DIVERSIFICATION, EXCHANGE RISK, AND CORPORATE INTERNATIONAL INVESTMENT

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Abstract. All international investments inevitably have some diversification consequences. Yet, the literature on foreign direct investment accords only a limited role to diversification or financial variables. This paper develops a theory of corporate international investment from the standpoint of finance in an environment where the segmentation of international capital markets for individuals or the presence of agency costs provide some independence to corporate decisions separate from shareholders. The model does not depend on any particular advantage of multinational firms, and it specifies the stochastic properties of domestic and foreign output and input prices. It is found that real exchange risk and diversification gains affect corporate international investment in a significant way. It is also shown that the model embodies several existing explanations based on behavioral and economic variables.

The conventional theory of corporate international investment accords only a limited role to diversification or financial variables. Industrial organization theory explains corporate international investment as a result of multinational corporations' attempts to exploit their oligopolistic advantages or their need to internalize transactions under one corporate roof [survey in Caves 1982]. Financial theory suggests that corporate international investment is superfluous in perfect capital markets because shareholders can gain the benefits of international diversification directly through their own international portfolio investments [survey in Adler and Dumas 1983]. Hence, despite the fact that all foreign investments, whether acquisitions or new plants, inevitably have some diversification consequences, the mainstream direct investment literature appears to be somewhat wary of accepting diversification as a formal theory of corporate international investment both on the strategic ground and on the ground that it is inconsistent with perfect international capital markets.[1]

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Several factors, however, argue for international diversification at the corporate level. The first explanations are barriers to individual portfolio investment due to the partial segmentation of international capital markets [survey in Mathur and Hanagan 1983]. Reasons for segmentation include restrictions imposed by government policies and regulations, transaction costs, lack of information, and unfamiliarity with foreign markets.[2] Of course, these restrictions and costs may apply to corporate as well as individual investors, but corporations possess certain assets (e.g., financial economies, managerial efficiency, etc.) that make them more efficient in overcoming such restrictions and costs. Moreover, as Rugman [1977a,b] notes, the degree of segmentation may be greater in product and real factor markets than in financial markets. This leaves room for profitable corporate international investments in real assets in addition to financial investments by individuals. In such a world, corporate international investment becomes an indirect means of achieving some of the gains from international diversification not fully realized by individuals [Agmon and Lessard 1977; Errunza and Senbet 1984].[3]

The second factor giving rise to the relevance of corporate investment is agency cost. Agency costs [Jensen and Meckling 1976] are the costs incurred by shareholders to ensure that the managerial decisions conform to the interests of the shareholders. With agency costs, there is some room for corporate activity independent of investor diversification. Corporate decisions can therefore result from maximizing managers' objective rather than that of the shareholders' although the two objectives can overlap. In addition, the managers may want to diversify because their human capital is undiversified.

The third reason has to do with the uncertainty of operational cash flows. Considering the case of two domestic firms, Lewellen [1971] shows that a conglomerate merger can reduce the default risk. The reduction in default risk depends on the correlation of the pre-merger cash flows of the two firms. Levy and Sarnat [1970] similarly argue that a large firm will have better access to capital markets and a lower cost of financing. This cost advantage again implies a reduction in the firm's risk from the lender's viewpoint, which can be achieved by corporate diversification or a conglomerate merger. Other authors point to tax savings on interest payments which will accompany the increased post-merger debt capacity [Galai and Masulis 1976; Scott 1977], or the reduction in agency costs [Marshall, Yawitz and Greenberg 1984] as additional reasons for corporate diversification achieved by conglomerate mergers. In an international context, these gains from diversification are even greater given the partial segmentation of national economies and markets. The additional gain is due to a lower systematic risk premium in world capital markets than in the domestic market, which is caused by the less-than-perfect correlation of national capital market returns.

