FINANCIAL PLANNING FOR THE MULTINATIONAL CORPORATION WITH MULTIPLE GOALS

by

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I. INTRODUCTION

In a world where there is uniform taxation, fixed and stable exchange rates, perfect capital markets and no barriers to the transfer of capital, the financial decisions for the multinational corporation (MNC) would be the same as that for a domestic corporation. Funds would be raised by the cheapest scource and transferred wherever they are needed. A single hurdle rate would also be used for all capital budgeting decisions.

Such a world does not exist, however. The financial manager of the MNC is faced with different tax structures, changing exchange rates, barriers to capital flows, and segmented capital markets.[1] Thus, he must not only be concerned with determining an optimal capital structure but also the sources of the relevant funds. Likewise, he must not only be concerned with funds flows but also the risk that the value of these flows will change due to changing exchange rates. Finally, he must be concerned with operating under widely differing governmental philosophies.

While some work has been done in the area of financial planning (see for example, Myers and Pogue (1975), Lyneis (1975), and others), the issues faced by the MNC have not been directly addressed. Ness (1972) has investigated the financing decision for the MNC but ignores the capital structure and exchange risk questions which are the areas of primary concern to the MNC.

Thus, a method is needed to guide the financial planning of the MNC. This paper presents a methodology for handling the problems raised by uncertain exchange rates and the various barriers to free capital flows. The stochastic goal programming model developed here allows a practical way to improve the efficiency with which alternative combinations of corporate strategies, various environmental assumptions, and financing mechanisms

can be evaluated. The first section develops the elements of a model to analyze these questions. Next, the use of the model in financial planning is described. The risk of exchange rate changes is then introduced into the model and the role it plays in the financial planning decision is investigated. Finally, the summary and conclusions are presented.

II. MODEL DEVELOPMENT

The model developed here assumes a firm consisting of a parent and several subsidiaries in host countries other than that of the parent. It is further assumed that for the parent and each subsidiary, three types of financing sources are available: internal funds generated in that unit as well externally obtained debt and equity. These sources can be supplemented by Eurocurrency borrowing or dividend remittances (generally only to the parent). It will be assumed throughout the paper that the Eurocurrency borrowing will be denominated in dollars for ease of exposition. Other denominations can be easily accomodated, however.

For each subsidiary, including the parent, decisions must be made about each of these variables--internally generated funds (those not paid out as dividends), externally obtained equity and debt raised locally, the amount of Eurocurrency debt, the amount of dividends to be paid, and the extent of intersubsidiary borrowing or lending--so as to optimize the objectives of the firm. Likewise, it is important to decide which will be the source country, i, for each type of financing, which will be the receiving country, j, and which source (if multiple sources are available in a country) of funds, k, will be used. It should be noted that many firms also integrate sales and production activities which allow the use of

transfer prices and transportation charges for moving funds between its subsidiaries. Each has many effects which would greatly increase the complexity of the model. Instead of burdening the analyses with all these issues, concentration will be focused on the sources previously listed.[2]

Several other assumptions are made in the construction of the model which are now enumerated. An attempt has been made to make them as realistic as possible. Using the basic philosophy developed here the model can, in general, be easily modified to accomodate different assumptions:

1. All loans are creditor denominated,

2. All financing of debt sources is transferred as debt at the same rate as the source country i. There is no gain or loss to the source country, therefore, and the tax rate of the recipient, country j, is used in finding the after-tax cost,

3. Funds raised as equity are transferred as equity. If internal funds are transferred to the parent they are in terms of royalties or other fees. Any other transfer of internally generated funds to other affiliates are as debt at the specified intersubsidiary lending rate,

4. Local tax rates apply as given and there are no subpart F payments by the parent. It is also assumed that tax rates are linear which is less realistic but more tractable,

5. Parent dividends are lost from the system. Subsidiary dividends go to the parent and out of the system in proportion to the factor given for portion of local ownership,

6. It is also assumed that project returns and local cost of the various financing sources are known with certainty.

7. The firm can issue only one period debt securities. Once a financing pattern is chosen it cannot be altered until the next period which assumes no recourse. While theoretically it is trivial to convert to multiperiod debt securities, computationally the available computer codes limit the available choices to only a few periods and/or financing choices.[3]

The Objective Function

In making decisions on the variables under consideration here, management attempts to choose the combination of investment and financing options

that maximize the market value of the firm to the stockholders. Specifying the objective in terms of the firm's market value, not in terms of someone's utility function, is equivalent to maximizing the present value of the stream of investment returns.[4] Since it is assumed that the local currency value of investment returns before financing costs are known with certainty, this objective can be attained by minimizing the total cost of financing. Unlike the domestic firm, however, one must choose which costs to minimize. Each source of financing has an associated cost in local and parent currency. It is assumed here that since the firm's objective is to maximize the value of the firm to the stockholders and the stockholders reside in the parent country, the objective to be attained here is to minimize the cost in parent country currency. In the development presented here, a U.S. MNC is assumed so dollar cost is minimized. Of course, any parent currency can be substituted for dollars.

