CHANNELING DOMESTIC SAVINGS INTO PRODUCTIVE INVESTMENT UNDER ASYMMETRIC INFORMATION: THE ESSENTIAL ROLE OF FOREIGN DIRECT INVESTMENT

Assaf Razin
Efraim Sadka
Chi-Wa Yuen

Working Paper **6338**

NBER WORKING PAPER SERIES

CHANNELING DOMESTIC SAVINGS INTO PRODUCTIVE INVESTMENT UNDER ASYMMETRIC INFORMATION: THE ESSENTIAL ROLE OF FOREIGN DIRECT INVESTMENT

Assaf Razin
Efraim Sadka
Chi-Wa Yuen

Working Paper 6338
http://www.nber.org/papers/w6338

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 1997

We thank seminar participants at the University of Chicago for helpful comments. The usual disclaimer applies. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

Channeling Domestic Savings into Productive Investment under Asymmetric Information: The Essential Role of Foreign Direct Investment
Assaf Razin, Efraim Sadka and Chi-Wa Yuen
NBER Working Paper No. 6338
December 1997
JEL Nos. F21, F35, H25, H30

ABSTRACT

Foreign direct investment (FDI) is observed to be a predominant form of capital flows to low and middle income countries with insufficiently developed capital markets. This paper analyzes the problem of channeling domestic savings into productive investment in the presence of asymmetric information between the managing owners of firms and other portfolio stakeholders. We emphasize the crucial role played by FDI in sustaining equity-financed capital investment for economies plagued by such information problems. Similar problems also exist for foreign portfolio debt flows. The paper identifies how, in the presence of information asymmetry, different capital market structures may lead to foreign over- or under-investment and to domestic under- or over-saving, and thus to inefficient equilibria. We show how corrective tax-subsidy policies consisting of taxes on corporate income and on the capital incomes of both residents and nonresidents can restore efficiency.

Assaf Razin
Eitan Berglas School of Economics
Tel Aviv University
Tel Aviv 69978
ISRAEL
and NBER
razin@econ.tau.ac.il

Efraim Sadka
Eitan Berglas School of Economics
Tel Aviv University
Tel Aviv 69978
ISRAEL

Chi Wa-Yuen
School of Economics and Finance
University of Hong Kong
Pokfulam Road
HONG KONG
cwyuen@econ.hku.hk

I. Introduction

Capital flows typically consist of foreign direct investment (FDI), portfolio equity and debt investment, commercial lending, and official flows. Using data from the World Bank's World Debt Tables, Figures 1 and 2 show the experience of low and medium income countries during the period 1980-95 (see Chen and Kahn (1997)). There are two notable features in these figures. One is the significance of FDI over the entire period (especially towards the latter part of this period), and the other is the emerging importance of portfolio equity flows in the 1990s. The emergence of and the rise in these equity flows appear to be positively correlated with the rise in the share of FDI in the capital flows total. While the existence of well-developed capital markets is necessary for equity flows, FDI flows may exist also when these markets are not mature. This may explain why FDI flows tend to precede and dominate equity flows from developed to developing countries.

In a formal sense, foreign acquisition of shares in domestic firms is classified as FDI when the shares acquired exceed a certain fraction of ownership (usually, 10-20%). From an economic perspective, however, FDI is not just a purchase of a sizable share in a company but, more importantly, an actual exercise of control and management. It therefore enables the acquiring firms to obtain better access to information about the acquired firm's current and potential performance than what is available to an outsider.

Generally, there is a significant asymmetry in information between the managing stockholders (owner-managers) and other portfolio stakeholders (such as the equity and debt holders).[1] This asymmetry causes a severe market failure which can be devastating in the case of equity-financed capital investment. In such case, the equity market will collapse to a "lemon" market *a la* Akerlof (1970) and no financing will be provided for capital

[1]Here, we abstract from the principal-agent problems that may exist between owners and managers.

investment. We show here that FDI has an essential role to play in restoring the function of an equity market for capital investment. Admittedly, such a market will not be fully efficient because it leads to foreign over-investment and domestic under-saving. But we show how a corrective tax-subsidy policy consisting of taxes on corporate income and on the capital incomes of both residents and nonresidents can restore full efficiency.

In the absence of FDI, capital investment can only be financed domestically or internationally via debt issue. In this case, there will also exist inefficiencies, with foreign over-investment and domestic over-saving. As with FDI, we show how efficiency can be restored fully through corrective taxes/subsidies.

Note the different nature of the inefficiencies between the laissez faire FDI and (domestic and foreign) debt regimes. While both regimes will result in foreign over-investment, the former involves domestic under-saving while the latter involves domestic over-saving. In the absence of corrective policies, therefore, we cannot presume that one regime dominates the other. To study the growth implications of these inefficiencies, we also consider the effects of asymmetric information on long term capital accumulation under the two capital market (i.e., FDI-equity vs. debt) regimes.

The organization of the paper is as follows. Section II describes the nature of the information asymmetry, develops an FDI-equity model, analyzes the nature of the inefficiencies under laissez faire, and derives a corrective policy package. We study similar problems in Section III in the context of a debt model, and discuss the gains from international trade (capital mobility). Section IV extends the analysis to a dynamic growth context so as to examine the implications of information asymmetry for short run growth and long run capital accumulation under the FDI-equity and debt regimes. Concluding remarks are provided in Section V.

II. Foreign Direct Investment and Equity Finance

In this section and the next, we assume a two-period model of a small, capital-importing country, referred to as the home country. In this section, it is assumed that capital imports are channelled solely through foreign direct investment (FDI) and/or equity flows. The economy is small enough that, in the absence of any government intervention, it faces a perfectly elastic supply of external funds at a given risk-free world rate of interest, r^*. This r^* is assumed to be lower than the domestic net marginal productivity of capital in the absence of capital flows, so that there could be welfare gains from capital imports.

We follow Gordon and Bovenberg (1996) and Razin, Sadka, and Yuen (1997a) in modelling the risk in this economy. Suppose there is a very large number (N) of *ex ante* identical domestic firms. Each firm employs capital input (K) in the first period in order to produce a single composite good in the second period. We assume that capital depreciates at the rate δ. Output in the second period is equal to $F(K)(1+\varepsilon)$, where $F(.)$ is a production function exhibiting diminishing marginal productivity of capital and ε is a random productivity factor. The latter has zero mean and is independent across all firms. (ε is bounded from below by -1, so that output is always nonnegative.) Given the very large size of N and the independence of ε across firms (which allow for complete diversification of such idiosyncratic risks through risk pooling), consumer-investors will behave in a risk-neutral way.

In the first period, firms commit their investment in the planning stage while the actual investment and its funding are delayed to the implementation stage. Investment decisions are made by the firms before the state of the world (i.e., ε) is known. Since all firms face the same probability distribution of ε, they all choose the same level of investment. They then seek funds, either at home or abroad, to finance the investment. At this stage, the owner-managers of the firms are better informed than the outside fund-suppliers (both foreign and domestic). There are many ways to specify the degree of this asymmetry in information. In order to facilitate the analysis, however, we simply assume that the owner-managers, being "close to the action", observe ε before they make their financing decisions; but the fund-providers, being "far away from the action", do not.

Evidently, this information asymmetry will give rise to market failures, which call for corrective taxation. Throughout this paper, we consider three tax/subsidy instruments: a corporate income tax (at the rate θ), a tax on the capital income of the residents (at the rate τ), and a tax on the capital income of the nonresidents (at the rate τ^*). Government spending is assumed to be zero in both periods, and lump-sum taxes are used to finance these distortionary subsidies/taxes. For simplicity, we further assume that the foreign (capital-exporting) country is tax-free.