The fourth explanation is the effect of exchange risk on corporate international investment. Aliber [1970, 1983] argues that exchange risk can create a difference in the cost of capital of firms located in different currency zones, thereby affecting the flow of international investment. The inclusion of an exchange risk premium (or discount) is justified by deviations from purchasing power

parity or international differences in consumption baskets [Adler and Dumas 1983; Solnik 1974]. In such cases, exchange risk has a real systematic element, with subsequent effects on the cost of capital and the flow of international investment.

This paper examines the effect of the last two factors—diversification of operational cash flows, and exchange risk—on corporate international investment decisions in a two-country dynamic optimization model, taking the first two factors as environmental factors. That is, it is assumed that the corporate environment is characterized by the partial segmentation of international capital markets for individuals and/or the presence of agency costs. In contrast to industrial organization theory, the present model does not depend on any particular oligopolistic advantage, such as technology, of multinational firms to explain corporate foreign investment. It also goes beyond existing financial models by permitting stochastic interdependence between exchange rates and cash flows and by treating output and input prices as stochastic. It is shown that real exchange risk and diversification motives are among the determinants of corporate international investment decisions. It is also shown that the resulting dynamic portfolio model includes as special cases several existing theories of foreign direct investment based on economic and behavioral factors.

THE MODEL

Suppose a "two-country" firm whose static cash flows for time t from its home and foreign operations can be written in a standard way (firm and time subscripts omitted):

$$\tilde{R} = (\tilde{P} - \tilde{C}) Q \tag{1}$$

$$\tilde{R}^* = \tilde{e} (\tilde{P}^* - \tilde{C}^*) Q^* \tag{2}$$

where $\tilde{P}$ and $\tilde{C}$ are uncertain output and input prices, and Q is the quantity of output which is assumed to be certain. (Variables with asterisks concern foreign operation, and the tilde denotes uncertain variables.) Foreign prices and costs are initially denominated in foreign currencies and therefore are translated by uncertain exchange rates, $\tilde{e}$. The numeraire, therefore, is domestic currency. Thus, the firm has overseas investment but retains its domestic consumption habitat. This reflects an implicit assumption that all projects—foreign or domestic—are evaluated in domestic currency unit because income from these projects will be expended only over domestic goods.[4]

The analysis focuses on real exchange exposure through the interaction of exchange rates and prices. Further specification of any conditions on goods markets is therefore restrained at this point; implications of integrated world goods markets will be discussed later. For now, the only source of "segmentation" is real exchange risk. The model, however, is consistent with a multi-good as well as a single-good world economy.

Using stochastic calculus, changes in the two cash flows per unit of time are:

$$d\tilde{R} = d\tilde{P} - d\tilde{C} \tag{3}$$

$$d\tilde{R}^* = \tilde{e}d\tilde{P}^* - \tilde{e}d\tilde{C}^* + (\tilde{P}^* - \tilde{C}^*)\,d\tilde{e} + d\tilde{P}^*d\tilde{e} - d\tilde{C}^*d\tilde{e} \tag{4}$$

where Q and Q^* are set at unity. All stochastic variables are assumed to follow the time motion specified by the Ito process:

$$dP = \alpha_p dt + SpdZp \tag{5}$$

$$dP^* = \alpha_{P^*} dt + S_{P^*} dZ_{P^*} \tag{6}$$

$$dC = \alpha_c dt + S_c dZ_c \tag{7}$$

$$dC_* = \alpha_{c^*} dt + S_{c^*} dZ_{c^*} \tag{8}$$

$$de = \alpha_e dt + S_e dZ_e \tag{9}$$

where tilde's are dropped for notational convenience. The Ito process separates the time motion into a deterministic trend term and a stochastic disturbance term: α_i is the instantaneous expected value of variable i, S_i is the instantaneous standard deviation of the value of variable i, and dZ is the standard Wiener process (which is the limiting process of a discrete-time random walk). A statistical assumption behind the Ito process is that the value of the variable concerned at time t is log-normally distributed so that, over a short time interval, the proportionate change in that variable is normal with mean $\alpha_p dt$ and variance $S_p^2 dt$.

