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Taxes and the Cost of Capital: Some Estimates for Developing Countries

Prepared by Liam P. Ebrill 1/

Approved by Ved P. Gandhi

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I. Introduction

There has been growing interest in the issue of how supply-side policies might be used to affect the growth rates of developing countries. In particular, there is the suggestion that taxes may well be powerful instruments of development policy. Central to this position is the presumption that tax policy can influence the level of investment. Within the context of neoclassical analysis, this presumption is sustained by the argument that taxes can be employed to reduce the cost of capital where the latter is viewed as the principal determinant of the level of fixed business investment. This paper is written in the tradition of that neoclassical analysis. As a preliminary to answering the question of how best to direct tax policy with a view to stimulating investment, one of its objectives is to quantify the impact of existing tax systems on the cost of capital in a selection of developing countries.

Of course, this is not to deny that other (nonneoclassical) factors such as liquidity and acceleration effects and the availability of foreign exchange, are important determinants of investment behavior. Indeed, the available empirical evidence for developing countries indicates that these latter factors are of great importance (for example, Billsborrow (1977), Sundararajan and Thakur (1980), and Wai and Wong (1982)). Accordingly, in the empirical work presented below, some of these nonneoclassical elements are accommodated. This permits an evaluation of the relative importance of a variety of factors in the determination of capital formation in developing countries. Given the number of potential influences on investment, care is taken to ensure that the countries studied below are chosen with a view to covering a broad range of developing country experience.

This paper proceeds by first presenting the theory behind the cost-of-capital approach. Subsequent sections consider the relevance of this approach for developing countries, show how the cost of capital in these countries may be sensitive to changes in anticipated inflation, discuss the estimates of the cost of capital for the selected sample of countries, and present cross-section regression results on the determination of investment levels in developing countries.

II. The Theoretical Framework

1. Background to cost-of-capital calculations

We begin with some comments which concentrate on the salient features of all cost-of-capital calculations.

The most obvious tax influencing the cost of capital facing corporations is the corporate income tax. The manner in which this tax exercises its influence is complicated. Thus, corporate taxes are levied on corporate income after the legitimate costs incurred in

the process of generating revenue have been deducted. These costs are relatively easy to calculate as far as outlays on labor and raw materials are concerned. They are much more difficult to calculate, however, for capital inputs, because capital is a durable good whose rate of depreciation is difficult to gauge.

Indeed, in much of the earlier theoretical work it was essentially assumed that corporate taxes were, by and large, borne by capital. Such an assumption is accurate to the extent that the deduction accorded capital is inadequate. Proceeding from this assumption, authors then analyzed the general equilibrium implications of such taxes. This work, exemplified by Harberger (1962), was very important not only because of its specific conclusions concerning the impact of the corporate income tax, but also precisely because of its demonstration that general equilibrium effects of taxes could and should be documented. (For a review of the original Harberger model and more recent extensions, see McLure (1975) and Ballentine and McLure (1980).)

Recent literature, which concentrates less on the general equilibrium effects of corporate taxes and more on the issue of how the corporate income tax actually affects the cost of capital, is more relevant for our purposes. 1/ Stiglitz (1973) points out that the effects of a statutory corporate income tax rate on the cost of capital cannot be viewed in isolation from other elements of the tax system such as specific provisions of the corporate tax code and the coexistence of the corporate tax with a personal income tax structure. For example, a combination of economic depreciation, interest deductibility, and the absence of uncertainty implies that the corporate income tax will leave the cost of capital unchanged for any company using debt finance at the margin, and, as a result, such a tax does not distort the allocation of capital. King (1975) and Flemming (1976) elaborate on the conditions for ensuring that the tax is nondistortionary in this sense. In general, a tax system which, between its interest deductibility provisions and its depreciation allowances permits a deduction whose present value is equal to the cost of a capital investment, is equivalent to a tax system with an immediate write-off provision. This, in turn, implies that such a tax system would be equivalent to a pure profits tax. The ability to accommodate the full range of possible tax structures suggested by this literature is precisely what makes the cost-of-capital formula specified below a useful device.

For institutional reasons, the general equilibrium effects of corporate income taxes are frequently complicated by inflation. There is a tendency in many tax systems to tax the nominal rather than the real income of capital. As a result, the tax system interacts with changes in the expected rate of inflation. For corporate taxes, this interaction is frequently the product of some combination of the following

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1/ Some important examples are Stiglitz (1973) and (1976), King (1975), and Flemming (1976).

factors, namely, the taxation of nominal capital gains, the use of depreciation allowances based on historic cost, and the requirement that inventory valuations be determined on a first-in first-out (FIFO) basis. This problem is compounded by the fact that tax systems rarely treat all capital assets in the same manner. For example, owner-occupied housing frequently receives a favorable tax treatment in that, not only is there no taxation of the implicit rental income which accrues to the owner-occupier, but also some amount of mortgage interest payments and property tax payments are often deductible against other income tax liabilities. This implies that one of the effects of an increase in the rate of inflation is for investors to shift their demand from corporate equity to owner-occupied housing. Thus, while changes in the expected rate of inflation might not be expected to result in large changes in total investment, there could be significant changes in the composition of that aggregate. Given the desire in many countries to encourage manufacturing investment, these effects could be important.

Of course, any country's corporate tax system could be modified to accommodate these effects. For example, one could index capital gains and depreciation allowances for inflation. This is administratively complicated given the need to determine both the rate of economic depreciation and the appropriate index to use as a basis for calculating the indexation adjustment. The alternative approach, administratively more simple, would be to abolish interest deductibility and permit expensing. While some countries do resort to such techniques, a more common response is to allow some form of accelerated depreciation allowances. Although these will counter the effect of a given expected rate of inflation, the system nonetheless remains sensitive to changes in inflation. These and other aspects of this general problem are discussed in Feldstein (1980 a, 1980 b, and 1980 c), and Ebrill and Possen (1982 a and 1982 b). Again, the cost-of-capital formula below is general enough to permit a consideration of these issues.

When it comes to the matter of empirically estimating the incentive effects of taxation on business investment, it should be noted that deriving a cost-of-capital estimate is by no means the only possible route to take. Indeed, a more traditional approach took as its starting point the actual taxes paid as a proportion of income. The presumption was that marginal tax rates in a given industry are not far from the ratio of actual taxes to capital income in that industry. This may not be too likely given the possibility that actual tax revenues may be the product of inframarginal supernormal profits due to the existence of noncompetitive market structures. Examples of well-known articles which rely on this approach are Harberger (1966), Shoven (1976), and Fullerton, King, Shoven, and Whalley (1981).

The use of cost-of-capital calculations is actually quite new. Based on the neoclassical framework developed by Hall and Jorgenson (1971), they have come to be used with increased regularity (e.g., Hall (1981), Jorgenson and Sullivan (1981)). The underlying methodology

of the approach is to consider a "hypothetical project" of a dollar invested in a particular asset to be used by a representative firm. The firm is assumed to be maximizing its value to the shareholders. Given the specifics of the tax code, the cost-of-capital formula is then derived permitting an evaluation of the impact of various tax provisions at both the corporate and the shareholder level on the actual cost of capital and, hence, on the incentive to invest.

2. Relevance of the cost-of-capital approach to developing countries

Before some of the difficulties associated with the mechanics of implementing the cost-of-capital approach are considered, some comments on the more general issue of its applicability to developing country circumstances are appropriate. Specifically, the cost-of-capital calculation is concerned with the investment climate facing corporations. That its usefulness is limited by the fact that the corporate sectors in developing countries are often small is not necessarily true. First, the corporate sector, although small, could well be important at the margin (Bhagwati (1978)). Second, and more important, the cost of capital facing the corporate sector may serve as an excellent proxy for the cost of capital facing unincorporated businesses. It is sufficient for both sectors to determine their tax bases in a similar fashion. For example, in countries where historic cost depreciation is the convention, that convention will usually apply to both corporations and unincorporated businesses, and, further, will be reflected in the cost-of-capital calculation.