In the case where investment is equity-financed, the original owner-managers observe ε while the new potential shareholders of the firm do not. The market will be trapped in the "lemon" situation described by Akerlof (1970). At the price offered by the new (uninformed) potential equity buyers, which reflects the average productivity of all firms (i.e., the average level of ε) in the market, the owner-manager of a firm experiencing a higher-than-average value of ε will not be willing to sell its shares and will pull out of the market completely. By recursive application of this argument to the remaining lower-than-average-productivity firms, the equity market will totally collapse. With such market breakdown, the firms' investment cannot be equity-financed. We therefore turn to consider another source of equity finance—viz., international capital flows in the form of foreign direct investment (FDI).

In a formal sense, foreign acquisition of shares in domestic firms is classified as FDI when the shares acquired exceed a certain fraction of ownership (say, 10-20%). From an economic point of view, we look at FDI not just as ownership of a sizable share in a company but, more importantly, as an actual exercise of control and management and acquisition of inside information (the value of ε in our model).

Suppose that foreign direct investors purchase domestic companies from scratch, at the "greenfield" stage, i.e., before any capital investment is made. For the sake of simplicity and in order to focus on FDI, we ignore, with no loss of generality, all other sectors of the economy in which information is symmetric, and assume that foreign direct investors acquire all the greenfield investment sites.

II.1 The FDI-Equity Equilibrium

Upon acquisition and before ε is known, these foreign investors make their capital investment decisions. The realized value of ε is then revealed to them, but not to the potential new equity-holders who are solicited to finance the capital investment.[2] Being unable to observe ε, domestic investors will offer the same price for all firms reflecting the average productivity for the group of low productivity firms they purchase. On the other hand, the foreign direct investors who do observe ε will not be willing to sell at this price the firms which experience high values of ε. Therefore, there will be a cutoff level of ε, say ε^0, such that all firms which experience a lower value of ε than the cutoff level will be purchased by domestic investors. All other firms will be retained by the foreign direct investors.

Define e^- as the mean value of ε realized by the low productivity firms:

$$e^- \equiv E\,(\varepsilon \,/\, \varepsilon \leq \varepsilon^0), \tag{1}$$

i.e., e^- is the conditional expectation of ε, given that $\varepsilon \leq \varepsilon^0$. For later use, we also define by e^+ the conditional expectation of ε, given that $\varepsilon \geq \varepsilon^0$:

[2] In principle, the FDI investors could finance 100% of their investment using their own funds. In that case, the domestic savers have no choice but invest their savings abroad (at a lower rate of return r^*) in the absence of domestic financial markets.

$$e^{+} \equiv E\,(\varepsilon \,/\, \varepsilon \geq \varepsilon^{0}). \tag{2}$$

Note that the weighted average of e^{-} and e^{+} must yield the average value of ε that is:

$$\Phi(\varepsilon^{0})e^{-} + [1-\Phi(\varepsilon^{0})]e^{+} = E(\varepsilon) = 0, \tag{3}$$

where $\Phi(.)$ is the cumulative probability distribution of ε, i.e., $\Phi(\varepsilon^{0}) = \text{Prob}(\varepsilon \leq \varepsilon^{0})$. Equation (3) also implies that $e^{-} < 0$ while $e^{+} > 0$, i.e., the expected value of ε for the "bad" ("good") firm is negative (positive).

The cutoff level of ε is then defined by

$$[(1-\theta)F(K)(1+e^{-}) + (1-\delta)K] \,/\, (1+r)$$
$$= [(1-\theta)F(K)(1+\varepsilon^{0}) + (1-\delta)K] \,/\, [1+r^{*}/(1-\tau^{*})], \tag{4}$$

where r is the domestic rate of interest. The value of a typical domestic firm in the second period is equal to its output minus corporate profit taxes plus the undepreciated capital, i.e., $(1-\theta)F(K)(1+\varepsilon) + (1-\delta)K$.[3] Since domestic equity investors will buy only those firms with $\varepsilon \leq \varepsilon^{0}$, the expected second-period value of a firm they buy is $(1-\theta)F(K)(1+e^{-}) + (1-\delta)K$, which they then discount by the factor $1+r$ [$= 1+(1-\tau)r$ for $\tau = 0$] to determine the price they are willing to pay in the first period.[4] At equilibrium, this price is equal to the price that a foreign direct investor is willing to accept for the firm which experiences a productivity value of ε^{0}. The cutoff price is equal to the expected value of the marginal ε_0-firm, $(1-\theta)F(K)(1+\varepsilon^{0}) + (1-\delta)K$, discounted at the rate of $1+r^{*}/(1-\tau^{*})$. Firms that experience a value of ε higher than ε^{0} are retained by the foreign direct investors. This explains the equilibrium condition (4).

---

[3]Strictly speaking, the corporate tax rate (θ) should apply to profits, $F(K)-\delta K$, i.e., output minus depreciation, and not to output, $F(K)$. However, there is a one-to-one correspondence between the tax base $F(K)-\delta K$ and the tax base $F(K)$. The tax rates corresponding to these two tax bases are naturally different.

[4]In this equity finance model, all borrowing/lending transactions, if any, take place among consumers or between consumers on the one hand and the government on the other. Therefore, the tax on domestic capital income τ drives no wedge between the consumer-savers and the firms. For simplicity, we set τ equal to zero in this section.

As $e^- < \varepsilon^0$, an interior equilibrium (i.e., $-1 < \varepsilon^0 < 1$) requires that the foreigners' rate of return ($r^*/(1-\tau^*)$) be higher than the residents' rate of return (r). In some sense, this means that domestic investors are "overcharged" by foreign direct investors for their purchases of domestic firms. These foreign investors will not accept a price below $[(1-\theta)F(K)(1+\varepsilon^0)+(1-\delta)K]/[1+r^*/(1-\tau^*)]$ for the low productivity firms. Note the crucial role of FDI in allowing for an international rate-of-return differential (viz., $r^*/(1-\tau^*) > r$). This differential is essential for the existence of an equity market. In an autarkic situation without FDI, there cannot exist a rate-of-return differential between the original owner-managers and potential equity buyers. Without this differential, the market will collapse to one of "lemons" and there will be no financing for capital investment.

Consider the capital investment decision of the firm that is made before ε becomes known while it is still owned by foreign direct investors. The firm seeks to maximize its market value, net of the original investment. With a probability $\Phi(\varepsilon^0)$, it will be sold to domestic investors, who pay $[(1-\theta)F(K)(1+e^-)+(1-\delta)K]/(1+r)$. With a probability $[1-\Phi(\varepsilon^0)]$, it will be retained by the foreign investors, for whom it is worth $[(1-\theta)F(K)(1+e^+)+(1-\delta)K]/[1+r^*/(1-\tau^*)]$. Hence, the firm's expected market value, net of the original capital investment, is

$$E[V(K_0)] = -[K-(1-\delta)K_0] + \Phi(\varepsilon^0)[(1-\theta)F(K)(1+e^-)+(1-\delta)K]/(1+r) + [1-\Phi(\varepsilon^0)][(1-\theta)F(K)(1+e^+)+(1-\delta)K]/[1+r^*/(1-\tau^*)], \tag{5}$$

where $K-(1-\delta)K_0$ is gross investment and K_0 is the initial stock of capital. Maximizing this expression with respect to K yields the following first-order condition:

$$\Phi(\varepsilon^0)[(1-\theta)F'(K)(1+e^-) + (1-\delta)] / (1+r) + [1-\Phi(\varepsilon^0)][(1-\theta)F'(K)(1+e^+) + (1-\delta)] / [1+r^*/(1-\tau^*)] = 1 . \tag{6}$$

Since the firm knows, when making its capital investment decision (while it is still under the complete ownership of foreign direct investors), that it will be sold to domestic investors at a "premium" under low-productivity events, it tends to over-invest relative to the rate of return to foreign investors and under-invest relative to the rate of return to domestic investors, i.e.,

$$r < (1-\theta)F'(K)-\delta < r^*/(1-\tau^*). \tag{7}$$

A formal proof of these inequalities is provided in Appendix A.