The objective function first consists of the expected after-tax dollar value of interest costs on local and Eurocurrency borrowing, equity costs, and the cost of internally generated funds used to meet the firm's required expenditures:[5]

$$\sum_{ijk}\sum\sum[A_{j\$}A_{ij}a_{ijk}I_{ijk} + A_{j\$}v_{ijk}E_{ijk} + A_{j\$}A_{ij}(1-t_j)(s_{ijk}D_{ijk} + y_{ijk}U_{ijk})] \quad (1a)$$

where:

a_{ijk} = Local cost attributed to I_{ijk}.

s_{ijk} = Local cost attributed to D_{ijk}.

v_{ijk} = Local cost attributed to E_{ijk}.

y_{ijk} = Dollar cost attributed to U_{ijk}.

t_j = Effective incremental corporate tax rate in affiliate j.

I_{ijk} = Funds internally generated by affiliate i for use in affiliate j, type k if two or more are available.

D_{ijk} = Debt raised in affiliate i for use in affiliate j, type k.

E_{ijk} = New equity raised in affiliate i for use in affiliate j, type k.

U_{ijk} = Eurocurrency debt raised in affiliate i for use in affiliate j, type k.

and

$$A_{ij} = \frac{\frac{XE_j}{XB_j}}{\frac{XE_i}{XB_i}}$$

where: XB_i = Beginning exchange rate for affiliate i (local currency/$).

XE_i = Ending exchange rate for affiliate i.

$A_{j\$}$ = Exchange rate change between recipient and the U.S. parent.

Once the local cost is obtained, it is adjusted for taxes if the source receives a tax benefit (only debt receives tax benefits, equity does not). This local cost is then converted to dollar cost using the end of period exchange rate.

Since debt securities are assumed to be one period, the after-tax dollar cost of principal repayments at the end of the period for local and Eurocurrency loans are next taken into account:

$$\sum_{ijk}\sum\sum[(A_{j\$}-1) + (A_{ij}-1)(1-t_j)](D_{ijk} + U_{ijk}). \qquad (1b)$$

The impact of exchange rate changes on the repayment of the loan principal at the end of the period must be added since internally generated funds transferred between subs are transferred as loans (except to the parent):

$$\sum_{ijk}\sum\sum[(A_{j\$}-1) + (A_{ij}-1)(1-t_j)]I_{ijk} \qquad (1c)$$
$$j\neq 1$$
$$i\neq j$$

where: 1 - Parent country as source or recipient.

Likewise, the impact of exchange rate changes on the dollar value of dividends, fees, and royalties transferred to the parent are included:

$$\sum_{ik}\sum (A_{i\$}-1)(Y_{i1} + I_{i1k}) \qquad (1d)$$
$$i\neq 1$$
$$j=1$$

where: Y_{ij} - Dividend paid by affiliate i to affiliate j.

Besides the impact on the principal amount of internal funds transferred as loans between subsidiaries, the effects of differential tax rates and exchange rates on interest payments must be considered:

$$\sum_{ijk}\sum\sum (_t r_{ijk} (t_i - A_{ij}t_j)I_{ijk}A_{j\$})_{i\neq j} \qquad (1e)$$
$$j\neq 1$$

where: $_t r_{ijk}$ - Actual loan rate used on loans of internally generated funds from affiliate i to affiliate j, type k.

Next, the dollar cost of dividends as a source of funds (to pay dividends or to transfer to the parent) is considered:

$$\sum_i [u_i A_{i\$} Y_{i1} + u_1 Y_{10}] \qquad (1f)$$

where: u_i - Local cost attributed to Y_{i1} (the cost of equity)

0 - Parent country stockholders as recipient.

The objective function, therefore, has the following form:

$$\text{Minimize } Z = \sum_{ijk} \{A_{j\$}A_{ij}a_{ijk}I_{ijk} + A_{j\$}v_{ijk}E_{ijk} + A_{j\$}A_{ij}(1-t_j)(S_{ijk}D_{ijk} + y_{ijk}U_{ijk})$$

$$+ [(A_{j\$}-1) + (A_{ij}-1)(1-t_j)] (D_{ijk} + U_{ijk}) \qquad (1)$$

$$+ [(A_{j\$}-1) + (A_{ij}-1)(1-t_j)] I_{ijk} \}_{\substack{j\neq 1 \\ i\neq j}} + \sum_{\substack{ik \\ i\neq 1 \\ j=1}} (A_{j\$}-1)(Y_{i1} + I_{i1k})$$

$$+ \sum_{\substack{ijk \\ i\neq j \\ j\neq 1}} ({}_t r_{ijk}(t_i - A_{ij}t_j)I_{ijk}A_{j\$}) + \sum_i u_i A_{i\$} Y_{i1} + u_1 Y_{10}$$

The objective function developed thus far assumes that minimizing the cost of financing is the only concern of the financial manager. While cost minimization is obviously quite important, it is shown later that management has other goals which impinge on the financing decisions. As a result further adjustments to the objective function will be needed when these other goals are explored.

Constraints

While it is desired to determine the optimal level of the decision variables, the optimization problem presented here must operate under certain constraints which are now reviewed.

