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Two Papers on Supply-Side Employment Policies

by

Frank G. Barry

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Abstract

In the first of these papers, Taxation and the Choice of Employment Policy, the taxation required to finance a programme of labour-subsidisation is shown to be less than that associated with investment subsidies when unemployment is of the classical variety. In the second paper, A Note on the Employment Effects of Investment Subsidies, the onset of a Keynesian recession is shown to reverse whatever positive employment effects are possible when capital is subsidised under classical unemployment.

I. INTRODUCTION

The cost-effectiveness of the IDA investment-subsidy programme has become the subject of widespread public comment in recent times, primarily as a result of the crisis in the public finances; explorations of the issue have inevitably tended under present circumstances to focus on comparisons with alternative policies also deemed capable of stimulating employment.

One such analysis, due to Hughes (1985, chapter 2), concludes that a reduction in the employer PRSI contribution would in fact be a far more costly means of raising the demand for labour. A response by Fagan and Murphy (1986), however, noted amongst other things the difficulties inherent in carrying out a rigorous empirical comparison of these job-creation costs. A full treatment of the issue, they suggest, would require a model in which output, employment and the capital stock were jointly determined, a conclusion with which Hughes (1986) himself concurs.

The present paper constructs a simplified two-period model of this type in order to bring forth several relevant theoretical insights into the choice of policy targets and the relative costs associated with the use of various instruments. At this level of abstraction a comparison of the tax costs of employment creation through investment grants and payroll-tax reductions yields ambiguous results; the paper instead deals with a marginal employment subsidy, which is equivalent to a payroll-tax reduction for new jobs, as advocated by Layard and Nickell (1980) and Chiarella and Steinherr (1982). This policy would appear to be the more appropriate one to compare with investment grants, which function as marginal capital subsidies.

The type of unemployment considered here is of the classical variety - i.e. due to excessive labour costs (relative to productivity) rather than to aggregate demand deficiency. Keynesian policies would be appropriate only under the latter circumstances. [Cf. Barry (1986)].

The paper is organised as follows : the impact of the subsidy policies on a competitive firm's employment and investment decisions is analysed in the next section, and these results are then used to determine the optimal size of each subsidy from the standpoint of social efficiency. Section IV demonstrates the relative superiority of the marginal employment subsidy in terms both of the associated financing requirement and of the aggregate consumption stream available to the economy. The major points of the paper are summarised in the concluding section.

II. BEHAVIOUR OF THE FIRM

It is necessary firstly to establish how the subsidies under consideration affect employment and investment decisions. Consider the two-period decision problem of a firm that produces and sells an internationally-traded good (which may also be used for investment purposes) at an internationally-determined price that, since it remains fixed throughout the analysis, may be normalised at a value of unity. As the paper is not concerned with Keynesian phenomena it is assumed that the firm can sell all it desires at this going price on world markets.

The firm chooses levels of employment in each period, L^t and L^{t+1}, and a second-period capital stock K^{t+1} (where investment $I = K^{t+1} - K^t$) in order to maximise P, the discounted stream of its profits:

$$(1) \quad P = F(K^t, L^t) - I - \frac{bI^2}{K^t} - w^t L^t + r\left[F(K^{t+1}, L^{t+1}) - w^{t+1}L^{t+1}\right] + rm\left[L^{t+1} - L_o^{t+1}\right] + g\left[I - I_o\right]$$

The firm's production function F(K,L) exhibits constant-returns-to-scale technology; r is the world interest rate which is employed as the discount factor because of international financial capital mobility, and the bI^2/K^t term represents a rising marginal cost of adjusting the capital stock, as in Lucas (1967); this serves to make the level of the capital stock determinate.

As is usually the case, labour is treated as an instantaneously variable factor while the capital stock may be changed only over time, through investment. In order to be able to rigorously compare the two policies therefore, first-period investment grants which affect the capital stock and the level of employment only in the second period will be compared with second-period employment subsidies. Accordingly, the current wage w^t is assumed to be set at its full-employment level while a wage contract sets future wages w^{t+1} at a level which in the absence of government intervention would generate unemployment in that period.