Substitution of (5)-(9) in (3) and (4) and the application of Ito's Lemma yield:

$$dR = \alpha_R dt + SpdZp - S_c dZ_c \tag{10}$$

$$dR^* = \alpha_{R^*} dt + eSp^* dZp^* - eS_{c^*} dz_{c^*} + (P^* - C^*)S_e dZ_e \tag{11}$$

where

$$\alpha_R = \alpha_p - \alpha_c \tag{11a}$$

$$\alpha_R^* = e\alpha_{p^*} - e\alpha_{c^*} + (P^* - C^*)\alpha_e + S_{p^*e} - S_c^*_e \tag{11b}$$

and S_{ij} is the instantaneous covariance between i and j. This result shows that in addition to the usual output and input price risk, foreign cash flows are also affected by exchange rate changes. The effect of exchange rates is through both the deterministic and stochastic terms.[5]

A more general specification of cash flows should also include quantity changes in equations (10) and (11). The actual result of this inclusion, however, depends on whether quantity changes are stochastic. If quantity changes have a stochastic component, these equations should contain additional covariances between quantity and exchange rate and price variables. Production uncertainty will then have a bearing on the firm's investment decisions. If quantity changes are deterministic and a matter of managerial decision, however, the dynamic cash flow equations remain intact, and the firm's production and location decision will depend on the solution of the optimization problem described below.

The firm is assumed to maximize the present value of the manager's expected utility of net cash flows subject to a flow balance sheet constraint. The decision problem can be written as:

$$J = \max \int_0^\tau E[U(t), s(t)] \, dt \tag{12}$$

subject to

$$dV = Vx dR^* + V(1-x) dR. \tag{13}$$

where V is real wealth, E is the expected value operator, x is the proportion of foreign investment in the firm's total capital budget, $U(t)$ is the manager's expected utility at time t, and $s(t)$ denotes the present value discount factor. In equation (13), contributions to the firm value from sources other than the operational cash flows are taken as given. The expected value function has concavity and other nice properties. Short sales are allowed, so that x can be negative.

The solution requires formation of the Bellman function and taking the first order condition. The Bellman function is a tool in stochastic dynamic programming and is equivalent to setting up an objective function using the Lagrange multiplier for a static constrained optimization problem.[6] The optimum proportion of foreign investment in the firm's total capital budget then is

$$x = \frac{1}{S_g^2} \left[\frac{\alpha_{R^*} - \alpha_R}{A} + \left(S_R^2 - S_{RR^*} \right) \right] \equiv H_1 + H_2. \tag{14}$$

where $S_g^2 = S_{R^*}^2 + S_R^2 - 2S_{RR^*}$ is the portfolio variability such that

$$S_R^2 = S_p^2 + S_c^2 - 2S_{pc}$$

$$S_{R^*}^2 = e^2 S_{p^*}^2 + e^2 S_{c^*}^2 + (P^* - C^*) S_e^2 - 2e^2 S_{p^* c^*}$$

$$+ 2e(P^* - C^*)(S_p{}^* e - S_{c^* e})$$

$$S_{RR^*} = e S_{P^* P} - e S_{P^* c} - e S_{Pc^*} + e S_{cc^*} + (P^* - C^*) (S_{eP} - S_{ec}),$$

and $A = -J_{vv} V / J_v$ is the Pratt-Arrow measure of relative risk aversion. The risk aversion parameter measures the firm's attitude in risk-taking, including the risk of foreign investment. H_1 and H_2 denote the two terms in the equation. This equation is similar, in form, to the one in Dornbusch [1980].

An important behavioral characteristic of a foreign investment decision is whether the firm is aggressive or passive. For an aggressive firm, an anticipation of greater expected return[7] is the main reason for going abroad. Such a firm is a leader in the industry and a risk-taker. A passive firm, on the other hand, reacts to the leader, and undertakes foreign investment after it has been "proven." Its motivation is to protect its existing market position rather than to increase it. The firm is a follower and risk-avoider.