1. Sources and Uses of Internally Generated Funds. The uses of internally generated funds (for local investment, intersub lending, and dividend remittances to the parent) must not exceed the sources of these funds. It is assumed that these sources will be after-tax profits generated by the subsidiary as well as from depreciation and expected non-cash expenses. Of course, other sources of internal funds can also be included if known. Likewise, liquid assets in excess of those needed for operation of the firm are available. The form of this constraint is then:

$$Y_i + \sum_{jk}\sum I_{ijk} = G_i + F_i + C_i \quad \text{(for all i)} \qquad (2)$$

where:
- Y_i - Dividend paid by affiliate i
- G_i - After-tax profit expected to be earned by affiliate i.
- F_i - Depreciation and expected non-cash expenses for affiliate i.
- C_i - Liquid asset balances currently held in excess of operating needs by subsidiary i.

2. Budget Constraint. Sources of funds for each subsidiary must equal or exceed the budget requirements. It is assumed that the only budget requirements to be considered are for investment and repayment of maturing debt. Of course, any other requirements unique to a given firm can be easily accomodated. It should be noted that raising funds from any source in subsidiary i for transfer to subsidiary j can be subject to various barriers to the flow. Such barriers as dividend withholding taxes, capital transfer fees or similar hinderances can result in leakages of funds out of the system upon transfer. For example, if there is a 20 per cent dividend withholding tax in country i, the parent receives eighty cents of each dividend dollar declared while twenty cents goes to the government and leaves the system. As a result, Y_{i1} is declared and paid out but only $0.8\ Y_{i1}$ is received by the parent. Other losses from the system must also be taken into account. When considering the choice of sources, these leakages must be included:

$$\sum_{ik}\sum (1-p_{ijk})I_{ijk}-(1-g_{ijk})D_{ijk}-(1-h_{ijk})E_{ijk}-(1-\ell_{ijk})U_{ijk}$$

$$+ \sum_{i} Y_{ij}(1-m_i)_{\substack{i\neq 1\\ j=1}} \geq R_j + B_j \quad \text{(for all j)} \qquad (3)$$

where: B_j = Investment budget for affiliate j

R_j = Long term debt repayments scheduled for affiliate j.

p_{ijk} = Factor applied to I_{ijk} to reflect transfer leakages from system.

g_{ijk} = Factor applied to D_{ijk} to reflect transfer leakages from system.

h_{ijk} = Factor applied to E_{ijk} to reflect transfer leakages from system.

ℓ_{ijk} = Factor applied to U_{ijk} to reflect transfer leakages from system.

m_i = Factor applied to Y_{ij} to reflect transfer leakages from system.

3. Leverage Constraint. The proportion of debt and equity which is to be raised must also be determined. For domestic firms, this question of whether an optimal capital structure exists has been the subject of considerable scrutiny. Although Modigliani and Miller (1958)(1963)(1966) contend that an optimal capital structure does not exist, work by Milne (1975), Baumol & Malkiel (1967), Rubenstein (1973) and others demonstrate that, in the presence of bankruptcy risk, transaction costs, segmented capital markets and other market imperfections an optimal capital structure obtains. Since it can be shown that the MNC operates in imperfect markets, it is assumed that some optimal mix of debt and equity is desired. Unlike the domestic firm, however, the MNC faces a unique problem. Whose debt-equity ratio should be optimized? Since each subsidiary operates in a host country, the financial structure of each sub must be considered within the context of that host country. Unfortunately, the proper debt-equity level is not the same for all countries. Some, such as Japan, not only tolerate debt levels far higher than many countries but actually encourage such high leveraging. Others, meanwhile, either have an aversion to high debt levels or such thin capital markets that excessive use of debt may not only be discouraged but prohibited. It is also suggested that capital

structures which vary drastically from industry or country norms invite scrutiny by host governments. For these reasons, Stonehill and Stitzel (1969), Eiteman and Stonehill (1973), and others suggest that the appropriate course is to adopt capital structures according to local norms.[6]

The problem with that approach is that the consolidated balance sheet may show higher debt ratios than acceptable to the owners of the firm, the parent country stockholders. It is highly unlikely that optimizing debt ratios in each country will result in an optimal capital structure on a consolidated basis. Thus, unlike the domestic firm, the MNC has conflicting goals to satisfy. This problem has never been formally addressed, however. The manager of the MNC is interested in assessing the tradeoff between raising funds to optimize each country's capital structure and optimizing the debt-equity ratio on a consolidated basis.[7] A firm will therefore accept deviations from an optimal capital structure goal if the marginal benefit exceeds the marginal cost of doing so. One way to analyze these considerations is to specify separate goals for the parent and the subsidiaries and analyze the tradeoffs involved. To do this, however, separate constraints are needed for the parent and each subsidiary. If we assume that for each unit:

$$q_i^* = \frac{\text{DEBT}_i}{\text{EQUITY}_i} \text{ , then}$$

a) For the parent:

