



## A Model of Firm Valuation with Exchange Exposure

Jongmoo Jay Choi

*Journal of International Business Studies*, Vol. 17, No. 2 (Summer, 1986), 153-160.

Stable URL:

<http://links.jstor.org/sici?sici=0047-2506%28198622%2917%3A2%3C153%3AAMOFVW%3E2.0.CO%3B2-T>

*Journal of International Business Studies* is currently published by Palgrave Macmillan Journals.

---

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at <http://www.jstor.org/about/terms.html>. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at <http://www.jstor.org/journals/pal.html>.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

---

JSTOR is an independent not-for-profit organization dedicated to creating and preserving a digital archive of scholarly journals. For more information regarding JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).

## A MODEL OF FIRM VALUATION WITH EXCHANGE EXPOSURE

Jongmoo Jay Choi\*  
*Temple University*

**Abstract.** This paper examines how the firm's exposure to exchange rate uncertainty influences its valuation. It identifies the variables affecting the firm's economic and accounting exchange exposure as well as the cost of capital in a formal unified model.

A key issue in international finance is the effect of the firm's exposure to exchange rate uncertainty on the value of a firm. The interaction of several factors, however, makes this relationship difficult to ascertain. At the corporate level, changes in exchange rates affect the value of firms because of the sensitivity of cash flows to exchange rate changes. If markets are "inefficient" due to taxes or other factors, the value of the firm may also be affected by the translation effects of exposed cash flow positions. Still another possibility is that the variability of exchange rates may affect the firm's systematic risk and hence its market value.

This paper develops a model of the firm's exchange exposure and its effect on market value. The contribution of this paper is two-fold: (1) it combines the various theoretical possibilities in a formal unified model, and (b) it explicitly treats the firm's economic exchange exposure in terms of output and input demand elasticities. It is shown that the effects of exchange exposure on firm value are generally ambiguous, in contrast to the positive association between currency and stock values suggested in the monetary model.

Fama [1981] explains the negative correlation observed between inflation and stock prices on the basis of changes in money demand resulting from changes in real income. His theory, combined with the standard monetary approach to balance of payments model, suggests a positive association between dollar values and stock prices. An increase in business activity leads individuals to hold a higher level of cash balances; the dollar then appreciates

---

\* Jongmoo Jay Choi is Associate Professor of Finance and International Business at Temple University. He has a Ph.D. from New York University, taught at Columbia and NYU, and was an Economist at the Chase Manhattan Bank. He has numerous publications on corporate finance and international finance.

The author would like to thank Clas Wihlborg, Robert Hawkins, Alan Severn, Donald Lessard, and three anonymous referees for helpful comments.

Date Received: April 1985; Revised: August and November 1985; Accepted: November 1985.

because they are now less willing to sell their dollars to foreigners. The result is the association of an appreciating dollar with a rising stock market.<sup>1</sup> The present analysis based on the firm model with exchange exposure indicates that such effect can be positive, zero, or negative.

### THE MODEL

Assume a partial equilibrium model with a "two-country" U.S. firm operating in both the U.S. and Germany; the firm sells output and buys inputs in both markets. Suppose further that the value of the firm equals the sum of the present values of its expected future net cash flows in dollars:

$$V_j = \int_0^{\infty} X_j(t) g(r_j, t) dt, \quad (1)$$

where  $X_j(t)$  denotes the firm  $j$ 's cash flows at time  $t$ , and the partial derivative of the discount function  $g$  with respect to the discount rate  $r$ , and time,  $t$ , are both negative.

At time  $t$ , firm  $j$ 's cash flow is:

$$X_j(t) = X_j^d(t) + e(t) X_j^*(t), \quad (2)$$

where  $X_j^d$  and  $X_j^*$  denote cash flows from its U.S. and German operation respectively. Note that the exchange rate,  $e$ , translates DM cash flows to dollars. This assumes that firm  $j$  exhibits a domestic "consumption habitat," and uses the dollar as the numeraire in its investment decisions.<sup>2</sup>

Obviously these cash flows are risky. Hence, the discount rate in the firm value equation should contain a risk premium. The risk premium in an international context reflects the gains from international diversification as well as exchange risk and costs associated with foreign location (more on this later).

