Effective Demand and Distributive curves would be cyclical.

[14] Blecker (1991) suggests that the Reagan fiscal package may have pushed the economy in a profit-led direction during the 1980s.

As discussed above, it is possible to use VAR estimation subject to adding-up restrictions to express the demand components of u and the price/productivity components of $\ln\psi$ as functions of lagged values of these two variables (for details on the procedure, see the Appendix). The results of these reduced form estimates are also shown in Table 1.

The estimated coefficients suggest that c_t, or the ratio of private consumption to potential GDP, has a positive trend and is pro-cyclical.[15] Investment i_t also varies pro-cyclically. Net exports n_t have a downward trend and respond negatively to both capacity utilization and the wage share (interpreted as an index of labor costs). Government spending g_t also has a negative trend, and responds positively to u and ψ. In the aggregate, the profit-led components predominate and, by construction, there is a trivial overall trend in u (see footnote 13).

Trends are stronger in the logs of W, P, and ξ. The real wage increases at approximately 0.57% per quarter in 1948-2002, due to trend money wage growth outstripping the trend in the price level. Labor productivity growth also grows at 0.57%, stabilizing the wage share.

The coefficients for $\ln\omega$ and $\ln\xi$ are consistent with the descriptions above for the long period 1948-2001. As already noted, during 1954-70, the sum of the coefficients on $\ln\psi$ in the productivity equation is -1.18, giving rise to the form of cyclical dynamics illustrated in the lower diagram of Figure 3.

The nominal wage responds positively over two lags to capacity utilization, along Phillips curve lines, and also responds positively to the wage share. The price level responds counter-cyclically to capacity utilization and (over two lags) is largely unaffected by unit labor costs as measured by ψ.

[15] Net lending by households, or their savings less investment, varies counter-cyclically, consistent with the econometric result (Taylor, 2003).

3. Conclusions

In summary:

There are rather regular counter-clockwise cycles involving capacity utilization *u* (horizontal axis) and the labor share ψ (vertical axis) in the US economy post-WWII. In Lotka-Volterra terms, ψ can be interpreted as a predator variable and *u* as prey.

The cycles can be rationalized in phase diagram terms as being driven by dynamics around schedules along which $\dot{u} = 0$ and $\dot{\psi} = 0$. The former can be interpreted in terms of effective demand - specifically demand responds negatively to ψ or is profit-led. The latter can be interpreted in distributive terms – in the long run the wage share rises along with capacity utilization or the functional distribution is subject to a profit squeeze.

Econometric results suggest that all components of demand contribute to its profit-led character. Real wage and labor productivity dynamics over the cycle are the main driving force behind the distributive profit squeeze. Across cycles, both the real wage and labor productivity grow at about 0.57% per quarter, holding the wage share broadly stable.

Modeling the cycle in the (*u*, ψ) plane provides a parsimonious description of demand and distributive dynamics that is consistent with the view of macroeconomics embedded in the work of Kalecki and many subsequent followers.

Appendix on estimating demand components and wage and price responses

The VAR model for *u* and ψ can be written as

$$\mathbf{y_t} = \mathbf{\Gamma x_t} + \boldsymbol{\varepsilon}_\mathbf{t}, \qquad \text{(A1)}$$

where naturally $\boldsymbol{\Gamma} = [\boldsymbol{\mu}\ \ \boldsymbol{\eta}\ \ \boldsymbol{\Phi}_1\ \ \boldsymbol{\Phi}_2]$ and $\mathbf{x}_t^{'} = [1\ \ t\ \ \mathbf{y}_{t-1}^{'}\ \ \mathbf{y}_{t-2}^{'}]$. The Ordinary Least Squares (OLS) and Maximum Likelihood (ML) estimator of $\boldsymbol{\Gamma}$ (Hamilton, 1994) is given by:

$$\hat{\mathbf{\Gamma}} = \left(\sum_{\mathbf{t=1}}^{\mathbf{T}} \mathbf{y_t x_t^{'}} \right) \left(\sum_{\mathbf{t=1}}^{\mathbf{T}} \mathbf{x_t x_t^{'}} \right)^{-1} . \qquad \text{(A2)}$$