$$\sum_{ijk}\sum\sum(D_{ijk} + U_{ijk}) - q_i^* \sum_{ijk}\sum\sum E_{ijk} + q_1^* Y_{10}$$

$$+ d_i^+ - d_1^- = q_1^*(E_{10} + G_1 - \sum_i P_i) - D_{10} + \sum_i R_i \qquad (4a)$$

where: E_{10} = initial equity

D_{10} = initial debt

Y_{10} = dividends paid by parent

G_1 = parent's net income

P_i = income from intra-firm transactions

q_1^* = optimal debt-equity ratio for parent[8]
(other variables as previously defined)

d^+, d^- = deviations from goals

b) For the subsidiaries:

$$\sum_{\substack{jk \\ i\neq j}} D_{ijk} + \sum_{jk} D_{jik} + \sum_{\substack{jk \\ i\neq j}} U_{ijk} + \sum_{jk} U_{jik}$$

$$- q_i^* \sum_{jk} E_{jik} + \sum_{\substack{jk \\ i\neq j}} I_{jik} + q_i^* Y_i + d_i^* - d_i^- =$$

$$q_i^*(E_{i0} + G_i) - D_{i0} + R_i + \sum_j K_{ij} \qquad \text{(for all } i,\ i\neq 1) \qquad (4b)$$

where: q_i^* = optimal debt-equity ratio for sub i

I_{jik} = intra-firm loan from sub j to sub i

K_{ij} = repayment of intra-firm loan from i to j

These equations differ for the parent and the subs due to eliminations that occur upon consolidation. The goal deviation penalties can be viewed as that penalty the firm would have to pay (higher cost of debt or equity) if the desired debt-equity ratio is exceeded or the higher cost of capital experienced due to insufficient use of lower cost debt.

4. Dividends. The question of whether the payment of dividends influences the value of the firm is still a controversial issue.[9] All agree, however, that dividends provide important information to the market place. For example, if dividends are withheld to finance asset expansion, generally the price of the stock declines. The stock market interprets the dividend exclusion as a negative signal concerning the future profitability of the firm, since returns from the investment are not known to the market for some time later.

The multinational also faces other problems. Dividends usually are closely scrutizined by government agencies in host and parent countries besides stockholders. To prevent interference, most firms attempt to prevent wide swings in dividends. However, paying dividends is a use of funds which may have to be replaced from another source.

As a result of these considerations, a desired level of dividends is indicated based on current levels and expected increases. However, the manager would like to investigate the tradeoff between dividend payments and using funds for projects or inter-sub lending:

$$Y_i + f_i^+ - f_i^- = GY_i \qquad (5)$$

where: GY_i = Dividend goal for affiliate i

f_i^+, f_i^- = Deviations from goals

5. Limits on Issue Sizes. Limits on the individual amounts, either on the source or amount transferable are included here. These limits are set by company policy, host country laws or regulations, or funds availability.

$$
\begin{aligned}
Y_i &\geq \text{minimum } Y_i \\
Y_i &\leq \text{limit } Y_i \\
D_{ijk} &\leq \text{limit } D_{ijk} \\
I_{ijk} &\leq \text{limit } I_{ijk} \\
E_{ijk} &\leq \text{limit } E_{ijk} \\
U_{ijk} &\leq \text{limit } U_{ijk}
\end{aligned}
\qquad \text{(for all i)} \qquad (6)
$$

6. Environmental Constraints. Each firm has constraints involving the decision variables I, D, E, U, and Y which must be added. Likewise, each host country can also specify certain limits and requirements on these same variables. The constraints will be specific for each situation and must be added separately.

An example of such a constraint may be the specification that internally generated funds for a given subsidiary i are used first before external funds are obtained. While this may appear suboptimal (the average cost of capital can be higher than the marginal cost of capital), it is unlikely that the firm would use external capital before internal sources are fully utilized due to the danger of host country intervention.

Goals and the Objective Function

Finally, it is shown that while the financial manager wants to minimize the cost of financing, he also has several other competing goals some of which may be in conflict with each other. Thus, he not only wants to minimize the cost of financing but minimize the deviations from all goals. These deviations from goal constraints must be included in the objective function:

$$\sum_i \left(\underline{d}_i^+ d_i^+ + \underline{d}_i^- d_i^-\right) + \left(\underline{f}_i^+ f_i^+ + \underline{f}_i^- f_i^-\right) \qquad (1g)$$

where:
- d_i - Deviation from leverage goal, affiliate i.
- f_i - Deviation from dividend goal, affiliate i.
- $\underline{d}_i$ - Penalty coefficient for d_i deviation.
- $\underline{f}_i$ - Penalty coefficient for f_i deviation.

Some consideration must be given to the method of setting the penalties on the goal deviations. As previously stated, the penalties for variations from the leverage constraint can be viewed as the increased cost of capital from either exceeding the debt level for a subsidiary or the parent (thereby increasing the cost of debt and equity capital) or by using more expensive equity capital than needed. The penalties set here should reflect these costs.