The (maximized) value of V in (5) is the price paid by the foreign direct investors at the greenfield stage of investment. Since the value of ε is not known at this point, the same price is paid for all firms. Thus,

$$FDI = N\{\beta[K-(1-\delta)K_0] + V\}, \tag{8}$$

where β is the fraction of firms with foreign finance.

The remainder of the equilibrium conditions is standard. In the first period, the economy faces a resource constraint, stating that FDI must suffice to cover the difference between domestic investment (viz., $N[K-(1-\delta)K_0]$) and national savings (viz., difference between the first period output and consumption, $NF(K_0)-c_1$):

$$FDI = N[K-(1-\delta)K_0] - [NF(K_0) - c_1]. \tag{9}$$

No matter what taxes are levied by the home country on FDI, foreigners will be able to extract from the home country an amount of $1+r^*$ units of output in the second period for each unit that they invest in the first period. Therefore, the home country faces the following second-period budget constraint:[5]

$$NF(K) + (1-\delta)NK - FDI(1+r^*) = c_2. \tag{10}$$

That is, the second period gross *national* output ($NF(K)-FDI(1+r^*)$) plus the undepreciated capital ($(1-\delta)K$) must suffice to support private consumption (c_2). Employing (9), one can rewrite (10) in present value terms as

---

[5]Note that aggregate output is $\Sigma_{i=1}^{N}F(K^i)(1+\varepsilon^i)] = NF(K)$, since $K^i = K$ for all i and $\Sigma^i \varepsilon^i = 0$.

$$N[F(K_0)+(1-\delta)K_0] + N[F(K)+(1-\delta)K]/(1+r^*) = c_1 + c_2/(1+r^*) + NK. \qquad (11)$$

Naturally, c_1 and c_2 are determined by utility-maximizing consumers. The government budget constraint is satisfied via lump-sum taxes/transfers.

II.2 Optimal Corrective Taxes under FDI-Equity Finance

Pareto efficiency requires fulfillment of two conditions. First, there must be aggregate production efficiency in the sense that the net-of-depreciation marginal product of capital at home (i.e., $F'(K)-\delta$) be equated to the international cost of capital (i.e., r^*):

$$F'(K) - \delta = r^*. \qquad (12)$$

Second, there must be production-consumption efficiency in the sense that the net marginal product of capital (i.e., $F'(K)-\delta$) be equated to the consumers' willingness to substitute future consumption for present consumption (which is equated to $(1-\tau)r$ by the utility-maximizing consumers), namely:

$$F'(K) - \delta = (1-\tau)r. \qquad (13)$$

Since τ is irrelevant and hence set to zero for simplicity in this section (see footnote 4), equations (12) and (13) together imply that

$$F'(K) - \delta = r^* = r. \qquad (14)$$

A comparison between the equilibrium condition (7) and the Pareto efficiency condition (14) describes the optimal tax-subsidy package:

$$\theta < 0, \qquad (15)$$

and

$$\tau^* > 0. \qquad (16)$$

That is, it is Pareto-efficient to subsidize corporate income and tax the capital income of the nonresidents.

The rationale behind this result is as follows. In the absence of taxes, the equilibrium condition (7) becomes

$$r \; < \; F'(K) - \delta \; < \; r^{*}.$$

That is, since the foreign direct investor knows, when making her capital investment decision, that she will be able to overcharge domestic investors in low-productivity events, she will over-invest relative to the home country's international cost of capital (i.e., $F'(K) - \delta < r^{*}$). Therefore, a tax on the capital income of the nonresidents will raise their pre-tax required rate of return (i.e., $r^{*}/(1-\tau^{*})$) and curtail their over-investment. On the other hand, being overcharged, domestic investors will tend to save less and supply less funds to the firm, thus resulting in domestic under-saving (i.e., $F'(K) - \delta > r$). A subsidy to corporate income will help boost domestic savings.

In sum, in the presence of asymmetric information between the original owner-managers and potential equity buyers, autarky leads to an extreme market failure *a la* Akerlof (1970): there exists no vehicle to channel domestic savings to productive investment. FDI flows are essential to finance capital investment if internal finance by domestic firms is infeasible (due to, say, financial constraints).

III. Debt Finance

An alternative source of finance to the FDI-cum-equity finance is to have domestic firms borrow from foreign banks and other lenders. We assume the same information structure and sequencing of investment and financing decisions as before. As in Stiglitz and Weiss (1981), a firm may choose to default on its debt if its future cash flow falls short of its accumulated debt.[6] Given its investment decision, a firm will thus default on its debt if the realization of its random productivity factor is low so that its output plus undepreciated capital, $F(K)(1+\varepsilon) + (1-\delta)K$, is smaller than its debt commitment $[K-(1-\delta)K_0](1+r)$. Hence, there is a cutoff value ε^0, such that all the $N\Phi(\varepsilon^0)$ firms which realize a value of ε below ε_0 default and all the other $N[1-\Phi(\varepsilon^0)]$ firms (i.e., firms with $\varepsilon > \varepsilon^0$) fully repay their debts and remain solvent. This cutoff level of ε (possibly different from the ε^0 in the FDI-equity case) is defined by

$$F(K)(1+\varepsilon^0) + (1-\delta)K = [K-(1-\delta)K_0](1+r). \quad (17)$$

Lenders do not observe ε, so that they will advance loans to all firms, which all look identical to them. They will therefore receive a total of $N[1-\Phi(\varepsilon^0)][K-(1-\delta)K_0](1+r)$ from the solvent firms. Each bankrupt firm can pay back only its output plus undepreciated capital, i.e., $F(K)(1+\varepsilon)+(1-\delta)K$. Thus, lenders receive a total of $N\Phi(\varepsilon^0)[F(K)(1+e^-)+(1-\delta)K]$ from the bankrupt firms,

Similar to the FDI-equity case, we define β here as the proportion of the total loans to domestic firms financed by foreign lenders. (This β is evenly spread across all types of firms.) Then, the foreign portfolio debt investment, FPDI (i.e., amount of foreign loans to the domestic firms), is given by:

$$FPDI = \beta N[K-(1-\delta)K_0]. \quad (18)$$

Foreign lenders receive the following sum before domestic taxes are levied on the FPDI

$$A \equiv \beta\{N[1-\Phi(\varepsilon^0)][K-(1-\delta)K_0](1+r) + N\Phi(\varepsilon^0)[F(K)(1+e^-)+(1-\delta)K]\}. \quad (19)$$

They thus accumulate a capital income of $A-FPDI$, which is subject to domestic taxation at

[6] Bester (1985) points out that, if the lenders can use collateral requirements as a signalling mechanism to screen the firms's riskiness (i.e., their levels of ε), the adverse selection problem will disappear. As in Stiglitz and Weiss (1981), we assume that the firm does not have at its disposal a credible instrument to signal its type to the lenders. For a useful survey of related external debt issues, see Obstfeld and Rogoff (1996).

