INCOME DISTRIBUTION AND THE INTERACTION BETWEEN CYCLES AND GROWTH*

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Abstract

The paper studies the relationship between cycles and growth by means of a macro approach and within a medium- run horizon, characterized by the presence of multiple equilibria and the interaction between income distribution and institutional and financial aspects. In this context, the actual rates of growth can diverge from the steady state values, which are the focus of most growth theories. The fact that the average growth (or feasible rate of growth) can be different from steady state values highlights the relevance of the interplay between business cycles and growth and therefore, indirectly, the role of aggregate demand beyond the very short-run.

Keywords: business cycles, multiple equilibria, learning, feasible growth, income distribution.

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1. INTRODUCTION

Although the integration of demand and supply was present in the beginning of formal growth theory (see Harrod, 1939), it has been largely absent afterwards.[1] Studies of economic growth have initially mainly paid attention to the supply side and focused upon a deterministic trend (see, for instance, Solow, 1956). This one-sidedness, however, runs the risk of leading to paradoxes or to wrong conclusions. If a long-run time series of growth rates is considered, for example, the hypothesis of an interdependence between short-run and long-run movements can be reasonably put forward, as is done by the stochastic trend hypothesis (see Prescott, 1986). Within this hypothesis, which has been largely supported by real business cycle theories (RBC), there is the tendency to attribute an acceleration of growth to technical change, while leaving decelerations largely unexplained, unless the possibility of negative technology shocks is admitted. The advent of endogenous growth theory (Romer, 1986) has helped remove these counterfactual features, for instance by allowing monetary aspects to have long-run effects (see Stadler, 1990).

Our thesis is that an effective way of dealing with the interaction between cycles and growth is through an explicit consideration of the interplay between demand and supply. In this perspective, four points deserve to be stressed. (1), the analysis is based upon a Keynesian model integrated with supply considerations, on the one side, and a link connecting income distribution, financial and institutional aspects, on the other. (2), it is based on a macro model that is not strictly microfounded, but it is compatible with other justifications (see, for instance, Akerlof, 2007). (3), the analysis mainly refers to a medium-run period, rather than a long-run period, as is traditionally done. In this context, it is possible to detect both periods of rapid expansion and of relative decline that are different from those stressed in the business cycle literature and that are ignored by growth models. (4), these phenomena are compatible

[1] For these considerations, see also Dutt (2006) and Palley (1997).

with the existence of multiple equilibria, where there is dynamic regime switching and agents learn accordingly.

The analysis is carried out by means of simulations in the methodological spirit of Tesfatsion (2006). The results of the simulations show a variety of dynamic patterns that are particularly rich and complex because the model is not constrained to be linear. The simulations show that accelerations and decelerations are possible and that the cyclical behaviour can be very persistent. In this context, one can distinguish between feasible rates of growth and steady state rates of growth. The former represent the averages that link cycles and growth and depend on the interaction between aggregate demand and supply. Values of these averages can be far away from the steady state values that, according to the supply side approach, necessarily determine growth. This gap represents the role of business cycles and, through this channel, the impact of demand on growth dynamics. Its comparative dynamics are studied from an income distribution perspective.

The structure of the paper is the following. Section 2 illustrates the main stylized facts from a medium-run perspective. Section 3 introduces the multiple equilibria and the regime switching hypotheses. Section 4 presents the relationship between income distribution, debts and the consumption function. Section 5 introduces the remaining equations of the model. Section 6 discusses the steady state properties, while Section 7 introduces expectations. Section 8 analyzes the results of the simulations, and Section 9 examines the dynamic role of income distribution. Section 10 discusses the concept of feasible growth, while Section 11 analyzes the impact of endogenous productivity changes. The last Section concludes.

2. THE MEDIUM-RUN STYLIZED FACTS

When considering growth in the advanced industrialized countries over a long-run period, it is clear that the actual performance of the economies is far from the steady state path suggested by the literature on long-run dynamics. The US economy, for example, experienced sustained output growth during the 1960s. From the early 1970s to the early 1980s, however, output growth was low on average, while since the mid-1990s, there has been, for the most part, a return to strong growth.