Let $\mathbf{z}_t^{'} = (\psi_t \; c_t \; i_t \; g_t \; n_t)$ be the vector containing the labor share and the demand-potential output ratios that add up to u_t. The "demand" VAR implicit in the equation for *u* in (A1) is given by the following regression:

$$\mathbf{z_t} = \mathbf{\Pi w_t} + \mathbf{v_t} , \qquad \text{(A3)}$$

where $\mathbf{\Pi}$ is a 4x12 coefficient matrix and $\mathbf{w}_t^{'} = [1 \; t \; \mathbf{z_{t-1}^{'}} \; \mathbf{z}_{t-2}^{'}]$. In other words, the demand VAR is a regression of the labor share and the demand components on their past values and a constant and a time trend. In relation to (A1), the crucial difference is that (A3) breaks u in its four components.

By analogy with (A2), the OLS and ML estimator of Π is

$$\hat{\mathbf{\Pi}} = \left(\sum_{\mathbf{t=1}}^{\mathbf{T}} \mathbf{z_t w_t^{'}} \right) \left(\sum_{\mathbf{t=1}}^{\mathbf{T}} \mathbf{w_t w_t^{'}} \right)^{-1} \qquad \text{(A4)}$$

By definition:

$$\mathbf{x_t} = \mathbf{G w_t} \qquad \text{(A5)}$$

where **G** is a 6x12 matrix of constant terms that maps $\mathbf{w_t}$ into $\mathbf{x_t}$. Substituting (A5) in (A2) and after some algebraic operations we obtain

$$\hat{\mathbf{\Gamma}} = \mathbf{H} \hat{\mathbf{\Pi}} \mathbf{F} , \qquad \text{(A6)}$$

where

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

and

$$\mathbf{F} = \left(\sum_{t=1}^{T} \mathbf{w_t w_t^{'}}\right)\mathbf{G}^{'}\left[\mathbf{G}\left(\sum_{t=1}^{T} \mathbf{w_t w_t^{'}}\right)\mathbf{G}^{'}\right]^{-1}$$

The purpose of (A6) is to find how each “aggregated” coefficient of the first line of (A1) can be decomposed in terms of the “disaggregated” coefficients of the first four lines of (A3). In other words, the purpose is to know how much of the aggregated demand coefficients come from consumption, investment, net exports and government expenditures. Given the sample values of ***w***, **F** is a matrix of fixed weights and the decomposition of the aggregated demand results is implicit in the right-hand side of (A6).

By analogy, the same method applies for the decomposition of the “aggregated coefficients” of the labor-share equation, provided that we use logs instead of levels to assure that the wage, price and productivity variables add up to the labor share variable.

References

Barbosa-Filho, Nelson H. (2001) “Income Distribution and Demand Fluctuations in the US Economy” in *Essays on Structuralist Macroeconomics,* New York NY: Department of Economics, New School University (unpublished Ph. D. dissertation)

Barbosa-Filho, Nelson H. (2003) “A Note on Aggregated and Disaggregated Estimates of Vector Autoregressive Models,” New York: Center for Economic Policy Analysis, New School University

Bhaduri, Amit, and Stephen A. Marglin (1990) "Unemployment and the Real Wage: The Economic Basis for Contesting Political Ideologies,” *Cambridge Journal of Economics, 14*: 375-393

Blecker, Robert A. (2002) "Distribution, Demand, and Growth in Neo-Kaleckian Macro Models," in Mark Setterfield (ed.), *Demand-Led Growth: Challenging the Supply-Side Vision of the Long Run*, Northhampton MA: Edward Elgar