the rate τ^*. Net of tax, their FPDI yields $A-\tau^*(A-FPDI)$. This amount must be equal to $FPDI(1+r^*)$, as foreign lenders can earn a rate of return of r^* in their own countries. Consequently,

$$FPDI[1 + r^*/(1-\tau^*)] = A. \tag{20}$$

The rationale behind the latter equality is straightforward. Foreign lenders must earn a before-tax rate of return of $r^*/(1-\tau^*)$ on their FPDI so that their after-tax rate of return remains r^*, the rate of return they can earn in their own countries. As a result, the tax that our small economy imposes on their capital income is fully shifted to the domestic borrowers. Substituting for the values of FPDI and A from (18) and (19), equation (20) becomes:

$$[K-(1-\delta)K_0][1+r^*/(1-\tau^*)]$$
$$= [1-\Phi(\varepsilon^0)][K-(1-\delta)K_0](1+r) + \Phi(\varepsilon^0)[F(K)(1+e^-)+(1-\delta)K]. \tag{21}$$

Similarly, domestic lenders advance loans in the amount of $(1-\beta)N[K-(1-\delta)K_0]$ and receive, after tax, an amount of $(1-\beta)N\{[1-\Phi(\varepsilon^0)][K-(1-\delta)K_0](1+r) + \Phi(\varepsilon^0)[F(K)(1+e^-)+(1-\delta)K] - \tau\{[1-\Phi(\varepsilon^0)][K-(1-\delta)K_0](1+r)+\Phi(\varepsilon^0)[F(K)(1+e^-)+(1-\delta)K] - [K-(1-\delta)K_0]\}\}$, which can be simplified as

$$B = (1-\beta)N \{ (1-\tau)\{[1-\Phi(\varepsilon^0)][K-(1-\delta)K_0](1+r)$$
$$+ \Phi(\varepsilon^0)[F(K)(1+e^-)+(1-\delta)K]\} + \tau [K-(1-\delta)K_0] \}. \tag{22}$$

As an alternative to lending $(1-\beta)N[K-(1-\delta)K_0]$ to the firms, they can purchase government bonds or extend loans to the consumers and receive an amount of $(1-\beta)N[K-(1-\delta)K_0][1+(1-\tau)r]$ in the second period. After-tax rate of return equalization (i.e., equating this amount to that given by equation (22)) dictates that

$$[K-(1-\delta)K_0](1+r) = [1-\Phi(\varepsilon^0)][K-(1-\delta)K_0](1+r) + \Phi(\varepsilon^0)[F(K)(1+e^-)+(1-\delta)K]. \tag{23}$$

Equations (21) and (23) imply that at an interior equilibrium (i.e., $0 < \beta < 1$), we must have

$$r^*/(1-\tau^*) = r. \tag{24}$$

Let us now turn to the debt-financed investment decision of a representative firm. This firm invests $K-(1-\delta)K_0$ in the first period and expects to receive an output of $E[F(K)(1+\varepsilon)] = F(K)$ in the second period. It also knows that if ε turns out to be smaller than ε^0, it will default on its debt. This firm expects then to pay back its accumulated debt, i.e., $[K-(1-\delta)K_0](1+r)$, with probability $1-\Phi(\varepsilon^0)$. It expects to default, paying only $F(K)(1+e^-)+(1-\delta)K$, with probability $\Phi(\varepsilon^0)$. Thus, the expected value of its cash receipts in the second period are

$$[F(K)+(1-\delta)K] - [1-\Phi(\varepsilon^0)][K-(1-\delta)K_0](1+r) - \Phi(\varepsilon^0)[F(K)(1+e^-)+(1-\delta)K]. \quad (25)$$

Note that, with debt financing, a corporate tax is essentially a tax on pure profits (rents), and therefore does not affect corporate behavior. For notational simplicity, therefore, we set θ equal to zero in this section. In practice, the neutrality of this tax in the presence of debt finance makes it efficient to set it at a high rate. Maximizing (25) with respect to K yields the following first-order condition:

$$F'(K) = [1-\Phi(\varepsilon^0)](r+\delta) \,/\, [1-\Phi(\varepsilon^0)(1+e^-)] \quad (26)$$

Since $e^- < 0$ and $r = r^*/(1-\tau^*)$ (see equations (3) and (24)), it follows that

$$F'(K)-\delta \;<\; r \;=\; r^*/(1-\tau^*). \quad (27)$$

Knowing that in "bad" realizations of ε (when $\varepsilon \le \varepsilon^0$) it will not fully repay its loan, the firm invests beyond the level where the unconditionally expected net marginal productivity of capital (viz., $F'(K)-\delta$) is just equal to the domestic interest rate (viz., r).

The remaining equations of this model are the same as equations (10) and (11) in the preceding section with FDI replaced by FPDI.

III.2 Optimal Corrective Taxes under Debt Finance

As before, Pareto efficiency requires production efficiency and production-consumption efficiency, which implies that

$$F'(K) - \delta = r^* = (1-\tau)r. \tag{28}$$

The corrective tax policy can now be derived by comparing the equilibrium condition (27) with the Pareto efficiency condition (28). First, (27) and the first equality in (28) imply that $r^*/(1-\tau^*) > r^*$, which, in turn, implies that

$$\tau^* > 0. \tag{29}$$

Second, it follows from (27) that $r = r^*/(1-\tau^*)$, so that

$$r^*/r = 1-\tau^*. \tag{30}$$

Similarly, it follows from the second equality in (28) that

$$r^*/r = 1-\tau. \tag{31}$$

Therefore, (29), (30), and (31) imply that

$$\tau = \tau^* > 0. \tag{32}$$

The rationale behind this result is straightforward. The asymmetric information debt-finance equilibrium will result in foreign over-investment and domestic over-saving (see condition (27)). Thus, a tax on the capital income of all lenders (foreign and domestic) is needed to restore Pareto efficiency. In other words, an efficient policy calls for *source*-based taxation: all income originating in the home country is taxed equally, regardless of the place of residence of the income recipient. This result contrasts with the superiority of *residence*-based taxation under symmetric information (see, e.g., Frenkel, Razin, and Sadka (1991)). It contrasts also with our earlier finding (see Razin, Sadka, and Yuen (1997)) that foreign lenders should receive a preferential tax treatment, possibly even a subsidy (i.e., $\tau^* < \tau$) when they are less informed than their domestic counterparts about the performance of domestic firms.[7]

[7]For an empirical study of this "home-court" advantage, see Tesar and Werner (1994).

III.3 Gains from Trade

We have seen that a package of tax instruments is needed to sustain a Pareto-efficient allocation in the presence of asymmetric information in both the FDI-equity and the FPDI cases. In the absence of such a corrective policy, trade (i.e., capital flows) does not yield an efficient outcome. The question arises whether there are still gains from free (intertemporal) trade.

More specifically, in the absence of any government intervention, an autarkic allocation will be characterized by over-saving as $F'(K)-\delta < r$ (see equation (27)). Thus, there is a production-consumption inefficiency. Namely, what the consumers get for postponing consumption (i.e., $F'(K)$) is below what is required to compensate them for forgoing present consumption (i.e., $r+\delta$) at the margin. Furthermore, with a binding constraint on capital imports (100% capital controls) under autarky, we must have $F'(K)-\delta > r^*$. As a result, a marginal increase in foreign-financed investment is beneficial.

To summarize, a laissez faire autarky is characterized by foreign under-investment and domestic over-saving:

$$r^* < F'(K)-\delta < r. \tag{33}$$

In contrast, free capital mobility (in the absence of taxes) is characterized by

$$F'(K)-\delta < r^* = r, \tag{34}$$

i.e., by foreign over-investment and domestic over-saving. Therefore, it is no longer true in general that there are gains from free capital flows relative to autarky. There is still gain from a marginal increment in trade (capital import), though, because $F'(K)-\delta > r^*$—but not necessarily from a fully free trade.