Three points are worth stressing. The first is that these ups and downs pertain not only to the US economy, but also extend to such economies as those of Europe and Japan. Although the details differ, the experience of these two areas is characterized by similar ups and downs. In the second place, these ups and downs manifest themselves over a time span that is longer than that expected for the statistical business cycles. In the third place, these movements seem to be more consistent than those identified at shorter frequencies.

Comin and Gertler (2006) have tried to link the high and medium frequencies. The purpose of the present paper is to link the medium-run to lower frequencies. The possible link between medium-run fluctuations and growth is one of the less explored themes in the economic literature. One might wonder whether this is a relevant area of analysis since business cycles seem to be less relevant in recent experience. From a medium-run perspective, i.e. a longer time perspective than is considered in conventional business cycle analyses, the record shows that many industrialized countries have tended to oscillate between period of sustained growth followed by intervals of stagnation.

These records suggest that the long-run rate of growth cannot depend only on the technology and a few other parameters that reflect the fundamentals, but also on the complex events that link economic policy, institutions and fundamentals.

3. MULTIPLE EQUILIBRIA AND REGIME SWITCHING

These oscillations between growth and stagnation might be studied with the hypothesis of multiple equilibria (for a similar hypothesis, see also Evans et alia, 1998) In this perspective, the economy is characterized by a "bad" state (state 1), with high unemployment, deflation and a low growth of productivity and by a "good" state (state 2), marked by low unemployment, inflation and high productivity growth. Aggregate demand may shape the performance within the two states, while growth depends on i) what happens within each state, ii) between the two states and iii) the time spent in each regime. In this case, history matters for growth (see also Day and Walter, 1989).

The dynamics of the model are generated by a nonlinear system of equations supplemented by a regime switching mechanism.

In detail, monetary authorities fix the nominal rate of interest (R) according to a Taylor rule of the type:

$$R_t = R_0 + \psi_1\left(\overline{E}\pi_t - \pi_0\right) + \psi_2\left(\overline{E}g_t - g_0\right) \tag{1}$$

where π and g represent, respectively, inflation and growth, a bar refers to expectations, and the subscript 0 refers to a steady state. This rule is strengthened by a regime switching mechanism that is triggered by a deterministic threshold:[2]

$$\pi_{t-1} > 0$$

When this threshold is passed, monetary authorities adjust the Taylor rule according to the steady state values of Regime 1, and the opposite happens when the economy is in a deflationary state. One might legitimately wonder whether the regime switching is the main mechanism generating the fluctuations. As will be shown later on, this rule does not create the fluctuations but it rather prevents the dynamics from exploding. It should be stressed that the cyclical behaviour of the economy is determined by the interaction between this economic policy strategy and the structural dynamics of the economics, which is enriched by the presence of learning.

[2] This behavior is different from that suggested by Davig and Leeper (2007), where the switching is Markovian and refers to the values of the parameters φ.

4. INCOME DISTRIBUTION, DEBT AND THE CONSUMPTION FUNCTION

The model is based upon two fundamental Keynesian features: saving and investment decisions are made by different decision makers, and the labor market does not clear. In particular, the model includes most of the non-neutralities described by Akerlof (2007), which can be justified by "social norms" and by uncertainty (see, Ferri and Variato, 2007).[3] Finally, productivity dynamics are introduced, and the resulting interaction with demand will be studied through the lens of income distribution.

Let us start from the equilibrium condition that aggregate demand equals supply. In dynamic terms, this equality implies that 1 plus the rate of growth of output (g_t) must be equal to the sum of the investment ratio ($i_t = \frac{I_t}{Y_{t-1}}$) and the consumption ratio (in a closed economy without Government). The latter is a positive function of past and expected incomes and a negative function of the interest rate on accumulated debt ratio (deflated by expected inflation):

$$g_t = i_t + c_1\left(1 + \overline{E}_t g_t\right) + c_2 - c_3 \frac{R_t d_t}{1 + \overline{E}_t \pi_t} - 1 \qquad (2)$$

where c_1 and c_2 represent the propensity to consume past and forecast income, while c_3 measures the impact of debt.