Bowles, Samuel, and Robert Boyer (1995) "Wages, Aggregate Demand, and Employment in an Open Economy: an Empirical Investigation," in Gerald A. Epstein and Herbert A. Gintis (eds.) *Macroeconomic Policy after the Conservative Era*, Cambridge: Cambridge University Press

Boddy, Raford, and James R. Crotty (1975) "Class Conflict and Macro Policy: The Political Business Cycle," *Review of Radical Political Economics, 7*(1): 1-19

Bowles, Samuel, David Gordon, and Thomas Weisskopf (1990) *After the Wasteland: A Democratic Economics for the Year 2000*, Armonk NY: M. E. Sharpe

Desai, Meghnad (1973) "Growth Cycles and Inflation in a Model of Class Struggle,” *Journal of Economic Theory*, *6*: 527-545

Dutt, Amitava Krishna (1984) "Stagnation, Income Distribution, and Monopoly Power," *Cambridge Journal of Economics, 8*: 25-40

Goldstein, Jonathan P. (1996) "The Empirical Relevance of the Cyclical Profit Squeze: A Reassertion," *Review of Radical Political Economics, 28* (4): 55-92

Goodwin, Richard M. (1967) "A Growth Cycle," in C. H. Feinstein (ed.) *Socialism, Capitalism, and Growth*, Cambridge: Cambridge University Press

Gordon, David M. (1995) "Growth, Distribution, and the Rules of the Game: Social Structuralist Macro Foundations for a Democratic Economic Policy," in Gerald A. Epstein and Herbert A. Gintis (eds.) *Macroeconomic Policy after the Conservative* Era, Cambridge: Cambridge University Press

Hamilton, James. D. (1994) *Time Series Analysis*. Princeton: University of Princeton Press.

Kaldor, Nicholas (1956) "Alternative Theories of Distribution," *Review of Economic Studies, 23*: 83-100

Kaldor, Nicholas (1957) "A Model of Economic Growth," *Economic Journal*, *67*: 591-624

Kalecki, Michal (1971) *Selected Essays on the Dynamics of the Capitalist Economy: 1933-1970,* Cambridge: Cambridge University Press

Lotka, Alfred Y. (1925) *Elements of Physical Biology*, Baltimore: Williams and Wilkins

Marglin, Stephen A. (1984) *Growth, Distribution, and Prices*, Cambridge MA: Harvard University Press

Rowthorn, Robert E. (1982) "Demand, Real Wages, and Economic Growth," *Studi Economici, 18*: 2-53

Steindl, Josef (1952) *Maturity and Stagnation in American Capitalism*, Oxford: Basil Blackwell

Taylor, Lance (2003). *Reconstructing Macroeconomics: Structuralist Proposals and Critiques of the Mainstream,* Cambridge MA: Harvard University Press

Volterra, Vito (1931) *Leçons sur la Théorie Mathématique de la Lutte por la Vie*, Paris: Gauthier-VillarNotes

Figure 1 – US Economy 1950-2002. Labor share of income = 100x(labor compensation/national income); global rate of capacity utilization = 100x(real GDP/ real potential GDP); real potential GDP = Hodrick-Prescott trend of real GDP; source: Bureau of Economic Analysis' NIPA tables 1.2 and 1.14.