This distinction between the aggressive and passive corporate investments is shown by the value of the firm manager's risk-aversion parameter, A in equation (14). The first term H_1, called "speculative demand," is the aggressive demand component because it depends on the value of A. The second term H_2, called

"hedging demand," is the passive demand component. It describes the demand for foreign investments on a risk-hedged basis, and hence is independent of the firm's attitude toward risk.

Consider the aggressive demand in more detail:

$$H_1 \equiv [(\alpha_{R^*} - \alpha_R)/A]/S_g^2. \tag{15}$$

After substituting (11) and (11b), this demand can be written as

$$H_1 = \frac{1}{S_g^2 A} [\underbrace{(\alpha_c - e\alpha_{c^*})}_{cost} + \underbrace{(e\alpha_{P^*} - \alpha_P)}_{price}$$

$$\underbrace{+ (P^* - C^*)\alpha_e + (S_{P^*e} - S_{c^*e})}_{exchange\ rate}]. \tag{16}$$

This expression embraces three existing theories on foreign direct investment. Earlier theories emphasized the cost advantage of host countries: firms are lured abroad by the comparative cost saving offered by foreign production vis-a-vis home production (assuming cost difference is not fully taken advantage of by trade due to barriers). This is shown in the first term in equation (16). Later, the demand side effect was incorporated into the literature: foreign investment decisions are also affected by the expectation of whether output prices are higher abroad than in the home market. This is the second term.

The third and fourth terms concern exchange rates. The third term shows that the flow of investment can be affected by a deterministic change in exchange rate assuming that the economy of the host country is not perfectly competitive, i.e., P^* is not equal to C^*. The fourth term measures the effect through stochastic changes. It indicates that the investment flow depends on the relative size of S_{P^*e} and S_{c^*e}, that is, investments flow from domestic to foreign country if $S_{P^*e} > S_{c^*e}$. In operational terms, this implies that a secret of successful foreign investment is finding a foreign project where output prices are more strongly positively correlated with the value of foreign currency than costs.

The last condition concerning the exchange rate covariances is intuitively appealing. A decline in the value of foreign currency, for instance, will raise both output prices and input costs in that country. The covariance term indicates that the firm will find it profitable to invest in that country ceteris paribus if the price increase is greater than the cost increase.

This explanation contrasts with Aliber's theory on currency premium. Aliber [1970, 1983] argues that the differential market valuation of home and host country currencies gives a competitive edge to multinational firms over indigenous firms in the host country. Multinational firms have access to strong-currency financing at home or in international capital markets, while indigenous firms are confined to local finance in weak currency. The different market valuation of these currencies implies that multinational firms would have lower cost of capital than the indigenous firms in the host country. Investments thus flow from a strong-currency country to a weak-currency country, because the same income stream from a foreign project is discounted to a higher present value for a multinational firm than for a local firm. In the present analysis, the flow of investment depends on the covariance of exchange rates with foreign output

and input prices. The investment flows can be in both directions because, depending on covariances, investors in both nations will want to diversify into each other.

This result also contrasts with Adler and Dumas [1975], but this difference is only apparent. Adler and Dumas find the irrelevance of exchange risk in international investment decisions because they assume that exchange rates and cash flows are independent. In this paper, exchange risk is defined in terms of its economic effect on cash flows, with the resulting dependence of international investment on real exchange risk.

If the world goods markets are completely integrated, the law of one price prevails (or the purchasing power parity in the case of many goods). In this case, the first three terms drop out, lending support to a view that international investments take place only with market imperfections. The fact that the fourth term still remains, however, suggests that, in a stochastic world, the variability of exchange rates vis-a-vis prices and costs can be an additional factor inducing aggressive foreign investments.