A related issue is that the cost-of-capital calculation presumes the existence of competitive capital markets. The reality in many developing countries is much different. Capital markets are commonly either nonexistent or fragmented. This does not, in and of itself, negate the relevance of the cost-of-capital calculation. Even in the absence of well-developed markets, the distinction between debt and equity continues to be maintained both in the practice of financing marginal investments and in the specifics of many developing countries' tax codes. Thus, interest payments, whether on a bank loan or a bond, are often deductible against corporate tax liabilities while retained earnings are not. Further, capital gains, dividends, and interest payments frequently receive separate treatments at the personal income tax level. However, this reservation does suggest that liquidity variables may have an important role to play in determining investment flows.

3. Difficulties in the use of cost-of-capital calculations

The cost-of-capital approach is not without its problems. As pointed out by Bradford and Fullerton (1981), since the method is concerned with expected future tax liabilities (statutory corporate and personal income tax rates are normally assumed to remain constant),

the choice of a discount rate is critical. Second, given generous depreciation allowances and investment tax credits of the type now widely available, the asset does not have to generate a positive marginal product to ensure a normal return for the investor. As the investment's return in the denominator of an effective tax formula approaches zero, the subsidy rate tends correspondingly to infinity. Third, effective tax rate estimates are a function of the assumptions made concerning how anticipated inflation affects nominal interest rates. We assume below that all gross nominal returns rise with the rate of anticipated inflation. 1/

To these caveats raised by Bradford and Fullerton, the most serious of which is the third, might be added a few further considerations. The value of depreciation allowances to the representative firm is gauged by the discrepancy, positive and/or negative, that exists over time between the depreciation allowances and economic depreciation, all expressed in present value terms. It is traditional to assume that economic depreciation is exponential, though there is evidence to suggest that this is not so (Feldstein and Rothschild (1974)). To the extent that economic depreciation is not exponential, one is valuing depreciation allowances against the wrong benchmark. Nonetheless, we will continue to assume that economic depreciation follows a path of exponential decay since alternative assumptions have their own difficulties. For example, assuming some straight-line formula as a benchmark effectively raises the question of the lifetime of the assets, that is, whether or not a statutory straight-line depreciation formula represents accelerated depreciation allowances depends on the true life of the asset.

Finally, it should be noted that a number of assumptions are needed to ensure that the cost-of-capital approach can be viewed as providing a general equilibrium framework in which a country's tax system can be evaluated. Implicitly, authors seem to assume a closed economy framework with fixed aggregate stocks of capital and labor. This allows one to take many variables, such as the underlying marginal productivity of capital, as constant. One can also ignore the effects of many other taxes. For example, general sales taxes on gross output may then be consistently presumed to be borne by capital and labor in the aggregate in line with their factor shares in gross domestic product (GDP) and, accordingly, such taxes do not affect the allocation of investment funds between the corporate sector and other sectors of any given economy. This permits one to concentrate on the implications of the interactions between the personal and corporate tax systems of developing countries. However, the assumptions necessary for this general equilibrium interpretation to hold may not be realistic. The economies of many developing

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1/ Although this may appear to be a partial equilibrium assumption, it is consistent with the empirical results reported for the United States by Feldstein and Summers (1978). The assumption is suspect when it is applied to those developing countries where interest rates are regulated. Indeed, as shall be seen below, the empirical results appear to be influenced by this effect.

countries are quite open. When this is combined with the common adoption of overvalued exchange rates and a relatively heavy reliance on trade taxes, one must recognize that the concomitant disequilibrium in the traded goods market can influence investment flows. Thus, as pointed out in the introduction, additional factors such as foreign exchange availability, etc., should be accommodated.

It is clear, then, that cost-of-capital calculations should be interpreted with great care. However, notwithstanding the caveats above, they continue to have the great advantage over alternative techniques of being based on a theoretical rather than on an ad hoc foundation. Even if the absolute values of the calculations are subject to error, they will still be useful if the rankings of tax effects across countries are accurate, thereby affording some insight into the sensitivity of investment to changes in the level of the cost of capital. Further, the technique has the advantage of allowing calculation to be made on the basis of statutory tax rates, where these are generally accessible. Given data availability in developing countries, this advantage is particularly valuable.

4. Derivation of the cost-of-capital formula

Before discussing the derivation of the cost-of-capital formula, we introduce the following summary of the notation which will be used throughout.

π = the anticipated rate of inflation
i = nominal rate of interest
δ = rate of economic depreciation
s = real interest rate, net of tax
n = share of marginal investment financed by new issues
h = share of marginal investment financed by borrowing
τ = corporate tax rate
τ^* = corporate tax rate corrected for tax holidays
M_G = effective tax rate on capital gains

M_D = tax rate on distributions

M = personal income tax rate
a = exponential rate, historic cost, depreciation allowances
G = share of investment qualifying for initial investment allowance
ρ' = gross real cost of capital
ρ = net real cost of capital
t_w = tax wedge on marginal investment

$D(t)$ = nominal income stream in period t from an additional $1 of investment
$V(t)$ = stock market value of a share of the "representative" firm in period t

As the procedure for deriving the actual formula for the cost of capital is well known, it will only be summarized here. One is referred to Agell (1982) for a more detailed discussion of the mechanics since his basic formula, with some modifications, will be used below.

The cost-of-capital calculation is derived from a model of the marginal investment decision facing a corporate firm. The marginal investment, financed in period 0 at least in part by retained earnings, yields a dividend stream D(t) where

$$(1)\quad D(t)=\left\{(1-\tau)\left[\rho'-ih\right]-(\delta-\pi)h-\frac{(s+\pi)}{1-M_D}n-(\delta-\pi)n\right\}e^{-(\delta-\pi)t} + \tau a e^{-at}$$

Thus, dividends net of corporate taxes are calculated by deducting payments associated with debt and the issue of new shares from the gross yield of a marginal investment and adding the tax value of depreciation allowances. To elaborate on a number of aspects of this expression, the term in $(\delta-\pi)h$ reflects the fact that that portion of the investment which is debt financed is amortized at a rate which reflects the rate of economic depreciation, δ, adjusted for the anticipated rate of inflation, π. Following Agell (1982), new share issues can be treated without loss of generality as a special debt instrument. These new shares must yield for their shareholders a competitive net of personal income tax return, where this is gauged by $\frac{(s+\pi)}{1-M_D}n$, and, as with regular debt, their share in the marginal investment is amortized at a rate measured by $(\delta-\pi)n$.

This dividend stream is reflected in the value of shares, V(0), as follows:

$$(2)\quad V(0) = \int_0^{\infty} \frac{(1-M_D)}{(1-M_G)} D(t) e^{-\frac{(s+\pi)t}{(1-M_G)}}\, dt$$

where this expression is a solution to the differential equation resulting from the equilibrium condition that the rate of return required by equity holders equals the sum of net of tax dividend payments and capital gains.