The policies to be considered are a capital grant g per unit of investment above a benchmark level I_o, this level being the amount of investment that would have occurred in the non-intervention case; and a grant m per worker employed in the second period above the non-intervention benchmark level L_o^{t+1}. (Perfect foresight over these non-intervention levels is of course assumed.) The final two terms in (1) therefore represent the discounted value to the firm of the government subsidies.

The first-order conditions resulting from this maximisation problem are:

(2) $F_L^t = w^t$

(3) $F_L^{t+1} = w^{t+1} - m$

and (4) $r F_K^{t+1} = 1 + \frac{2b I}{K^t} - g$

Equations (2) and (3) are the familiar equalities between the value of the marginal product of labour and the cost of labour in each period; the marginal employment subsidy, by reducing the cost of labour in the second period, raises the labour-intensity of production. Equation (4) represents the condition of equality between the marginal benefit and the marginal cost of investment, the latter of course being reduced by the investment grant. From this equation is derived the investment function :

$$I = \frac{1}{2b}\left[r F_K^{t+1} + g - 1\right] K^t$$

The following effects of the subsidies may be found from equations (2) - (4) by taking into account the fact that under constant returns to scale the marginal products of labour and of capital, F_L and F_K, are functions only of the capital-labour ratio:

(5) $\frac{\delta K^{t+1}}{\delta m} = \frac{1}{2b} r L^t$

(6) $\frac{\delta L^{t+1}}{\delta m} = \frac{\delta K^{t+1}}{\delta m}\frac{L^t}{K^t} + \frac{e}{k w^t} L^t$

(7) $\frac{\delta K^{t+1}}{\delta g} = \frac{1}{2b} K^t$

(8) $\frac{\delta L^{t+1}}{\delta g} = \frac{\delta K^{t+1}}{\delta g}\frac{L^t}{K^t}$

where these partial derivatives express the changes between t and t+1 that are attributable solely to policy; k is capital's share in output, and e is the elasticity of substitution in production.

The investment grant, it may be noted, does not affect the firm's capital-labour ratio; by raising investment it raises second-period employment. The wage subsidy lowers the capital-labour ratio, and by raising the marginal product of capital also stimulates investment.

Several points emerge from equation (12): full employment is an appropriate target only when non-distortionary taxation is available, since in this case the loss function term, a, is zero and the optimal subsidy completely bridges the gap between the excessive wage agreement w^{t+1} and the full employment wage w^t. The greater the distortionary effects of taxation, the lower the level of employment that the government should attempt to create. In the extreme case, for very large values of a, intervention of this type is undesirable.

If investment rather than employment is subsidised, social welfare must be maximised with respect to g, subject to equations (2)-(4) and (11), which reveals that the optimal investment subsidy is:

$$(13) \quad g^* = \frac{1}{1+2a} r \frac{L^t}{K^t} \left[w^{t+1} - w^t \right]$$

The same level of investment is generated under this policy as under the optimal employment subsidy, as may be seen by combining equations (5) and (7) with (12) and (13) respectively.

IV. COMPARISON OF POLICIES

The welfare effects of the two policies can now be compared. The increase in social welfare resulting from the introduction of a marginal employment subsidy of size m^* may be measured by the difference between the resulting welfare level $U(m^*)$ and the welfare level that would prevail in the absence of policy intervention, U_o. Taking a Maclaurin series expansion and linearising, difference is approximated by $m^* \frac{dU}{dm}$ where the derivative is measured at the initial point m=g=o.

Employing equations (2) - (6), (9), (10) and (12) we find

$$(14) \quad U(m^*) - U_o = m^* \frac{dL^{t+1}}{dm} r \left[w^{t+1} - w^t \right] \frac{1+a}{1+2a}$$

while the welfare effects of investment subsidies are found in an equivalent manner as

$$(15) \quad U(g^*) - U_o = g^* \frac{dL^{t+1}}{dg} r \left[w^{t+1} - w^t \right] \frac{1+a}{1+2a}$$

These equations reveal that the relative welfare effects of the two policy instruments depend only on the differential levels of employment generated when each subsidy is set at its optimal level. As it has already been seen that the same level of investment is generated under these circumstances, while the employment subsidy raises the labour-capital ratio, it is clear that $L(m^*)$ is greater than $L(g^*)$ and the employment subsidy is therefore the more socially efficient of the two policies.