The penalty for dividend deviations are somewhat similar to those for the leverage constraint. To the extent dividends are paid external equity must be raised. The penalty then should be the cost per dollar of additional equity which must be raised for paying an additional dollar of dividends. Added to that amount, should be the equivalent increase in the cost of funds through increased uncertainty due to fluctuating dividends.

III. FINANCIAL PLANNING FOR THE MNC

The model can now be solved for the decision variables using any standard linear programming algorithm. After determining the optimal financing pattern, the overall cost of capital can be determined based on the minimum cost as a percentage of total funds obtained.

The investment decision must now be reviewed. In solving the model, it is assumed that the investment schedule is known. There are several ways to develop this schedule. One might determine a hurdle rate for each country based on some locally optimal capital structure as is done for a domestic firm. This approach, however, defeats one of the advantages of being multinational; i.e., the ability to obtain lower cost funds from sources other than the host country. The alternative is to set a company wide hurdle rate with which the internal rate of return of a project is compared. The investments are obtained by accepting those with internal rates of return greater than the hurdle rate and rejecting those which do not.[10]

Once the overall cost of financing is obtained, it must be compared to the hurdle rate used. If the cost of capital as determined here is different from that assumed to obtain the investment schedule, the model must be rerun until the final cost of capital is the same as that used as a hurdle rate for the investment decision. At that point, the investment and financing plans for each subsidiary are completed as well as for the firm as a whole.

IV. EXCHANGE RISK MANAGEMENT

As developed thus far the model assumes that the end of period exchange rate is known with certainty. Even in a period of fixed exchange rates such a situation is highly unlikely. With the current floating exchange rate regime it is even more unlikely. Recent work by Giddy and Dufey (1975) and Rogalski and Vinso (1977) demonstrate that explicitly forecasting these rates is not feasible, however. Since one cannot know

for certain what the end of period exchange rates will be, there is the risk that the cost of funds will be different from that on which the decisions were based. Since interperiod adjustments are not allowed, decisions which appeared optimal at the beginning of the period would now be suboptimal.

One way to reduce this risk is through internal means by managing accounting exposure.[11] Local financing of local assets can reduce this exposure while borrowing external to the host country increases exposure. It should be noted that only local debt can reduce exposure as equity (internal funds and externally-raised equity) is not considered exposed. Thus, the manager would like to reduce his exposure as close to zero as possible. However, satisfying such a desire by obtaining sufficient locally denominated debt can lead to a conflict with other firm's goals particularly the leverage constraint previously discussed. The manager would, therefore, be interested in assessing the tradeoff involved between increasing leverage and decreasing accounting exposure. As a result another constraint is needed where an exposure goal is considered. Taking the various financing alternatives into account, the following obtains:

$$\sum_{\substack{jk \\ j\neq i}} I_{jik} - \sum_{\substack{jk \\ j=i}} D_{jik} + \sum_{\substack{jk \\ j\neq i}} D_{jik} + \sum_{jk} U_{jik} + e^{+} - e^{-} =$$

$$DEL_i^{*}\,(XPO_i) - WC_i^{*}(B_i) \quad \text{(for all } i,\ i\neq 1) \qquad (7)$$

where:

I_{jik} = internally generated funds loaned by j to i

XPO_i = initial exposure level, subsidiary i

WC_i^{*} = proportion of the budget attributable to an increase in net working capital, subsidiary i

e^+, e^- = deviations from goal

DEL_i^* = desired adjustment to initial (accounting) exposure

= < 1 reduction of exposure
= 1 no change desired
> 1 increase in exposure

Thus, debt obtained external to the host country increases accounting exposure while locally obtained debt decreases accounting exposure. While not corresponding exactly to the accounting definition of exposure, it provides a better structure for the consideration of the role of exposure in exchange risk management by the financial manager. It also helps specify how much of the exchange risk faced by the firm is hedged using internal means.

One question which must be addressed is the proper determination of DEL*. As DEL* changes, the amount of exchange risk covered through internal means changes. The alternative to covering this exchange risk internally is to use external means such as forward contracts. Initially, it can be assumed that the cost of such external contracts exceeds that of the cost of exposure reduction using local debt. As debt increases, the cost of funds also increases until the cost of an additional increase in exchange risk reduction using debt will be equal to that of using a forward contract. That point is the optimal level of exposure risk reduction using internal means. The factor DEL* should then be set appropriately so that sufficient debt is issued to reach that point.

Since goal deviations are included in the constraint, penalties for deviating from the exposure goal must be added to the objective function and a method determined for setting these penalties. To the extent that

exposure is not entirely convered through internal means, it must be hedged externally using forward contracts or left uncovered. The logical penalty then would be the cost of forward cover. In this way, if the optimal solution provides for some uncovered exposure, the firm cannot reduce this exposure cheaper internally than externally.