The firm is assumed to be maximizing its value to its existing equity holders. Given that assumption, the capital market will be in equilibrium if, at the margin, the equity holders are indifferent as to whether or not the marginal investment is undertaken; that is, equity holders will be indifferent between having the firm pay out dividends and having it make the marginal investment. This equilibrium condition can be expressed as follows:

$$(3) \quad (1-M_D)(1-h-n-\tau G) = (1-M_G)V(0)$$

that is, the forgone dividend payment, net of personal income tax, must equal the capital gain, net of capital gains tax, associated with the investment. Substituting equations (1) and (2) into (3) yields

$$(4) \quad \rho = ih + \frac{(s+\pi)n}{(1-\tau)(1-M_D)} + \frac{(s+\pi)}{(1-\tau)(1-M_G)}\left[1-h-n-\tau G-\frac{\tau(a-(\partial-\pi))}{\frac{s+\pi}{1-M_G}+a}\right] - \frac{\tau G(\delta-\pi)-\pi}{(1-\tau)}$$

where the major differences between this expression and Agell's corresponding equation (5) are: (i) the fact that interest deductibility of debt against corporate tax liabilities is permitted by all the countries selected below is already incorporated in the formula, and (ii) it is assumed from the outset that no relative price changes take place. This last assumption implies that the anticipated rate of general inflation is equal to the expected rate of change in the price level of capital goods.

Having introduced the cost-of-capital calculation and having discussed the caveats relevant to its use, let us now proceed to its estimation and evaluation for a number of developing countries.

III. Empirical Results

The sample of countries is presented and characterized in Appendix I. As can be seen there, it consists of 31 countries chosen with a view to covering a broad range of developing country experience.

1. Derivation of cost-of-capital estimates

In this section, the derivation of the estimates of the cost of capital for a subset of the sample of countries is presented in some detail. This will serve a twofold purpose. First, it will elucidate by example the procedure which is used for the whole sample. Second, the subset will be used to illustrate the sensitivity of the cost of capital to changes in both the anticipated rate of inflation and tax parameters.

Five countries were selected from the sample for this exercise: Argentina, Ghana, India, Jamaica, and Korea. The choice was dictated by a desire to include a group of countries with diverse experiences and structures. The salient features of the corporate tax structures of these countries are presented in Tables 1 and 2. In particular, Table 1 delineates the statutory tax rates together with the treatment of standard deductions, while Table 2 presents the tax incentives available to investors. Casual observation suggests that the treatment of corporate profits, at least in nominal terms,

Table 1. Taxation of Corporate Profits

	Argentina	Ghana	India	Jamaica	Korea
			(In percent)		
Corporate income tax rate	33-45	45-55	48.6-64.5	35-45	26.4-47.5 1/
Tax treatment of:					
Inventory	LIFO not permitted	LIFO not permitted	FIFO	LIFO not permitted	LIFO or FIFO
Depreciation	Straight line, indexed	Declining balance, historic cost	Declining balance, historic cost	Declining balance, historic cost	Straight line and declining balance, historic cost
Dividends	Some withholding	No imputation	No imputation, personal tax deduction	No imputation	Some withholding
Deductibility of nominal interest payments	Yes	Yes	Yes	Yes	Yes

Sources: Price Waterhouse and Company: Doing Business in Argentina (New York, 1980), Doing Business in India (New York, 1980), Doing Business in Jamaica (New York, 1981); and International Bureau of Fiscal Documentation, Supplement No. 43 (Spring 1982), Supplement No. 44 (Summer 1982).

1/ Includes defense tax surcharge.

Table 2. Tax Incentives

	Argentina 1/	Ghana	India	Jamaica	Korea 2/
Income tax holiday	Tax exemptions of up to 10 years possible	5 years	25 percent of taxable income exempt for 8 years	Up to 10 years	4 years + further 2 years at 50 percent
Investment allowance or tax credit	Tax holidays and investment rebates available	Investment allowances of 5 percent	Investment allowances of 25 percent	Investment allowances of of 20 percent (40 percent for some agricultural industries)	Tax credit of 8 percent of investment
Accelerated depreciation	Possible for some types of capital equipment	Additional annual allowance at 10 percent of appropriate qualifying expenditures	None	None	Immediate write-off possible

Sources: Price Waterhouse and Company: Doing Business in Argentina (New York, 1980), Doing Business in India (New York, 1980), Doing Business in Jamaica (New York, 1981); and International Bureau of Fiscal Documentation, Supplement No. 43 (Spring 1982), Supplement No. 44 (Summer 1982).

1/ Argentina has potentially generous tax incentives for investment. They appear to be negotiable on a case-by-case basis.

2/ The investment incentives in the case of Korea are alternatives.

does not vary greatly across countries. It is noteworthy, however, that, with the exception of Argentina, historic cost depreciation is the rule. Thus, for the countries other than Argentina, there is the potential of an interaction occurring between the tax system and changes in inflation. It should also be noted that to the extent that the countries' tax codes do not permit last-in first-out (LIFO) inventory valuation, a problem analogous to that associated with historic cost depreciation also arises with inventories. Unfortunately, inventory valuation effects cannot be incorporated in the simplified framework implied by equation (4) above. The implications of these inventory effects for investment, the variable of primary concern, are not clear. It depends on whether inventories are a complement of or a substitute for capital. 1/ It is assumed here that the results are not greatly affected by this omission.

Turning to the matter of tax incentives, it can be seen that the countries offer similar packages. In particular, some type of additional depreciation allowance, in the forms of accelerated depreciation and/or tax credits, is generally available. Further, tax holiday provisions exist for start-up companies.

With this as background, we turn now to consider how the cost of capital is affected by taxes. We will present two sets of calculations. First, the cost of capital and the effect of taxes will be presented for a representative firm in the selected countries where the firm has been in existence for some time and is contemplating an additional dollar of investment. Second, analogous calculations will be presented for a start-up firm where that firm can avail itself of the tax holiday provisions. The value of this exercise lies in its ability to test the sensitivity of the calculations to changes in the tax parameters.

The parameters in the cost-of-capital formula are of three different types, namely,

(a) macrovariables (π, i, s), which are exogenous to the representative firm;

(b) microvariables (δ, n, h), which are specific to the firm;

(c) tax variables (τ, τ^*, M_G, M_D, M, a, G).

Consider the specific parameter values for each of these categories in turn, noting that the values for the first two categories are chosen not only because they are reasonable in their own right but also because they are consistent with Agell's (1982) results.

1/ On this point, Chirinko (1982) argues that, for the case of the United States, the widespread use of first-in first-out (FIFO) accounting may actually stimulate business investment.

It is assumed that the expected rate of inflation can take on two values, namely, 0 percent and 10 percent. This is not meant to reflect realistic rates of inflation for these countries. Rather, as pointed out above, the intent is to test the sensitivity of the cost of capital calculations to changes in anticipated inflation.

As mentioned earlier, the nominal rate of interest is presumed to rise pari passu with the rate of inflation (the Fisher assumption) so that

(5) $i = i_r + \pi$

where i_r is the real rate of interest. 1/ The real rate of interest is set at 2 percent a year. Further, the shareholder's required real rate of return, s, is also equal to the real rate of interest, implying s = 2 percent.

Turning to a consideration of the microvariables, it is assumed that the rate of economic depreciation may be set equal to 0.1225. This estimate is the same as that derived by Hulten and Wykoff (1981) for "general industrial equipment" using U.S. data. Data availability precludes obtaining accurate estimates of n, the share of new financing in the marginal investment, and h, the analogous share for debt. Accordingly, in line with Agell's (1982) benchmark case, n = 0.10 and h = 0.30 are the chosen values.

Finally, the most important tax parameters are presented in Table 3. A few comments are in order. The corporate tax rate corrected for tax holidays, τ^*, is based on the most generous tax holiday available. There is no guarantee that these terms are available to all start-up firms. The method for correcting the statutory tax rate for tax holidays is presented in Agell (1982). The cases of India and Korea, as indicated in Table 2, provide for partial tax holidays. The determination of the corrected corporate tax rates for these two cases is presented in Appendix II.