This consumption function stresses the relationship between income distribution, financial aspects and institutional factors.[4] In this formulation. debt, increases from interest and consumption and diminishes because of wages received. In terms of last year output, the debt ratio

[3] Even though the origin of social norms and uncertainty is different, the effects may be similar. In fact, both create some kind of ' conventional environment' where individuals can take meaningful decisions.
[4] These relationships have been justified by Cynamon and Fazzari (2007) along the lines suggested by Akerlof (2007).

$$d_t = \frac{D_t}{P_{t-1}Y_{t-1}}$$

evolves according to the following formula:

$$d_t = \frac{d_{t-1}(1+R_{t-1})}{(1+g_{t-1})(1+\pi_{t-1})} - \frac{i_{t-1}}{(1+g_{t-1})} + \theta(1-\omega_{t-1}) \qquad (3)$$

where R is the nominal rate of interest, ω stands for the labor income share and θ represents a correction for distributed profits. Since debts contracts are predetermined in nominal terms, inflation can affect them. This is the reason why π appears in the denominator.

5. CLOSING THE MODEL

The interdependence between real and financial aspects is mainly concentrated in the consumption function because we want to pay a tribute to the "*zeitgeist*" characterized by the tendency of consumers to borrow. Consequently, the investment function has been rather simplified; it depends on both the accelerator and the cost of capital:

$$i_t = \eta_1 + \eta_2 \overline{E} g_t - \eta_3 r_t \qquad (4)$$

Since this equation is expressed in terms of Y_{t-1} , it implies that a normalized output/capital ratio is assumed throughout the analysis. The real cost of capital is related to the nominal rate of interest by the Fisher formula:

$$r_t = \frac{(1+R_t)}{(1+\overline{E}_t \pi_t)} - 1 \qquad (5)$$

We next introduce the labor market equations. Labor demand is given by the following equation:

$$l_t = l_{t-1}\frac{(1+g_t)}{(1+\tau)} \qquad (6)$$

Two aspects of this formulation should be stressed. First, l_t represents the employment ratio, referred to a normalized labor supply. Second, productivity is initially considered exogenous and equal to τ . It follows that the dynamics of unemployment (u_t) are given by

$$u_t = 1 - l_t \qquad (7)$$

Finally, price inflation is determined by the following formula:

$$\pi_t = -\sigma_1\left(u_t - u^*\right) + (1-\varphi)\overline{E_t}\pi_t \qquad (8)$$

where, as in Akerlof (2000), φ measures the percentage of people who are boundedly rational. (In the current literature, φ measures nominal rigidities, while σ_1 measures (inversely) real rigidities).

For given expectations, the model contains the following 9 unknowns in 8 equations:

$$d_t, i_t, g_t, l_t, u_t, \pi_t, \omega_t, R_t, r_t$$

In order to close the model, income distribution ω is initially assumed to be given.

6. THE STEADY STATES

As stressed by Solow (2000), the medium-run is a sort of no man's land that is worth analyzing. It does not belong to the Marshallian tripartite classification (see Leijonhufvud, 2006) and from a statistical point of view it occupies a range that is included between high frequencies (short-run) and low frequencies (long-run). In economics terms, its steady state is defined by the fulfilment of expectations,

$$\overline{E}g_t = g_t$$
$$\overline{E}\pi_t = \pi_t$$

the constancy of growth and of the main ratios. In this perspective, unemployment is constant and so is the debt ratio and the investment ratio.

Two caveats deserve attention. The first is that the model does not consider the relationship between investment and capital, and it assumes a normalized labor supply. Both assumptions would be untenable in the long-run. The second one refers to the fact that there is not a single steady state, since the model is marked by the presence of two regimes.

