Devaluation, Conflict Inflation and Endogenous Growth in a Small Open Economy

José Antonio Cordero[1]

■ **Abstract:** This article attempts to formalize some of Kaldor's ideas about endogenous growth (resulting from a process of cumulative causation). In the context of a small open economy, the rate of growth of this economy is determined by effective demand, with the trade deficit adjusting to clear the goods market. The wage rate and exchange rate inflation are driven by a distributional conflict.

■ **Resumen:** Este articulo trata de formalizar alguna de las ideas de Kaldor, acerca del crecimiento endógeno, como resultado de un proceso de causalidad acumulativa. En el contexto de una economía abierta pequeña, la tasa de crecimiento de esta economía es determinada por la demanda efectiva, con el déficit comercial que se ajusta para eliminar exceso de demanda en el mercado de bienes. Por otro lado la tasa de salario y la tasa de devaluación son conducidos por un conflicto distribucional.

■ **Keywords:** Effective demand, distributional conflict and Technical progress function.

■ **JEL Code:** O44, O15, O3.

■ *Introduction*

Formal arguments on endogenous growth probably started with Adam Smith in the 18th century. Although Ricardo later found that diminishing returns could impose limits on the process of economic growth, John Stuart Mill later argued that inventions and innovations are capable of exercising an *antagonist* effect to the operation of diminishing returns. (Rostow, 1990; p. 99).

These arguments provided a fertile ground for more comprehensive theories on economic development, but they were later forgotten along

1. Escuela de Economía, Universidad de Costa Rica. E-mail: jacorder@cariari.ucr.ac.cr

with the classical theories of distribution, especially after the marginalist authors turned their eyes to the static analysis of resource allocation. According to Deane (1978, p. 101) "*the problems of growth were outside the effective range of marginal analysis ...*" It is fair to say, however, that Alfred Marshall, one of the creators of marginalist analysis, did have very clear thoughts on the effects of increasing returns and technological change on economic expansion.[2]

In 1928 ***The Economic Journal*** published "Increasing Returns and Economic Progress," an article by Allyn Young which generated a great deal of attention, especially because it raised again the topic of endogenous growth. However, the technical difficulties to formalize the ideas by Young and the other authors we have mentioned soon led economists to abandon the possibilities of those arguments.

An influential book by Joseph Schumpeter, "***Theory of Economic Development,***" was published in Germany in 1911, but it was translated into English only until 1934 (Deane, 1978; p.190). In this book, Schumpeter presents his preliminary ideas on the business cycle and the role of innovation and creative destruction in the endogenous process of economic evolution (Schumpeter, 1955). The works of this author were frequently kept in the minds of several development and industrial economists, but a group of formal research on his views only emerged after 1990 as the *Schumpeterian approach* to endogenous growth.[3]

The works of Harrod (1939), Domar (1946), Solow (1956), and Swan (1956) led to a renewed interest on the analysis of economic expansion, and set the standard for a more formal presentation of ideas in this area; but in all these cases growth was seen as exogenous. Thus, in this process, we gained much elegance, but lost many interesting insights.

The limitations that we have mentioned encouraged an aggressive search for alternatives to formalize economies in which economic expansion is endogenous. Although the search spread mostly since 1986 and 1988 -years in which Paul Romer (1986) and Robert Lucas (1988) published two very influential papers on this field- it has been argued that these works were built upon the basis of prior research by Arrow (1962) and Uzawa (1965).[4]

---

2. See Rostow (1990, p. 171-72) for a more detailed presentation of Marshall's ideas on economic growth, scale of production, increasing returns, external economies, and technological change.
3. According to Aghion and Howitt (1998), this group attempts to formalize the way in which the economic, social and legal environment affect the incentives of economic agents to engage in innovation and knowledgeproducing activities.
4. An interesting and original analysis of these views can be found in Ros (2001).

Authors like Jong-il You (1993), however, hold that the pioneering attempts at endogenizing growth come from Kaldor (1957, 1961), and from Kaldor and Mirrlees (1962). In these works endogenous technical change is introduced by means of an explicit technical change function which makes the growth of labor productivity depend on some sort of notion of capital accumulation. Kaldor's investigation is, thus, the first to formalize the argument that growth is endogenous and results from a process of cumulative causation.

In his 1957 paper (p. 595), he wrote that his model was different from others in that it made no distinction between changes in techniques that are induced by changes in the capital-labor ratio, and those induced by technical innovation or invention. And he added: "The use of more capital per worker ... inevitably entails the introduction of superior techniques which require "inventiveness" of some kind ... On the other hand, most ... technical innovations which are capable of rising the productivity of labor require the use of more capital per man."

