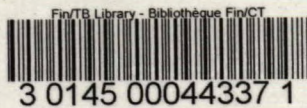


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Inflation tax-indexation corporate investment
and equity values in Canada : a closed
economy analysis by Ignatius Peprah

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INFLATION TAX-INDEXATION CORPORATE INVESTMENT
AND EQUITY VALUES IN CANADA: A CLOSED ECONOMY ANALYSIS

by

Ignatius Peprah

Consultant

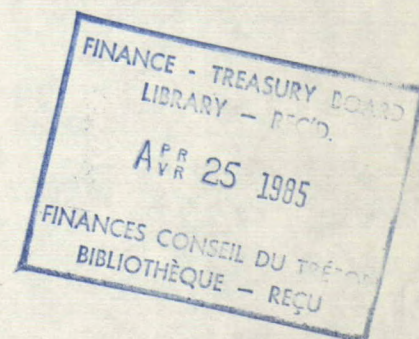
Tax Policy and Legislation Branch

Department of Finance

Government of Canada

Ottawa

February 1983



INFLATION TAX-INDEXATION CORPORATE INVESTMENT
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by Ignatius Peprah*

ABSTRACT

The paper is a theoretical investigation of the impact of tax indexation on corporate investment and equity values in Canada assuming a closed economy. The model used was originally developed by Summers who also based it on an earlier work of Hayashi. The tax indexation instruments investigated include:

- i) the use of replacement cost rather than historic cost as a basis for computing capital cost allowance,
- ii) the deduction of only real interest payments in computing corporate taxable income rather than the present deduction of all nominal interest payments,
- iii) the taxation of only real capital gains rather than the present taxation of nominal capital gains, and
- iv) taxation of only real interest receipts rather than the present taxation of all nominal interest receipts.

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The results show that some tax indexation elements would favorably affect investment while others would discourage investment. The tax indexation elements that would favor investment include the use of replacement cost depreciation, taxation of only real capital gains and taxation of only real interest receipts. The deduction of only real interest payments in computing corporate taxes, on the other hand, would tend to reduce investment, but as firms shift out of debt as a result of the high cost of debt, this would tend to reduce the negative impact on investment and may even reverse it. The tax benefit from the use of replacement cost as a basis for computing capital cost allowance does not continue to increase with inflation at high levels of inflation. Rather, it tends towards a limit. This is because there is a limit to the gain a firm gets by using replacement cost depreciation. This limit is set by the amount of depreciable assets.

All the tax indexation instruments, except the taxation of only real interest receipts at final equilibrium would lower equity values. In the process of reaching this final equilibrium, however, the equity values may go up. For example, for the use of replacement cost depreciation and taxation of only capital gains, the equity values are likely to go up at first before settling down at a steady state value lower than their original values. For the deduction of only real interest payment in computing corporate tax, equity values are likely to go down to a much lower level before rising back to a level still below the

original value. That is they would 'overshoot' their final value. Taxation of only real interest receipts, on the other hand, would leave equity values intact.

The model presented in this paper can be simulated.

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INFLATION TAX-INDEXATION CORPORATE INVESTMENT AND
EQUITY VALUES IN CANADA: A CLOSED ECONOMY ANALYSIS

by Ignatius Peprah^{*}

A. Introduction

In this paper, we study how tax indexation to insulate Canada from inflation would affect corporate investment, and savings in the country. The point of view is that of a closed economy. In general, an increase in the rate of inflation in our economy will change the capital intensities, the yields on assets and capital durabilities.¹ Tax indexation policies thus would have investment and savings incentives (or disincentives). Both would both work towards greater (or less) capital formation.

*

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I would like to thank Glenn Jenkins and Nick LePan for helpful comments on an earlier version.

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Although the effects of inflation on capital durability is important, its introduction would complicate the analysis and obfuscate the issues we want to discuss. Essentially, inflation in its interaction with historic cost depreciation for instance would make investors shift to shorter lived capital goods and tax indexation would at least partially undo this.

The approach is to use Tobin's 'q' as a basis for estimating the impact of tax policies on investment. This approach has several advantages over more conventional theories of investment. Perhaps, the most important for our purpose is that compared to conventional investment theories it is easier to introduce individual income taxes and with it the impact of tax indexation through capital gains and interest income taxation.^{1,2}

The model we use is that of Summers (1981)³. Summers' model is adapted and applied to the problem we are dealing with. The model derives a 'q' theory of investment assuming firms face adjustment costs of the stock of capital and make investment decisions with the objective of maximizing market value. With individual taxes, firms invest up to the point at which the cost of investment in terms of after-tax dividends equals the increase in the firms' value after capital gain taxes. Valuation in the model is the present value of dividends given a perfect foresight path of wages, interest rates, inflation and tax policy. Thus there are no systematic prediction errors.

¹ In addition, because the 'q' theory is derivable directly from the assumption of inter-temporal optimization, it is ideally suited for evaluating the effects of policy announcements in comparing permanent and temporary policies. However, we do not go into announcement effects and temporary policies in this paper.

² Firms are encouraged to supply more output by a reduction in the cost of capital. This response is missing in most investment theories in which the level of output is taken as predetermined.

³ Summers' work as he indicates draws on an earlier work of Hayashi (1982), though the dates do not indicate this.

The model assumes the firm neither issues new equity nor repurchases existing shares. Hence share prices are proportional to the outstanding value of a firm's equity. It is also assumed that equity holders require a fixed real after-tax return ρ in order to induce them to hold the outstanding equity. To begin with, we assume that the value of ρ is not affected by either changes in tax rules or the quantity of equity. This is equivalent to postulating a perfectly elastic supply of funds to the business sector. Thus, it assumes that all tax changes rebound onto changes in the price of investment. The analysis at this point therefore provides an upper bound on the effects of tax policy on investment demand. Later in the paper we consider how our results are affected if we relax the assumption that ρ is fixed.

B. The Model

We start by examining how individuals value corporate stock and then turn to the decision facing firms. Investors' required after tax rate of return ρ is the sum of capital gains and dividends both of which should be net of tax. Therefore

$$(1) \quad (\rho + \pi)V_t = (1-C)\dot{V}_t + (1-\theta)\text{Div}_t$$

where V_t is the value of a firm's equity, C is the capital gains tax rate on an accrual basis, θ is the dividend tax rate, Div is dividend and π is the rate of inflation. \dot{V} is total differential of a firm's value with respect to time. Here and throughout the paper, a dot above a variable denotes the derivative of that variable with respect to time.