Regime 1 is characterized by a smaller productivity growth than Regime 2:

$$\tau_{01} < \tau_{02}$$

where 0 refers to the steady state, while 1 and 2 represent, respectively, the "stagnation" and "exuberant" states. Furthermore, Regime 1 is marked by the presence of deflation. Equation (1) implies that $R_{01} = 0$, while by means of (4) the real rate of interest is determined by

$$r_{01} = \frac{\eta_1 - i_{01} + \eta_2 g_{01}}{\eta_3}$$

once (6) and (2) have determined g_{01} and i_{01}.

In this Regime, inflation is determined by the Fisher equation (5), while (7) and (8) identify the steady state value of the employment ratio and the unemployment level.

In Regime 2, there is inflation and the monetary authorities try to fix the real rate of interest. Investment is then determined by equation (4), growth by equation (6) and debt by equation (3). In this framework, inflation is determined by equation (2):

$$\pi_{02} = \frac{c_3 d_{02}}{B - i_{02} + c_3 (1 + r_{02}) d_{02}} - 1$$

where $B = g_{02} - c_1 \ (1 + g_{02}) - c_2 + 1$.

This formula illustrates the role of debt and hence of income distribution in affecting inflation. This role is absent in Regime 1, because there the debt service is zero due to the presence of deflation and the constraint that $0 \leq R$.[5]

[5] The presence of a single rate of interest allows to avoid considerations of risk spread.

R_{02}, l_{02} and u_{02} are determined respectively by equations (5), (7) and (8).

Given the hypotheses made, the following inequalities hold:

$$g_{02} > g_{01}$$

$$\pi_{01} > \pi_{02}$$

$$u_{01} < u_{02}$$

which define the properties of the two regimes.

7. THE MARKOVIAN EXPECTATIONS

In this two regime system, the decision makers know that the economy experiences periods of "high" and "low" growth, along with phases of deflation followed by periods of inflation. We make the assumption that in forming their expectations they follow a two-state Markovian regime switching process (see Hamilton, 1989 and Jaimovich and Rebelo, 2006) In more detail, at the end of period t-1, agents believe that the growth rate in period t will be

$$g_t^e = \alpha_1 + \beta_1 s_t + (\rho_1 + \mu_1 s_t) g_{t-1}$$

where s_t is a random variable that assumes the value 0 in the low state and 1 in the high state. It evolves according to the following transition probabilities:

$$\begin{aligned}
\Pr(s_t = 0 | s_{t-1} = 0) &= a_1 \\
\Pr(s_t = 1 | s_{t-1} = 0) &= 1 - a_1 \\
\Pr(s_t = 0 | s_{t-1} = 1) &= 1 - b_1 \\
\Pr(s_t = 1 | s_{t-1} = 1) &= b_1
\end{aligned}$$

Since s_t is not known at time t, the expected value, conditioned on s_{t-1}, is taken as a forecast. If $s_{t-1} = 0$, the conditional forecasting rule is:

$$\overline{E}(g_t | s_{t-1} = 0) = \alpha_1 + (1 - a_1)\beta_1 + [\rho_1 + (1 - a_1)\mu_1] g_{t-1}$$

where the operator E is written with a bar to indicate its subjective character, which is different from rational expectations objective conditional expectation. For $s_{t-1} = 1$, the conditional forecasting rule is:

$$\overline{E}\left(g_t \middle| s_{t-1} = 1\right) = \alpha_1 + b_1\beta_1 + \left[\rho_1 + b_1\mu_1\right]g_{t-1}$$

The general forecasting rule is given by:

$$\overline{E}g_t = E\left(g_t \middle| s_{t-1}\right) = \alpha_1 + \beta_1\left[b_1 s_{t-1} + (1-a_1)(1-s_{t-1})\right] + \left\{\rho_1 + \mu_1\left[(1-a_1)(1-s_{t-1}) + b_1 s_{t-1}\right]\right\}g_{t-1}$$

With this formulation agents are supposed to form their expectations according to a particular form of bounded expectations (see Grandmont, 1998). Hommes and Sorger (1998) argue that expectations must be consistent with data in the sense that agents do not make systematic errors. This criterion implies that, at least, the forecasts and the data should have the same means and autocorrelations.