He assumes that productive improvements that result from innovation are translated into a higher capital-labor ratio (where capital takes the form of more elaborate equipment).

In other words, the technical dynamism of a society (its ability to invent and introduce new techniques of production), determines "*the speed at which a society can 'absorb' capital (i.e. it can increase its stock of man-made equipment, relatively to labour"* (Kaldor, 1957; p. 595).

There have been several attempts at formalizing Kaldor's ideas in more detail,[5] but they have mostly been in the context of closed economies. This article attempts to fill such a gap in the literature, by means of a model in which a Kaldor technical progress function is slightly modified to formalize endogenous growth in a small-open economy. The rate of growth of this economy is determined by effective demand, with the trade deficit adjusting to clear the goods market. The rate of wage and exchange rate inflation are driven by a distributional conflict.

■ *The structure of the small-open economy*

General assumptions

This section is built upon the work of Cordero (2002), where a model of growth is developed for a small-open economy. As in other models of this kind, the analysis is divided in two parts. First, we have a short-run

5. Examples are You (1993), Dutt (1986), Palley (1997), and Taylor (1991).

in which the system is solved assuming that certain variables are given while others are exogenous. The endogenous variables are determined then in terms of the exogenous arguments and givens of the system. In the longrun, the given variables are allowed to adjust, while those which were found in the shortperiod are assumed to remain at their equilibrium level. This procedure allows us to focus our attention on the construction of a dynamic system with the capital-labor ratio and the wage share as the unknowns of such system.

For the production side of the economy, we assume here that a good Q is produced by means of a fixed coefficient function:

$$Q = \text{Min}\ \{\ (L/a),\ uK\ \}$$

where L and K are, respectively the amounts of labor and capital utilized in the production process. Both "a" and "u" represent fixed coefficients. It is further assumed that u remains fixed throughout the analysis, while "a" is given in the short-run but may adjust in the longrun, as we will see in section 3. The stock of capital is fully utilized, does not depreciate, and is given in the short-run.

The domestically produced good Q is assumed to be used for consumption and export purposes, and its price (in terms of foreign currency) P^Q is determined exogenously in the international market. The domestic currency price will then be eP^Q, where "e" represents the nominal exchange rate.

The economy imports one good M, which is used only as capital or for investment purposes. In this model all investment goods are imported; there is no local production of capital goods.[6] The international price of the imported good is determined exogenously at the level P^M and its price in terms of domestic currency would be eP^M.

As in other structuralist models (like the ones presented in Dutt, 1990 and Taylor 1991, for example), we assume a society with two social classes: workers and capitalists or producers. Workers do not save and spend their entire wage in the consumption of the domestic good Q.

The real wage is defined in terms of the domestic good: $V = W/\ eP^Q$, V is the real wage, and W is the nominal wage. It is further assumed that the nominal wage and the nominal exchange rate are given in the short-run; this, along with the assumption of exogenous international prices P^Q implies that the real wage V is also given in the shortrun.

6. The assumption that all investment is imported simplifies the algebra considerably, and does not change the results of the paper.

Capitalists save a constant fraction “s” of their profits, and the remaining portion (1-s) is spent on consumption of the local good. The capital stock does not depreciate, and it its assumed fixed in the short-run.

With these assumptions we have every variable in the model given exogenously, or given in the short-run, or may be derived directly in terms of those variables. Next we try to bring the model to its short-run equilibrium level so we can later analyze the long-run dynamics.

Short-run analysis

We start by defining a cost-profit relation, which tells us that the value of production equals total wages plus total profits. With this, and our definition of technical coefficients we can obtain an equation for the rate of profit:

(1) $$r = \frac{P^Q}{P^M} u[1 - A]$$

where $$A = \frac{WL}{eP^Q Q} = \frac{Wa}{eP^Q}$$

represents the wage share. Notice that A is given in the short-run since it depends on exogenous terms (P^Q) and variables that are given in the short-run (W, e, a).

Next we use, as in Cordero (2002), a production equation along with a balance of payments equilibrium condition, and equation (1) to obtain an expression for the rate of total savings:

(2) $$g = sr + f$$

This equation tells us that the rate of total savings equals domestic savings plus foreign savings “f”. Notice that “f” is the trade deficit ratio; in other words it represents the gap between imports and exports, divided by the value of the capital stock.

