EMPLOYMENT POLICY FOR BALANCED GROWTH UNDER AN INPUT CONSTRAINT

by
D. WEISERBS, A. KERVYN
and A. INGHAM (*)

Working paper n° 8107

(*) Université Catholique de Louvain and University of Southampton.
The authors are grateful to F. Melese for research assistance.

Institut des Sciences Economiques
Institut de Recherches Economiques
Université Catholique de Louvain

29, rue des Wallons, B-1348 Louvain-La-Neuve (Belgique)

EMPLOYMENT POLICY FOR BALANCED GROWTH UNDER AN INPUT CONSTRAINT

D. Weiserbs, A. Kervyn and A. Ingham*

§ 1. Introduction

We consider a vintage model in which an economy combines labor, capital and an imported resource (raw material) to produce a single manufactured good.

The purpose of the paper is to study the behavior of the system when it is shocked out of its "golden rule" path by the sudden imposition of a constraint on the volume of imports of the resource, while the relative price of the resource grows at a rate determined exogeneously.

A "capitalist" and a "socialist" solution are presented.

The capitalist solution retains the constraint that the wage rate is equal to labor productivity on the oldest vintage in use.

The socialist solution chooses the path on which consumption per capita is maximized and then examines various policies such that all of the labor force is employed.

---

*Université Catholique de Louvain and University of Southampton. The authors are grateful to F. Melese for research assistance.

§ 2. The model

2.1 The goods market

a) Supply

Output serves as the numeraire, and the capital coefficient is constant. A "machine" is defined either in terms of its opportunity cost in production (one unit of output), or in terms of the output it produces, v. Output per machine is thus constant, both over the life of a single machine, and over all vintages of machines. Technical progress appears as a reduction in the labour crew and in the inputs of raw materials associated with successive vintages to produce the same output.

The stock of machines, K_t, is determined by past investment. k_θ machines built at time θ yield at period t ($t > \theta$) an output of $q_{t,\theta}$

$$q_{t,\theta} = vk_\theta \tag{1}$$

Denote by s the useful life of a machine (s is endogenous, that is, the machine is scrapped on economic grounds before it breaks down). Then the oldest vintage in operation at time t is t-s, and the useful stock of machines at t is :

$$K_t = \sum_{\theta=t-s}^{t-1} k_\theta \tag{2}$$

so that total output is simply given by :

$$Q_t = \sum_{\theta=t-s}^{t-1} q_{t,\theta} = vK_t \tag{3}$$

b) Demand

Assuming that no stockpiling may occur in the economy (any stock of output or input evaporates at the end of the period), current output is either consumed (C_t) invested (k_t) or exported (X_t).

Denoting total demand for the good by D_t, we have

$$D_t = C_t + k_t + X_t . \tag{4}$$

Under the classical assumption that the economy's saving ratio is equal to the share of profit in the value added - or equivalently, that all wages are consumed and all profits are invested - consumption is determined by

$$C_t = w_t L_t, \tag{5}$$

where w_t is the wage rate and L_t the volume of labor employed at period t.

If M_t is the quantity of the resource imported at a (relative) price p_t and X_t is the value of output exported in return, the external debt, B_t, evolves according to

$$B_t = (1 + r_{t-1})B_{t-1} + p_t M_t - X_t,$$

where r_t is the rate of interest on foreign debt.

For simplicity we shall impose, in the present paper, equilibrium in the balance of trade at every period t :

$$X_t = p_t M_t. \tag{6}$$

This implicitely assumes that exporters of the resource purchase $p_t M_t$ of the manufactured good regardless of its competiveness on the world market.

2.2 The labor market

a) Demand

The number of workers required to operate one machine of vintage θ is

$$\ell_\theta = \frac{1}{1+\mu}\,\ell_{\theta-1} = (1+\mu)^{-\theta}\ell_o, \tag{7}$$

where ℓ_o is the amount of labor required to operate one machine of the oldest vintage utilized at the beginning of the plan and μ the coefficient of Harrod-neutral technical progress.