Because exchange rates may be different at the end of the period than expected, the manager must also consider more than one future outcome. Accordingly, management must draw up a set of "scenarios" about future exchange rates and specify the probability of a given scenario occurring. To distinguish among outcomes relative to a given scenario, the ending exchange rate has an additional subscript, H. Thus, the adjustment in the objective function for exchange rate changes is defined as:

$$A_{ij} = \sum_{H=1}^{N} b_H \frac{\frac{XE_{jH}}{XB_j}}{\frac{XE_{iH}}{XE_i}}$$

where: b_H - Probability of scenario H occur, with N different scenarios and the additional constraint must be added that the set of scenarios be exhaustive:

$$\sum_{H=1}^{N} b_H = 1$$

In this way, the model minimizes expected cost of financing.[12]

As previously shown, the risk encountered with end of period exchange rate variations is that the cost of funds can be different from that used in determining the optimal financing pattern. The extent of this risk can

now be estimated. Once the pattern of financing and the expected cost is determined, the cost of that pattern of financing can be determined under each exchange rate scenario. Using the assigned probabilities, the variance in the cost of funds can now be determined.

This risk is handled in several ways. First, it is assured that decisions are feasible for all futures by repeating the constraints for all scenarios. If the total risk assumed is too high, additional constraints can be included to reduce the impact of adverse outcomes. Risk aversion can, therefore, be handled by adding constraints. While it is true that using constraints to eliminate unfavorable outcomes is crude as compared to using utility function approaches, it is managerially more feasible and is far more tractable.

Once the total risk has been determined the amount to be covered by external means can be estimated. Since the penalties on the exposure goal constraint are set using the cost of alternative external means, such as forward cover, the deviation from that goal provides a clue as to whether external means of risk avoidance are needed. If the deviation from the exposure goal is negative, no external means of risk avoidance are needed. If the deviation is positive, then some amount of forward cover is needed.[13]

Thus, it can be seen that although the model does not explicitly contain variables which consider currency transactions, exchange risk is incorporated into the model (the Appendix provides a complete listing of the model). Management can ascertain the impact of various end of period exchange rates and determine to what extent that impact will be mitigated through internal or external means or will be left uncovered. Similarly, the investment decision in the face of uncertain exchange rates can be investigated using the methodology previously shown.

V. SUMMARY AND CONCLUSIONS

Analysis of the financing decision for the MNC is far more complicated than for a domestic firm because of the additional sources of financing available, differing tax impacts and the existance of exchange risk. Furthermore, the manager must decide to what extent will optimal capital structures be adhered to in each subsidiary as opposed to a consolidated one for the parent. Likewise, he must decide to what extent will the risk of foreign exchange variations be reduced through internal means, external contracts, or left uncovered. The stochastic goal programming model developed here provides a way to handle these concerns and determine the impact on the financing decision.

One problem with the approach taken here is that for many futures, the model becomes excessively large. While this is a practical limitation, it is unlikely that data for such a large number of futures would be available. Another problem is the linearity assumption of essentially non-linear tax laws. This might be solved by using various tax assumptions iteratively. Introducing non-linearities directly into the model, however, would result in an excessively complex model which would be only marginally more accurate.

In summary, such a model would be useful for firms to investigate potential sources and patterns of financing. It would also be useful to governments to examine the impact of various policies on the movement of funds and demands on the capital markets in a host or parent country.

In conclusion, if all the model did was to avoid taxes, it would be of dubious contribution as Rutenberg (1970) has pointed out. It is hoped that the model developed in this paper provides some assistance to managers of a MNC in assessing the issues which impinge on the financing decision they face.

FOOTNOTES

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[1]Some preliminary work has been done by Solnik [1974] and Pogue and Solnik [1975] to determine the impact of such international factors on the pricing of the securities of the MNC. To date, however, there has not been any definitive evidence to warrant the rejection of a segmented market assumption. Also see Adler [1974] for an investigation of the pooled vs. segmented market approach.

[2]See Hutchison and Lane [1973] or Petty and Walker [1972] for examples of working capital management models which include transfer prices. It should be noted that transfer pricing is of limited usefullness to a firm as a primary method of managing exchange risk as there are many external influences on the pricing decision which must be considered.

[3]Myers and Pogue (1975) (MP) show how to develop such a multiperiod financial planning model. Implementing their model for just one country, two financing sources with several classes and five periods produces a very large constraint matrix. Using even a limited number of countries and the financing sources assumed here, most computer algorithms would not allow more than one or at most two periods. Thus, the model developed here could be converted to a multiperiod model with recourse by including time subscripts on the variables and introducing the time value of money but it is unlikely to be of practical value.

[4]Myers and Pogue (1975) directly maximize the market value of the firm, but they assume uncertain investment returns. The model developed here can be reformulated to have the same form as the MP model under the appropriate assumptions but would be considerably more complex. Likewise, Hutchison and Lane (1973) present an objective function that maximizes current dividend flows but that assumes that investors prefer current dividends to future dividends, an assumption not supported theoretically or empirically. It also assumes that the firm has only one objective which has been shown to the innacurate (see Lee (1975), for example).

[5]The adjustment for interest rate from local to dollar cost uses the methodology outlined by Shapiro (1975). The local cost coefficients are the appropriate market rates for each type of security. It is assumed that the unit cost for each type of funds, k, is constant although it is not assumed that the cost from all sources in a country are constant. If a subsidiary is wholly owned and the equity is not traded in the market, its cost of equity can be determined using the method outlined by Gordan and Halpern (1974).