The above differential equation can be solved to find the time path of V . We turn to our mathematics text book to find that the solution to (1) is

$$(2) \quad V_t = \int_0^{\infty} \frac{(1-\theta)}{(1-C)} \text{Div}_s \left(\exp \int_t^s -\frac{(\rho+\eta)}{(1-C)} du \right) ds$$

Equation (2) says that the value of the firm is the sum (integral) of net receipts discounted at an appropriate discount rate, where

$\frac{(\rho+\eta)}{(1-C)}$ is the appropriate discount rate at a point in time and $\frac{(1-\theta)\text{Div}}{(1-C)}$ is the appropriate net receipt because of the presence of capital gains taxes.

The model assumes firms operate with constant returns to scale, that there is perfect competition in all markets and the firms take as given the price of output, the wage, and the rate of return required by investors. These assumptions, together with the requirement that capital is homogeneous are essential to the derivation of the linkage between market valuation and investment incentives that are discussed below. The typical firm seeks to choose an investment and financial policy that maximize (2). In doing so, it is subject to the constraints given by its initial capital stock, by a requirement that the sources of funds equal the uses and the requirement that the firm maintains debt equal to a fixed fraction b of the capital stock. A crucial feature of models of this type is that there is a cost to changing the capital stock. Without this cost, the rate of optimal investment and hence the size of the firm would be indeterminate because of the assumptions of constant returns to scale and perfect competition. The

cost of installing additional capital rises with the rate of capital accumulation.¹ This prevents jumps in the demand for capital or what in control theory is called a bang-bang solution. The cost function (ϕ) is taken to be convex and homogeneous in investment and capital. Under these conditions, dividends can be derived as after-tax profits minus investment expenses.²

$$(3) \text{ Div} = [pF(K,L) - wL - pbiK](1-\tau) - (1-ITC-b+(1-\tau)\phi)pI \\ + \tau D + pbK(1-\theta^R)$$

where $\phi' > 0$ $\phi'' > 0$

K and L = factor inputs

p = overall price level

F(K,L) = production function

w = wage rate

i = the nominal interest rate

τ = corporate tax rate

ITC = investment tax credit

ϕ = adjustment-cost function, assumed convex

I = investment

θ^R = rate of economic depreciation of the capital stock

D = value of currently allowed depreciation allowances.

¹ An alternative way to make the optimal capital stock determinate is to assume diminishing returns to scale. See Arrow (1964) for the derivation of the optimal stock under this assumption.

² The assumption here is that all marginal equity finance comes from retained earnings. This follows from the assumption of a constant number of shares made earlier.

The first term in equation (3) is the after-tax profits except that the depreciation element $PK\delta^h(1-\tau)$ has not been taken out. δ^h is actual depreciation reflecting both historic depreciation and accelerated depreciation.

The treatment of the term $PK\delta^h(1-\tau)$ is a little tricky. The tax shield portion $\tau PK\delta^h$ appears as τD (i.e. the third term). The equity portion of the actual depreciation portion $PK\delta^h$ need not be taken out since the investment cost term (i.e second term) takes care of any investment to replace capital and also to create net investment. The debt portion must also reflect economic depreciation and not historic depreciation. This appears as $pbK\delta^R$ in the last term together with $pbK\pi$ which is the gain to equity holders as a result of reduction in the real value of debt in an inflationary environment. The second term is investment expense to equity owners. A dollar of investment costs equity owners $(1-b)$ as well as the adjustment or installation cost $(1-\tau)\phi$. The firm, however, gets investment tax credit ITC. Note that the adjustment cost ϕ is expensed and therefore its net of tax cost is $(1-\tau)\phi$. Further, it is ineligible for investment tax credit.

Combining (2) and (3) and separating the terms reflecting the tax savings from the value of depreciation allowances on existing capital, B , and future acquisitions, Z , yields an expression for the market-value of a firm's equity at time t :

$$4) \quad V_t = \int_0^\infty ((pF(K,L) - wL - pbKi)(1-\tau) - (1-ITC-Z-b+(1-\tau)\phi)PI \\ + pbK(\Pi - \partial^R)) \frac{1-\theta}{1-C} \mu_s ds + B_t$$

$$4a) \quad \mu_s = \exp \int_t^s - \frac{(\rho + \Pi)}{(1-C)} du$$

$$4b) \quad B_t = \int_t^\infty \tau_s \partial^T \mu_s \frac{(1-\theta)}{(1-C)} KDEP_t [\exp(-\partial^T)(s-t)] ds$$

$$4c) \quad Z_s = \int_s^\infty \tau \partial^T \mu_a [\exp(-\partial^T)(u-s)] du \\ \overline{\mu_s}$$

$KDEP_t$ refers to the depreciable capital stock at time t . It differs from K_t because of historical cost and accelerated depreciation. The variable B_t represents the present value of tax savings due to depreciation on existing capital. Z_s is the present value, evaluated at time s of the tax savings due to depreciation on a dollar of new investment.

The firm maximizes equation (4) subject to the equation of motion of capital (ie the capital accumulation constraint).

$$(5) \quad \text{ie} \quad \text{Max} \int_0^\infty ((pF(K,L) - wL - pbKi)(1-\tau) - (1-ITC-Z-b+(1-\tau)\phi)pI \\ + pbK(\Pi - \partial^R)) \frac{1-\theta}{1-C} \mu_s$$

$$(6) \quad \text{Subject to} \quad \dot{K} = I_s - \partial^R K_s$$

In maximizing equation (4), the firm can ignore B_t because it is independent of any current or future decisions. We solve this dynamic optimization problem assuming perfect foresight, using Pontryagin Maximum Principle. A shadow price $\lambda(t)$ is introduced for the constraint given by (6) in the Hamiltonian. Thus the Hamiltonian is:

$$(7) \quad H = [(pF(K,L) - WL - pbKi)(1-\tau) - (1-ITC-Z-b+(1-\tau)\phi)pI \\ + pbK(\pi-\partial^R)) \frac{1-\theta}{1-C} + \lambda (I_s - \partial^R K_s)] \mu_s$$

where $\phi' > 0$

and I and L are our control variables

K is our state variable

Using Pontryagin Maximum Principle, the first order conditions are:

$$0 = \frac{\partial H}{\partial L} \Rightarrow F_L = W/P \quad (8a)$$

$$0 = \frac{\partial H}{\partial I}$$

$$\Rightarrow 1-ITC-Z-b+\phi(1-\tau) + \frac{I}{K} \phi' (1-\tau) = \frac{\lambda(1-C)}{p(1-\theta)} \quad (8b)$$

$$\frac{\partial H}{\partial K} = \dot{\lambda}$$

$$(8c) \Rightarrow \dot{\lambda} = \lambda \left(\frac{p+\pi}{1-C} + \partial^R \right) - ((PF_K - bi)(1-\tau) - p \left(\frac{I}{K} \right)^2 (1-\tau) \phi' + b(\pi - \partial^R)) \frac{1-\theta}{1-C}$$

The transversality condition that ensures a unique solution i.e. non-explosive behaviour is $\lim_{s \rightarrow \infty} V_s (\exp \int_t^s -(\rho + \eta)) du = 0$.