The passive hedging demand—the second component in equation (14)—describes a familiar portfolio story: foreign investment will increase (a) the greater the variability of domestic returns, and/or (b) the lower the correlation between domestic and foreign returns. This demand can also be traced to uncertainties in prices and costs:

$$H_2 \equiv (S^2 - S_{RR^*})/S_g^2$$

$$= \frac{1}{S_g^2} [(S_p^2 + S_c^2 - 2S_{pc} - eS_{pp^*} + eS_{p^*c} + eS_{Pc^*} - eS_{cc^*}) - (P^* - C^*) \quad (17)$$

$$(S_{ep} - S_{ec})]$$

The greater variability of domestic price and cost (i.e., s_p^2 or S_c^2), for instance, stimulates foreign acquisitions and investments. However, an increase in their covariance with similar foreign variables (i.e., S_{pp^*} or S_{cc^*}) reduces foreign investments. The flow of investment is also affected by cross–covariances through this channel (S_{pp^*} and S_{p^*c} as well as S_{pc}). It is interesting that, in the last term, in a noncompetitive economy where a firm can make non-zero (above-normal) profits, the covariance of exchange rates with only domestic prices and costs also affects the flow of investment.

In this model, the management is concerned with the total variability of the firm's net cash flows, in contrast to the usual emphasis on the systematic risk component only. This follows from our modelling of a firm rather than shareholder behavior, and is justified by the manager's desire to avoid excessive earnings volatility or financial distress.

It is often argued that the availability of various hedging vehicles such as futures and the like would make exchange risk irrelevant. Aside from the fact that these hedging vehicles are not cost-free, there is also a question of consistency between exchange exposure and the hedging vehicles used. The usual hedging through financial markets is appropriate if exchange exposure is nominal and

temporary in nature. If the exposure, however, is more permanent and "real" as in the present model, offsetting financial operations are inappropriate. Shapiro [1986] discusses the importance of production and marketing decisions in the firm's operating exchange exposure management. Similarly, Rutenberg [1982] argues that real decisions are part of the exchange management strategy in the case of a geocentric firm. A geocentric firm is concerned with cash flows rather than the balance sheet, and will finance the construction of a Canadian mine, for instance, by issuing yen bonds if the products are destined for Japan. In this case, such real operational policies as production location decisions are in order, and this is the sense in which real exchange risk "causes" a foreign investment decision in this paper.

Obviously, the distinction between the aggressive and passive investment is extreme. For a usual firm, $0 < A < \infty$, and both types of investments are relevant. The rationale for an aggressive investment in addition to hedging is that complete hedging is suboptimal from the standpoint of an optimum trade-off between risk and return (unless the investor is a complete risk-averter).

An interesting feature of this model is that it does not rely on any particular assumption on the market structure. On one hand, the model is consistent with competitive markets for the firm's outputs and inputs, because no assumption was made regarding the possession of any oligopolistic advantages by multinational firms. On the other hand, the model can also accommodate the industrial organization view. This will, however, require further specification of cost and price structures depending on specific forms of firm, industry, or country characteristics singled out for analysis.

Finally, equation (14) can be aggregated over all firms to yield an equilibrium relationship between domestic and foreign investments. Define q as the ratio of the supply of foreign assets to total wealth of the domestic economy; for an aggregate economy, q is the time integral of current account balances. The equilibrium relationship after aggregation is

$$\alpha_{R^*} - \alpha_R = A_m[qS_m^2 - (S_R^2 - S_{RR^*})]. \tag{18}$$

where A_m is a weighted average of the firm's measure of relative risk aversion, and S_m^2 is the variance of return on the world portfolio of investment projects. Equation (18) describes the capital market line and is similar to the standard international asset pricing models [Solnik 1974; Stulz 1981] which accommodates international differences in investors' consumption baskets. Empirically, α_R is the minimum-risk benchmark case which is measured by the return on domestic assets. The expression in bracket measures the excess return on world market portfolio. As in consumption-based international asset pricing models, equation (18) relates individual asset returns to some real quantity rather than nominal market returns. The present analysis goes further and examines the sources of the firm's real exchange exposure.