Thus, at time t, the volume of labor demanded in the economy is :

(8) $$L_t = \ell_o \sum_{\theta=t-s}^{t-1} (1+\mu)^{-\theta} k_\theta .$$

b) Supply

The labor force, N_t, grows at a constant rate λ :

(9) $$N_t = (1+\lambda)N_{t-1} = (1+\lambda)^t N_o ,$$

so that u_t, the unemployment rate, is

(10) $$u_t = 1 - \frac{L_t}{N_t} = 1 - \frac{\ell_o}{N_o} (1+\lambda)^{-t} \sum_{\theta=t-s}^{t-1} (1+\mu)^{-\theta} k_\theta \geqslant 0.$$

Should labour demand, L_t, exceed labor supply, N_t, then some machines, presumably of the oldest vintage, must be crapped (machines cannot lay idle).

c) Wages

The real wage rate, w_t, is determined endogeneously (i) by the profitability condition (equation (14) below) in a "capitalist" system or (ii) by the maximization of a welfare function in a "socialist system".

2.3 The resource market

a) Demand

Similarly, the resource requirement for a machine of age θ is defined as :

(11) $$m_\theta = \frac{1}{1+\nu} m_{\theta-1} = (1+\nu)^{-\theta} m_o ,$$

where ν expresses resource-saving technical progress (if $\nu > 0$) analogous to the Harrod neutral type.

Total demand for the resource is thus determined by

(12) $$M_t = m_o \sum_{\theta=t-s}^{t-1} (1+\nu)^{-\theta} k_\theta .$$

b) Supply

The economy receives a share of the world market which covers its needs up to period $t = \tau-1$. From period $t=\tau$ onward, its demand is rationned at the level of the previous period :

(13) $$M_t = \bar{M} = M_{\tau-1} \text{ for } t > \tau.$$

If M_t as determined by (12) exceeds $\bar{M}$, then some machines must be scrapped.

c) Price

We consider that the economy is too small to influence the price of the resource, p_t. We shall further assume that p_t grows exponentially at the rate $1+\nu$. In other words, the price of the resource remains constant in terms of efficiency units. The monopolist controlling the resource is in a position to capture all the gains derived from growing efficiency in its use. In terms of output prices, there is a continuing deterioration in the terms of trade of our economy.

2.4 Profitability

A necessary condition to maintain in operation at time t a vintage of age $t-\theta$, is that it covers its costs. Thus, for $t-s$, the oldest vintage producing at time t, we have :

(14) $$v = w_t \ell_{t-s} + p_t m_{t-s},$$

or

$$v = w_t \ell_o (1+\mu)^{1-t} + p_t m_o (1+\nu)^{s-t}.$$

However, as we shall see later, in a "socialist system" where the economy is fully controlled, the planner will decide to keep a machine operating as long as its net social marginal utility is non negative.

*
* *

The disequilibrium regimes *a la Malinvaud* arising from the model are analyzed in an other paper[(1)]. In order to avoid the difficulties posed by a three input vintage production structure in an intertemporal maximization framework, we shall confine ourselves to a balanced growth path in the following contexts :

a) no rationing so that full employment prevails ("walrasian golden age") ;

b) resource rationing as defined by (13) under (i) profit maximization ("capitalist system") and (ii) maximization of a social welfare function whose arguments are consumption per capita and the rate of employment ("socialist system").

[(1)] A. Ingham, D. Weiserbs and F. Melese, "Unemployment Equilibria in a Small Resource Importing Economy with a Vintage Production Structure", Working Paper de l'ISE, n° 8106.

§ 4. Golden Age

4.1 As is well known for this kind of model the Walrasian Golden Age is characterized by

a) Supply equals demand on each market (full employment is assumed) :

(15.1) $Q_t = D_t$;

(15.2) $N_t = L_t$;

(15.3) $X_t = p_t M_t$;

b) Investment grows at a constant rate (denoted by ρ), determined by the rate of Harrod neutral technical progress and the rate of growth of the labor force :

(16) $k_t = (1+\rho)k_{t-1} \qquad [=(1+\rho)^t k_o]$,

where

(17) $1+\rho = (1+\mu)(1+\lambda)$;

c) The wage rate grows at the rate of Harrod neutral technical progress :

(18) $w_t = (1+\mu)w_{t-1} \qquad (=(1+\mu)^t w_o)$;

d) The price of the resource grows (decline if ν happens to be negative) at the rate of progress (or inefficiency) in resource use :

(19) $p_t = (1+\nu)p_{t-1} \qquad (= (1+\nu)^t p_o)$;

e) The useful life of equipment is constant and the oldest vintage just covers its costs :

$$v = w_t \ell_{t-s} + p_t m_{t-s} = w_t \ell_o (1+\mu)^{s-t} + p_t m_o (1+\nu)^{s-t}.$$

4.2 A sufficient condition for t-s to be constant is of course (18) and (19). Then it follows that

(20) $v = w_o \ell_o (1+\mu)^s + p_o m_o (1+\nu)^s$.