1-C

λ/P can be interpreted as Tobin's marginal q , that is the change in a firm's value resulting from a unit increment to the capital stock. Equation 8a is the familiar marginal productivity condition. It says that labor is hired until its marginal product and real wage are equal. Equation 8b defines a function linking investment to the real shadow price of capital, λ/P , the tax parameters and the cost of adjustment. This equation says that for optimization, investment is chosen so that the shadow price of additional capital good (ie the right hand side) is equal to its marginal cost in after-tax corporate dollars (ie the left hand side). The condition for zero investment is:

$$(9) \quad \frac{\lambda}{P} = \frac{(1-\theta)}{1-C} [1-ITC-Z-b]$$

This equation implies that there will be investment even if Tobin's marginal q or the shadow price of new capital goods is less than 1. This is because taxes and debt finance reduce the effective price of new capital goods. The third first order condition (8c) describes the evaluation of the shadow price λ . It guarantees that the shadow price equals the present value of the future marginal product of a unit of capital. This in fact is an arbitrage condition. Thus, the shadow price is linked to the market valuation of existing capital. This is demonstrated as follows:

Note that $V_t - B_t$ given by equation (4) is homogeneous in K_t . That is doubling of K_t together with the optimal doubling of investment and labor in every subsequent period will double $V_t - B_t$. This is a consequence of the constant-returns-to scale production function and the homogeneity of the adjustment-cost function. It follows directly that

$$(10) \quad V_t^* - B_t = \gamma P_t K_t$$

where V_t^* is the stock markets value at time t when the optimal path is followed. γ is a constant. In other words, the maximized value of the firm at time t minus the value of depreciation allowances on existing capital is proportional to the value of its initial capital stock. The Maximum Principle implies that

$$(11) \quad \frac{dV_t^*}{dK_t} = \lambda_t$$

That is what is meant by the assertion that λ is the shadow price of new investment or marginal q . From (10) and (11) this λ_t is

$$(12) \quad \lambda_t = \frac{V_t^* - B_t}{P_t K_t}$$

This expression provides an observable counterpart for the shadow price of new investment, if it is assumed that the firm maximizes value so that $V_t = V_t^*$. From equation 8b, it implies that the investment function can be written as

$$(13) \frac{I}{K} = h \left\{ \frac{(V-B)(1-C)}{PK(1-\theta)} - 1 + b + ITC + Z \right\} \\ 1-\tau$$

$$h(\cdot) = (\emptyset + (I/K)\emptyset')^{-1}$$

$$h(0)=0; h^1>0$$

Equation (13) characterizes the equation of motion of the capital stock, i.e. \dot{K} which equals $K + \partial^R K$ (see equation 6).

Equation (13) may be interpreted as follows:

$\frac{V}{PK} + b$ is Tobin's 'q' which in the absence of taxes must equal to unity in equilibrium. Thus $h(\frac{V}{PK} + b - 1)$ is the investment function. When h is positive, we have investment. When it is negative we have disinvestment. This is represented by $h(0)=0; h^1>0$. The next step is to introduce taxes and subsidies. The investment tax credit (ITC) directly reduces the price of new capital goods; the knowledge that the purchase of a new capital good carries with it a stream of future tax-deductible depreciation allowances (Z) has a similar effect. These two factors reduce equation (13) to:

$$\frac{I}{K} = h \left(\frac{V}{PK} + b - 1 + ITC + Z \right)$$

Z represents the value of tax savings from the depreciation deductions arising from a new investment of one dollar. $\frac{V}{PK}$ is the market value of the firm's stock. This is compared to the investment cost $(1-b-ITC-Z)$

which is the equity cost $(1-b)$ less deductions (ITC) and (Z) . If we allow for the present value of tax savings due to depreciation deduction of existing capital (B) , the formula reduces to:

$$\frac{I}{K} = h \left(\frac{V-B}{PK} - 1 + ITC + Z \right)$$

$$h(0) = 0 \quad h' > 0$$

Next, we take into account taxes on dividends and capital gains. At the margin, the firm is faced with a choice between retaining and investing a dollar, or paying it out as dividends. Assume, the rate of dividend taxation exceeds the rate of capital gains taxation (i.e. $\theta > C$). Firms must thus invest past the point at which a dollar of retained earnings raises market value by one dollar. In particular, they will retain earnings until the last dollar raises market value by $\frac{(1-\theta)}{(1-C)}$ dollars. Thus we should modify equation (13) to

$$\frac{I}{K} = h \left[\frac{(V-B)(1-C)}{PK(1-\theta)} - 1 + b + ITC + Z \right]$$

Finally we recognize that adjustment costs are expensed. This implies that firms invest until the market value of the additional capital minus its acquisition cost equals the after-tax cost of installation. When the corporate tax rate rises, marginal installation costs decline on an after-tax basis so investment increases, other things being equal. This leads to the final expression (13).

$$(13) \quad \frac{I}{K} = h \left(\frac{\frac{V-B}{PK} \frac{(1-C)}{(1-\theta)} - 1 + b + ITC + Z}{1 - \tau} \right)$$

In order to analyze the model, we describe the evolution of $\left(\frac{V}{PK}\right)^1$, described by 'q'. Remember, this q plus b is Tobin's q normally defined. q evolves according to the equation.

$$(15) \quad \dot{q} = \frac{(\rho+\pi)}{(1-C)} q - q \left(\pi + \frac{\dot{K}}{K} \right) - \frac{(1-\theta)}{(1-C)} \frac{Div}{PK}$$