Furthermore, since there is a welfare trade-off between consumption and taxation, a greater level of taxation is acceptable when the more efficient policy instrument is used. This may be verified by employing equations (10) - (13) to find:

(16) $T(m^*) = m^* \frac{dL^{t+1}}{dm} r \frac{1}{1+2a} [w^{t+1} - w^t]$

and (17) $T(g^*) = g^* \frac{dL^{t+1}}{dg} r \frac{1}{1+2a} [w^{t+1} - w^t]$

which reveal that the optimal tax burden is a function of the employment generated when an instrument is set at its optimal level. The linear relationship between optimal employment and taxation levels that emerges from equations (16) and (17) is graphed as the AA locus in Figure 1. It traces the points of tangency between a set of indifference curves (IC_1 and IC_2) and a set of feasibility constraints which depict the association between any level of employment and the taxation required to generate it using a particular policy instrument. The above results imply that the slope of the feasibility constraint increases as one moves down the policy hierarchy. The curves gg and mm represent this constraint for investment and employment subsidies respectively.

It is apparent from the diagram that the investment subsidy generates less employment for any given level of tax intake, and the employment subsidy also dominates in terms of the financing requirement if full employment is alternatively adopted as the (non-economic) policy target.[1]

V. CONCLUSIONS

In comparing the use of investment grants and marginal employment subsidies (MES) the following points have been made:

i) The level of employment which it is optimal to generate depends on the policy instrument adopted.

ii) The optimal target level of employment is reduced when account is taken of the burden associated with financing the subsidy programmes.

iii) For classical unemployment, which is the type usually assumed in public discussion in Ireland of the relative merits of these aggregate supply-management policies, the marginal employment subsidisation policy dominates the investment-grant programme in the following ways:

a) The increase in social welfare attainable with MES is greater than that associated with the alternative policy.

b) For any given level of tax revenue the MES is capable of generating a higher level of employment.

c) For any target level of employment-creation the MES is less costly in terms both of the financing requirement and of aggregate consumption foregone.

Essentially what has been shown is that the implication of the standard theory of optimal intervention, i.e. that the optimal subsidy policy is that which treats the distortion at source [Cf. Corden (1974)], remains valid when financing requirements are taken into account.

1. These propositions are demonstrated mathematically in the larger work, Barry(1984), from which this paper is an excerpt.

Two points on distributional effects should however be noted. Firstly such effects have not appeared in the social welfare function: their inclusion would presumably affect the optimal level of employment. Secondly, the possibility of subsidy - and tax-shifting between employers and employees has been precluded by the type of wage rigidity adopted here. If workers were, for example, able to reap some of the benefits of the introduction of subsidies in the form of wage increases the employment effect would be diminished thereby. However, if the employment effects identified in the present paper may be taken as a crude measure of employee's ability to garner wage increases in a fuller model with a more complex specification of wage stickiness then the effects quantified here would simply be replaced by lesser employment effects occurring alongside wage increases, and the policy hierarchy would remain unchanged.

Finally, it is important to note the serious lacuna which separates macroeconomists, who tend to locate the causes of labour-market disequilibrium in the prevailing vector of labour-market prices [Cf. Walsh (1978)], from those who, influenced by the perspective of industrial organisation theory, view unemployment as the product of a weak industrial structure whose adjustment to external shocks is severely constrained by the existence of barriers to entry [Cf. NESC (1981, 1982)]. The latter view implies that these are the major distortions to be tackled; investment grants are sub-optimal in this case also.