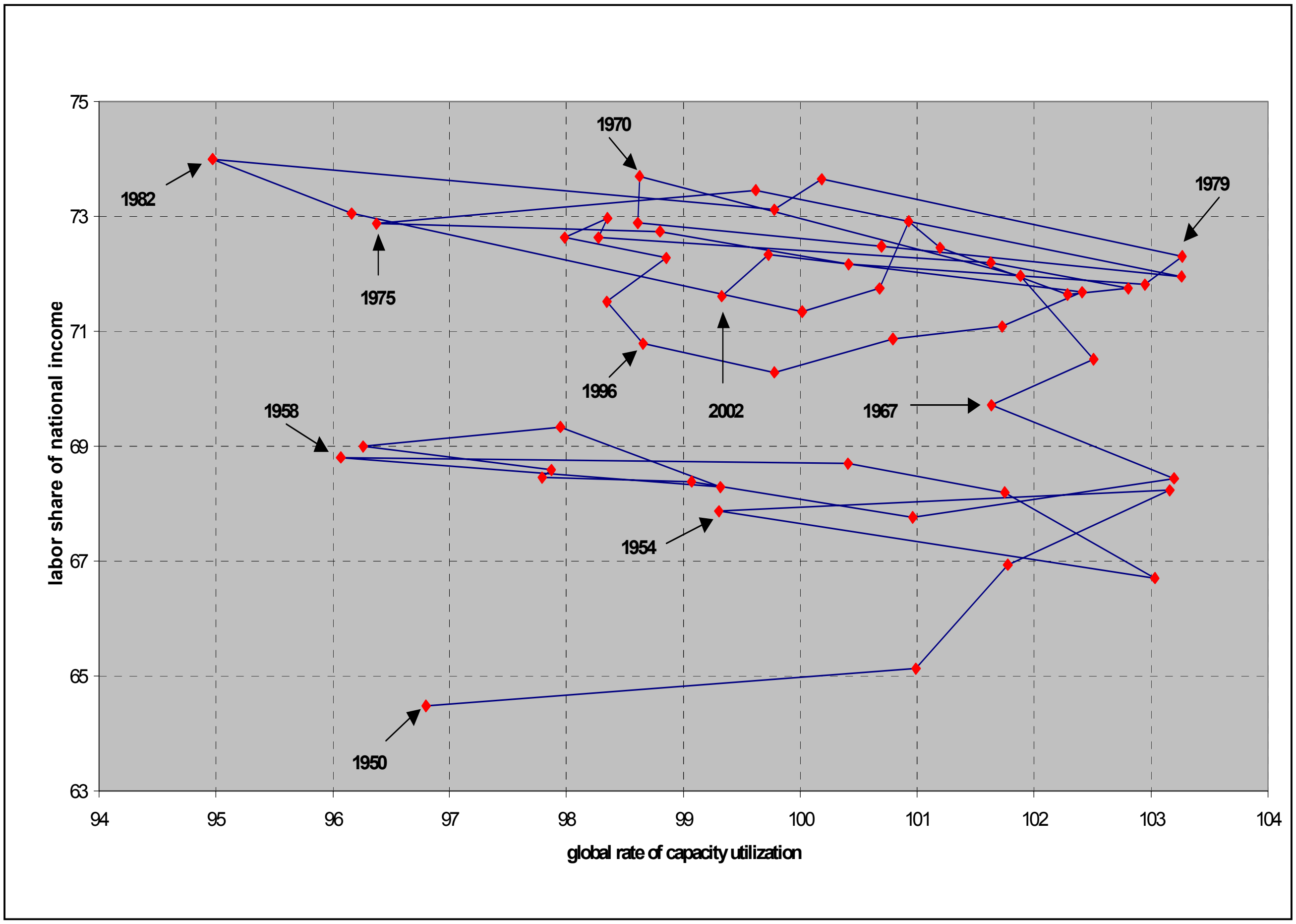