Given the floating exchange rate system or, at least, the regime in which rates are not permanently fixed, the firm's accounting exposure is immediately apparent. This is because changes in exchange rates affect the accounting value of the firm's exposed positions after translation. In addition, an economic exposure arises because exchange rate changes affect DM cash flows directly. There is a view that only economic exposure is relevant, since, in an efficient market, the accounting effects will be fully discounted by rational investors (e.g., Giddy [1976]). There are several reasons, however, why accounting exposure may also be present. First, taxes affect the real cash flows and hence firm values. Second, hedging decisions of firm managers—which have real cash flow consequences—are often motivated by expected reported earnings (Dufey and Srinivasulu [1983]). Third, information signalling of the earnings announcement may have an effect on firm value. Whether these reasons are sufficient to establish a nonzero accounting exposure is an empirical issue. Theoretically, the present model accommodates a case of zero as well as positive accounting exposure.

A major issue in currency accounting concerns different ways of fixing  $e$  for each reporting period in the face of an intertemporal uncertainty in  $e$  and  $X_j^*$ . The FASB's Statement of Financial Accounting Standards 8, for instance, uses contemporaneous exchange rates for translation of monetary assets and liabilities and historical rates for translation of nonmonetary assets and liabilities. In the present model, this amounts to separating  $\int_0^t X_j^*(t)g(\cdot)dt$  into the two components, and applying current or historical rates depending on whether or not items concerned are monetary; here we refer to translation rather than transaction exposure since we are concerned with balance sheet items or cumulative cash flows.<sup>3</sup> This selective matching of exchange rates and asset/liability items was corrected in the current rate method adopted by FASB 52. Translation exposure stemming from the intertemporal exchange rate uncertainty, however, still remains.

In the analysis of economic exposure, both home and foreign cash flows are sensitive to exchange rate changes. To be sure, portions of home cash flows are basically domestic and hence independent of exchange rates (in a more general setting, even these cash flows have some sensitivity to exchange rate because of the effects through financial markets and the effect of cross elasticities with other countries). Other home cash flows, denoted by  $X_j^e$ , are directly tied to exchange rate-dependent international trade of U.S. firms and U.S. affiliates of foreign firms. Equation (3) combines these two components, where  $\gamma_j$  is the proportionality factor between the total and exchange rate-sensitive home cash flows at  $t$ :<sup>4</sup>

$$X_j^d = \gamma_j X_j^e \equiv \gamma_j (P_j - C_j) Q_j^e \tag{3}$$

$P_j$  and  $C_j$  respectively are output price and input cost, and  $Q_j^e$  is the production quantity in the exchange rate-sensitive sector.

The home economic effect of exchange rates is

$$\frac{\partial X_j^d}{\partial e} = (\gamma_j Q_j^e / e) [(P_j - C_j) s(Q_j^e, e) + P_j s(P_j, e) - C_j s(C_j, e)], \tag{4}$$

where  $s(Q_j^e, e)$  is the absolute elasticity of  $Q_j^e$  with respect to  $e$ , or  $(\partial Q_j^e / \partial e)(e / Q_j^e)$ , and so forth. Following variables determine the firm's home economic exposure: the production response to exchange rate changes,  $s(Q_j^e, e)$ ; the sensitivity of output price and input cost to exchange rate changes,  $s(P_j, e)$  and  $s(C_j, e)$ ; the sign and the value of existing net home cash flows,  $X_j^d = \gamma_j Q_j^e (P_j - C_j)$ . Home cash flows depend on the importance of international trade and related business in home operation,  $\gamma_j$ , and market structure. The level of home cash flow is zero if output and input markets are perfectly competitive in the domestic economy, and positive *ex ante* if there is some degree of market imperfection. Assuming a positive  $X_j^d$  and reasonably elastic foreign demand, domestic economic effects are likely to be positive (following a strong DM

or weak U.S. dollar), although the J curve phenomenon suggests a slight temporary downturn immediately following the depreciation of home currency.<sup>5</sup>