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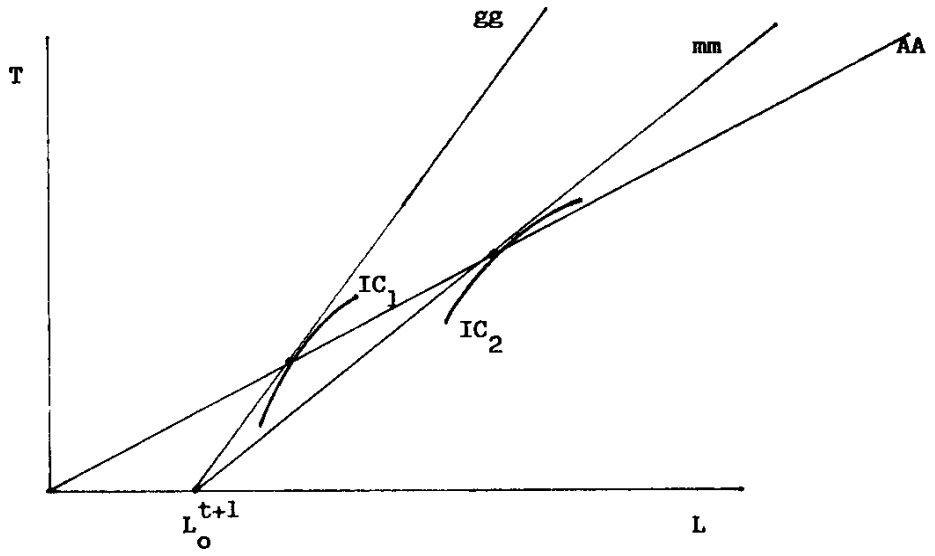

Figure 1: The tax cost of employment creation under alternative policy instruments.

A Note on the Employment Effects of Investment Subsidies*

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Abstract

Investment subsidies are frequently used to stimulate employment in economies in which real wages are sticky. While this policy operates as expected when the economy is cost-constrained, it is shown here that employment losses result from its implementation in a situation where the economy is experiencing a prolonged Keynesian recession.

* An earlier version of this paper was written while the author was a graduate student at Queen's University, Ontario. Helpful comments from Dick Lipsey, Doug Purvis and an anonymous referee are gratefully acknowledged.

1 Introduction

It is well known that the conventional employment effects of fiscal, monetary and exchange-rate policies are considerably weakened and may even be reversed when production is cost-constrained by rigidities in the levels of real, as opposed to nominal, wages.

[See e.g. HELPMAN (1977), RODSETH (1979).]

Under these circumstances policy-makers frequently resort to the subsidization of factors of production in order to stimulate employment and growth. Whilst economic theory implies that labour subsidization is optimal in this situation, investment subsidies are nevertheless widely used. Various aspects of the consequences of this policy have been analyzed by AHLUWALIA (1973), NEARY (1978) and BARRY (1984).

The purpose of the present paper is to demonstrate that the direction of the employment effects of investment subsidies depends crucially on economic conditions prevailing in the domestic economy's trading partners.

As Malinvaud (1977) has argued, world recessions may be of the classical type, with production and employment constrained by excessive costs, or of the Keynesian type, characterized by generalized demand-deficiency. These features of the world economic climate tend to impose themselves upon a small open economy (SOE) since SOE-exporters may be cost-constrained but are unlikely to be demand-constrained although the non-tradable sector may be, as in NEARY (1980), if foreign producers are suffering from high internal costs, while demand-deficiency abroad may prevent SOE-exporters

from selling all they desire at existing world prices.

This paper shows that the subsidisation of SOE-investment improves employment prospects when unemployment is of the classical variety, but that it magnifies the reduction in SOE-employment if the world economy moves into Keynesian recession.

2 The Model

The domestic economy is assumed to produce a composite commodity which is traded internationally at a fixed foreign price which remains constant throughout the analysis. The real wage, ω, is also rigid and is set at such a level as to yield involuntary unemployment.

Assuming point expectations to be held with perfect certainty, and suppressing the expectations operator for notational convenience, the optimization problem of the unconstrained firm is to maximize the following present discounted value of its expected cash flow, specified here in real terms:

(1)

$$V = \int_t^{\infty} \left\{ F[K(\tau), L(\tau)] - I(\tau) + g.[I(\tau) - \delta K(\tau)] - bI^2(\tau) - \bar{\omega} L(\tau) \right\} \alpha(\tau) d\tau$$

subject to $\dot{K}(\tau) = I(\tau) - \delta K(\tau)$ and $K(t) = \bar{K}$, where $Y = F(K, L)$ is a constant-returns-to-scale production function in capital and labour, I is gross investment, δ is the rate of depreciation of capital, g is a net-investment subsidy [1] and $\dot{K}$ is the time rate of change of the capital stock. The bI^2 term represents the cost of adjusting the capital stock, indicating, as will be seen later, that gradual adjustment is optimal [2]. $\alpha(\tau)$ is the discount factor

(with $\alpha(t) = 1$).