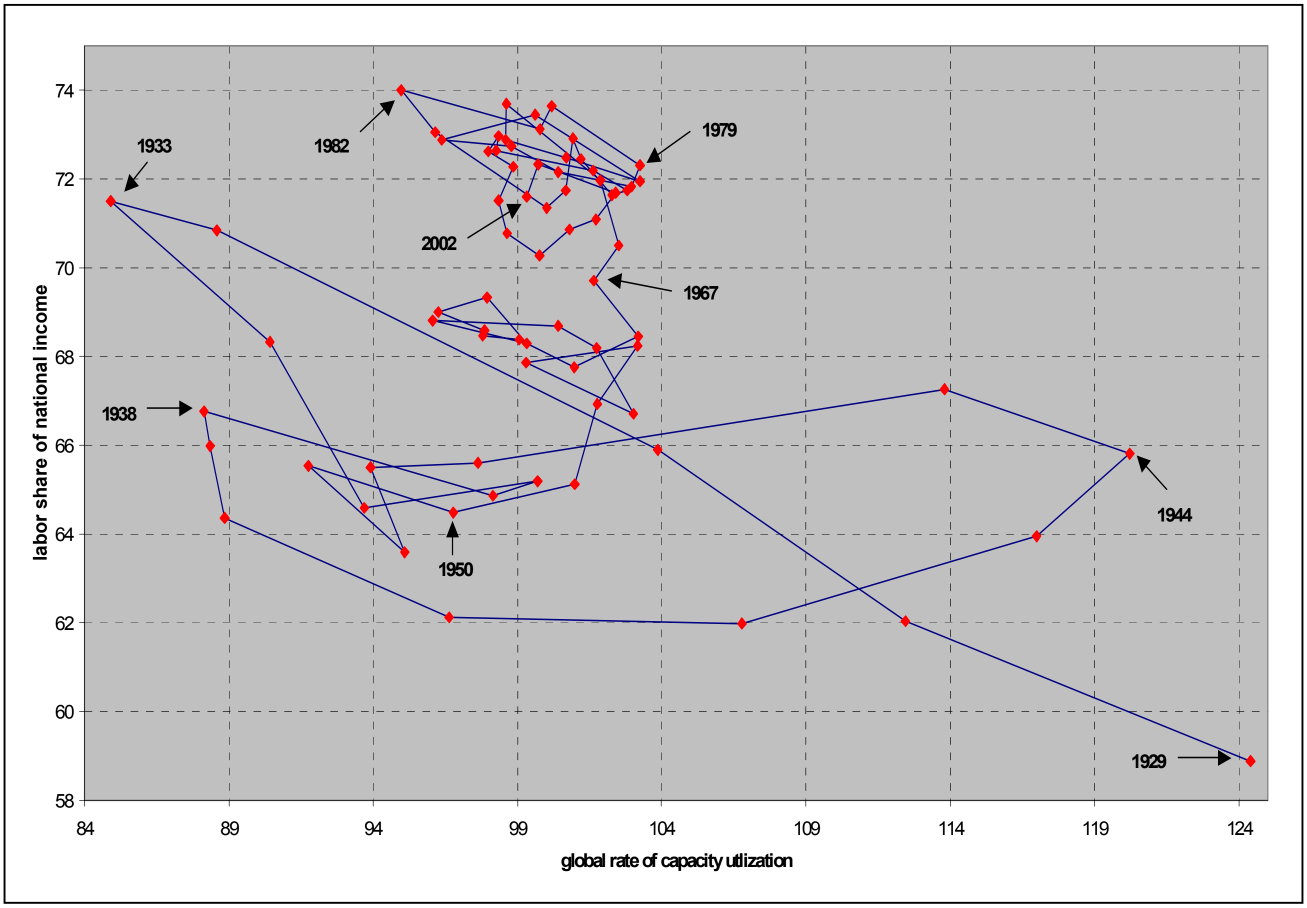