Economic impact in the foreign market can be similarly examined from the German subsidiary's cash flow equation:

$$X_j^* = [P_j^*(e) - C_j^*(e)] Q_j^*(e) \quad (5)$$

where  $P_j^*$ ,  $C_j^*$ , and  $Q_j^*$  are respectively unit output price, input cost, and production quantity in the German affiliate. It is immediately clear that the foreign economic effects—the effects of exchange rate changes on cash flows of foreign subsidiaries—depend on the elasticities of output prices, input prices, and production quantity in foreign markets with respect to exchange rates.

$$\frac{\partial X_j^*}{\partial e} = \frac{Q_j^*}{e} [(P_j^* - C_j^*)s(Q_j^*, e) + P_j^*s(P_j^*, e) - C_j^*s(C_j^*, e)] \quad (6)$$

Note that foreign economic effects are zero if (a)  $s(P_j^*, e) = s(C_j^*, e)$  and (b)  $P_j^* = C_j^*$ . Condition (a) stipulates that the price impact of exchange rate changes should be neutral in output and input markets. This condition is similar but not identical to purchasing power parity. For one thing, the present condition refers to a particular firm rather than an aggregate economy; for another, it speaks of a *sectoral* neutrality of price impacts, as opposed to fully-offsetting movements between prices and exchange rates in each sector. In addition, there is condition (b), which will be met only if output and input markets are perfectly competitive. With imperfect markets,  $P_j^* > C_j^*$  *ex ante* so that the quantity effect,  $s(Q_j^*, e)$ , also becomes relevant.<sup>6</sup>

The "law of one price" suggests a one-to-one correspondence between price changes and changes in real exchange rates given trade impediments. An appreciation of DM, for instance, reduces output and input prices in Germany *ceteris paribus*. Levi [1983], however, provides two reasons why price responses might be smaller in the input market than in the output: (a) imported inputs are only a fraction of total inputs used by the firm, and (b) only a fraction of goods purchased by workers are produced abroad. This, combined with a homogeneous production response, means that the effect of a rising DM on German net cash flows is negative.<sup>7</sup>

This result is also obtained if we alternatively assume that the firm faces a price-inelastic market demand for its output, and/or that its own demand for input is price-elastic. (The latter presupposes some flexibility in substituting domestic and imported inputs.) In this case, a given decline in output and input prices causes a decrease in revenue, and/or an increase in expenditures; the resultant negative foreign economic effect conflicts with the positive accounting (transaction or translation) effect of given foreign cash flow positions.<sup>8</sup>

Fundamentally, three variables determine the foreign *economic* impact of exchange rate changes: the linkage between exchange rates and output/input prices, the market demand structure for the firm's output, and input supply conditions which determine the firm's own input demand elasticity. For an overall foreign effect, these economic effects must be combined with the effect of the accounting exposure:

$$\frac{\partial(eX_j^*)}{\partial e} = e \frac{\partial X_j^*}{\partial e} + X_j^* \quad (7)$$

The overall effect of exchange rates on firm value can now be determined:

$$\frac{\partial V_j}{\partial e} = \int_0^\infty \left[ \frac{\partial X_j^d}{\partial e} + \left( e \frac{\partial X_j^*}{\partial e} + X_j^* \right) \right] g(r_j, t) dt \equiv H + F + T. \quad (8)$$

This has three components: (a) home economic effect  $H = \int (\partial X_j^d / \partial e) g(\cdot) dt$  which is positive, assuming reasonably elastic foreign demand for U.S. exports, (b) foreign economic effect  $F = \int e (\partial X_j^* / \partial e) g(\cdot) dt$ , which is likely to be negative under certain conditions, but which depends on the linkage between exchange rates and prices, market structure, and output and input demand elasticities, and (c) the accounting (transaction or translation) effect of foreign cash flows  $T = \int X_j^* g(\cdot) dt$ , which is positive assuming some market "inefficiency" and positive net foreign exposed positions. Thus, the likelihood that a strong (weak) DM or a weak (strong) U.S. dollar will raise the firm value increases (decreases), (a) the greater is the home economic effect  $H$  relative to foreign economic effect  $F$ , and (b) the greater is the effect of accounting  $T$  vis-a-vis foreign economic effects  $F$ .