[6]Stonehill and Stitzel [1969] also argue that the similarity of capital structures of firms in the same industry in a country suggests that firms act as if there is an optimal capital structure for that industry.

[7]One approach might be to use the decomposition methods outlined by Morris [1975] and Carleton, Kendall and Tandon [1974]. While it has been shown that such methods are useful to the domestic firm, they have not been extended to the MNC.

[8]Specifying the optimal debt equity ratio is not a trivial matter. Vickers (1970) and others provide insight into the problem but no unambiguous method currently exists to determine this quantity.

[9]MM (1961) suggest that dividends do not influence the value of the firm but do provide information to investors. Gordon (1963), on the other hand, argues that investors do have a preference for current dividends over retained earnings. It is not the purpose of this paper to resolve that conflict but merely acknowledge that dividends must be considered.

[10]This approach must also be used with care. If projects are accepted in a host country with a lower rate of return than would be accepted by a comparable domestic firm, an inefficient use of the country's resources results. If done regularly it can be expected that the host country will react to such an inefficient allocation. The advantage of the model developed here is the ability to adjust for this result by using appropriate environmental constraints.

[11]Exposure can be defined in several ways but generally refers to assets net of certain liabilities which will lose (gain) in value on the devaluation (revaluation) of a currency (for a complete discussion, see Dufey (1972)). This question of exposure is of even more relevance than in the past in that under current accounting conventions, exchange gains and losses are included directly in the determination of net income in the period in which the rate changes. This exposure to greater net income variability is a major concern of financial managers.

[12]This methodology is known as stochastic programming (see Hutchison and Lane (1973) and Contini (1968) for further examples). Other options are also open for the introduction of risk. One could, for example, determine a variance of financing costs and introduce that directly into the objective function using quadratic programming as Lietaer (1970) did for exchange risk management. Such an approach, however, does not generate an explicit outcome making it less useful than the stochastic programming approach. Another choice is to use chance-constraint programming as developed by Charnes and Cooper (1961). Here, for example, one could specify a constraint like $PR(\tilde{z}_A > (1+\alpha)\tilde{z}_E) < \varepsilon$: where $\tilde{z}_A$ is the actual cost of funds, $\tilde{z}_E$ is the expected cost of funds, α is the variation which is acceptable, and ε is the acceptable probability for that event to occur. The user, however, must come up with the probability distribution of $\tilde{z}_A$, which is no easy task. Another technical problem with this approach is that the stochastic elements will appear in the constraints. This situation would preclude using a deterministic linear programming requiring instead iterative two state linear program. For these reasons, stochastic goal programming is preferred.

[13]The amount of that forward cover to be obtained is shown by Lietaer (1970) to be a function of the preferred risk position of the firm. While Lietaer shows how to generate the efficient frontier, specifying the position on the frontier is left to the user. Likewise, here the user can determine the amount of forward cover after specifying the preferred risk position. Unlike Letaer, however, the model developed here does tell him whether external means must be considered.

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APPENDIX

Stochastic Goal Programming Model

Objective Function

$$\text{MINIMIZE } Z = \sum_{ijk}\Big\{ \Big[A_{j\$}A_{ij}{}^{a}{}_{ijk}I_{ijk} + A_{j\$}{}^{v}{}_{ijk}E_{ijk} + A_{j\$}A_{ij}(1-t_j)(s_{ijk}D_{ijk}+{}^{y}{}_{ijk}U_{ijk})\Big]$$

$$+ \Big[((A_{j\$}-1) + (A_{ij}-1)(1-t_j))(D_{ijk}+U_{ijk})\Big]$$

$$+ \Big[((A_{j\$}-1) + (A_{ij}-1)(1-t_j))I_{ijk}\Big]\Big\} + \sum_{\substack{ik\\ i\neq j\\ j\neq 1}}\Big[(A_{i\$}-1)(Y_{il}+I_{ilk}\Big]$$

$$+ \sum_{ijk}\Big[({}_{t}r_{ijk}(t_i-A_{ij}t_j)I_{ijk}A_{j\$})_{\substack{i\neq j\\ j\neq 1}}\Big] + \sum_{\substack{i\\ i\neq 1\\ j=1}}\Big[u_iA_{i\$}Y_{il} + u_1Y_{10}\Big]$$

$$+ \sum_{i}\Big[\underline{d}_i^{+}d_i^{+} + \underline{d}_i^{-}d_i^{-}) + (\underline{e}_i^{+}e_i^{+} + \underline{e}_i^{-}e_i^{-}) + (\underline{f}_i^{+}f_i^{+} + \underline{f}_i^{-}f_i^{-})\Big]$$

$$i\neq 1$$

Subject to:

1. Sources and Uses of Internally Generated Funds

$$Y_i + \Big[\sum_{jk} I_{ijk}\Big] = G_i + F_i + C_i \qquad \text{(for all i)}$$