The capital gains tax rates are effective tax rates--the statutory tax rates have been corrected for the fact that capital gains are levied on a realization rather than an accrual basis. Some countries have separate deductions against capital gains liabilities. For Argentina,

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1/ Taken at face value, this assumption would appear to be violated in those countries where interest rates are institutionally fixed at an artifically low rate. However, to the extent that the resultant financial disintermediation results in the creation of secondary financial markets, such as the curb markets of Korea, this problem is ameliorated--the interest rates in such markets are likely to be responsive to changes in inflation. Further, as shall be seen below, the regression results will be altered in an attempt to accommodate those cases where the assumption is most likely to be seriously in error.

the deduction amounts to US$3,600, while for India the deduction, a function of the amount of the shareholder's other income, is large. This explains the discrepancy between the effective rates reported in Table 3 and the statutory rates for those countries, namely, 15 percent in both cases.

As in Agell (1982), the personal income tax rate on dividends is based on the marginal tax rate of the typical investor where the investor is assumed to have a taxable income equal to ten times the per capita 1981 GDP of the country under consideration. Finally, where necessary, the straight-line depreciation allowance formulas have been converted to an equivalent declining-balance formula characterized by the value of the parameter a.

2. Sensitivity of the cost of capital to parameter values

With the above as background, turn now to consider the implications of the tax structures for the cost of capital, ρ, of an ongoing firm. 1/ The results for the chosen rates of inflation are presented in Table 4. This table not only presents the cost-of-capital calculations but also an estimate of the tax wedge, t_w. 2/ This latter is derived on the presumption that the shareholder is guaranteed a rate of return, so that

(6) $t_w = \rho - s$.

It is clear that the calculations are sensitive to the level of anticipated inflation. At rates of inflation higher than those considered here, the tax wedges would tend to become larger for most of the countries. The major exception to this is, of course, Argentina, where it was presumably precisely because of high rates of inflation that that country resorted to indexation. Nonetheless, the calculations suggest that inflation policy may be of critical importance.

1/ Since Argentina indexes its depreciation allowances, the cost of capital formula is somewhat altered. The manner of the alteration is described in Appendix II.

2/ Agell also calculates what he refers to as a "subsidy rate" for the representative firm. The actual cost of capital is compared with the cost of capital which would result in the absence of incentives such as accelerated depreciation. This is an ambiguous concept, however, since whether a tax instrument is or is not an incentive depends upon the circumstances. We have seen that, in the absence of indexing, inflation can adversely affect the return to investment. Accordingly, "accelerated depreciation allowances" may be implemented merely to compensate for inflation. Further, Argentina permits indexation of depreciation allowances (not an incentive by Agell's reasoning), while other countries in the sample tend to rely on accelerated allowances (one of Agell's incentives).

Table 3. Tax Rates, 1982

(In percent)

	τ	τ^*	M_G	M	M_D	a	G
Argentina	33.0	7.9	10.0	38.0	—	N.A. 1/	20.0 2/
Ghana	55.0	27.0	40.0 3/	40.0	40.0	22.3	25.0
India	56.0	46.5	0.0 4/	25.0	25.0	12.3	25.0
Jamaica	45.0	10.8	—	57.5	57.5	10.0	20.0
Korea	39.6 5/	19.6	25.0	36.0	31.0	24.5	—

Sources: Price Waterhouse and Company: Doing Business in Argentina (New York, 1980), Doing Business in India (New York, 1980), Doing Business in Jamaica (New York, 1981); and International Bureau of Fiscal Documentation, Supplement No. 43 (Spring 1982), Supplement No. 44 (Summer 1982).

1/ Argentina indexes depreciation allowances. $\partial = 12.25$, $\pi = 130.8$.
2/ Approximate.
3/ The statutory tax rate varies with the holding period. Here, it is assumed shares are held for more than five but less than ten years.
4/ This is approximate--the capital gains rate on long-term gains depends on the individual's other income.
5/ Includes defense tax.

Table 4. The Cost of Capital, ρ, and Tax Wedge, t_w for Ongoing Firms

(In percent)

Inflation Rate	Argentina	Ghana	India	Jamaica	Korea
		(Cost of capital, ρ)			
0	1.46	-2.15	3.59	1.53	2.91
10	-0.68	6.24	2.76	2.21	6.50
		(Tax wedge, t_w)			
0	-0.54	-4.15	1.59	-0.47	0.91
10	-2.68	4.24	0.76	0.21	4.50

Table 5 presents analogous estimates to those of Table 4 for the case of start-up or "pioneer" investments. The most interesting feature of the table is that it implies that, for some countries, tax holidays appear to increase the cost of capital. This is not as strange as it first appears. First, if the tax system is such that, in the absence of tax holidays, the tax wedge is negative, then a tax holiday tends to remove this implicit subsidy. This effect can also be observed in Agell's work. Second, the effective tax rate on corporate capital is the product of an interaction between the corporate and personal income taxes. In the case of Ghana, for example, one observes that taxes at the corporate level tend to be very low, even negative, due to accelerated depreciation allowances, while the treatment of capital income at the personal level involves high tax rates. As a result, a tax holiday at the corporate level implies an increase in the tax burden on corporate capital.

Table 5. The Cost of Capital, ρ, and Tax Wedge, t_w, for Start-up Firms

(In percent)

Inflation Rate	Argentina	Ghana	India	Jamaica	Korea
			(Cost of capital, ρ)		
0	1.22	0.06	2.63	-0.30	2.64
10	2.26	7.20	2.54	3.48	5.53
			(Tax wedge, t_w)		
0	-0.78	-1.94	0.63	-2.30	0.64
10	-0.26	5.20	0.54	1.48	3.53

However, while the calculations imply that there are circumstances under which a tax holiday can increase the tax burden, a couple of reservations should be noted. First, as mentioned in an earlier section, the cost-of-capital calculation is set in a world where the representative firm is presumed to know its future tax liabilities with certainty. In the real world, notwithstanding the fact that in present value terms it implies an increase in taxes, a firm might well opt for the certainty of a tax benefit now. Second, and more important, the cost-of-capital formula is symmetric--if the incentives are sufficiently great, it requires the government to pay the firm. In reality, most tax systems do not make such payments. This reduces the potential for a tax holiday to result in an increase in the cost of capital.

Even with these reservations, the results in Table 5 are still of interest. They imply that tax holidays do not have a major impact on the cost of capital. This surprising result appears to be due to the fact that most corporate taxes have generous allowances built into them. Another way of expressing this is that the cost of capital is not very responsive to changes in the corporate tax rate. A similar lack of sensitivity occurs when other tax parameters are altered. Where sensitivity does exist is in the specification of the special provisions. In particular, the interaction between inflation and the historic cost depreciation and investment allowances is of critical importance. Indeed, the only possibility for a negative cost of capital arises when

depreciation and investment allowances are so generous as to provide a subsidy--in contrast, reducing the tax parameters merely reduces the degree to which corporate capital is taxed. It is fortunate that the source of the sensitivity lies in these allowances since their value can be determined with a fair degree of accuracy for any given class of capital equipment.

3. Consideration of estimates for sample

In his study, Agell (1982) concluded that the tax structures of the Association of South East Asian Nations (ASEAN) countries were not a major source of investment disincentives. Does this conclusion hold true for the more extended sample employed here? An answer to this question can be found in Table 6 in which are presented, for the complete sample of 31 countries, estimates of the cost of capital, ρ, at a zero rate of inflation; the anticipated rate of inflation, π; and the cost of capital both for ongoing firms, ρ, and pioneer firms, ρ^*, at these anticipated rates of inflation. The cost-of-capital estimates are derived along the lines laid out in the previous section. 1/ Estimates of the expected rate of inflation were obtained by taking an annual average of the actual rate of inflation experienced by the countries over the period 1970-80. This is an admittedly crude measure, particularly so given the possibility that price controls may have been in force in some of the countries.