Figure 2 - US Economy: 1929-2002. Labor share of income = 100x(labor compensation/national income); global rate of capacity utilization = 100x(real GDP/ real potential GDP); real potential GDP = Hodrick-Prescott trend of real GDP; source: Bureau of Economic Analysis' NIPA tables 1.2 and 1.14.



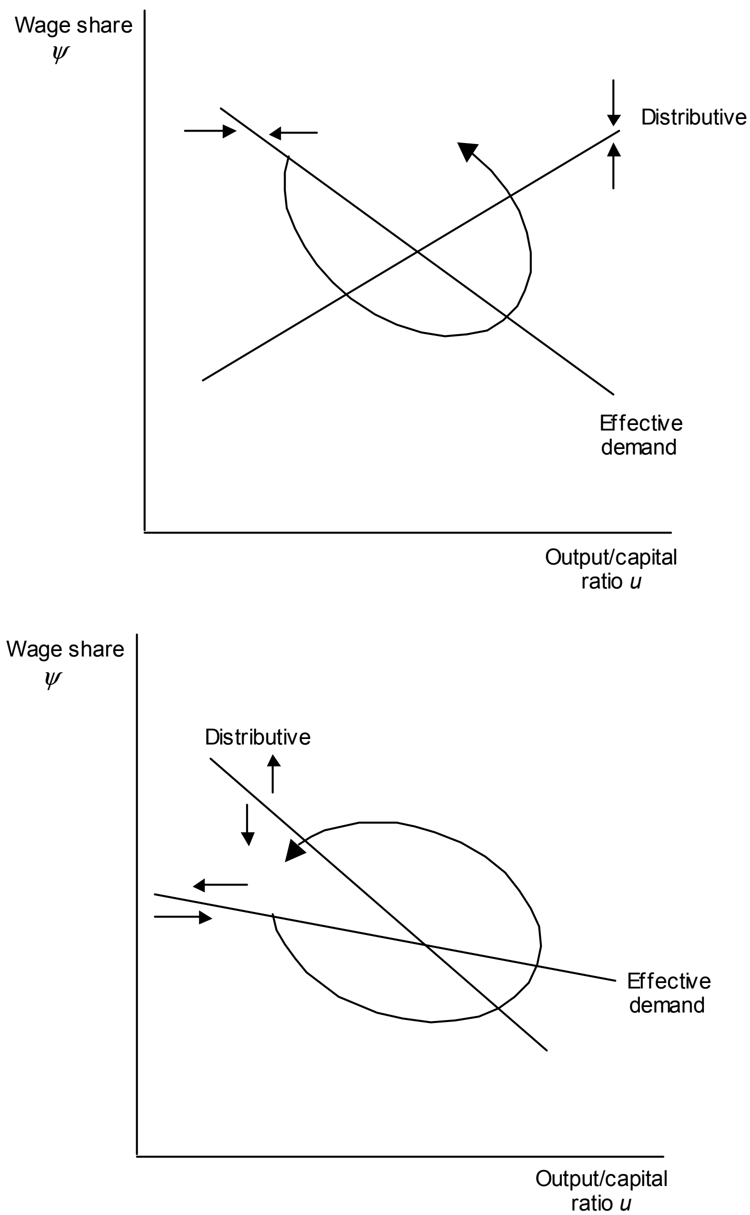
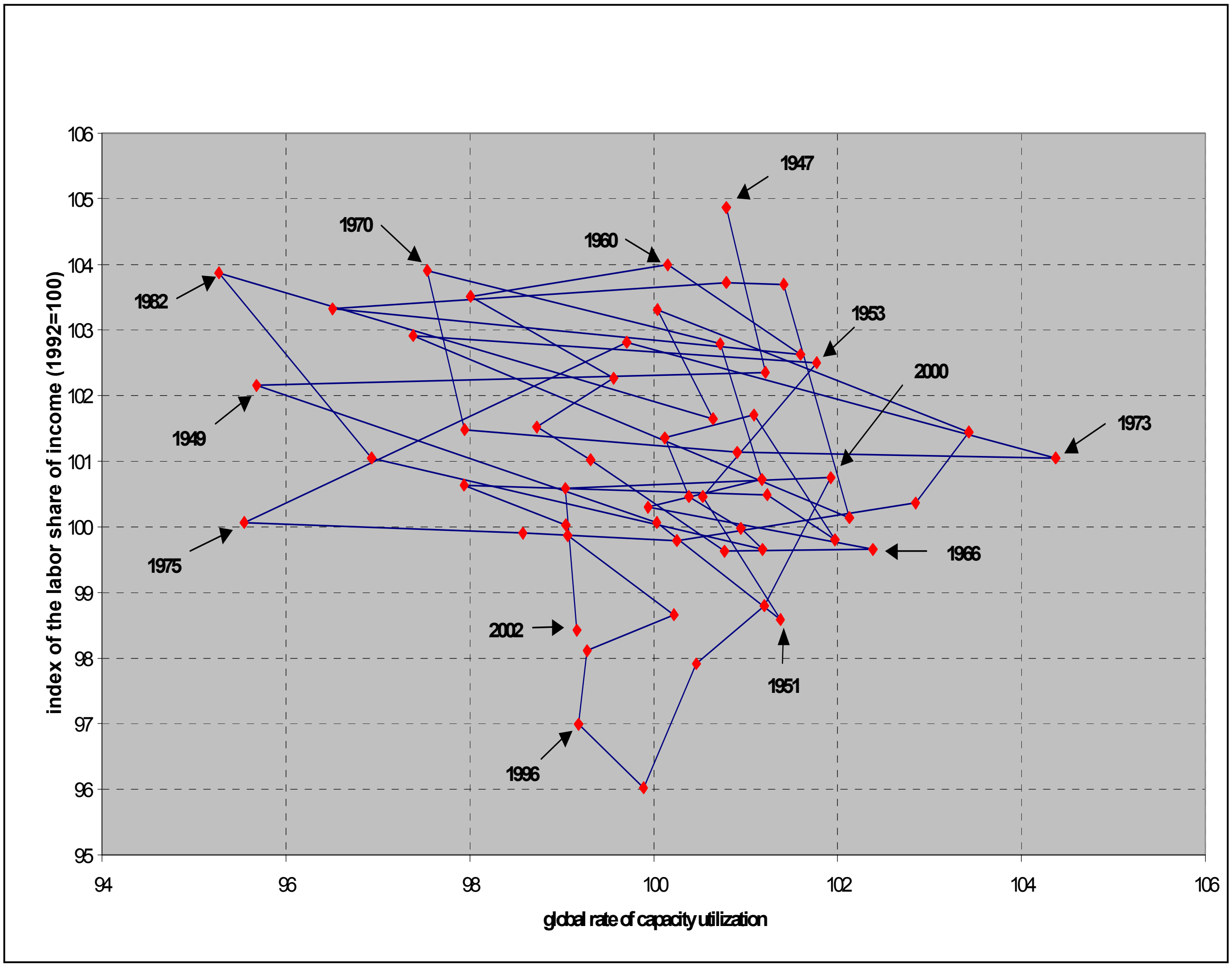