Thus far we have examined the effect of exchange rates through the firms' expected cash flows in a certainty world, ignoring the impact on the discount rate. In the following, we will discuss the effect of exchange rate variability on the firm value through the cost of capital.

Various authors have demonstrated that exchange risk in general is not fully diversifiable if exchange rates have some "real" components. Factors contributing to such condition include government interventions, deviations from purchasing power parity, and international differences in investors' consumption baskets; see the survey paper by Adler and Dumas [1983].<sup>9</sup>

Solnik [1974], Stulz [1981], and Hodrick [1981] have developed international asset pricing models which recognize this systematic exchange risk. The upshot of these models is a three-fund theorem where the required rate of return on a security contains the premium for the systematic exchange risk, in addition to the usual risk-free rate and the (global) market risk premium. The exchange risk premium exists unless all investors are risk-averse or security returns are uncorrelated to exchange rates (which

assumes zero economic exposure for firms). This suggests that the exchange rate variability *certis paribus* raises the cost of capital of an international firm and hence reduces its value. Political risk and other costs associated with foreign location may add to the cost. But then gains from international diversification, or hedging service of some asset or cash flow components, could offset all or part of this cost. This opens up a possibility for a lower as well as higher cost of capital for international as opposed to domestic project evaluation; see Choi and Severn [1985].

For a complete analysis of an international firm's exchange exposure, these effects on the cost of capital should be combined with the effect of accounting and economic exposures.

### CONCLUDING REMARKS

An interesting feature of this model is its explicit consideration of the firm's economic exposure in terms of output and input demand elasticities. The model is sufficiently general to include the effect of accounting exposure, as well as the effect of exchange rate variability on the firm's cost of capital. The analysis, however, is limited by its use of a micro partial equilibrium model; it abstracts from a number of issues such as the effects of cross-elasticities, inflation, and interactions with the money market. In contrast to the monetary model which suggests a positive association between currency and stock prices, the present analysis shows that exchange rates can have a positive, zero, or negative effect on stock prices. Such effects depend on accounting versus economic effects, and home versus foreign market effects (or structural variables behind them).

### NOTES

1. This discussion was suggested by a referee.
2. If the firm, instead, has a global consumption pattern, the numeraire should be some sort of world prices. For implications of consumption patterns for international investment decisions, see Solnik [1974], Senbet [1979], Stulz [1981], and Choi [1984].
3. The difference between a transaction and translation exposure is whether cash flows refer to a particular transaction, or to the cumulative result as of a given point in time. For the present purpose, this difference is immaterial; the translation exposure, *mutatis mutandis*, applies to the transaction exposure, and vice versa.
4. The proportionality factor  $\gamma_j$  equals  $(2w_j - 1)/w_j$  where  $w_j$  is the weight of  $X_j^e$  in domestic cash flows. This is seen by writing

$$X_j^d = w_j X_j^e + (1 - w_j) X_j^n, \quad 0 < w_j \leq 1$$

where  $X_j^n$  is domestic cash flows independent of exchange rates.

Substituting  $X_j^n = X_j^d - X_j^e$  and rearranging yield

$$X_j^d = \frac{(2w_j - 1)}{w_j} X_j^e,$$

from which the definition of  $\gamma_j$  follows.