IV. Asymmetric Information and Capital Accumulation in an Infinite Horizon Model

The two-period analysis in the two preceding sections has a natural extension to an infinite horizon. For simplicity, we assume that the random productivity factor is serially uncorrelated and there is no information gathering or learning over time, so that the same asymmetric information problem will repeat itself period after period. In this section, we consider only the laissez faire case with no taxes. Details of the derivations of the equations referred to below are contained in Appendix B.

IV.1 FDI-Equity Finance

In the case of FDI-equity finance, the cutoff level of ε is defined by equating the value of the firm from the perspective of the domestic equity investors to that from the perspective of the FDI investors:

$$\frac{F(K')(1+e^{-\prime}) + E[V(K')]}{1+r'} = \frac{F(K')(1+\varepsilon^{0\prime}) + E[V(K')]}{1+r^{*\prime}}, \quad (4)'$$

where E[V(K')] is the expected next period (denoted by the "prime") value of the greenfield investment site for the FDI investors.

Optimal investment by the owner-managers of the firms is determined by

$$1 = \Phi(\varepsilon^{0\prime})\left(\frac{[F'(K')(1+e^{-\prime})+(1-\delta)]}{1+r'}\right) + [1-\Phi(\varepsilon^{0\prime})]\left(\frac{[F'(K')(1+e^{+\prime})+(1-\delta)]}{1+r^{*\prime}}\right). \quad (6)'$$

Equations (4)' and (6)' imply that $F'(K') < r^{*\prime} + \delta$. These equations also imply that $F'(K') > r' + \delta$. Together, these two inequalities imply

$$r' < F'(K') - \delta < r^{*\prime}. \quad (7)'$$

As always, the domestic interest rate r' represents the willingness of domestic savers to forego current consumption in return for future consumption. The first inequality in (7)' thus implies domestic under-saving. On the other hand, the foreign interest rate r^{*}' represents the country's external cost of funds. Hence, the second inequality in (7)' implies foreign over-investment. In other words, the asymmetric information problem leads to over-accumulation of capital in the FDI-equity case relative to the Pareto-efficient stock of capital.

IV.2 Debt Finance

In the case of FPDI, two extreme kinds of credit market arrangements that span the whole spectrum of financing possibilities can be considered. In one extreme, the firm is allowed to use as collateral its expected future value E[V(K')]. In the other, collaterals are not allowed.

Assuming full distribution of current profits to the households every period (i.e., no past accumulated profits by the firms), the cutoff value of ε^{0}' when the firm is allowed to borrow against its expected future value E[V(K')] is determined by the following condition

$$F(K')(1+\varepsilon^{0\prime}) + E[V(K')] = [K' - (1-\delta)K](1+r'). \tag{17'}$$

The objective function of the firm can be specified by the Bellman equation below:

$$\begin{aligned} E[V(K)] = Max_{K'} \{ \; & F(K') + E[V(K')] - [1-\Phi(\epsilon^{0\prime})][K'-(1-\delta)K](1+r') \\ & - \Phi(\epsilon^{0\prime})[F(K')(1+e^{-\prime}) + E[V(K')]] \; \} \; / \; (1+r'). \end{aligned} \tag{25'}$$

Observe that the term E[V(K')] appears twice in the firm's objective function—for the first time in the period after next since, whether or not it defaults, this is its expected future value to its owner, and for the second time under the default situation in the next period since the firm uses its expected future value as collateral. Optimal investment is determined by

$$F'(K') = \left[\frac{1-\Phi(\varepsilon^{0'})}{1-\Phi(\varepsilon^{0'})(1+e^{-'})}\right][(r'+\delta)+\Phi(\varepsilon^{0''})(1-\delta)], \quad (26)'$$

where the "double prime" denotes two-period-ahead values. Since $e^{-} < 0$, it follows from (26)' that $F'(K') < r' + \delta$, i.e., the asymmetric information problem will lead to domestic over-saving, only when $\Phi(\varepsilon^{0''})$ is close to zero and/or δ is close to unity. Note that equation (26)' is different from its two-period analogue (26) due to the inclusion of the term $\Phi(\varepsilon^{0''})(1-\delta)$, which is equal to the expected marginal future value of the firm from one unit investment, $E[V'(K')]$—a value that will be lost if the firm chooses to default, hence interpretable as the marginal default penalty. Obviously, this term is absent in the two-period framework, where the second period is terminal. As the firm's liability is no longer limited by its current output in the case of default, domestic under-saving may occur if such marginal penalty is large (as when the default probability is high or when the capital depreciation rate is low).

From equation (24), $r^{*\prime} = r'$, so that $F'(K') < r^{*\prime} = r'$ when $\Phi(\varepsilon^{0''})(1-\delta)$ is small. This means that the asymmetric information problem will lead to foreign over-investment, hence over-accumulation of capital relative to the Pareto-efficient stock of capital, when the marginal default penalty is small. In the opposite case, we may have domestic under-saving and foreign under-investment, which will call for a different corrective tax package than that described in Section III above.

In the alternative debt regime where the firm cannot use its expected future value as a collateral, its optimal investment decision implies that

$$F'(K') = \left(\frac{1-\Phi(\epsilon^{0'})}{1-\Phi(\epsilon^{0'})(1+e^{-'})}\right)\left[(r'+\delta)+(1-\delta)\left(\frac{\Phi(\epsilon^{0''})-\Phi(\epsilon^{0'})}{1-\Phi(\epsilon^{0'})}\right)\right]. \quad (26)''$$

Given the assumed constancy of the foreign interest rate r^*, the domestic capital stock and the cutoff level of the random (serially uncorrelated) productivity factor will attain their steady state values in one period, so that $\Phi(\varepsilon^{0}{}') = \Phi(\varepsilon^{0}{}'')$ and $F'(K') - \delta < r'$, since $e^{-} < 0$. In other words, the asymmetric information problem will lead to domestic over-saving as in the two-period model of Section III.

From equation (24), $r^{*}{}' = r'$, so that $F'(K') - \delta < r^{*}{}' = r'$. This means that the asymmetric information problem will lead to foreign over-investment, hence over-accumulation of capital relative to the Pareto-efficient stock of capital, as well.

In summary, therefore, the efficiency and growth (as well as the corrective tax) implications of asymmetric information can be very different under debt finance in an infinite horizon setting than in the two-period setting, depending on whether the firm can borrow against its expected future value and hence whether its liability is limited to its current cash flow.

IV. Conclusion

In this paper, we have explored the welfare implications of FDI and foreign and domestic equity and debt flows for capital investment in the presence of information asymmetry between the managing owners of firms and other portfolio stakeholders. We find that, in the absence of international debt flows, FDI is essential for channelling domestic savings into productive investment. But even with FDI, asymmetric information causes a market failure, which is reflected in foreign over-investment and domestic under-saving. This can be corrected by a tax on the capital income of nonresidents and a subsidy to corporate income. Under the alternative debt regime, the home country will save and borrow too much relative to the Pareto optimum. In this case, source-based taxation (with equal rates of taxes applied to the capital incomes of both residents and nonresidents) is required to restore efficiency. When the expected future marginal value of collateral is high, however, the foreign over-investment and domestic over-saving and the corresponding corrective tax package can be reversed. These results are summarized in Table 1.