Figure 3: A structuralist Goodwin model, with stable (upper) and unstable (lower) wage share dynamics

Figure 4 - Business Sector of the US Economy: 1947-02. Labor share index = (business labor compensation per hour)/[(business price deflator)x(business output per hour)], all series calculated with 1992=100; global rate of capacity utilization = 100x(real business output)/(real potential business output); real potential business output = Hodrick-Prescott trend of real business output; source: Bureau of Labor Statistics' productivity and costs series.



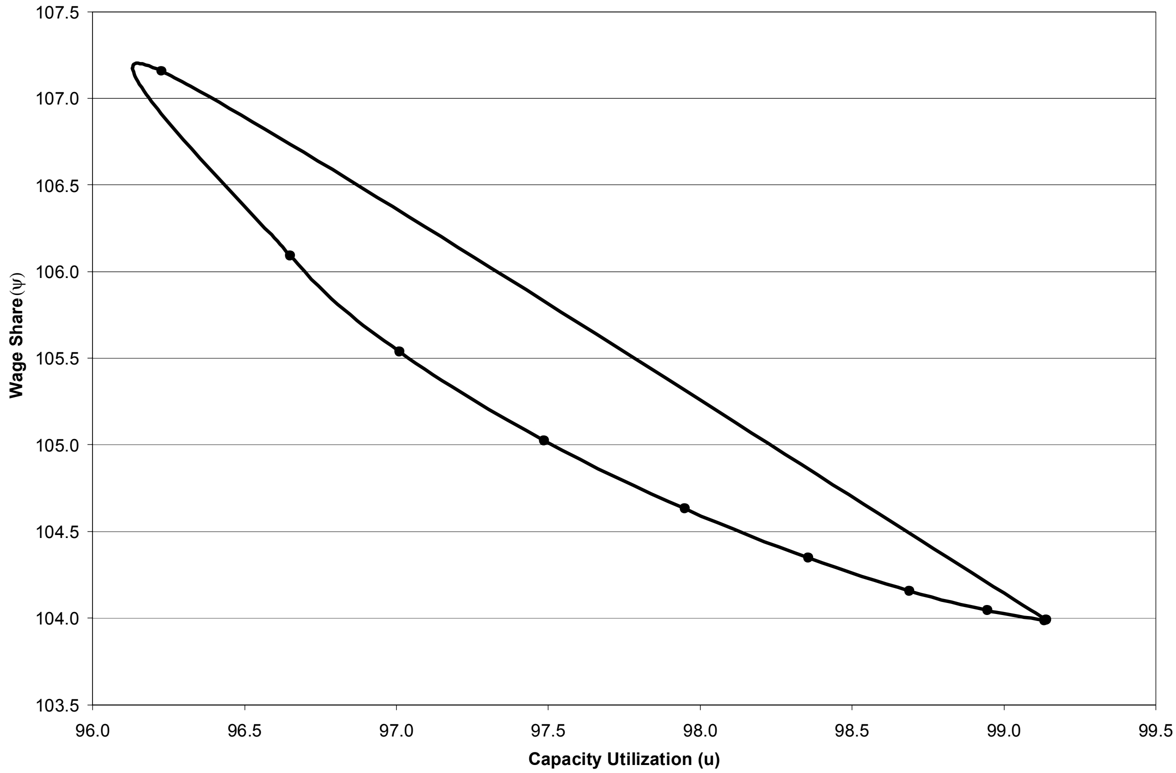


Figure 5: Model response to a combination of a -3% shock to effective demand and a +3% shock to the wage share, applied to the steady state.

Table 1: Estimated Coefficients for Capacity Utilization and the Labor Share, 1948-2002

	Constant	Trend	u(-1)	u(-2)	ψ (-1)	ψ (-2)	Steady state $d\psi / du$
u	**37.4275**	**-0.0013**	**1.2042**	**-0.4862**	**0.3031**	**-0.3931**	**-3.1334**
c	54.9465	0.0232	0.3820	-0.1443	-0.1253	-0.0473	
i	-13.4468	0.0010	0.8021	-0.3931	0.1924	-0.3060	
n	12.8739	-0.0176	-0.2143	0.1489	-0.1553	0.1059	
g	-16.9461	-0.0079	0.2344	-0.0977	0.3912	-0.1458	

	Constant	Trend	lnu(-1)	lnu(-2)	lnψ(-1)	lnψ (-2)	Steady state $d\ln\psi / d\ln u$
$\ln\psi$	**-1.2780**	**0.000**	**0.0461**	**0.1365**	**0.7128**	**0.1919**	**1.9166**
$\ln W$	9.0715	0.0150	0.7266	-0.5300	1.3955	0.3757	
$\ln P$	4.2386	0.0093	-0.4176	0.2684	-0.3398	0.4958	
$\ln\xi$	6.1109	0.0057	1.0981	-0.9349	1.0226	-0.3121	
$\ln\omega$	4.8329	0.0057	1.1442	-0.7984	1.7354	-0.1202	

Table 2: Slopes of Effective Demand and Distributive Curves for Sub-periods, 1948-2002

Period	Effective demand $d\psi / du$	Distributive $d\ln\psi / d\ln u$
1948-2002	-3.1334	1.9166
1954-2002	-2.7867	1.9964
1948-1970	-2.0362	3.6253
1954-1970	-1.4337	-6.2525
1971-2002	-6.9026	1.1591