The conclusion must be that, contra Agell, the actual cost of capital facing some countries in this sample is such that the interaction between their respective tax systems and the rate of inflation is the source of investment disincentives--any value greater than 2 percent implies a positive tax wedge. For several countries, the disincentive effects are pronounced.

A comparison of the cost of capital calculated at the anticipated rates of inflation with the corresponding cost of capital at a zero rate of inflation reinforces a point made in the previous section, namely, that the estimates are sensitive to changes in inflation. The latter set of estimates also demonstrate that, while many countries may have a high nominal rate of corporate income tax, the deductions are such as to leave the cost of capital relatively unaffected at low rates of inflation. Indeed, the large number of values less than two imply that the tax system in many countries subsidizes the cost of

1/ An important reservation to these estimates should ne noted, namely, that they do not incorporate many specific tax incentives such as regional and industry specific grants. For these and other reasons mentioned above, too much stock should not be placed in the absolute values of the estimates. Rather, it is hoped that the ranking implied by the calculations is accurate.

Table 6. Cost of Capital at Zero and Actual Rates of Inflation

(In percent)

	ρ at Zero Rate of Inflation	Anticipated Inflation Rate π	ρ at Anticipated Inflation Rate	ρ* at Anticipated Inflation Rate
Argentina	.46	130.8	-5.85	7.59
Brazil	2.50	36.7	4.50	4.50
Chile	0.80	185.6	-14.44	-14.44
Colombia	2.84	22.0	6.93	6.93
Ecuador	2.47	14.4	-5.91	-5.91
Egypt	1.23	11.5	2.18	2.18
Ghana	-2.15	34.8	19.90	19.29
India	3.59	8.5	3.34	2.53
Indonesia	2.40	20.5	-1.80	2.60
Israel	3.15	39.7	8.40	8.40
Ivory Coast	-3.30	13.2	-2.13	0.98
Jamaica	1.53	17.0	5.39	4.23
Kenya	1.28	11.0	3.36	3.36
Korea	2.91	19.8	7.82	6.60
Malaysia	1.50	7.5	-0.30	0.85
Mexico	0.69	19.3	1.65	1.65
Morocco	2.79	8.1	6.29	3.81
Nigeria	1.72	18.2	6.74	6.74
Pakistan	1.92	13.5	4.53	4.53
Papua New Guina	1.29	8.8	4.11	4.11
Paraguay	2.87	12.4	3.43	3.43
Philippines	1.90	13.2	0.88	0.98
Senegal	2.75	7.6	2.96	2.40
Singapore	-2.90	5.1	-3.20	1.00
Sudan	6.00	15.8	14.33	5.97
Syria	3.93	11.4	8.07	8.07
Thailand	2.00	9.9	1.60	1.11
Trinidad and Tobago	0.86	18.5	1.36	2.25
Tunisia	2.78	7.7	5.09	5.09
Venezuela	2.89	12.1	5.07	5.07
Zaire	2.74	32.2	4.25	3.67

Source: The data were obtained from World Bank, World Development Report, 1982, 1983.

Definition: π: the anticipated inflation rate is assumed to equal the average annual rate of inflation as measured by the implicit gross domestic product deflator for the period 1970-80.

investment at low inflation rates. Again, however, as was pointed out in footnote 2, page 13, the generous deductions implied by this outcome may have been a response to the higher actual rates of inflation experienced by these countries.

4. Regression results

In this section regression results based on the cross-section of countries in the sample are presented with a view to casting some light on the quantitative impact of the cost of capital on investment flows in the sample of developing countries. Given that the results are based on cross-section data drawn from a range of countries rather than on time-series data for individual countries, care must be taken in interpreting the coefficients. It is assumed here that the observations can be interpreted as reflecting the behavior of a representative country; that is, were they all to face the same economic circumstances (e.g., the same cost of capital), every country would exhibit exactly the same response (e.g., the same level of investment). Accordingly, all differences in investment behavior across the sample of countries may be ascribed to differences in their economic circumstances, and the coefficients are, therefore, properly interpreted as gauging long-term effects.

The share of gross domestic investment in gross domestic product for 1980, designated as GDI/GDP, was selected as a dependent variable, a choice dictated by data availability. Unfortunately, the variable includes a number of extraneous components. For example, it includes government investment. This component is unlikely to be responsive to market-determined rates of return. It may be possible to assume that it does not vary systematically across the sample. On the basis of the available empirical evidence, this may not be an overly strong assumption. Thus, Sundararajan and Thakur (1980) find evidence of some short-term crowding out between public and private investment for the case of India, while for Korea they find these two components to be strong complements. Wai and Wong (1982), testing data drawn from a number of countries, find evidence of financial crowding out for some e.g., Malaysia and Mexico) but not to the same degree for others.

In an attempt to circumvent this potential problem, estimates of central government fixed capital formation 1/ were chosen as a proxy for government investment and were netted out of gross domestic investment. The resultant alternative dependent variable is referred to as GDIP/GDP. 2/

1/ Note that this does not include capital formation by public enterprises which may respond to changes in the cost of capital and should, therefore, be part of the dependent variable.

2/ The data used in the regressions are presented in Appendix III.

The dependent variable also includes noncorporate private investment and residential housing. It was argued above that the former poses no serious problems as long as the tax bases for the corporate and noncorporate sectors are similarly defined in the sample countries. The latter, however, could weaken the link between the dependent variable and the cost of capital. Thus, to the extent that the increase in the cost of capital is induced by increases in the expected rate of inflation, investors will have an incentive to substitute assets such as owner-occupied housing for corporate assets. Accordingly, if the cost of capital is an insignificant variable in the regressions below, it may be due to this effect. As a final comment on the specification of this variable, it should be noted that the conventional theoretical justification for employing it--rather than a measure of the private capital stock--comes from the presumed existence of adjustment costs in attaining a desired level of the capital stock (Lucas (1967), Gould (1968), Treadway (1969)).

Turning to a consideration of the independent variables, two alternative estimates of the cost of capital can be used. The first of these, designated ρ, gives estimates of the cost of capital faced by ongoing firms and is presented in Table 6, above. The second, for which no explicit estimates are presented below, substitutes the cost of capital faced by "pioneer" firms where such provisions exist.

As mentioned in the introduction, other variables could influence the level of investment activity in developing countries. A few proxies for these variables are also included as additional regressors. The annual average real growth rate of exports over the period 1970-80, designated as ΔX, is included as a proxy for foreign exchange availability--the more rapid the growth rate, the more likely will funds be available for investment. Note that, to the extent that this is the correct interpretation of the role of this variable, it is measuring a supply rather than a demand effect. Accordingly, it must be argued that the single equation regression results presented below represent a reduced form. Note further that this variable can also be interpreted as an accelerator variable. A more accurate proxy for accelerator effects is provided by the annual average growth rate in gross domestic product (ΔGDP).

As mentioned above, the cost of capital estimates presume that nominal interest rates rise in line with inflation. As pointed out earlier, this is not always so. The rigidity of nominal interest rates in reality, which can be ignored if inflation rates are not too high, may well be a problem for some of the countries in the sample, notably, Argentina and Chile, both of whom experienced annual inflation rates well in excess of 100 percent. The large and negative cost of capital estimates recorded for both of these countries--suggesting a positive correlation between inflation and investment--could be very misleading. Indeed, there may be an independent negative correlation

between inflation and investment. Thus, as McKinnon (1973) observes, the capital market in these countries may be in disequilibrium. As a result of pursuing low interest rate policies, investment funds are rationed with realized investment being less than desired. As a practical matter, this financial repression tends to be more severe the higher the rate of inflation (Galbis, 1979). Accordingly, this suggests that the anticipated rate of inflation, π, may act as a useful proxy for the presence or absence of financial disintermediation and, thus, for the availability of investible funds.