To see this note that

$$\dot{q} = \left\{ \frac{\dot{V}}{PK} \right\} \equiv \frac{PK\dot{V} - V(P\dot{K} + \dot{PK})}{(PK)^2}$$

$$\dot{q} = \frac{\dot{V}}{PK} - \frac{V}{P^2 K^2} (P\dot{K} + \dot{PK})$$

$$= \frac{\dot{V}}{PK} - \frac{V}{PK} \left(\frac{\dot{K}}{K} + \frac{\dot{P}}{P} \right)$$

Substituting equation 1.

$$\dot{q} = \frac{(\rho+\pi)V_t}{(1-C)PK} - \frac{(V)}{(PK)} \left\{ \pi + \frac{\dot{K}}{K} \right\} - \frac{(1-\theta)}{(1-C)} \frac{Div_t}{PK}$$

$$(15) \quad \dot{q} = \left\{ \frac{(\rho+\pi)}{(1-C)} \right\} q - q \left\{ \frac{\dot{K}}{K} + \pi \right\} - \frac{(1-\theta)}{(1-C)} \frac{Div_t}{PK}$$

which gives equation 15.

¹

Actually we could analyze our model with Tobin's marginal q, λ rather than q. As a matter of fact normally, in control theory one would analyze the model using λ .

Phase Diagram

The phase diagram for equations (15) and (13) are given below.

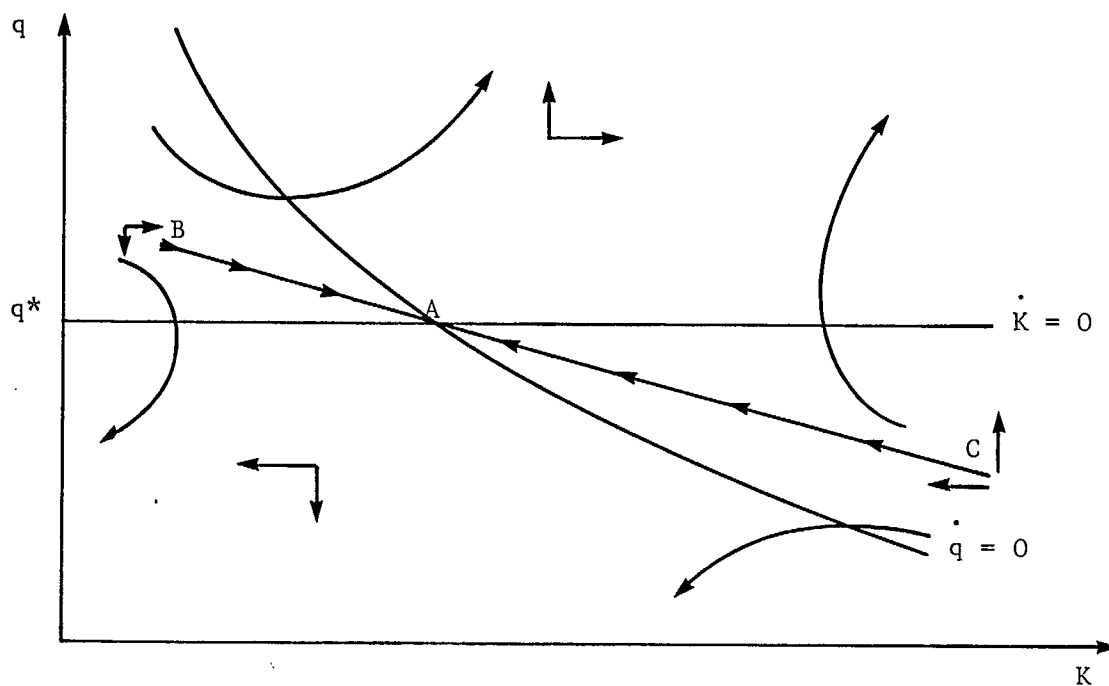


Figure 1 - Investment Phase Diagram

The diagram exhibits a saddle-point stability. There is a unique path (BAC) along which the system converges to equilibrium. This path assumes perfect foresight. Point A is the steady state equilibrium.

To obtain the $\dot{K} = 0$ and $\dot{q} = 0$ schedules, set equations (13) and (15), respectively to zero. For the $\dot{K} = 0$ schedule, equation (13) gives

$$\frac{(V-B)(1-C)}{(PK)(1-\theta)} - 1 + b + ITC + Z = 0$$

This gives $\left\{ q - \frac{B}{PK} \right\} \frac{(1-C)}{(1-\theta)} = (1-b-ITC-Z)$

or $q = (1-b-ITC-Z) \frac{1-\theta}{1-C} + \frac{B}{PK} = q^* \quad (\text{see figure 1}).$

which is a horizontal line because of the homogeneity property of

$$\frac{V-B}{PK}$$

For the $\dot{q} = 0$ schedule, from equation (15)

$$0 = \frac{(\rho+\eta)}{(1-C)} q - q \left(\frac{\dot{K}}{K} + \eta \right) - \frac{(1-\theta)}{(1-C)} \frac{\text{Div}_t}{PK}$$

which gives

$$q \left[\frac{\rho+\eta}{1-C} - \left(\frac{\dot{K}}{K} + \eta \right) \right] = \frac{(1-\theta)}{(1-C)} \frac{\text{Div}_t}{PK}$$

Thus,

$$q = \frac{\frac{(1-\theta)}{(1-C)} \frac{\text{Div}_t}{PK}}{\frac{\rho+\eta}{1-C} - \left(\frac{\dot{K}}{K} + \eta \right)}$$

and finally

$$q = \frac{\frac{(1-\theta)}{(1-C)} \frac{\text{Div}_t}{P}}{(\rho+C\eta)K - \dot{K}(1-C)}$$

Clearly, the $\dot{q}=0$ schedule decreases with increases in K around $K=0$. It is also easy to see that the $\dot{q}=0$ schedule maintains this slope at all K s.

Note that if $\frac{\rho+\eta}{1-C} < \frac{\dot{K}}{K} + \eta$ the $\dot{q}=0$ schedule would lie in the fourth quadrant (i.e. negative q) which is not acceptable.

To investigate the direction of the arrows as one departs from the $\dot{q}=0$ and $\dot{K}=0$ schedules is simple. For example, to see the direction of K above the $\dot{K}=0$ schedule, consider q slightly above q^* . From equation (13) this should make \dot{K} positive. Thus, K would be rising. Similarly below the $\dot{K}=0$ schedule, K would be decreasing. For points above the $\dot{q}=0$ schedule, from equation 15, \dot{q} would be positive. That is q would be rising. It follows that below the $\dot{q}=0$ schedule, q would be decreasing. These directions of K and q put together give as the arrows indicated in figure 1.