The role of the collateral under debt finance is highlighted in an extension of our model to an infinite horizon growth setting. In this context, we still find a tendency for the economy to over-accumulate capital under both the FDI-equity and debt regimes. But capital under-accumulation becomes a possibility also under the debt finance regime when the firms are permitted to use their expected future net worth as collateral.

In the multi-period setup, we have assumed a simple time-invariant asymmetric information structure. Should we allow for active learning and information gathering on the part of the outsiders of the firms, the inefficiencies associated with the information asymmetry may diminish over time. This means that the inefficient accumulation of capital may only be a short run transitional phenomenon that will not necessarily carry over to the long run steady state equilibrium.

The way we model information asymmetry here—featuring information advantage possessed by the firms ("insiders") over and above the suppliers of funds ("outsiders")—is conventional in the finance literature. In Gordon and Bovenberg (1996) and Razin, Sadka, and Yuen (1997a), the asymmetry in information is between foreign and domestic savers. Evidently, difference in the nature of asymmetric information gives rise to different kinds of market failure and different implications for corrective taxes.[8] In reality, there may exist two levels of information asymmetry whereby the domestic firms are better informed about their productivity level than the domestic savers, who are in turn better informed than the foreign savers. The analysis of this more realistic asymmetric information structure is left for future research.

References

Akerlof, George, "The market for 'lemons': Qualitative uncertainty and the market mechanism," *Quarterly Journal of Economics* 89 (1970), 488-500.

Bester, Helmut, "Screening vs. rationaing in credit markets with imperfect information," *American Economic Review* 57 (1985), 850-55.

Chen, Zhaohui, and Mohsin S. Khan, "Patterns of Capital Flows to Emerging Markets: A Theoretical Perspective," *IMP Working Paper*, January 1997.

Frenkel, Jacob A., Assaf Razin, and Efraim Sadka, 1991, International taxation in an integrated world economy (MIT Press, Cambridge, MA).

Gordon, Roger H., and A. Lans Bovenberg, "Why is capital so immobile internationally?: Possible explanations and implications for capital income taxation," *American Economic Review* 86 (1996), 1057-75.

Obstfeld, Maurice, and Kenneth Rogoff, Foundations of international macroeconomics (MIT Press, Cambridge, MA).

Razin, Assaf, Efraim Sadka, and Chi-Wa Yuen, "A pecking order of capital inflows and international tax principles," *Journal of International Economics* (1997a), forthcoming.

__________, "Quantitative implications of the home bias: Foreign underinvestment, domestic oversaving, and corrective taxation," working paper, 1997b.

Stiglitz, Joseph E., and Andrew Weiss, "Credit rationing in markets with imperfect information," *American Economic Review* 71 (1981), 393-410.

Tesar, Linda L., and Ingrid M. Werner, "U.S. equity investment in emerging stocks markets," *World Bank Economic Review* 9 (1994), 109-30.

[8] There, we find foreign under-investment and domestic over-saving in both the FPDI and FPEI cases. But their tax remedies are quite different: a higher capital income tax on the residents than the nonresidents in the former case, and a tax on corporate income coupled with a subsidy to the nonresidents in the latter. In simulations based on this alternative setup, we [Razin, Sadka, and Yuen (1997b)] find a welfare ranking among the various types of capital flows consistent with the pecking order of capital flows from the developed countries to the developing countries: FDI comes first, followed by debt flows, and lastly by equity flows.

Appendix A: Proof of inequality (7)

Substituting for 1/(1+r) from (4) into (6) and rearranging terms, we get:

$$\Phi(\varepsilon_o)[(1-\theta)F'(K)(1+\varepsilon_o)+(1-\delta)]x + [1-\Phi(\varepsilon_o)][(1-\theta)F'(K)(1+e^+)+(1-\delta)] = 1 + r^*/(1-\tau^*), \quad \text{(A1)}$$

where $x = [(1-\theta)F(K)(1+\varepsilon_o)+(1-\delta)K]/[(1-\theta)F(K)(1+e^-)+(1-\delta)K] > 1$ since $\varepsilon_o > e^-$. It follows from (A1) that

$$1 + r^*/(1-\tau^*) > [(1-\theta)F'(K)+(1-\delta)]\{\Phi(\varepsilon_o)(1+e^-) + [1-\Phi(\varepsilon_o)](1+e^+)\} = [(1-\theta)F'(K)+(1-\delta)],$$

because the term in the curly brackets is equal to one (see equation (3)). This proves the inequality in the right end of (7). Substitute for $1+r^*/(1-\tau^*)$ from (4) into (6) and rearrange terms to get:

$$\Phi(\varepsilon_o)[(1-\theta)F'(K)(1+e^-)+(1-\delta)] + [1-\Phi(\varepsilon_o)][(1-\theta)F'(K)(1+e^+)+(1-\delta)]/x = 1+r. \quad \text{(A2)}$$

Since $x > 1$, it follows from (A2) that

$$1+r < [(1-\theta)F'(K)+(1-\delta)]\{\Phi(\varepsilon_o)(1+e^-) + [1-\Phi(\varepsilon_o)](1+e^+)\} = [(1-\theta)F'(K)+(1-\delta)],$$

which completes the proof of (7).

Appendix B: The Infinite Horizon Model

This appendix presents the derivations of the growth model in Section IV, the analogue of Sections II and III without taxes.

B.I FDI-equity finance

The value to the domestic equity investors who purchase only low productivity firms is given by

$$V^{-}(K) = \{F(K')(1+e^{-\prime})+E[V(K')]\} / (1+r') - [K' - (1-\delta)K],$$

where the "prime" denotes next period values. Similarly, the value to the marginal FDI investors who purchase the lowest-ε firms in the high productivity group is given by

$$V^{0}(K) = F(K')(1+\varepsilon^{0\prime})+E[V(K')]\} / (1+r^{*\prime}) - [K' - (1-\delta)K].$$

The cutoff level of ε is defined by equating $V^{-}(K)$ to $V^{0}(K)$, which can be simplified as follows:

$$\frac{F(K')(1+e^{-\prime}) + E[V(K')]}{1+r'} = \frac{F(K')(1+\epsilon^{0\prime}) + E[V(K')]}{1+r^{*\prime}}. \quad \text{(B1)}$$

The firm's expected market value, net of capital investment, is

$$E[V(K)] = Max_{\{K'\}} \; \Phi(\epsilon^{0\prime})\left(\frac{F(K')(1+e^{-\prime}) + E[V(K')]}{1+r'}\right) + [1-\Phi(\epsilon^{0\prime})]\left(\frac{F(K')(1+e^{+\prime}) + E[V(K')]}{1+r^{*\prime}}\right) - [K' - (1-\delta)K]. \quad \text{(B2)}$$

Maximizing this expression with respect to K' yields the following first order condition (FOC):

$$1 = \Phi(\epsilon^{0\prime})\left(\frac{F'(K')(1+e^{-\prime}) + E[V'(K')]}{1+r'}\right) + [1-\Phi(\epsilon^{0\prime})]\left(\frac{F'(K')(1+e^{+\prime}) + E[V'(K')]}{1+r^{*\prime}}\right).$$

The envelope condition implies that $E[V'(K')] = 1-\delta$. Combining this with the FOC, we have

$$1 = \Phi(\varepsilon^{0\prime})\left(\frac{[F'(K')(1+e^{-\prime})+(1-\delta)]}{1+r'}\right) + [1-\Phi(\varepsilon^{0\prime})]\left(\frac{[F'(K')(1+e^{+\prime})+(1-\delta)]}{1+r^{*\prime}}\right). \quad \text{(B3)}$$

To address the issue of foreign over-investment and domestic under-saving, we compare the net marginal productivity of capital $(F'(K')-\delta)$ with the foreign and domestic interest rates ($r^{*\prime}$ and r').