On the matter of the available supply of investible funds, there is a frequently expressed concern that the government sector might "crowd out" private investors. To accommodate this possibility, an additional regressor is defined, namely, the current account balance (without grants), designated hereafter as CAB. This specification of a crowding out variable was chosen rather than some measure of an overall surplus or deficit on the presumption that borrowing on the capital account is productively invested where this investment, as suggested above, is assumed to be neither a substitute nor a complement for private investment.

Since the share of gross domestic investment in gross domestic product can be expected to be influenced by the level of economic development, the 1980 per capita gross national product (Y) of the sample of countries is included as an independent variable. The final independent variable is the share of fuels, minerals, and metals in merchandise exports (Min). This variable is a proxy for the natural resource endowments of the countries under consideration where the relative abundance of these endowments might be expected to influence the investment climate, particularly from the point of view of foreign investors.

Turn now to consider a selection of the more important regression results.

$$(7) \quad \frac{GDI}{GDP} = 14.72 - 0.33\rho + 1.48\Delta GDP + 0.002Y - 0.02Min$$

$$(6.7) \quad (-2.4) \quad (5.3) \quad (2.8) \quad (-0.9)$$

$$\bar{R}^2 = 0.625 \quad F = 13.5 \quad D\text{-}W = 2.21 \quad N = 31$$

The regression is run in linear form. The t-ratios are presented in parentheses below the relevant coefficient. R^2 refers to the adjusted R squared, F to the F ratio, D-W to the Durbin-Watson statistic, and N to the number of observations.

In this regression, the signs of most of the variables are as expected. The accelerator variable, ΔGDP, is positive and significant. Further, per capita gross national product has a positive and significant

coefficient implying that one cannot reject the plausible hypothesis that the more developed the country, the greater the share of gross domestic product devoted to gross domestic investment. The sign of the coefficient of the share of natural resources in exports is of no particular significance given the value of the t-ratio for that variable.

The coefficient on the cost-of-capital variable is negative as predicted, and significant. It is not possible to reject the hypothesis that the interaction between the tax systems of these countries and their anticipated rates of inflation can influence the level of investment. The elasticity value, calculated at the means of the variable, is -0.044. Such a value implies, for example, that if the cost of capital were increased from 3.0 to 4.0, a 33 percent increase, the share of gross domestic investment in gross domestic product would fall by 1.5 percent--a substantial effect. 1/

In view of the potential for the existence of financial repression in some of the countries in the sample, consider the outcome if π, the anticipated rate of inflation, is introduced as a regressor. Specifically, consider:

$$(8) \quad \frac{GDI}{GDP} = 18.16 - 0.54\rho + 1.10\Delta GDP + 0.002Y - 0.068\pi$$

$$(7.44) \quad (-3.61) \quad (3.74) \quad (3.40) \quad (-2.59)$$

$$\bar{R}^2 = 0.693 \quad F = 17.9 \quad D\text{-}W = 2.21 \quad N = 31$$

It appears from this equation that inflation has a significant and strong negative impact on the level of investment (the value of the elasticity is -0.039, which is large given the potential for large changes in inflation). Note, further, that the cost-of-capital variable is still significant but that its coefficient has increased significantly in

1/ Unfortunately, there is no obvious way of expressing this elasticity in terms of changes in the underlying parameters such as a change in the corporate tax rate, τ. This is so because the impact is country-specific, depending on other specifics such as depreciation allowances. To see this, consider equation (4). The derivative of this equation with respect to τ is ambiguous--if the tax system of a given country subsidizes investment through its special provisions, a reduction in the corporate tax rate could increase the cost of capital.

magnitude, suggesting that any elasticity estimates should be treated with caution. 1/

Consider the outcome if GDIP/GDP, the share of gross investment net of gross governmental fixed capital formation in gross domestic product, is the dependent variable. The analogous regression equation to equation (8) above is

$$(9)\quad \frac{GDIP}{GDP} = 13.17 - 0.60\rho + 1.22\Delta GDP + 0.002Y - 0.060\pi$$

$$(4.63)\quad (-3.42)\quad (3.54)\quad (3.12)\quad (-1.96)$$

$$\bar{R}^2 = 0.657 \quad F = 15.4 \quad D\text{-}W = 2.23 \quad N = 31$$

It is clear that, at least for this set of regressors, the change in the dependent variable makes little difference.

Both above regression equations are potentially affected by simultaneous equation bias. Thus, it could be argued that the greater the share of gross domestic investment in gross domestic product, the more rapid the growth rate in gross domestic product. To alleviate the statistical problems posed by this chain, ΔGDP can be replaced with ΔX where the latter variable, as was pointed out above, is a proxy for both accelerator effects and foreign exchange constraints. Also, to test for the possibility that governments may be crowding out private investors, CAB, the governmental current account balance of the countries in the sample, is also introduced into the regression equation. The results corresponding to equations (8) and (9) are, respectively:

$$(10)\quad \frac{GDI}{GDP} = 22.89 - 0.49\rho + 0.43\Delta X + 0.002Y - 0.11\pi + 0.13\ CAB$$

$$(13.11)\quad (-2.81)\quad (3.32)\quad (3.24)\quad (-4.51)\quad (0.93)$$

$$\bar{R}^2 = 0.661 \quad F = 12.68 \quad D\text{-}W = 2.20 \quad N = 31$$

1/ The volatility of the regression coefficients indicates that the independent variables may be multicollinear. Indeed, as can be seen from the correlation matrix presented in Table 9 in Appendix III, the simple correlation between ρ and π is -0.51 which is consistent with the change in the coefficient value of ρ when π is included in the regression (Rao and Miller (1971)). As an aside, note that the negative correlation between ρ and π, a cross-section result, is not inconsistent with the fact that, within any given country, the cost of capital tends to increase with increases in anticipated inflation. As can be seen from Table 9, the positive correlation is due to the inclusion of Argentina and Chile whose cases, as pointed out on page 20, are extreme.

$$(11)\quad \frac{GDIP}{GDP} = 18.40 - 0.56\rho + 0.56\Delta X + 0.002Y - 0.11\pi + 0.008\ CAB$$

$$(9.94)\quad (-3.02)\quad (4.08)\quad (3.36)\quad (-4.30)\quad (0.05)$$

$$\bar{R}^2 = 0.686 \qquad F = 14.12 \qquad D\text{-}W = 1.89 \qquad N = 31$$

It is clear that this measure of crowding out has no effect on the results. Again, the cost of capital and the inflation variables both continue to be significant with the coefficient of the latter having increased substantially.