As in Marglin (1984), the system formed by (1) and (2) is underdetermined: we have two equations and four unknowns. Since, as it was argued above, A is given in the short-run, r must also be given in the short-run. In Marglin’s closed economy, fixing the wage share (and therefore the rate of profit) would have been enough to close the model in a somewhat Neomarxian fashion. In this open economy, however, that is not enough; we need to introduce yet another equation to close the system. Following Dutt (1990, 1992) and Marglin (1984), a Neokeynesian closure would call for the introduction of a desired or planned investment function:[7]

(3) $g^d = b_0 + b_1 r$

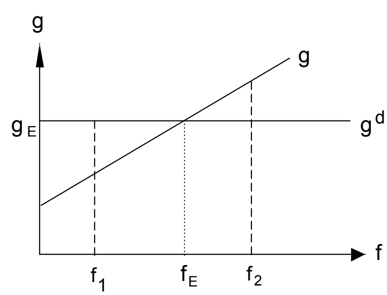
where g^d represents the desired investment ratio (i.e. the ratio of the value of desired investment to the value of the capital stock), and both b_o and b_1 are positive parameters.

Now we can add a macroeconomic equilibrium condition to solve the problem

(4) $g = g^d$

and the system thus consists of equations (1) through (4). It is now possible to solve for the trade deficit ratio (f) that clears the goods market as shown in the following graph:

Figure 1



where f_E and g_E represent, respectively the equilibrium levels of "f" and "g". There are two important characteristics of the model:

i. With prices and technical coefficients given in the short-run, the excess demand for goods ($g^d - g$) must be cleared by changes in f.[8]
ii. The rate of growth of the economy is determined by desired investment; in other words, the rate of growth depends on effective demand.

7. In Cordero (2002), the model is closed with the introduction of a desired investment function like the one we use here.
8. The short-run adjustment process may be described by the following differential equation: $df/dt=z(g^d-g)$, where z is a positive parameter. Using (2) and (3) we may show that the adjustment process is always stable.

Next, we use (2) and (3) to obtain the equilibrium value of the trade deficit:

(5) $$f_E = b_0 + (b_1 - s)\frac{uP^Q}{P^M}(1 - A)$$

As indicated before, it will be assumed that the variables which adjust in the short run (f, g), remain in their short-run equilibrium level during the long-run analysis. With this in mind, we next look at the long-run behavior of this open economy.

Long-run analysis

In this section we assume that the nominal wage, the nominal exchange rate, the capital stock, and the labor-output ratio (a) can adjust to bring the system to the long-run equilibrium level. We start with the equation of motion for the wage share. We recall that

$$A = \frac{Wa}{eP^Q}$$

and therefore:

(6) $$\hat{A} = \hat{W} - \hat{e} - \hat{y}$$

where the hats denote rate of growth, and y = 1/a (i.e. y represents labor productivity).

The nominal wage goes up in response to the gap between the exogenous wage share workers target AW and the actual wage share A:

(7) $$\hat{W} = \theta(A_w - A)$$

The devaluation rate depends on the gap between the trade deficit ratio and f_T, a critical level of the trade deficit determined exogenously by the Central Bank:

(8) $$\hat{e} = \beta(f - f_T)$$

We now suggest a technical progress function in which labor productivity growth depends on the capital-labor ratio, and the investment ratio:

(9) $\hat{y} = Y(h, g)$

and[9] $Y_g > 0$, $Y_h > 0$, $Y_{hh} < 0$

Our goal here is to combine Kaldor's (1957) approach with the notion of learningby-doing developed by Arrow in his 1962 paper. Thus, it will be argued that the rate of labor productivity growth depends on the capital-labor ratio (h), and learning, which we assume to be positively related to production, which in turn is associated to the rate of growth of the capital stock (or rate of investment) g. As could be observed, and as Kaldor also suggested, the technical progress function exhibits diminishing returns to the capitaloutput ratio.

We can also write a more explicit function for the rate of labor productivity growth, which satisfies the conditions appearing in (9), as shown below:

(10) $\hat{y} = \tau_1 g + \tau_2 h - \tau_3 h^2$

Using expressions (6) through (10) we get the following differential equation:

(11) $$\hat{A} = Do + A\left[-\theta + \beta(b_1 - s)u\frac{P^Q}{P^M} + \tau_1 b_1 \frac{P^Q}{P^M}u\right] - \tau_2 h + \tau_3 h^2$$

where *Do* captures all the constant and exogenous terms in (11).
In order to analyze the motion of h, we first recall that:

$$h = \frac{K}{L} = \frac{K}{Q}\frac{Q}{L} = \frac{y}{u}$$

and since "u" is a fixed technical coefficient we can write

$$\hat{h} = \hat{y}$$

9. The subindex represents partial derivative; for example, Yg represents the partial derivative of Y with respect to g.

and from (10)

$$\text{(12a)} \quad \hat{h} = \tau_1 g + \tau_2 h - \tau_3 h^2$$

Now we use (1) and (3) to get, from the previous expression:

$$\text{(12b)} \quad \hat{h} = D_1 - \tau_1 b_1 \frac{P^Q}{P^M} uA + \tau_2 h - \tau_3 h^2$$

where D_1 represents all the constant and exogenous terms in (12b). We now have a system, which consists of equations (11) and (12b), and two variables: the wage share A, and the capital-labor ratio h.