A similar forecasting rule can applied to inflation, where the random state variable is denoted by z. The forecast for this variable is

$$\overline{E}\pi_t = E\left(\pi_t \middle| z_{t-1}\right) = \alpha_2 + \beta_2\left[b_2 z_{t-1} + (1-a_2)(1-z_{t-1})\right] + \left\{\rho_2 + \mu_2\left[(1-a_2)(1-z_{t-1}) + b_2 z_{t-1}\right]\right\}\pi_{t-1}$$

Although s and z are unobserved (latent) random variables that introduce regime switching, this does not imply that they have no economic meaning. Regime switching is interpreted as a convenient device to apply to the problem of forecasting, and, in view of its popularity among forecasters, it may reflect their practices.

In the present model, we suppose that agents learn the value of these parameters by means of rolling regression,[6] and this is another source of dynamics in the model. The assumptions that all the agents have the same learning simplify the coordination problem, as underlined by Howitt (2006).

[6] See Gilchrist and Saito for the use of a Kalman filter in the case of learning. For an introductory exposition, see Turnovsky (2000). It must be stressed that in our model the agents do not learn the probabilities, but this option can be accomplished.

8. THE DYNAMICS OF THE MODEL

The system of structural equations above, along with the forecasting rules, is nonlinear and can be solved only by means of simulations. In this sense, our exercise is very close to the experiments suggested by Testfatsion (2006). It differs in that heterogeneity of agents is considered in a macro version, and it is based upon a functional distinction (consumers, investors, firms, labor) rather than microeconomic heterogeneity.

The parameters of the simulations are presented in Table 1.

Table 1. The parameters of the simulations

$u^* = 0.08$	$\varphi = 0.3$	$\sigma_1 = 0.03$	$\tau_1 = 0.08$	$\tau_2 = 0.0140$
$\eta_1 = 0.20$	$\eta_2 = 0.35$	$\eta_3 = 0.60$	$c_1 = 0.40$	$c_2 = 0.405$
$c_3 = 0.15$	$\psi_1 = 1.40$	$\psi_2 = 0.6$	$\omega = 0.78$	$\theta = 1$

Variable	a_j	b_j	β_j	μ_j	ρ_j
$\overline{E}g_t$ (j = 1)	0.4	0.6	0.001	0.43	0.55
$\overline{E}\pi_t$ (j = 2)	0.45	0.8	0.0002	0.48	0.48

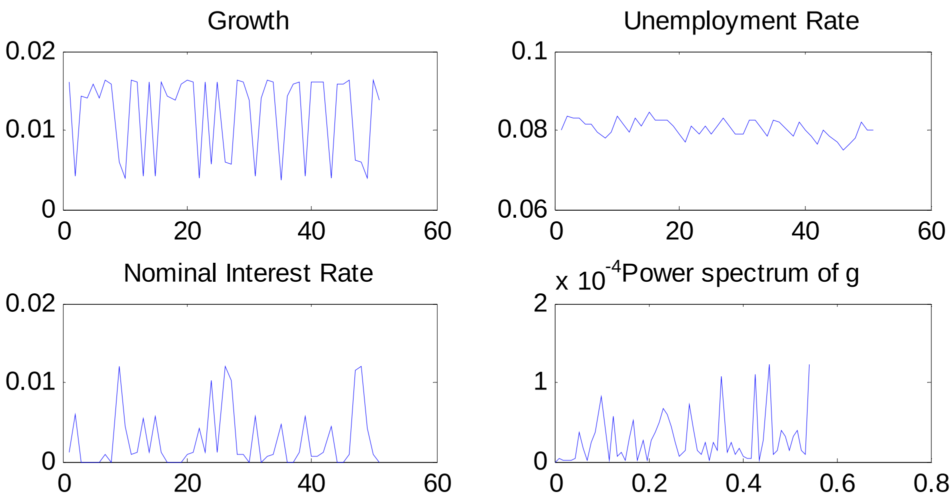
The results of the simulations (the last 50 runs over N=2000) are illustrated in Figure 1.