All of the above indicates that the cost of capital may have a significant impact on investment levels in developing countries. However, it should also be noted that the other variables, and in particular ΔX and π, both of which are proxies for a number of important nonneoclassical effects, are also significant, which at least raises the question of which is the most promising path for policy to take. Further, there is also the possibility that the results are sensitive to the choice of countries in the sample. As a partial test of this possibility, the regressions were rerun with Argentina and Chile excluded. These two countries were chosen on account of their high rates of inflation and the concomitant possibility that the resulting financial disintermediation has not been adequately accounted for by the inclusion of π as a regressor. The analogous regression equations to (8) and (9) are:

$$(12)\quad \frac{GDI}{GDP} = 25.51 - 0.27\rho + 0.46\Delta X + 0.003Y - 0.37\pi$$

$$(16.32)\quad (-1.58)\quad (4.13)\quad (4.54)\quad (-4.24)$$

$$\bar{R}^2 = 0.759 \qquad F = 23.09 \qquad D\text{-}W = 2.10 \qquad N = 29$$

$$(13)\quad \frac{GDIP}{GDP} = 19.87 - 0.36\rho + 0.60\Delta X + 0.003Y - 0.28\pi$$

$$(10.88)\quad (-1.82)\quad (4.57)\quad (3.87)\quad (-2.83)$$

$$\bar{R}^2 = 0.734 \qquad F = 20.32 \qquad D\text{-}W = 1.84 \qquad N = 29$$

It is clear that some of the coefficient estimates are volatile. In particular, the cost-of-capital coefficient is reduced in magnitude and is no longer as significant. Further, the magnitude of the impact of inflation on investment levels has increased--the elasticity of the effect in equation (12) is 0.25. Part of the reason for this volatility can be seen in the correlation matrix where the correlation coefficient is now positive at 0.43. This not only reinforces the impression that the observations on Argentina and Chile are extreme outliers, but also suggests that there is still some multicollinearity between the regressors. This multicollinearity might be responsible for the reduction

in the significance of the cost-of-capital variable, though, as pointed out above, the reason could also lie in the fact that the dependent variable includes investments made in noncorporate assets such as owner-occupied housing. Be that as it may, these results should temper any strong policy conclusions concerning the effectiveness of tax reform proposals. Indeed, they suggest, if anything, that more attention should be paid to the role of inflation since increases in the anticipated inflation appear to affect adversely the level of investment via a number of channels; that is, not only do increases in anticipated inflation interact with the tax system to increase the cost of capital, but they may also directly affect the level of investment by inducing financial disintermediation. In addition, given the significance of ΔX, the growth rate of exports, the results also suggest that policymakers should concentrate on alleviating distortions which might result in foreign exchange shortages.

Finally, it should be noted that the regressions were rerun, replacing ρ with ρ^*. The results, not presented here, suggested a weaker link between the cost of capital and investment levels. This is not surprising given some of the assumptions underlying the specification of ρ^* (see page 16, above).

IV. Conclusions

The tentative nature of the results must be emphasized. The regressions are based on cross-sectional data, whereas tax reform proposals for any given country should more properly be based on empirical work (time series) drawn from that country. However, even given these reservations, the results are suggestive. Thus, it could well be the case that to concentrate on taxes as the primary source of economic inefficiency in a developing country's economic system is too narrow. The regression results indicate that investment levels are influenced by a number of other factors and, in particular, by the rate of inflation and the availability of foreign exchange as gauged by ΔX. This lends support to the approach adopted in the World Bank's World Development Report, 1983 where it is argued that if one takes a broad definition of price distortions, then one observes a strong negative correlation between this index and the economic performance of developing countries. Further, if concern should properly be directed at this broader measure, then, as pointed out by Tanzi (1982), given the nature of the political process in many developing countries, radical reform may not be easy to implement; that is, not only are the simplistic tax reform proposals of the pure supply-side approach inadequate, but the appropriate reform proposals may not be politically feasible. For example, given the underdeveloped institutional framework in place in many developing countries, the admonition that they reduce

Even though this all suggests that supply-side based tax reform proposals are only of limited use, this is not to say that they should be ignored. The results do suggest that the provisions of developing country tax structures may well interact with their respective personal tax systems and changes in anticipated inflation to influence investment activity. This implies that the effective tax on capital may be subject to arbitrary changes which is hardly desirable. Therefore, given the particular sensitivity of the cost-of-capital calculations to the specification of the depreciation allowances, an obvious tax reform proposal would be to recommend the indexation of such allowances. An alternative strategy, which has the merits of being administratively more simple, would be to disallow the deductibility of interest payments on debt and to permit the expensing of all investment. The resulting corporate tax structure would define its tax base in terms of a company's cash flow and would be neutral as far as changes in inflation are concerned. At a minimum, the authorities of those countries in which indexation is not allowed should be aware of the interactions which recur between tax systems and inflation.

Selection of Developing Country Sample

The sample was chosen with a view to ensuring that it would both contain a sufficient number of observations and cover a broad range of developing country experience. The list of countries selected is presented in Table 7. This table presents estimates of the share of total tax revenue (TTR) in the gross domestic products of the selected countries. It is clear that this share exhibits significant variation. It ranges from a high of 36 percent in the case of Israel to a low of 10 percent for Ecuador. (It should be noted as an aside that the significance of these shares varies in importance from one country to another depending on the share of gross domestic product that is generated in the monetary economy. If the monetary sector of an economy is small, then even though the share of tax revenue in gross domestic product might appear to be small, as a share of monetized output it would be larger, implying higher marginal tax rates. One of the advantages of the cost-of-capital approach is that it attempts to calculate the effective tax rates faced in the monetized sector, avoiding this problem.)

Table 7 also gauges the degree to which the selected countries rely on direct taxes (IT), domestic taxes on goods and services (DT), import duties (MT), and export taxes (XT) for their sources of revenue. Again, there is considerable variation. Further, the data confirm what is already well known, namely, that many developing countries do not use individual income taxes to a great degree. This becomes more obvious when it is recognized that those developing countries which happen to rely heavily on direct taxation typically do so because they are taxing a natural resource through their corporate tax rather than individuals through their income tax. For example, Nigeria's Petroleum Profits Tax accounts for 89 percent of direct tax revenue, while Venezuela's corresponding Oil Tax accounts for 84 percent, and Papua New Guinea's tax on the Bougainville Copper Mine for 31 percent of their respective direct tax revenues. There is an important caveat to Table 7. The figures presented only take account of taxes levied by central governments. For some countries, taxes raised at the state and regional levels are important. For example, for Argentina, these taxes are equal to 55 percent of central government tax revenues. The corresponding figures for Brazil, India, Mexico, and Pakistan are 30, 45, 21, and 24 percent, respectively. Finally, it should be noted that many countries use local property taxes as well. However, since income taxes tend to be levied primarily at the national level, this caveat does not have a direct bearing on the cost-of-capital calculations. An important exception is Nigeria. While it does have a national income tax, the tax both is the responsibility of, and also is levied at, the state level. This is allowed for in the calculations presented below.

Table 7. Some Tax Characteristics of Sample Countries

(In percent)

	TTR/GDP	IT/TTR	DT/TTR	MT/TTR	XT/TTR
Argentina	15.14	4.93	34.27	9.98	0.94
Brazil	16.68	18.01	28.97	3.47	1.89
Chile	25.15	20.82	49.00	6.56	—
Colombia	11.58	25.68	23.16	13.64	16.40
Ecuador	10.36	48.14	19.45	27.22	1.64
Egypt	25.87	19.41	21.22	29.69	—
Ghana	11.77	21.98	30.28	13.15	33.72
India	10.47	9.75	50.30	24.49	0.99
Indonesia	20.84	82.02	9.09	4.53	3.08
Israel	35.88	47.22	28.54	4.12	—
Ivory Coast	20.60	13.94	27.08	35.12	11.14
Jamaica	20.97	28.22	53.25	4.54	—
Kenya	21.07	33.28	44.37	19.85	1.36
Korea	16.68	25.50	52.44	17.19	—
Malaysia	20.89	39.02	22.16	16.07	20.59
Mexico	14.96	38.65	30.72	7.55	21.33
Morocco	21.72	21.99	39.65	21.98	1.43
Nigeria	22.09	79.81	2.85	17.11	0.07
Pakistan	13.22	16.80	40.99	38.79	1.43
Papua New Guinea	17.27	61.87	15.89	18.24	3.21
Paraguay	10.92	14.57	20.67	21.55	0.80
Philippines	11.48	27.12	41.68	2.55	1.39
Senegal	20.68	20.13	32.70	41.57	2.32
Singapore	17.98	47.03	22.86	9.94	—
Sudan	12.06	17.24	31.12	48.73	2.11
Syria	10.67	24.67	13.42	33.65	2.61
Thailand	12.77	21.84	50.78	22.14	3.17
Trinidad and Tobago	30.41	82.07	6.00	8.94	—
Tunisia	24.88	18.78	30.63	30.51	17.51
Venezuela	21.52	80.72	5.00	7.76	—
Zaïre	19.82	34.84	14.23	23.46	20.61

Source: The data were obtained from the International Monetary Fund, GFS Yearbook, Vol. VI (1981).