Substituting for $1/(1+r')$ from (B1) into (B3) and rearranging terms, we get

$$\Phi(\varepsilon^{0\prime})[F'(K')(1+e^{-\prime})+(1-\delta)]z' + [1-\Phi(\varepsilon^{0\prime})][F'(K')(1+e^{+\prime})+(1-\delta)] = 1+r^{*\prime},$$

where $z' = \{F(K')(1+\varepsilon^{0\prime})+(1-\delta)K'+E[V(K')]\} / \{F(K')(1+e^{-\prime})+(1-\delta)K'+E[V(K')]\} > 1$ since $\varepsilon^0 > e^-$. It therefore follows that

$$1+r^{*\prime} > [F'(K')+(1-\delta)]\{\Phi(\varepsilon^{0\prime})(1+e^{-\prime}) + [1-\Phi(\varepsilon^{0\prime})](1+e^{+\prime})\} = F'(K')+(1-\delta)$$

because the term in curly brackets is equal to one (see equation (3)). This implies, in turn, that

$$F'(K') < r^{*\prime} + \delta.$$

In other words, the asymmetric information leads to foreign over-investment, hence excessive capital accumulation.

Substituting for $1/(1+r^{*\prime})$ from (B1) into (B3) and rearranging terms, we get

$$\Phi(\varepsilon^{0\prime})[F'(K')(1+e^{-\prime})+(1-\delta)] + [1-\Phi(\varepsilon^{0\prime})][F'(K')(1+e^{+\prime})+(1-\delta)]/z' = 1+r'.$$

Since $z' > 1$ (given $\varepsilon^0 > e^-$), it follows that

$$1+r' < [F'(K')+(1-\delta)]\{\Phi(\varepsilon^{0\prime})(1+e^{-\prime}) + [1-\Phi(\varepsilon^{0\prime})](1+e^{+\prime})\} = F'(K')+(1-\delta),$$

which implies, in turn that

$$F'(K') > r'+\delta.$$

In other words, the asymmetric information growth model will lead to domestic under-saving.

B.II Loan and debt finance

Assuming full distribution of current profits to the households every period (i.e., no past accumulated profits by the firms), the cutoff value of $\varepsilon^{0\prime}$ when the firm is allowed to borrow against its expected future value E[V(K')] is determined by the following condition

$$F(K')(1+\varepsilon^{0'}) + E[V(K')] = (1+r')[K' - (1-\delta)K]. \tag{B4}$$

The objective function of the firm can be specified by the Bellman equation below:

$$\begin{aligned} E[V(K)] = Max_{K'} \{ & F(K') + E[V(K')] - [1-\Phi(\epsilon^{0'})][K' - (1-\delta)K]1+r') \\ & - \Phi(\epsilon^{0'})[F(K')(1+e^{-'}) + E[V(K')]] \} / (1+r'). \end{aligned} \tag{B5}$$

The first two terms are the expected current and future values of the firm before observing the current period ε. The term multiplied by $1-\Phi(\varepsilon^0)$ is the principal and interest payment on the debt, and the term multiplied by $\Phi(\varepsilon^0)$ is the liquidation value of the firm. Observe that the term E[V(K')] appears twice in the firm's objective function—in the next period under the default situation since the firm is allowed to use its expected future value as collateral, and in the period after since, whether or not it defaults, its expected future value to its owner is captured by this term.

The first order condition with respect to K' is given by

$$F'(K') - [1-\Phi(\epsilon^{0'})](1+r') - \Phi(\epsilon^{0'})F'(K')(1+e^{-'}) + [1-\Phi(\epsilon^{0'})]E[V'(K')] = 0.$$

The envelope theorem implies

$$E[V'(K')] = [1-\Phi(\epsilon^{0''})](1-\delta),$$

where the "double prime" indicates two-period ahead values. Combining this with the FOC, we have

$$F'(K') = \left[\frac{1-\Phi(\epsilon^{0'})}{1-\Phi(\epsilon^{0'})(1+e^{-'})}\right][(r'+\delta) + \Phi(\epsilon^{0''})(1-\delta)]. \tag{B6}$$

Since $e^- < 0$, it follows from (B6) that $F'(K') < r' + \delta$, i.e., the asymmetric information problem will lead to domestic over-saving, only when $\Phi(\varepsilon_0'')$ is close to zero and/or δ is close to unity. The term $\Phi(\varepsilon_0'')(1-\delta)$ can be interpreted as the marginal penalty due to the seizure of the collateral in the case of default, which may result in domestic under-saving.

From equation (24), $r^{*\prime} = r'$. Together with (B6), this means that the asymmetric information problem may lead to foreign over- or under-investment depending on the size of the marginal penalty.

In an alternative debt regime where the firm cannot use its expected future value as a collateral, the cutoff level of $\varepsilon^{0'}$ is determined by

$$F(K')(1+\varepsilon^{0'}) = [K' - (1-\delta)K](1+r'). \tag{B4'}$$

The objective function of the firm becomes

$$E[V(K)] = Max_{K'} \{F(K') + E[V(K')] - [1-\Phi(\epsilon^{0'})][K' - (1-\delta)K](1+r') \quad \text{(B5)'}$$
$$- \Phi(\epsilon^{0'})F(K')(1+e^{-})\} \ / \ (1+r').$$

The FOC and envelope condition from the firm's optimal investment decision imply that

$$F'(K') = \left(\frac{1-\Phi(\epsilon^{0'})}{1-\Phi(\epsilon^{0'})(1+e^{-'})}\right)\left[(r'+\delta)+(1-\delta)\left(\frac{\Phi(\epsilon^{0''})-\Phi(\epsilon^{0'})}{1-\Phi(\epsilon^{0'})}\right)\right]. \quad \text{(B6)'}$$

In the steady state where $\Phi(\varepsilon^{0'}) = \Phi(\varepsilon^{0''})$, (B6)' implies that $F'(K') < r' + \delta$, i.e., the asymmetric information problem will lead to domestic over-saving, since $e^{-} < 0$.

From equation (24), $r^{*'} = r'$, so that $F'(K') - \delta < r^{*'} = r'$. This means that the asymmetric information problem will lead to foreign over-investment in the steady state as well.