C. Application of the Model to Tax Indexation

C.1 The Tax Structures

Presently, Canada's tax structure is not indexed. Tax indexation would change many of the parameters in our model. Below are what we assume to be the features of the Canadian tax code under tax indexation and of the presented unindexed tax code which are relevant for our discussion. We also indicate the directions of movement of various parameters in our model when Canada indexes.

<u>Canada Indexed Tax System</u>	<u>Canada Unindexed Tax System</u>
1. Depreciation allowed at the replacement cost (Z ↑)	Depreciation at the historic rate
2. Only real interest payments are exempt from corporate profit taxes (i ↑)	Nominal interest payments are exempt from corporate profit taxes
3. Only real bond interest payments are taxed and they are taxed at the rate of ordinary income (ρ ↓)	Nominal bond interest payments are taxed at the rate of ordinary income
4. Only real capital gains are taxed and they are taxed at the ordinary income tax rate ² (C ↓)	Capital gains are taxed at 1/2 ordinary income rate; they are taxed only at realization ²
5. Dividends are taxed at the rate of ordinary income ²	Dividends are taxed at the rate of ordinary income ²

-
- 1 Several other features of the tax system such as treatment of losses (their effect against capital gains), accelerated depreciation and investment credits are not discussed in this paper.
- 2 In this paper, I am not specifying the structure of these taxes exactly as they are applied in the Canadian tax law. For example, I do not show a gross-up of dividends followed by the application of the tax rate and subsequent credit.

The above says that the use of replacement cost depreciation under tax indexation would lower the effective tax rates relative to those under our present tax system. (i.e. Z goes up).

The exemption of only real interest payments would increase the effective tax rate in Canada and also increase the cost of debt. The taxation of only real bond interest payments would lower the personal income tax rate. Finally the taxation of only real capital gains would lower capital gains tax. We assume dividend's taxation would not change under indexed system.

In the paper we assume that tax rate reduction from the use of replacement cost depreciation dominates the tax rate increase due to the deduction of only real interest. This is correct under low rates of inflation (say less than 15%). At high inflation the reverse holds. This is illustrated below.

There is a basic non-linearity in the tax loss due to historical cost depreciation whereas the gain from interest deductibility is linear with inflation. Figures 2 and 3 below illustrate this point. On the horizontal axis is inflation and on the vertical axis is the required rate of return which for a given steady state of real investment keeps Tobin's q equal to unity.

τ is the tax rate

R is the gross real before-tax rate of return

∂ is the depreciation rate

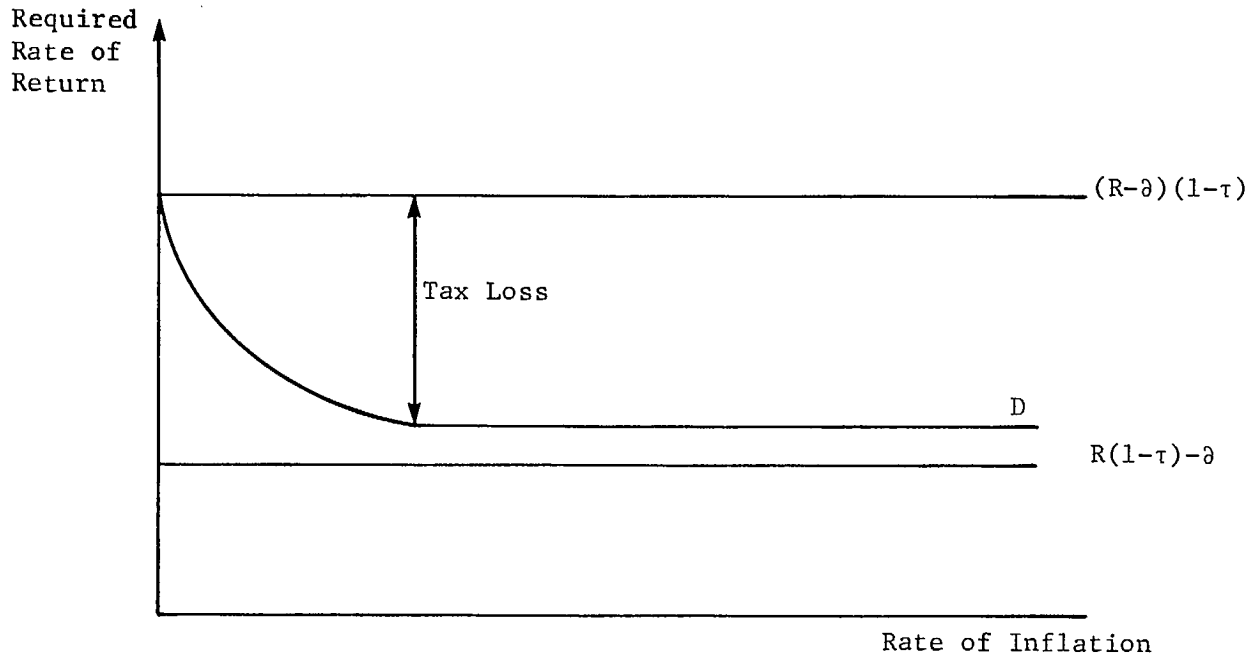


Figure 2

Along AD, the internal rate of return decreases with inflation but it is asymptotic to a lower limit. No matter how high inflation is, the most the firm can lose is the value of this depreciation tax deduction.

If the firm borrows enough to maintain its debt at a constant fraction of the replacement cost of its capital stock and the nominal interest rate rises point per point with inflation, the benefit of the

deductibility of interest payments is the tax rate times the ratio of debt to replacement cost times the rate of inflation. This is linear in inflation and plotted as curve AF in fig. 3.