The solution to this problem is generated by considering the current-value Hamiltonian:[3].

(2)

$$J = F(K, L) - I + g(I - \delta K) - bI^2 - \bar{\omega}L + q(I - \delta K)$$

where q is the shadow value of an increment to the capital stock.

Maximization of (2) with respect to L and I yields:

(3)

$$F_L(\frac{K}{L}) = \bar{\omega}$$

and

(4)

$$I = \frac{1}{2b}(q + g - 1)$$

The evolution of q satisfies:

(5)

$$r = \frac{F_K(\frac{K}{L}) - g\delta}{q} - \delta + \frac{\dot{q}}{q}$$

where $r(\tau) = \frac{\dot{\alpha}(\tau)}{\alpha(\tau)}$, which is the real rate of interest at time τ. This is seen to equal the value of output resulting from an increment to the capital stock relative to the shadow value of that investment, adjusted for capital depreciation and capital gains.

Under the assumption of perfect international capital mobility the interest rate expected to prevail may be regarded as being determined abroad and is henceforth held constant.

Furthermore, since the means by which expectations are generated has no effect on the main results of this paper, the analysis can be considerably simplified by assuming static expectations on q, so that the expected capital gains term $\dot{q}/q$ in equation (5) vanishes.

The current value of q, given equation (3), can therefore be found from equation (5′), in which $\bar{r}$ is the fixed foreign interest rate:

(5′)

$$\bar{r} = \frac{F_K\left(\frac{K}{L}\right) - g\delta}{q} - \delta$$

From equations (3) - (5′)a net-investment subsidy is seen to reduce the value of a unit of installed capital, $\frac{dq}{dg} = \frac{-\delta}{\bar{r}+\delta}$, while nevertheless stimulating investment. The first effect occurs because unsubsidised replacement investment is required to maintain the capital stock at its new higher long run level. Employment expands alongside investment since, as may be seen from equation (3), the capital-labour ratio remains constant[4].

This outcome is illustrated in Figure A. In the upper panel is graphed the positive relationship between the investment subsidy and the stationary state capital stock, K^*, found by setting $\dot{K} = 0$ in equation (4). The straight line CC in the lower panel graphs the positive relationship between employment and the capital stock resulting from a constant capital-labour ratio. The introduction of an investment subsidy g_1 under the circumstances discussed above raises the stationary-state capital stock and level of employment to K_1 and L_1 respectively.[5]

These results are conditional on the assumption that the domestic economy faces an infinitely elastic demand curve for its products. A Keynesian

recession abroad can, however, impose a sales constraint, $\bar{X}$, on SOE

exports[6]. As Barro and Grossman [1971] have shown, the imposition of a sales constraint breaks the one-to-one correspondence between the real wage and the capital-labour ratio as firms move off their notional labour-demand functions. An investment-subsidy policy operated under these circumstances will have quite different effects from those emerging in the classical case. Adopting a simple Keynesian consumption function and ignoring direct government expenditures, the export constraint, which states that the SOE's exports cannot exceed the fixed level $\bar{X}$, is:

(6)

$$\bar{X} \geq F(K, L) - I - bI^2 - C(Y)$$

The Hamiltonian is now:

(7)

$$J \quad J + \lambda\{\bar{X} - F(K, L) + I + bI^2 + C(Y)\}$$

and the first-order conditions are

(8)

$$F_L(\frac{K}{L}) = \omega / \left[1 - \lambda(1 - C') \right]$$

(9)

$$I = \frac{1}{2b}[\frac{q + g}{(1 - \lambda)} - 1]$$

(10)

$$\bar{r} = \frac{F_K[1 - \lambda(1 - C')] - g\delta}{q} - \delta$$

where C' is the marginal propensity to consume.

With the constraint assumed to be binding the Lagrange multiplier λ is positive and the capital-labour ratio is greater than in the unconstrained

equilibrium, implying that the imposition of the constraint immediately reduces employment. A change in g in this case induces changes in q, λ and K/L. Investment is stimulated and the demand-expansion allows employment to increase initially but this effect is reversed over time as the new capital comes on line, raising aggregate supply and requiring the shedding of labour in order for production to remain within the sales constraint.