The dynamics of the model show persistent fluctuations in growth, unemployment and rate of interest in spite of the presence of a monetary rule that respects the Taylor principle. These fluctuations, however, do not explode but remain bounded after 2000 simulations. These complex results[7] depend on many factors that are worth considering. First of all, they depend on the presence and the nature of the two regimes. In the present case, the values of

[7] On the different asymptotic results in the case of nonlinear system,see Kuznetsov (2004). On complex dynamics, see Arthur, Durlauf and Lane (1997).

the parameters guarantee the existence of two steady states with the desired characteristics, as appears from Table 2.[8]

Figure 1. The dynamics of the model



In the second place, the dynamics are a function of the value of the threshold. To this purpose, one can say that the higher is the value assumed for the inflation rate, which is 0 in the text, the higher is the rate of growth because the system can stay longer in Regime 2, where the rate of growth is bigger.[9] In the third place, the dynamics are also a function of expectations.

Table 2. The steady state value of the two regimes

Regime	u	π	g
1	0.1298	-0.0050	0.008
2	0.0484	0.0032	0.0140

[8] In regime 1, a steady state nominal rate of interest equal to 0 has been assumed, while in regime 2 a steady state real rate of interest of 0.001 has been fixed.
[9] Were the threshold given too high a value, it would as if there were no regime switching. In this case, the dynamics become explosive.

Since expected values are very close to the actual, the learning mechanism is working in a satisfactory way.[10] Finally, we consider the role of endogenous dynamics generated by the system of equations.

9. THE ROLE OF INCOME DISTRIBUTION

Exogenous changes to income distribution can be a privileged point of view from which to understand the dynamics of the model. In the first place, it may facilitate the understanding of the working of the system. In the second place, it is a sensitivity exercise that ascertains the degree of structural stability of the dynamics.

Some points are worth making. First of all, the sensitivity analysis, obtained by changing the value of ω, shows that the model has structural stability, which is an important dynamical property that allows us to conduct comparative dynamics exercises. In other words, by changing the values of ω within a certain range, fluctuations remain bounded.[11] In the second place, from a more economic point of view, there is a nonlinear negative relationship between the labor share and growth. This result depends both on the particular consumption function that has been specified and the steady state values of the model. An increase in the labor share impacts on debt and therefore the steady state value of inflation in Regime 2. This higher level of steady state inflation (π_{02}), increases the actual inflation rate.

Two further consequences can be identified. On the one hand, the greater inflation rate increases the chances of violating the threshold value and thereby triggering a more severe monetary policy that must lower the growth rate. On the other, it implies falling unemployment. In other words, the dynamics of unemployment can be different from that of growth. However, the bounded growth fluctuations imply a similar property for unemployment. It fol-

[10] The mean values of g and Eg are respectively 0.0122 and 0.0116, while for π and $E\pi$ are -5.6 e-005 and -5.2e-005. The autocorrelation values are equal respectively to -0.17, -0.11, -0.10 and -0.15.

[11] In the present case, ω has been changed from 0.775 to 0.79, with a benchmark value equal to 0.78.

lows that unemployment varies within ranges, which is a dynamic pattern that differs from the NAIRU hypothesis, where there is no stability away from the equilibrium point.

Finally, one can assume that income distribution is endogenous. An endogenous income distribution can result from a wage dynamics that is different from inflation dynamics (see Asada et al, 2006). In the present paper, we theorize a macro relationship of the kind:

$$\omega_t = \omega_{t-1}\left[1-\gamma\left(u_{t-1}-u_0\right)\right]$$

The results are similar to those obtained with an exogenous income distribution. In the present case, a negative correlation is obtained between g and γ . Furthermore, from the stability point of view, there is a trade off between ω_0 and γ in the sense that, in order to keep the dynamics within bounds, an increase in the steady state value of ω_0 must accompanied by a simultaneous decrease in γ; otherwise the system explodes.

Were the variable ω present in other equations (for instance in the investment equation), then the results would have been more complex.