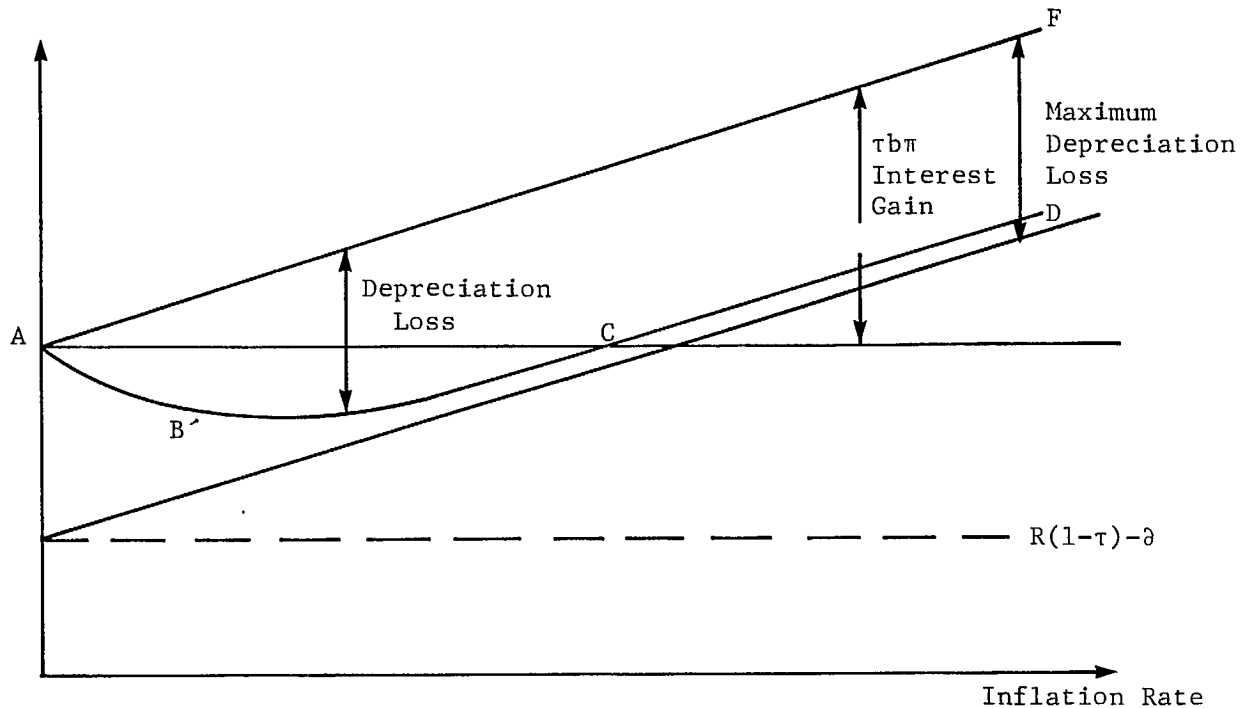


Figure 3.

b is the share of debt in inflation financing

What the above says is that at high rates of inflation, the net effect of the use of replacement cost depreciation (rather than historic cost) as a basis for calculating capital cost allowance, and deduction of only real interest payments in computing corporate income tax is to adversely affect investment. At low rates of inflation, the reverse holds. That is switching from historic cost depreciation to replacement cost depreciation at low levels of inflation would favorably affect investment.

C.2 Effects of Tax Indexation

C.2.1 Replacement Cost Depreciation (Z)

The use of replacement cost depreciation rather than historic depreciation would have a positive effect on long-run capital accumulation. The $\dot{q}=0$ schedule will shift to the right reflecting increased dividends, and the $\dot{K}=0$ schedule will shift downward because of the increased value of the tax deduction for depreciation, (Z). Hence the investment and the long run capital stock will be higher. But equity values would decrease. These effects are illustrated in figure 4.

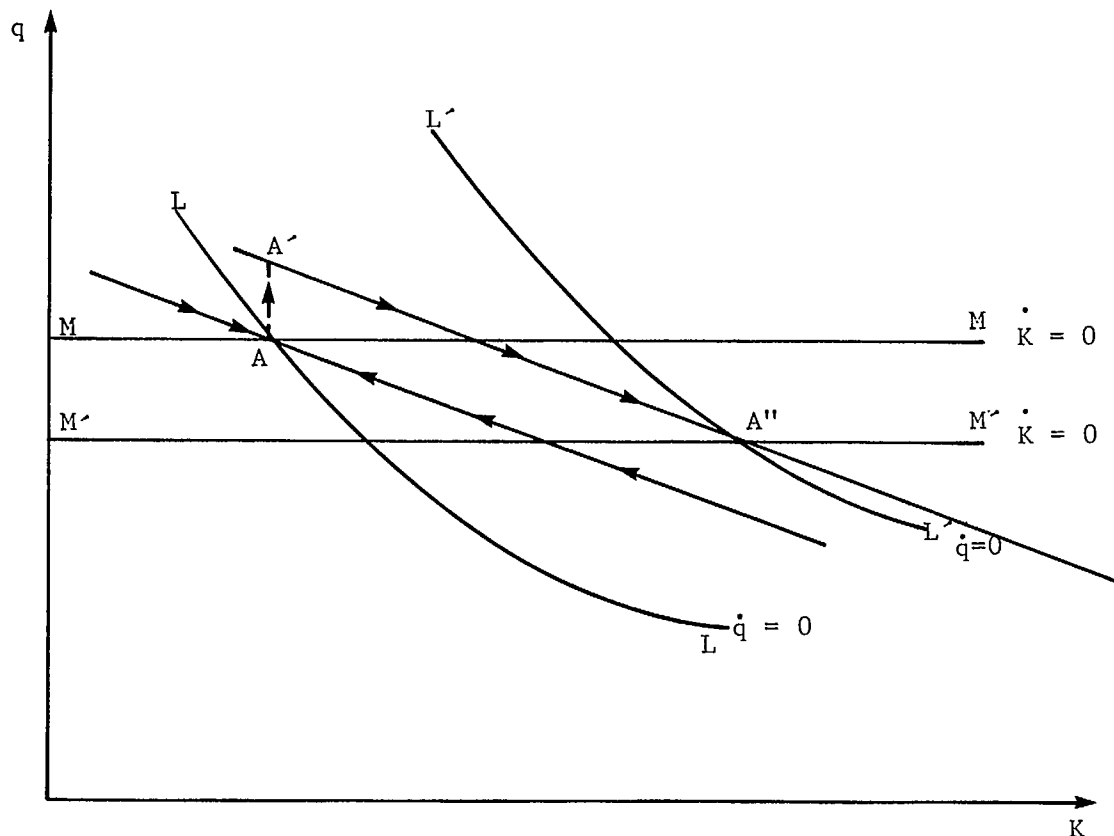


Figure 4

C.2.2 Taxation of Only Real Capital Gains

Next, we consider a reduction in capital gains tax, c . The $\dot{q}=0$ curve would shift up and the $\dot{K}=0$ curve would shift down. Therefore investment and capital stock would unambiguously increase, and the value of the firm would decrease. These effects are illustrated in figure 5.