The total number of machines operating at time t is :

$$(21) \qquad K_t = \sum_{\theta=t-s}^{t-1} k_\theta = (1+\rho)^t \left[1 - (1+\ )^{-s}\right] \frac{k_o}{\rho} \ .$$

Hence supply for the good is defined by

$$(22) \qquad Q_t = (1+\rho)^t \left[1 - (1+\rho)^{-s}\right] \frac{k_o v}{\rho} \ .$$

From (7), (11) and (18), we deduce the evolution of demand for labor and the resource

$$(23) \qquad L_t = \sum_{\theta=t-s}^{t-1} \ell_\theta k_\theta = (1+\rho)^t (1+\mu)^{-t} \left[1 - (\frac{1+\rho}{1+\mu})^{-s}\right] \frac{\rho_o k_o (1+\mu)}{\rho-\mu} \ ,$$

and

$$(24) \qquad M_t = \sum_{\theta=t-s}^{t-1} m_\theta k_\theta = (1+\rho)^t (1+\nu)^{-t} \left[1 - (\frac{1+\rho}{1+\nu})^{-s}\right] \frac{m_o k_o (1+\nu)}{\rho-\nu} .$$

Labour supply is exogeneously determined by (9). Then full employment implies (17) since

$$L_t = \frac{1+}{1+\mu} L_{t-1} \text{ and } N_t = (1+\lambda) N_{t-1} .$$

Since consumption equals $w_t L_t$, by assumption (cfr (5) and (6)) and exports equal $p_t M_t$, total demand on the good market is given by the sum of

$$(25) \qquad C_t = (1+\rho)^t \left[1 - (\frac{1+\rho}{1+\mu})^{-s}\right] w_o \rho_o k_o (\frac{1+\mu}{\rho-\mu}) ;$$

$$(26) \qquad X_t = (1+\rho)^t \left[1 - (\frac{1+\rho}{1+\nu})^{-s}\right] p_o m_o k_o (\frac{1+\nu}{\rho-\nu}) ;$$

and

$$(27) \qquad k_t = (1+\rho)^t k_o .$$

A numerical illustration is presented in Table I. This example has been constructed with parameters values :
$\mu = .05$; $w = .02$; $\lambda = .01$; $v = .7569$; and initial conditions $\tau-1$: $k = 100$; $w = 1$; $p = 1$. As a result equipment is used during 10 periods.

Table I

t	k	C	X	Q=D	$\bar{M}$	w	p	u	s
τ-2	94.295	313.835	115.932	524.062	118.251	.952	.980	0	10.
τ-1	100.000	332.822	122.946	555.768	122.946	1.000	1.000	0	10.
τ	106.050	352.958	130.384	589.392	127.827	1.050	1.020	0	10.
τ+1	112.466	374.312	138.272	625.050	132.903	1.102	1.040	0	10.
τ+2	119.270	396.957	146.638	662.865	138.180	1.158	1.061	0	10.
τ+3	126.486	420.973	155.509	702.969	143.667	1.216	1.082	0	10.
--									
τ+5	142.254	473.452	174.895	790.601	155.302	1.340	1.126	0	10.
--									
τ+8	169.666	564.687	208.598	942.952	174.545	1.551	1.195	0	10.
--									
τ+15	255.959	851.888	314.691	1422.539	229.235	2.183	1.373	0	10.

Along this golden age path, output grows at 6.05 % per period, consumption per capita, c_t ($=w_t$), at 5 % per period while the labor share in value added is .769.

We now turn to the behavior of the economy when rationing is imposed in the use of the resource. With the volume of imported resource constrained to a maximum value $\bar{M} = M_{\tau-1}$, the maximum rate of growth becomes the rate of technical progress in resource use.

§ 4. The capitalist solution

We shall first examine the steady-rate and then briefly discuss the transition period.