The long-run effects can be found from equality (6) and the long-run equilibrium version of (9):

(9′)

$$K = \frac{1}{2b\delta}\left[\frac{(q+g)}{(1-\lambda)} - 1\right]$$

These multipliers are:

$$\frac{dK}{dg} = \Delta^{-1} \quad \frac{1}{2b\delta}\frac{(1-C)'}{(1-\lambda)}F_L\frac{\bar{r}}{(\bar{r}+\delta)}$$

and

$$\frac{dL}{dg} \quad \Delta^{-1} \quad \frac{1}{2b\delta}\frac{1}{(1-\lambda)}\{F_K(1-C') - \delta - 2b\delta^2 K\}\frac{\bar{r}}{(\bar{r}+\delta)}$$

where

$$\Delta = F_L(1-C')$$

$$+ \quad \frac{\{\frac{Y}{L}(1-C') \quad \frac{K}{L}(\delta+2b\delta^2K)\}\frac{1}{2b\delta}\frac{F'L}{L}\frac{1}{F_L^2}\frac{\omega}{(r+\delta)}\frac{\omega L - C'Y}{K} - g\bar{r}}{(1-C')(1-\lambda)^2}$$

The signs of these multipliers are $\frac{dK}{dg} > 0$ and $\frac{dL}{dg} < 0$ under the following set of sufficient conditions [7] :

(a) Stability of the dynamic system, which ensures $\Delta > 0$

(b) $F_K > C' F_K + \delta + 2b\delta^2 K$

This is the standard condition that an increase in the capital stock, ceteris paribus, should generate excess supply of commodities.

Given these conditions a policy of investment subsidization leads to a long-run reduction in employment when the economy faces an export constraint. Diagrammatically the constraint means that there is no demand for output beyond the level represented by the isoquant YY in the lower panel of Figure A. An investment subsidy which raises the capital stock to K_1 therefore causes employment to fall to L_1' in the long run.

3 Concluding Comments

Private decision makers choose the level of investment that equates the (expected) marginal costs and benefits of capital accumulation. An investment subsidy, by reducing marginal costs, causes the capital stock to be higher in the long run than it would otherwise be.

When the economy is cost-constrained, a greater capital stock is associated, through its effect on labour productivity, with higher employment. In a Keynesian recession, however, the level of output is constrained by an aggregate demand deficiency so that a policy which encourages the use of one factor of production, without operating to relieve the constraint, thereby discourages the use of other factors. The substitution effect on employment is seen to manifest itself in the Keynesian case while the output effect dominates under classical conditions.

A *labour subsidy* would, of course, raise employment in the long run under Keynesian or classical conditions, while aggregate demand policies, by relaxing the sales constraint, would encourage both employment and investment in the Keynesian case.

One further point deserves to be mentioned. The initial effect of an increase in the investment subsidy under Keynesian conditions is to raise aggregate demand and hence employment. These short-run gains are outweighed by the long-run losses when the new capital comes on line. However, if the policy change is introduced towards the end of a Keynesian recession then both short- run and longer-run employment prospects are improved.

FOOTNOTES

1. Accelerated depreciation allowances and the capital grants scheme in effect in Ireland conform roughly to net-investment subsidies. The qualitative results of the paper apply equally well when gross investment is subsidised.

2. The issue of how these costs arise is discussed in SÖDERSTROM (1976).

3. See BAILEY AND SCARTH (1980) for a more detailed discussion of this optimization problem.

4. Another common formulation of the adjustment cost function, bI^2/K, would imply that each industry expands at a constant capital-labour ratio, with the overall capital-labour ratio in the economy shifting towards that of the industries with the highest capital stocks. This would not, however, affect the employment result.

5. The subsidy is assumed to be financed by non-distortionary taxation. A referee points out that employment could possibly fall if the subsidy were instead financed by increased taxation of labour income, with wages rigid in after-tax terms, since a substitution effect would then raise the capital-labour ratio.

6. Surveying the empirical evidence on the determination of Irish export

prices and quantities, HONOHAN (1982) concludes that "so far as exports are concerned... a textbook Keynesian model - fixed prices, sales dependent on demand - seems appropriate". Other export- constrained fix-price models include CUDDINGTON (1980) and STEIGUM (1980).

7. From (9′) it can be seen that λ must be less than unity for K^* to be positive and finite.

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