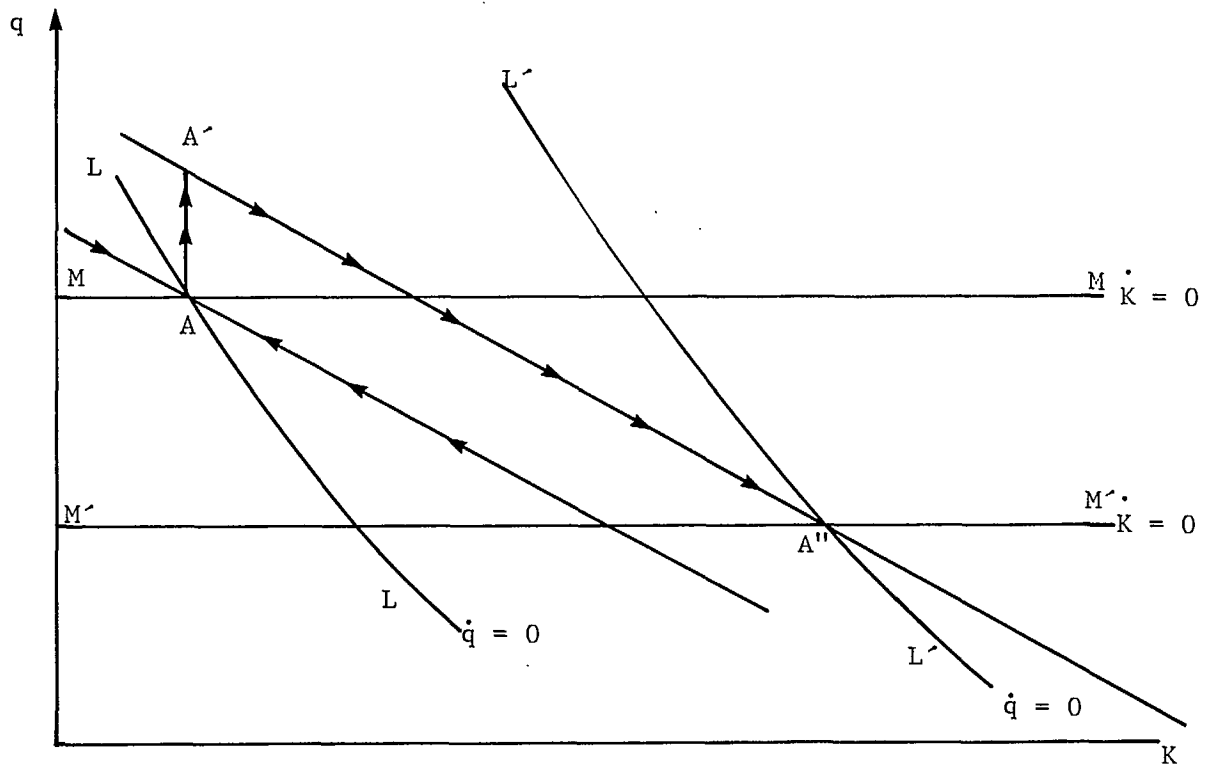


Figure 5

C.2.3 Deduction of only Real Interest Payment in Computing Corporate Tax (i)

Deductibility of only real interest expenses in computing corporate after tax income would decrease dividends. This would shift the $\dot{q}=0$ schedule downwards. The increased cost of debt in Canada would make firms shift out of debt into equity. The shift out of debt would shift the $\dot{K}=0$ schedule downward. As a result the equilibrium capital stock may decrease or increase. Equity values, however, would decrease. These effects are illustrated in figure 6.

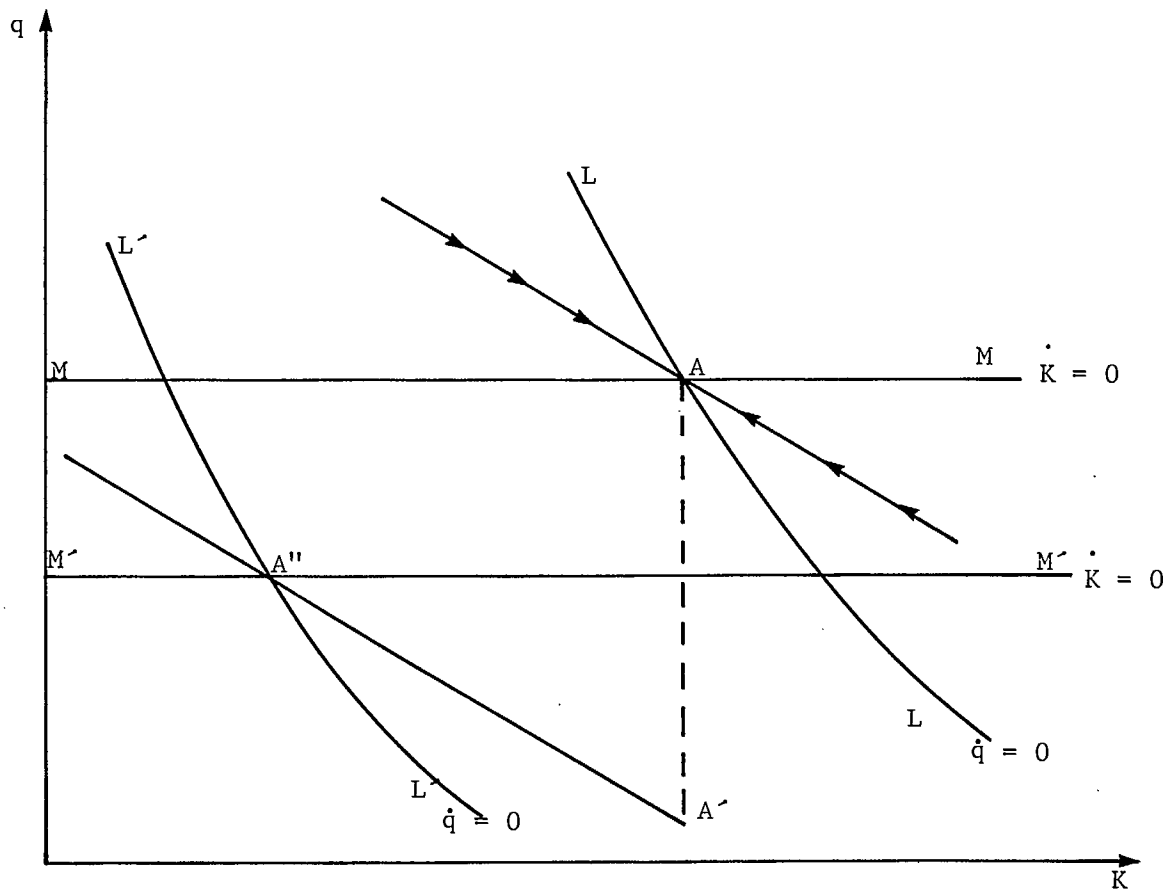


Figure 6.