4.1 Since no stockpiling is allowed in our economy, profit maximization implies that firms will not produce more than they can sell. Therefore, investment (= profits), denoted by k_t^c, along the capitalist path follows the highest possible rate of growth :

$$(26) \qquad k_t^c = (1+\nu)k_{t-1}^c = (1+\nu)^{t-\tau}k_\tau^c, \qquad t \geqslant \tau.$$

It follows (cfr (3)) that supply on the goodsmarket evolves according to

$$(27) \qquad Q_t = (1+\nu)^{t-\tau}k_\tau^c \frac{\nu}{\rho} \left[1 - (1+\nu)^{-s}\right].$$

As we shall see below, (34), k_τ^c depends on $\bar{M}$ while the useful life of the equipment is simultaneously determined by the level of total demand on the goods market.

4.2 By assumption total demand is defined as

$$(28) \qquad D_t = c_t + k_t^c + X_t = w_tL_t + k_t^c + p_t\bar{M}, \qquad t \geqslant \tau.$$

The wage rate is determined by the profitability condition :

$$(29) \qquad w_t = (1+\mu)^{t-s-\tau} \left[v - p_\tau \; m_\tau \; (1+\nu)^s \right] \frac{1}{\ell_\tau} \, ,$$

and, since labor demand evolves according to

$$(30) \qquad L_t = \left(\frac{1+\nu}{1+\mu}\right)^{t-\tau} \left[1 - \left(\frac{1+\nu}{1+\mu}\right)^{-s} \right] \left(\frac{1+\mu}{1+\nu}\right) \ell_\tau \; k^c_\tau \, ,$$

consumption is given by :

$$(31) \qquad C_t = (1+\nu)^{t-\tau} \; (1+\mu)^{-s} \left[\nu - p_\tau \; m_\tau \; (1+\nu)^s \right] \left[1 - \left(\frac{1+\nu}{1+\mu}\right)^{-s} \right] \left(\frac{1+\mu}{\mu-\nu}\right) k^c_\tau \, .$$

Since $M_t = \bar{M}$ $(t \geq \tau)$, exports continue to grow at the same rate as p, or

$$(32) \qquad X_t = p_t \; \bar{M} = (1+\nu)^{t-\tau} \; p_\tau \; \bar{M} \, .$$

However, demand for the resource is

$$(33) \qquad M_t = \sum_{t-s}^{t-1} m_\theta \; k^c_\theta = s \; m_\tau k^c_\tau \, ,$$

and therefore

$$(34) \qquad k^c_\tau = \frac{\bar{M}}{s m_\tau} = \frac{X_\tau}{s p_\tau m_\tau} \, .$$

Substituting (31) and (34) in (28), yields total demand on the goods market :

$$(35) \qquad D_t = (1+\nu)^{t-\tau} \; k^c_\tau \left[\left(\frac{1+\mu}{\mu-\ell}\right) (1+\mu)^{-s} \left[v - p_\tau m_\tau (1+\nu)^s \right] \left[1 - \left(\frac{1+\nu}{1+\mu}\right)^{-s} \right] + 1 + s p_\tau m_\tau \right] .$$

Then, the optimal value for s is given by the equilibrium condition (34) = (27). In our numerical simulation, we find s = 9.2869.

4.3 It is worth noticing that if the system was somehow forced to be on this new balanced growth path right from period τ, (i) investment would drop by 12.5 % with respect to its τ-1 level (instead of increasing by 6 % along the golden age path) ; (ii) the wage rate would increase by 9 % (instead of 5 %) because the oldest vintage is τ - 9.2869 (instead of τ-10) ; (iii) the unemployment rate grows by approximately 4 % per period (output grows at a 2 % rate, while the labour force grows by 1 % and labour productivity by 5 %). Also notice that the labor share in value added is now .798 (instead of .769). This results from a shortening of the useful life of equipment.

4.4 This steady state programme could be initiated at period τ only if some of our initial assumptions were relaxed, to allow firms to accumulate cash balances arising out of an export surplus. Without such an export surplus, insufficient demand along the new golden rule path (during the transition period) would make the appropriate investment decisions incompatible with profit maximisation.

Under the hypothesis of instantaneous profit maximization, as illustrated in table II, the system oscillates around the optimal path and couverges only for $t \to \infty$.