The variables are defined as follows:

TTR = total tax revenue (category IV);
IT = tax on income, profits, capital gains (category 1);
DT = domestic taxes on goods and services (category 5);
MT = import duties (category 6.1);
XT = export duties (category 6.2);
GDP = gross domestic product (calculated on fiscal year basis).

The data are for the most recent year available in each case.

A. Calculation of Effective Corporate Taxation Rates for Economies with Partial Tax Holidays

1. India

An investment in period 0 yields a nominal income stream which depreciates over time at rate

$$\int_0^\infty e^{-(\delta-\pi)} dt \tag{1A}$$

India applies a statutory rate, τ, to the income stream so that 25 percent of profits are exempt for eight years, yielding a present value of expected tax payments equal to

$$T = \int_0^8 3/4\tau e^{-(\delta-\pi)t} e^{-(s+\pi)t} dt + \int_8^\infty \tau e^{-(\delta-\pi)t} e^{-(s+\pi)t} dt \tag{2A}$$

where nominal tax payments are discounted by the required nominal rate of return.

The effective tax rate, τ^*, is that tax rate which, if applied to the same income stream at a uniform rate from period 0, would yield the same present value of expected tax payments. Thus, set

$$\int_0^\infty \tau^* e^{-(\delta-\pi)t} e^{-(s+\pi)t} dt = T \tag{3A}$$

and solve for τ^*. It follows that

$$\tau^* = 3/4\tau + 1/4\tau e^{-(s+\delta)8} \tag{4A}$$

where $s + \delta = 0.225$ and τ is taken to equal 55 percent. Hence, $\tau^* = 46.5$ percent.

2. Korea

Korea grants a complete tax holiday for four years followed by a halving of corporate tax liabilities for a subsequent two years. Following a procedure analogous to that above yields

$$\int_0^\infty \tau^* e^{-(\delta+s)} dt = 1/2\int_4^6 \tau e^{-(\delta+s)t} dt + \int_6^\infty \tau e^{-(\delta+s)t} dt \tag{5A}$$

which implies, for $\delta + s = 0.225$ and $\tau = 0.396$, that $\tau^* = 0.196$.

B. Cost-of-Capital Formula with Indexed Depreciation Allowances

Indexed depreciation allowances imply that the term measuring the tax value of depreciation allowances in equation (1), namely, $\tau a e^{-at}$ should be replaced by $\tau a e^{-(a-\pi)\tau}$. If the additional assumption of $\delta = a$ is made, which is approximately correct for Argentina, then substituting the resulting modified equation (1) together with equation (2) into equation (3) results in

$$(4') \quad \rho = ih + \frac{(s+\pi)n}{(1-\tau)(1-M_D)} + \frac{(s+\pi)}{(1-\tau)(1-M_G)}\left[i-h-n-\tau G\right] - \frac{\tau G(\delta-\pi)}{1-\tau} - \frac{\pi}{1-\tau}$$

This is the expression which is relevant for the case of countries such as Argentina. Note that some countries, notably Israel and Mexico, allow indexation of depreciation allowances but the enabling legislation for this was so recent that it does not enter the cost-of-capital calculations in this paper.

Table 8. Data for Regression Analysis

	GDI/GDP	GDIP/GDP	ΔX	Min	ΔGDP	Y	CAB
Argentina	26	21.3	9.3	2	2.2	2,390	1.18
Brazil	22	21.3	7.5	11	8.4	2,050	1.88
Chile	18	16.1	10.9	59	2.4	2,150	6.94
Colombia	25	22.2	1.9	4	5.9	1,180	1.97
Ecuador	25	23.6	7.5	46	8.8	1,270	0.94
Egypt	31	25.8	-0.7	47	8.1	580	-1.39
Ghana	5	-0.9	-8.4	16	-0.1	420	-3.00
India	23	22.5	3.7	8	3.6	240	0.20
Indonesia	22	15.7	8.7	69	7.6	430	11.11
Israel	22	21.4	9.6	2	4.1	4,500	-16.41
Ivory Coast	28	22.0	4.6	5	6.5	1,150	3.98
Jamaica	16	7.5	-6.8	31	-1.1	1,040	-2.26
Kenya	22	16.2	-1.0	21	6.5	420	1.98
Korea	31	29.6	23.0	1	9.5	1,520	3.10
Malaysia	29	26.0	7.4	29	7.8	1,620	4.42
Mexico	28	24.0	13.4	39	5.2	2,090	3.93
Morocco	21	10.6	2.1	44	5.6	900	0.51
Nigeria	24	15.7	2.6	91	6.5	1,010	9.45
Pakistan	18	15.0	1.2	7	4.7	300	0.97
Papua New Guinea	27	22.0	2.0	46	2.3	780	-9.15
Paraguay	29	26.4	7.1	1	8.6	1,300	4.34
Philippines	30	28.8	7.0	18	6.3	690	3.76
Senegal	15	13.4	1.2	29	2.5	450	1.80
Singapore	43	38.9	12.0	27	8.5	4,430	9.10
Sudan	12	5.4	-5.7	4	4.4	410	0.35
Syria	25	19.1	6.8	74	10.0	1,340	-3.45
Thailand	27	23.6	11.8	12	7.2	670	-0.23
Trinidad and Tobago	28	20.5	-2.8	91	5.1	4,370	18.47
Tunisia	28	22.7	4.8	52	7.5	1,310	9.20
Venezuela	25	23.2	-6.7	98	5.0	3,630	9.11
Zaïre	11	8.4	2.2	56	0.1	220	-4.83

Sources: GDI, ΔX, Min, ΔGDP, Y, were obtained from World Bank, World Development Report, 1982, 1983.

Estimates of gross fixed capital formation of central government were obtained from the International Monetary Fund, Government Financial Statistics Yearbook, 1982. The most recent share available was used. For Colombia and Syria, capital expenditure estimates were used. The information for Trinidad and Tobago, Indonesia, Ecuador, and Argentina were obtained from the most recent relevant IMF RED. CAB was obtained from the International Monetary Fund, Government Financial Statistics Yearbook, 1982. The data for 1980 or the most recent year available were used. The data for Ecuador came from the most recent IMF RED.

The variables are defined as follows:

GDI/GDP: share of gross domestic investment in gross domestic product for 1980.

GDIP/GDP: share of gross domestic investment less government fixed capital formation in gross domestic product.

ΔX: average annual growth rate of exports over the period 1970-80.

Min: share of fuels, minerals, and metals in merchandise exports, 1979.

ΔGDP: average annual growth rate of gross domestic product over the period 1970-80.

Y: per capita gross national product, 1980.

CAB: Current Account Balance of Consolidated Central Government as a share of GDP.

Table 9. Correlation Matrix

N = 31

	ρ	ΔX	Y	CAB	π
ρ	1.0				
ΔX	-0.45	1.0			
Y	-0.23	0.20	1.0		
CAB	-0.35	0.03	0.22	1.0	
π	-0.51	0.22	0.20	0.02	1.0

N = 29

	ρ	ΔX	Y	CAB	π
ρ	1.0				
ΔX	-0.40	1.0			
Y	-0.17	0.17	1.0		
CAB	-0.36	0.01	0.21	1.0	
π	0.43	-0.20	0.17	-0.34	1.0

Note: N = 29 refers to the correlation matrix when Argentina and Chile were excluded.

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