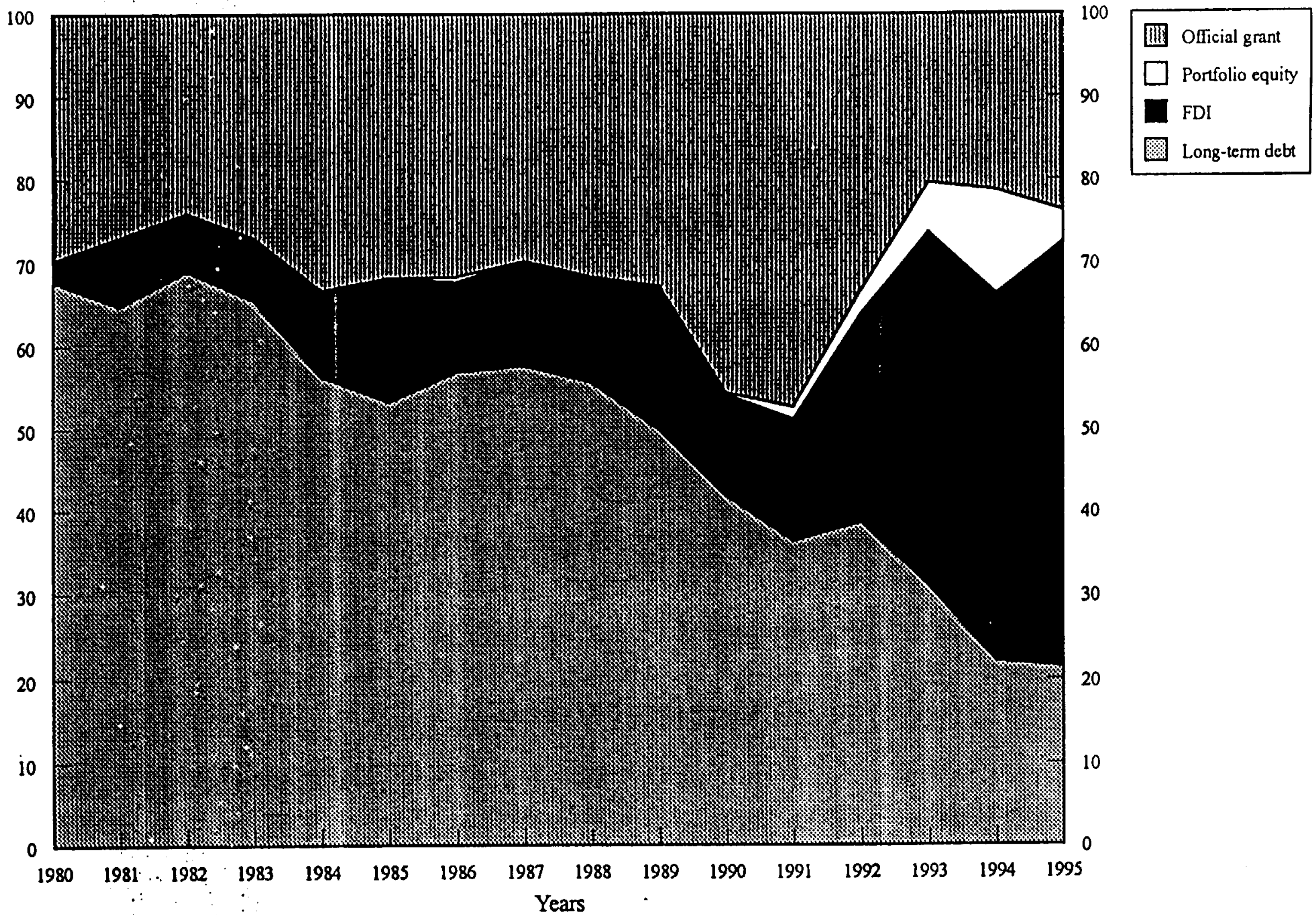
Table 1. First Best Tax Treatment of Foreign Investment and Domestic Saving

Type of tax	Type of finance		
	FDI-equity finance	Debt finance with low marginal value collateral	Debt finance with high marginal value collateral
Corporate tax (θ)	negative	irrelevant	irrelevant
Tax on Capital Income of Residents (τ)	irrelevant	positive (equal to τ^*)	negative (equal to τ^*)
Tax on Capital Income of Nonresidents (τ^*)	positive	positive (equal to τ)	negative (equal to τ)

Composition of Capital Flows: Low Income Countries, 1980-95

Figure 1. Composition of Capital Flows: Low Income Countries, 1980-95 1/

(In percent)

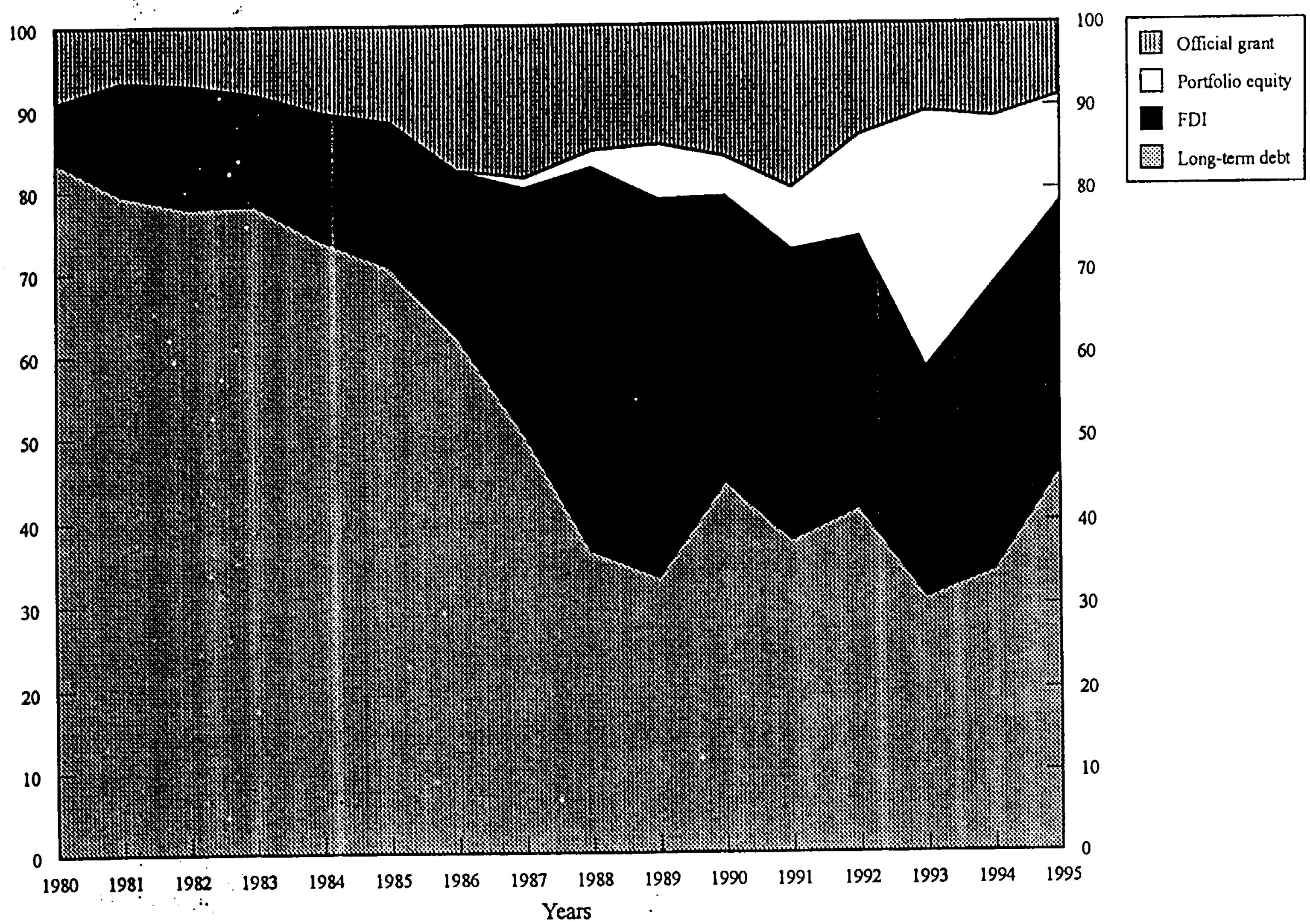


Source: The World Bank: World Debt Tables. & Chen and Kahn (1997)

1/ 1995 figures are estimates.

Composition of Capital Flows: Medium Income Countries, 1980-95

Figure 2. Composition of Capital Flows: Medium Income Countries, 1980-95 1/
(In percent)



Source: The World Bank: World Debt Tables. & Chen and Kahn (1997)
1/ 1995 figures are estimates.