Table II

t	k	C	X	Q=D	$\bar{M}$	w	p	u	s
τ-2	94.2951	313.8349	115.9319	524.0619	118.2505	.9524	.9804	0	10.000
τ-1	100	332.8219	122.9458	555.7677	122.9458	1.0000	1.0000	0	10.000
τ	97.4209	346.1394	125.4047	568.9650	122.9458	1.0768	1.0200	.0438	9.5421
τ+1	95.3256	358.2476	127.9128	581.4860	122.9458	1.1511	1.0404	.0833	9.2172
τ+2	93.7540	369.2450	130.4710	593.4700	122.9458	1.2228	1.0612	.1194	9.0056
τ+3	92.5907	379.2711	133.0804	604.9422	122.9458	1.2919	1.0824	.1523	8.8937
--									
τ+5	92.5430	396.4674	138.4568	627.4671	122.9458	1.4247	1.1262	.2123	8.8890
--									
τ+8	99.1442	416.3592	146.9315	662.4348	122.9458	1.6188	1.1951	.2934	9.2280
--									
τ+15	124.1622	471.1791	168.7781	764.1195	122.9458	2.2575	1.3728	.4652	9.3902

§ 5. The Socialist Solution

5.1 In a socialist system, the "capitalist" constraint that no equipment will be operated at a loss, is no longer binding. Provided that they are socially desirable, negative rents are acceptable as long as macroeconomic balances are respected. In other words, the wage rate is no longer constrained by the profitability conditions. The production constraint originated by the limited volume of resource available links the investment and scrapping decisions which in turn determine the level of capacity. The wage rate is chosen such that it guarantees equality between demand and supply on the goods market.

The standard social objective is to maximize consumption per capita. However, the planner may also take into consideration the rate of unemployment. Thus the social welfare function can be written :

$$J_t = j\left[J_1\ (c_t)\ ,\ J_2(-u_t)\right]. \tag{36}$$

First, we consider the case where $J_2 = 0$ i.e. the maximization of consumption per capita with no regard to employment.

5.2 The natural growth rate is the rate of productivity increase in terms of resource use. Denoting by k_t^s investment along the "socialist balanced growth path", we have

$$k_t^s = (1+\nu)^{t-\tau}\ \frac{\bar{M}}{sm_\tau}\quad (t \geq \tau). \tag{37}$$

Since along this path, demand for the resource is

$$M_t = \sum_{t-s}^{t-1} m_\theta\ k_\theta^s = s\ m_\tau\ k_\tau^s = \bar{M}\ , \tag{38}$$

it follows that output evolves according to

$$Q_t = vK_t = \frac{v}{\nu}\left[1 - (1-\nu)^{-s}\right]k_t^s\ , \tag{39}$$

while exports grow according to (31).

Now total consumption is defined by :

$$(40) \qquad C_t = q_t - k_t - X_t = (1+\nu)^{t-\tau} \frac{\bar{M}}{sm_\tau} \left[\frac{v}{\nu}[(1-(1+\nu)^{-s}]-1 - s\ p_\tau\ M_\tau \right]$$

yielding consumption per capita of :

$$(41) \qquad c_t = (\frac{1+\nu}{1+\lambda})^{t-\tau} \frac{\bar{M}}{sm_\tau \ell_\tau} \frac{1}{s} \left[\frac{v}{\nu} [1-(1+\nu)^{-s}]-1 \right] - (\frac{1+\nu}{1+\lambda})^{t-\tau} \bar{M} \frac{p_\tau}{\ell_\tau} ,$$

since $c_t = C_t/N_t$.

Differentiating (4) with respect to s gives :

$$\frac{\partial c_t}{\partial s} = 0 = \frac{v}{\nu} (1+\nu)^{-s} \ln (1+\nu) - \frac{1}{s} \left[\frac{v}{\nu} [1 - (1+\nu)^{-s}] - 1 \right] \text{ ; and}$$

$$(42) \qquad (1+\nu)^s (\frac{\nu}{v} - 1) + s \ln (1+\ell) + 1 = 0 ,$$

which yields s = 12.605005 in our simulation exercice.

This implies that the transition period is in effect from τ to $\tau + 12$.

At period τ, investment drops drastically (by 34 %) making room for an immediate wage increase (of almost 18 %). Along the balanced growth path, investment (as well as Q, C, X) grows by 2 % (=ν), wages by 5 % and consumption per capita by 1 % [2 % (c) - 1 % (N)]. Employment declines by almost 3 %. However the labor share in value added becomes .85.

This solution is superior to the capitalist one both in terms of employment and, of course consumption per capita.