A quick look at (12a) allows to determine that the rate of growth in the stationary

state (that is, at $\hat{h} = 0$), is:

$$\text{(13)} \quad g = \frac{-\tau_2 h + \tau_3 h^2}{\tau_1}$$

so that the rate of growth depends on the capital-labor ratio. When this ratio is large enough, g increases as h goes up. In other words, growth in this model is not exogenous as it is in other models for closed and open economies. Instead, it is endogenous and depends upon the capital-labor ratio (whose long-run value is determined within the system).

The stability of the long-run equilibrium is analyzed by means of the Jacobian:

$$J = \begin{bmatrix} \dfrac{\partial \hat{A}}{\partial A} & \dfrac{\partial \hat{A}}{\partial h} \\ \dfrac{\partial \hat{h}}{\partial A} & \dfrac{\partial \hat{h}}{\partial h} \end{bmatrix} = \begin{bmatrix} \left\{ -\theta + u \dfrac{P^Q}{P^M} \left[\beta(b_1 - s) + \tau_1 b_1 \right] \right\} & -\tau_2 + 2\tau_3 h \\ -\tau_1 b_1 \dfrac{P^Q}{P^M} u & \tau_2 - 2\tau_3 h \end{bmatrix} = \begin{bmatrix} \alpha_1 & \alpha_2 \\ \alpha_3 & \alpha_4 \end{bmatrix}$$

where

$$\alpha_1 = \left\{ -\theta + u\frac{P^Q}{P^M}\left[\beta(b_1 - s) + \tau_1 b_1\right]\right\}$$

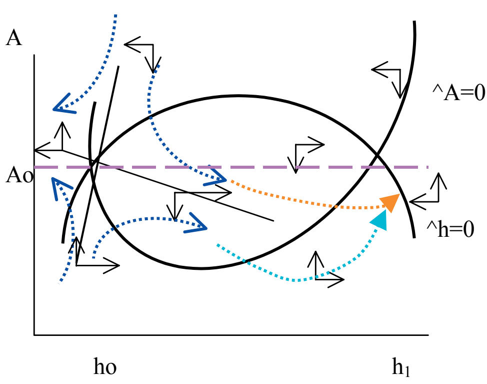
$$\alpha_2 = -\tau_2 + 2\tau_3 h$$

$$\alpha_3 = -\tau_1 b_1 \frac{P^Q}{P^M} u$$

$$\alpha_4 = \tau_2 - 2\tau_3 h$$

The determinant of the Jacobian is Det (J) = $\alpha_1\, \alpha_4$ - $\alpha_3\, \alpha_2$. When b_1 is small we have that s > b_1 and [$\beta(b_1 - s) + \tau_1 b_1$] would be either negative or very small in absolute value, so $\alpha_1 < 0$. In addition, $\alpha_4 > 0$ and $\alpha_2 < 0$ for low levels of the capital-labor ratio h, while α_3 is always negative. Therefore, at low levels of h, the determinant is negative and we then have a saddle point.

If we maintain our assumptions about b_1 so that α_1 is still negative, we could argue that, for higher levels of h, α_2 is positive and α_4 is negative. Under these conditions Det (J) = $\alpha_1\, \alpha_4$ - $\alpha_3\, \alpha_2$, is positive. We next look at the trace: Tr (J) = $\alpha_1 + \alpha_4$ which is negative for higher levels of h, and therefore the equilibrium is stable when h is big.



As the phase diagram shows, we have two equilibrium points; a low level equilibrium (already characterized as a saddle point), which could be seen as underdevelopment or poverty trap as in Ros (2001). Here, a disturbance leading to a higher capital-labor ratio, moves the system to the right of ho and will make h rise until it reaches h_1, a stable high-level equilibrium level. During the process the wage share remains unchanged.