10. THE FEASIBLE RATE OF GROWTH

Once fluctuations in growth that remain within bounds after a considerable number of runs have been obtained, some further discussions of the actual rate of growth is worth while. For instance, it is not straightforward to identify the long-run rate of growth. It cannot be the steady state value, because there are two of them. An alternative is to take a long- run average of actual growth rates to obtain “a feasible rate of growth” (see Ferri, 2001). According to Solow (1997), one can argue whether “it is best to think about the trend as passing through successive cyclical averages, defined one way or another, or best to think of it passing through cyclical peaks, or some other measure of ‘potential’ output” (p.230). In the first alternative, there is a coupling between the short run and the long-run. In other words, there is an interaction between cycles and growth. This is the strategy followed in the present paper.

The actual rate of growth depends on the dynamics of the model which, as has been already mentioned, depends on three factors: i) the values of the steady states that constitute a corridor within which actual rate of growth evolves; ii) the time spent in each regime[12]; iii) the actual values in each regime. Table 3 gives some hints on the first point.

Table 3. Steady state values and actual growth

τ_{01}	τ_{02}	G
0.008	0.010	0.0091
0.008	0.014	0.0112
0.008	0.016	0.0142

The table shows how the actual rate of growth (i.e. the average of 1000 runs) depends on the rate of productivity growth in Regime 2, given $\tau_{01,}$ the value of productivity in Regime 1. It follows that the greater the range of productivity values, the higher is, ceteris paribus, the feasible rate of growth.

The caveat arises because feasible growth is not a supply side concept that depends on exogenous productivity, but it also depends upon aggregate demand. In fact, both the value of the threshold and the time spent in each regime depend on the interrelationships between aggregate demand, expectations, inflation and monetary policy.

In this sense, feasible growth depends on history with its interplay of demand and supply factors.

[12] The ergodic probabilities that discipline this aspect is different according to the different hypotheses. For a Markov regime switching, see Hamilton (1994). In a case of regime switching based upon different stochastic processes, see Tong (1990). While in the deterministic case, see Ferri et al. (2001).

11. ENDOGENOUS PRODUCTIVITY

In a model dealing with growth, the assumption of exogenous productivity change may be considered naive. One might assume that productivity growth is a function of the investment ratio in the following way[13]:

$$\tau_t = \tau_{1j} + \tau_2 i_{t-1}$$

where j = 1, 2.

Under this hypothesis, investment, productivity and growth must be solved simultaneously in steady state. In Regime1, where monetary policy sets $R_{01} = 0$, the above productivity equation along with equation (6) and (2) determine

$$i_{01} = \frac{\tau_{11}(1-c_1) - c_1 - c_2 + 1}{1 - \tau_2(1-c_1)}$$

which in turn determines τ_{01} and g_{01}.

Mutatis mutandis, with the same productivity equation and (4) and (6), one obtains for Regime 2, the following value:

$$i_{02} = \frac{\eta_1 - \eta_3 r_{02} + \eta_{02}\tau_{12}}{1 - \eta_2 \tau_2}$$

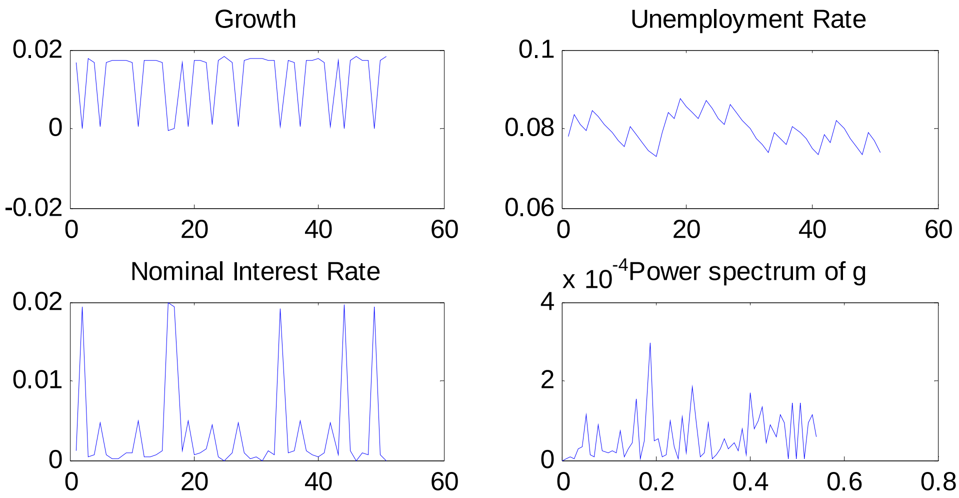
It follows that under the current hypothesis of endogenous productivity, the steady state values of g reflect not only technological aspects and saving fundamentals but also the role of aggregate demand factors along and of monetary policy.