2. Budget Constraint

$$\sum_{ik} (1-p_{ijk})I_{ijk} - (1-g_{ijk})D_{ijk} - (1-h_{ijk})E_{ijk} - (1-\ell_{ijk})U_{ijk}$$

$$+ \sum_{i} Y_{il}(1-m_i)_{i\neq 1} \geq R_j + B_j \qquad \text{(for all j)}$$

3. Leverage Goal Constraint

a) For the Parent

$$\sum_{ijk}(D_{ijk} + U_{ijk}) - q_1^{*}\sum_{ijk} E_{ijk} - q_1^{*}Y_{10}$$

$$+ d_1^{*} - d_1^{-} = q_1^{*}(E_{10} + G_1 - \sum_{i} P_i) - D_{10} + \sum_{i} R_i$$

b) For each Subsidiary

$$\sum_{\substack{jk \\ i\neq j}} D_{ijk} + \sum_{jk} D_{jik} + \sum_{\substack{jk \\ i\neq j}} U_{ijk} + \sum_{jk} U_{jik}$$

$$- q_i^* \sum_{jk} E_{jik} + \sum_{\substack{jk \\ i\neq j}} I_{jik} + q_i^* Y_i + d_i^+ - d_i^- = q_i^*(E_{i0} + G_i)$$

$$- D_{i0} + R_i + \Sigma k_{ij} \qquad \text{(for all } i,\ i\neq 1)$$

4. Exposure Constraint

$$\sum_{\substack{jk \\ j\neq i}} I_{jik} - \sum_{\substack{jk \\ j=i}} D_{jik} + \sum_{\substack{jk \\ j\neq i}} D_{jik} + \sum_{jk} U_{jik} + e^+ - e^- =$$

$$DEL_i^* (XPO) - WC_i^* B_i \qquad \text{(for all } i,\ i\neq 1)$$

5. Dividend Goal

$$Y_i + f_i^+ - f_i^- = GY_i \qquad \text{(for all } i)$$

6. Limits on Issue Sizes

Limits on individual decision variables based on availability.

7. Environmental Constraints

Limits on individual decision variables set by company policy or host government regulations.

List of Variables

Decision Variables

D_{ijk} - Debt raised in subsidiary i for use in subsidiary j, type k

E_{ijk} - New equity raised in subsidiary i for use in subsidiary j, type k

I_{ijk} - Funds internally generated by affiliate i for use in affiliate j, type k if two or more are available

U_{ijk} - Eurocurrency debt raised in subsidiary i for use in subsidiary j, type k

Y_i - Dividend paid by subsidiary i (Y_{10} - dividends paid by parent)

Parameters

$$A_{ij} = \sum_{H=1}^{N} \left[b_H \frac{\frac{XE_{jH}}{XB_j}}{\frac{XE_{iH}}{XB_i}} \right]$$

B_i - Investment budget for subsidiary i

b_H - Probability of scenarios H, with N different scenarios

C_i - Liquid Asset balances currently held in excess of operating needs by subsidiary i

DEL_i^* - Desired adjustment to initial (accounting) exposure

- < 1 reduction of exposure
- $= 1$ no change desired
- > 1 increase in exposure

D_{10} - Initial debt on a consolidated basis

E_{10} - Initial equity on a consolidated basis

F_i - Depreciation and expected non-cash expenses for subsidiary i

G_i - After-tax profit expected to be earned by subsidiary i

g_{ijk} - Factor applied to D_{ijk} to reflect transfer leakage

h_{ijk} - Factor applied to E_{ijk} to reflect transfer leakage

ℓ_{ijk} - Factor applied to U_{ijk} to reflect transfer leakages

m_i - Factor applied to Y_{ij} to reflect transfer leakages

p_{ijk} - Factor applied to I_{ijk} to reflect transfer leakages

k_{ij} - Repayment of intra-firm loan from i to j

P_i - Income from intra-firm transactions

q_i^* - Optimal debt-equity ratio (1 = parent)

R_i - Long term debt repayments scheduled for subsidiary i

a_{ijk} - Local cost attributed to I_{ijk}

s_{ijk} - Local cost attributed to D_{ijk}

v_{ijk} - Local cost attributed to E_{ijk}

y_{ijk} - Dollar cost attributed to U_{ijk}

μ_i - Local cost attributed to Y_{ij} (the cost of equity)

t^r_{ijk} - Actual loan rate used on loans of internally generated funds from affiliate i to affiliate j, type k

t_j - Effective incremental corporate tax rate in subsidiary j

XB_i - Beginning exchange rate for subsidiary i (local currency/$)

XE_{iH} - Ending exchange rate for subsidiary i (local currency/$), scenario H

j$ - Exchange rate between recipient and U.S. parent

XPO_i - Initial exposure level, subsidiary i

WC_i - Proportion of the budget attributable to an increase in net working capital, subsidiary i

d_i - Deviation from leverage goal, subsidiary i

e_i - Deviation from exposure goal, subsidiary i

f_i - Deviation from dividend goal, subsidiary i

$\underline{d}_i$ - Penalty coefficient for d_i deviation

$\underline{e}_i$ - Penalty coefficient for e_i deviation

$\underline{f}_i$ - Penalty coefficient for f_i deviation