We next turn to a more detailed analysis of the long-run behavior of the model. Suppose that the economy experiences a sudden increase in investment demand (perhaps as a result of the operation of "animal spirits"). Other things being the same, this will cause an excess demand for goods (i.e. $g^d > g$), which will be cleared in the short-run by means of an increase in the trade deficit ratio (f). The higher level of f leads to devaluation, which, in turn, causes a reduction in A and an increase in the rate of profit. As a result, the rate of investment goes up generating two effects from equation (10): an increase in labor productivity "*y*", and an increase in the capital-labor ratio (which also leads to higher labor productivity).

The increase in "*y*" also causes a decline in A, and this, from equation (7) encourages the pressure of workers for higher nominal wages. As a result, the nominal wage moves up, and this, in turn, increases the labor share, thus compensating the decline in A mentioned previously. Thus, an interesting feature of the long-run equilibrium is that it is possible to have a higher capital-output ratio with the same level of the wage share. In other words, endogenous growth allows producers to use a higher h, without affecting the long-run level of A.

■ *Concluding remarks*

We have developed a model of endogenous growth for a small open economy. Here, effective demand, distributional conflict and a technical progress function allow obtaining two possible long-run equilibrium levels. The combination of conflicting claims on income and the effect of a higher investment ratio on productivity, make it possible to reach a high capital-labor ratio without affecting the wage share.

The low level equilibrium position is characterized as a saddle point. A shock or decision which increases the use of capital per worker will put the system on the unstable arm and this will inevitably lead to a stable equilibrium at a higher capital-labor ratio. What is in operation here is the effect of higher capital per worker on the rate of productivity growth, which stimulates the rate of investment and this, in turn causes further increases in the capital-labor ratio and labor productivity. The result is a downward movement on the labor share which, due to conflicting claims, pushes up the nominal wage and thus the wage share. Producers can then increase their capital-labor ratios without observing a reduction in their profit share.

An important policy implication of the model is that, the instability arising from lower levels of capital accumulation could be solved by means of an effort to increase the ratio of capital per worker.

■ *References*

Aghion, P. and Howitt, P. (1998). *Endogenous Growth Theory*, Cambridge: The MIT Press.

Arrow, K. (1962). "The economic implications of learning by doing," *American Economic Review*.

Cordero, J. (2002). "A model of growth and conflict inflation for a small open economy," *Metroeconomica*, 53:3, 261-289.

Dean, P. (1978). *The evolution of economic ideas*, Cambridge, Cambridge University Press.

Domar, E. (1946). "Capital expansion, rate of growth and employment," *Econometrica*, 14:137-147.

Dutt, A.K. (1986). "Growth, distribution and technological change," *Metroeconomica*, vol. XXXVIII, No. 2, 113-134.

Dutt, A. K. (1990). Growth, distribution and uneven development, *Cambridge Journal of Economics*.

Dutt, A.K. (1992). "Conflict inflation, distribution, cyclical accumulation and crises," *European Journal of Political Economy* , 8, pp. 579-97.

Harrod, R.(1993) "An essay in dynamic theory," *Economic Journal*, 49: 14-33.

Lucas, R. (1988). "On the mechanics of economic development," *Journal of Monetary Economics.*

Kaldor, N. (1957). "A model of economic growth," *The Economic Journal*, 67, 591-624.

Kaldor, N. and Mirrlees, J. (1962). "A new model of economic growth," *Review of Economic Studies*, No. 3.

Marglin, S. (1984). *Growth, distribution, and inflation*, Cambridge: Harvard University Press.

Palley, T. I. (1997). "Aggregate demand and endogenows growth: a generalized Keynes-Kaldor model of economic growth," *Metroeconomica*, 48:2, 161-176.

Romer, P. (1986). "Increasing returns and long run growth," *American Economic Review*.

Ros, J. (2001). *Development Theory and the Economics of Growth*, Ann Arbor: The University of Michigan Press.

Rostow, W. W. (1990). *Theorists of Economic Growth from David Hume to the Present*, New York: Oxford University Press.

Swan, T. W. (1956). “Economic growth and capital accumulation,” *Economic Record*, 32: 334-61.

Schumpeter, J. (1955). *The Theory of Economic Development*, Cambridge: Harvard University Press.

Taylor, L. (1991). *Income distribution, inflation, and growth: lectures on structuralist macroeconomic theory* , Cambridge: MIT Press.

Uzawa, H. (1965). “Optimal technical change in an aggregative model of economic growth,” *International Economic Review* , 6: 18-31.

You, Jong-il (1993). “Macroeconomic structure, endogenous technical change and growth,” Cambridge Journal of Economics.

Young, Allyn (1928). “Increasing Returns and Economic Progress,” *The Economic Journal* .