Under these hypotheses,[14] the model shows the dynamics illustrated in Figure 2, while comparative dynamics exercises are illustrated in Table 4.

[13] On the relationship with Kaldorian hypothesis, see Ferri (2007) For a discussion, see Aghion and Howitt (1998).

[14] The parameters are the same as those of those of Table 1, except that φ =0.10; ψ_1= 1.8 and ψ_2 =0.85, while τ_{11} = 0.001 , τ_{12}= 0.01 and τ_2 =0.025. N = 1000.

Figure 2. The dynamics with endogenous productivity



Some aspects are worth stressing. First of all, fluctuations remain bounded even though the dynamic profile changes. In fact, there is more action going on at a higher frequencies as emerges also from the comparison of the power spectra of the two figures. In the second place, the greater is τ_2, (the coefficient that links investment to productivity) the higher is the rate of growth. This is not a surprising result, since there is a direct link between productivity and growth. What must be stressed is that the values of τ_2 included in the range illustrated in Table 4 do not alter the dynamical properties of the system for N =1000. Finally, while between the values of ω_0 and γ there is a dynamical trade-off, the relationship between γ and τ_2 goes in the same direction. This implies that the endogeneity of productivity growth allows a greater endogenous component of income distribution, given a similar dynamic setting.

Table 4. The impact of endogenous productivity and income distribution ($\omega_0 = 0.76$)

τ_2	γ	G
0.0010	0.003	0.0097
0.0020	0.003	0.0120
0.0025	0.003	0.0134
0.0030	0.003	0.0152

12. CONCLUDING REMARKS

The paper has studied the interaction between cycles and growth. By means of a macro approach and within a medium-run horizon, the model contains multiple equilibria, where one regime is characterized by low productivity growth, high unemployment and deflation, while the other has the opposite properties. In this context, monetary policy reacts with a regime switching policy. This has two impacts on the system. First, under the hypothesis of endogenous productivity growth, steady state values are not independent of aggregate demand. Second, the regime switching mechanism constitutes a check on endogenous dynamics, where consumers, investors and workers adjust expectations according to a Markov learning device.

The actual rates of growth can diverge from both steady state values, which are the objects on which most growth theories focus. In fact, determination of the actual growth is rather complex and depends, in addition to the steady state values, on the time spent in each regime and on the economic factors that determine the rate of growth within each regime.

In particular, the results depend very much on the existence of a relationship between consumption, income distribution and debt. In this context, a higher labor share, both in the exogenous and the endogenous versions of productivity growth, seems to lead to a smaller average rate of growth

This average rate of growth can be defined to be the feasible rate of growth, a concept that is more compatible with a range rather than a single point and that depends on technological, economic, institutional and policy factors. The fact that average growth can be different from steady state values measures the relevance of the interplay between business cycles and growth and therefore, indirectly, the role of aggregate demand beyond the very short-run.

There are different way to extend the analysis. First of all, one could extend the link between income distribution and debt to other functions (such as the investment function). In the second place, more long-run forces should be considered in order to move the medium-run horizon towards a long-run. Physical capital along with human capital are the obvious candidates. In this perspective, also the problem of the creative destruction, i.e. the cleansing mechanism present in recessions, along with the possible feedback from growth to cycle, could be considered. The Schumpeterian concepts could enrich the multi phase approach suggested by Day and Walter (1989) where different regimes, characterized by different institutional settings, can produce complex dynamics in the long-run.

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