Taxation of only Real Interest Receipts (ρ)

Taxation of real interest receipts in our model would shift ρ down as greater supply of savings would make capital cheaper. The $\dot{q}=0$ schedule would shift up. This would increase the capital stock and equity values may remain at their original level. These are shown in figure 7 below.

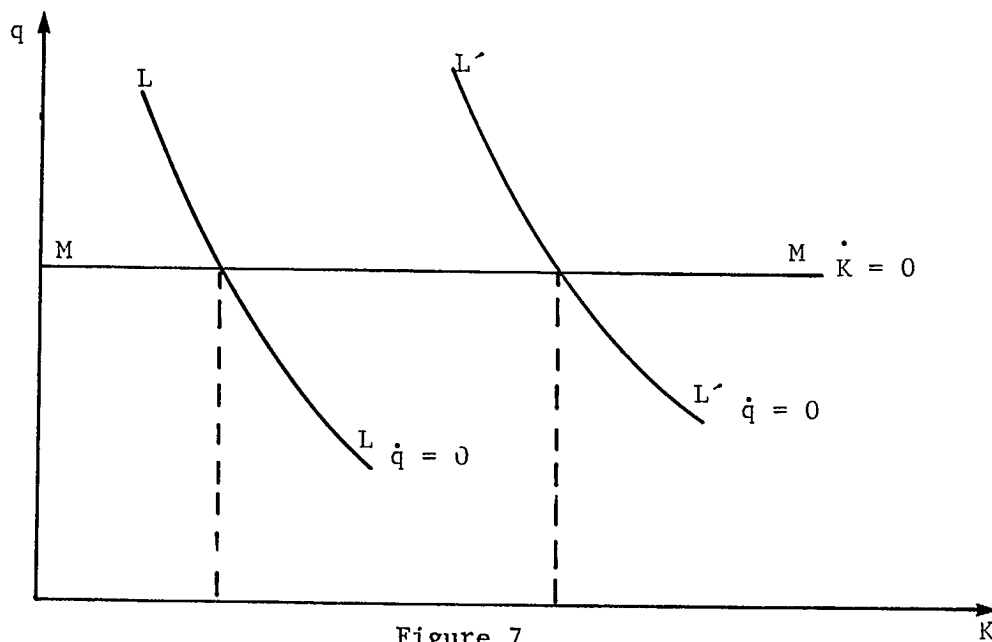


Figure 7

C.2.5 Summary

The above impacts of tax indexation on investment and equity values are summarized in the table 1 below:

Table 1. Impact of Tax Indexation on
Corporate Investment and Equity Values

Tax Indexation Instrument	Impact On:	
	Corporate Investment	Equity Values (q)
1) Replacement Cost Depreciation (Z)	up (with a limit)	down (with a limit)
2) Only real interest payments are exempt from corporate profit tax computation (i)	ambiguous (likely to be down)	down
3) Only real capital gains are taxed and at the ordinary income tax rate (c)	up	down
4) Only real bond interest payments are taxed (ρ)	up	remain

C.2.6 Upward Sloping Supply Curve for Capital

If the supply curve for capital is upward sloping, the after-tax return required by investors (ρ) would go up if investment is to increase and would go down if investment decreases. This would dampen the above effects, but it is believed would not reverse them. Put in another way, effects which would be obtained under the assumption that (ρ) is fixed are the upper bound results.

D. Conclusion

This paper presented a model originally developed by Summers (who also based it on an earlier work of Hayashi) to investigate the impact of tax indexation on corporate investment and equity values in Canada assuming a closed economy. The results show that some tax indexation elements would favorably affect investment while others would discourage investment. Those that would favor investment include the use of replacement cost rather than historic cost as a basis for computing capital cost allowance, the taxation of only real capital gains and the taxation of only real interest receipts. The deduction of only real interest payments in computing corporate taxes on the other hand would tend to reduce investment but as firms shift out of debt as a result of the high cost of debt, this would tend to reduce the negative impact on investment and may even reverse it.

The impact of the use of replacement cost as a basis for computing capital cost allowance has a limit. This is because with historic cost depreciation no matter how high inflation is, the most a firm can lose is the value of its depreciation tax deduction. On the other hand, the effect of the deduction of only real interest payments in computing corporate taxable income continues to increase with inflation. The net effect of these two indexation instruments alone is therefore to favor investment at low levels of inflation and reduce investment at high levels of inflation.

With regard to the effect of indexation on equity values, all the tax indexation instruments except the taxation of only real interest receipts would lower equity values. The latter would leave equity values intact.

Appendix

Some Key Parameters that Need to be Estimated in Empirical Work

The Model presented in this paper can be simulated. Some of the important parameters which need to be determined and used in the model are as follows:

Technological Parameters

- Assuming Cobb-Douglas production function - share of capital in the production function
- Population growth rate
- The adjustment cost function
- Rate of depreciation of capital.

Financial Parameters

- Real interest rate
- Real after-tax required rate of return on equity, ρ
- b : the ratio of market value of outstanding corporate debt, less financial assets to the capital stock.
- V : the stock market value of all non-financial corporations for several years (TSE)

- K: the capital stock, may be taken as the sum of equipment, structures, and inventories, all valued at current replacement cost.
- B: the present value of depreciation allowances.

Tax Parameters (both under indexation and without indexation)

- C: the effective tax rate on capital gains
- θ : the marginal tax rate on dividends
- ITC: the effective rate of the investment tax credit
- Z: the present value of future depreciation allowances on a dollar of investment calculated on the basis of tax lifetime and depreciation methods.
- τ : the corporate tax rate
- ∂^t : the rate of depreciation for tax purposes on the capital stock.

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