5.3 Let us now consider the case where the planner is primarily concerned with the level of employment ($J_1 = 0$, $J_2 > 0$). The older rather than newer technologies appear preferable. In terms of employment a single machine of vintage t-1 provides $1+\mu$ the number of jobs supplied by a machine of vintage t. In terms of resource use the trade-off is one machine of vintage t-1 against $1+\nu$ machines of vintage t.

Table III

t	k	C	X	O=D	$\bar{M}$	w	p	u	s
$\tau-2$	94.2951	313.8349	115.9319	524.0619	118.2505	.9524	.9804	0	10.0000
$\tau-1$	100.000	332.8219	122.9458	555.7677	122.9458	1.0000	1.0000	0	10.0000
τ	65.7298	377.8304	125.4046	568.9648	122.9458	1.1754	1.0200	.0438	9.5421
$\tau+1$	67.0444	382.6131	127.9128	577.5703	122.9458	1.2170	1.0404	.0740	9.6415
$\tau+2$	68.3852	387.6047	130.4709	586.4608	122.9458	1.2608	1.0612	.1035	9.7707
$\tau+3$	69.7530	392.8503	133.0803	595.6835	122.9458	1.3073	1.0824	.1323	9.9272
--									
$\tau+5$	72.5710	403.9364	138.4569	614.9642	122.9458	1.4073	1.1262	.1876	10.3260
--									
$\tau+8$	77.0129	423.1780	146.9315	647.1225	122.9458	1.5860	1.1951	.2670	11.1112
--									
$\tau+15$	88.4636	482.1786	168.7782	739.4204	122.9458	2.1925	1.3728	.4365	12.6050

This situation defines an appropriate technology where full employment can be maintained by replacing existing machines by older vintages.

Among all possible solutions of this type insuring full employment, we suppose that the planner chooses the one which minimizes consumption losses, i.e. minimizes investment. The optimal solution could then be determined as follows

(i) Since some investment is necessary to provide jobs for the increase in the labor force, one machine of vintage t-n is built at any period t.

(ii) Simultaneously machines of the oldest vintage are scrapped in order to meet the resource constraint (this seem more realistic than scrapping the most recent vintages).

(iii) n is chosen to maintain full employment.

In our numerical simulation, the planner's decision at period τ in this context is to build one machine of vintage τ-58. While a period τ technology will still be operating at τ+200.

This, of course, does not sound very reasonable and additional constraints ought to be imposed. For instance, one might specify :

- the maximum life of a machine of vintage t ;
- the reverse technology frontier (what is the oldest vintage that can be built at time t ?).

The quasi-stoppage of investment permits a large increase in consumption at period τ : the wage rate rises at once by almost 30 %. However, at period τ+1 it is reduced by approximately 2 % (a negative rate of growth of the economy) and by a slightly growing fraction in each subsequent period.

5.4 The question becomes : "Is it possible for the planner to do better in terms of consumption per capita, or (with respect to the solution where c_t is maximized) in terms of employment ?". For the latter case the answer is yes and simple on paper.

Consider the case where the planner's objective was to maximize consumption per capita (§ 5.2). In such a system the wage rate no longer depends on labor productivity. Indeed, wages are growing at the same rate as C/N (1 % per period) while labor productivity is rising by μ (5 %). In terms of social policy, we could go one step further and distinguish productive from unproductive (services) employment,

Ignoring the latter, full employment can still be achieved by distributing labor demand between the total labor force, for instance by continuously reducing working hours - (work sharing) or by continuously augmenting the number of workers per machine.

Alternatively it is possible to provide "unproductive" employment for excess labor (i.e, caring for the sick and the elderly, educating the young, revitalizing cities or improving their cultural and artistic level, doing research and so on).

Such an altruistic combination would provide an agreable solution far better than technological regression with full employment, or to the capitalist solution with the wage rate equal to marginal labour productivity.

Of course such an utopian scheme is only possible within the limited framework of our model. In the real world, do we imagine government levying taxes on firms and workers in order to redistribute these revenues respectively (i) in the form of subsidies to those plants which fail to cover their production costs as long as their "social marginal utility" is non negative ; and (ii) to provide jobs for and pay wages to labor which would otherwise be unemployed ? While this solution satisfies the requirements of both internal and external balances, it raises problems of social concensus and incentives : labour would have to accept real wages growing 1 % per period, while its productivity (the output of goods) rises by 5 % and profits by 2 % ; and firms would have to maintain steady state investment while the government confiscates most of the quasi-rent on new machines.