Equilibrium models, however, have limited validity as a description of the firm's micro behavior. If international financial markets as well as real markets are always in equilibrium, then no additional international investments would take place. Therefore, although equation (18) can serve as a reference point

for normative decisions, equation (14) is more appropriate as a theory of the firm's international investment behavior at the micro level.

CONCLUDING REMARKS

All international investments inevitably have some diversification consequences. Yet, diversification as a motive for corporate international acquisitions and investments has not been well supported by a formal theory. This paper provides a formal theory of corporate international investment in an environment where the partial segmentation of international capital markets for individuals and/ or the presence of agency costs provides some independence to corporate decisions separate from shareholders'. The model goes beyond existing ones by specifying the stochastic as well as deterministic properties of the firm's domestic and foreign output and input prices. The covariances of these prices are found to affect the flow of investment. In addition, the real exchange risk affects corporate investment in a significant way.

It is also shown that the model embraces several existing explanations based on behavioral and economic variables. The model, however, does not explain the choice between foreign direct investment and exports or licensing, nor is applicable to situations where international diversification by individuals is more efficient than diversification by corporations.

The relative evaluation of diversification versus other motives is not the purpose of this paper. In one sense, the portfolio model is quite general because it considers the interdependence of project cash flows in a risk-return framework, which is essential in any investment decision but lacking in traditional foreign direct investment theories. In another sense, the portfolio model is a subset of internalization or transaction cost theories because it owes its presence to imperfections in capital markets, which can be embraced under the general market-imperfection hypothesis of traditional theories. In any event, the diversification theory only supplements rather than supplants other existing theories.

Major empirical implications of this paper include (a) the extent to which the diversification affects corporate international investments, and (b) the possibility that foreign investment is induced by real exchange risk. For the former, there is substantial evidence both among the traditional multinational firms [Aggarwal 1980; Miller and Pras 1980; Rugman 1977a,b] and among "unconventional" multinationals based in Japan and other countries [Ozawa 1979]. For the latter, there is some casual evidence [*Wall Street Journal*, 1985, 1987a, 1987b], but it remains an open question to be substantiated by future work.

NOTES

1. Hanink [1985] uses a mean-variance model to analyze the location strategy of multinational firms. Similarly, Rugman [1977b] examines the profile of international diversification by direct and financial investments. These studies, however, do not formally discuss financial theory or exchange risk.

2. Mathur and Hanagan [1983] also include exchange risk as one of the reasons for barriers to individual investments. Exchange risk, however, affects the firm as well as individual investment, and is fundamentally different from market segmentation due to government policies and costs imposed by location-specific factors. For these reasons, exchange risk is discussed as a separate category in this paper.

3. A somewhat different result was obtained, however, by the empirical work of Jacquillat and Solnik [1978] and Senschack and Beedles [1980]. They report much smaller gains in investing in the stocks of multinational firms, compared with investing in foreign stocks directly. All studies, however, agree that investing in a combination of domestic and multinational firms is better than investing only in domestic firms. Country mutual funds are another indirect means of investing in (partially) segmented foreign capital markets. No empirical studies exist on this as yet.

4. An alternative is using some sort of world prices as numeraire. This would be appropriate for a truly multinational firm with multinational "consumption habitat."

5. If the world price is used as the numeraire [Note 4], even home cash flows are subject to exchange risk. For this and other implications of the numeraire currency and consumption basket, see Choi [1984].

6. The Bellman function is

$$B = E[U(t),t] + J_t + J_v V[x\alpha_{R^*} + (1-x)\alpha_R] + (J_w V^2/2)[x^2 S_{R^*}^2 + (1-x)^2 S_R^2 + 2x(1-x)\alpha_R]$$

The first order condition with respect to x then yields equation (14). Another first order condition, which does not affect the result, is $U_c = J_v$. This indicates that the firm should invest until the use of funds has the same marginal effect on the value of the firm as saving them. For an early application of this technique in finance, see Merton [1971].

7. The use of "return" in a portfolio model is not as narrow as it seems. It can include qualitative strategic considerations and other benefits from international investment.

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