5. The J curve phenomenon is a temporary perverse response of trade balance to exchange rates due to the short-term inelasticity of import demand. Upon aggregation, the effects of exchange rates on firm cash flows are related to balance of payments stability conditions.
6. Continued market equilibrium in a perfectly competitive, informationally efficient, and sectorally and internationally homogeneous economy, by definition, eliminates all economic exposures as well as the effect of an accounting exposure. See Levi [1983] for further discussion of market structure.
7. Levi [1983] provides a graphical analysis of price and quantity adjustments.
8. With reversed elasticities—elastic output and inelastic input demand—a strong DM brings about an increase in net cash flows in Germany. The foreign economic effect, in this case, reinforces the accounting effect. If output and input demand elasticities are of the same kind, the economic effects depend on the relative importance of the two market effects. See Shapiro [1975] for further discussion of some of these variables.
9. Frankel [1979] and Branson [1983] relate the nondiversifiability of exchange risk to the origin of national monies and other macroeconomic influences.

## REFERENCES

- Adler, Michael and Dumas, Bernard. "International Portfolio Choice and Corporation Finance: A Synthesis," *Journal of Finance* (June 1983), pp. 925-984.
- Aggarwal, Raj. "Exchange Rates and Stock Prices: A Study of the U.S. Capital Markets under Floating Exchange Rates," *Akron Business and Economic Review* (Fall 1981), pp. 7-12.
- Ang, J. and Ghallab, A. "The Impact of U.S. Devaluations on the Stock Prices of Multinational Corporations," *Journal of Business Research* (February 1976), pp. 25-34.
- Branson, William H. "Macroeconomic Determinants of Real Exchange Risk," in R. Herring, ed., *Managing Foreign Exchange Risk*, Cambridge University Press, 1983.
- Castanias, Richard P. "Macroinformation and the Variability of Stock Market Prices," *Journal of Finance* (May 1979), pp. 439-469.
- Choi, J. J. "Consumption Basket, Exchange Risk and Asset Demand," *Journal of Financial and Quantitative Analysis* (September 1984), pp. 287-298.
- Choi, J. J. and Severn, A. K. "The Effects of International Risk, Segmentation and Diversification on The Cost of Equity Capital: A Synthesis," presented at the Academy of International Business, New York (October 1985).
- Dufey, Gunter and Srinivasulu, S. L. "The Case for Corporate Management of Foreign Exchange Risk," *Financial Management* 12 (Winter 1983), pp. 54-62.
- Fama, Eugene F. "Stock Returns, Real Activity, Inflation and Money," *American Economic Review* (September 1981), pp. 545-565.
- Frankel, Jeffrey, A. "The Diversifiability of Exchange Risk," *Journal of International Economics* (November 1979), pp. 115-146.
- Frenkel, Jacob A. and Johnson, Harry G., eds., *The Economics of Exchange Rates: Selected Studies*, Reading, Mass.: Addison-Wesley, 1978.
- Giddy, Ian. "Why It Doesn't Pay to Make a Habit of Forward Hedging," *Euromoney* (December 1976), pp. 96-100.
- Heckerman, Donald. "The Exchange Risk of Foreign Operations," *Journal of Business* (January 1972), pp. 942-948.
- Hodrick, R. J. "International Asset Pricing with Time-Varying Risk Premia," *Journal of International Economics* (November 1981), pp. 573-587.
- Lessard, Donald R. "World, Country and Industry Relationships in Equity Returns: International Diversification," *Financial Analyst Journal* (January-February 1976), pp. 2-8.
- Levi, Maurice. *International Finance*, McGraw-Hill, 1983.
- Senbet, Lemma W. "International Capital Market Equilibrium and the Multinational Firm Financing and Investment Policies," *Journal of Financial and Quantitative Analysis* (September 1979), pp. 455-480.



Shapiro, Alan C. "Exchange Rate Changes, Inflation and the Value of the Multinational Corporation," *Journal of Finance* (May 1975), pp. 485-502.

Solnik, Bruno. "An Equilibrium Model of the International Capital Market," *Journal of Economic Theory* (August 1974), pp. 500-524.

Stulz, R. M. "A Model of International Asset Pricing," *Journal of Financial Economics* (December 1981), pp. 383-406.

Wihlborg, Clas. "Economics of Exposure Management of Foreign Subsidiaries of Multinational Corporations," *Journal of International Business Studies* (Winter 1980), pp. 9-18.