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The impact of currency changes on the persistence and pricing of multinational corporation earnings

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THE IMPACT OF CURRENCY CHANGES ON THE PERSISTENCE AND PRICING OF MULTINATIONAL CORPORATION EARNINGS

by

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OF MULTINATIONAL CORPORATION EARNINGS

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ABSTRACT

This paper examines the impact of foreign-exchange rate changes on the time-series behavior and pricing of multinational corporation (MNC) earnings. Exchange-rate changes can be expected to have immediate translation effects on the consolidated earnings of foreign subsidiaries, as well as lagged effects on the local operating results of these subsidiaries. Domestic operations may experience these operating effects but will not be subject to translation effects. Consequently, exchange-rate changes can be expected to differentially impact the time-series behavior of domestic and foreign-source earnings. This differential level of persistence can lead to differences in the rates at which foreign and domestic earnings are capitalized.

This study utilizes a sample of firms from the Compustat geographic segment tape to examine the relationship between the persistence of the firm's earnings stream and a measure of the foreign-exchange sensitivity of its subsidiaries. A multivariate regression model is employed for this test, which includes other variables that have been associated with the time-series behavior of earnings. Varying-parameters models are used to examine the extent to which foreign-exchange sensitivity affects the capitalization of multinational corporation earnings.

The results do not successfully establish a direct link between the time-series behavior of MNC earnings and the foreign-exchange sensitivity of their foreign subsidiaries. There is also no strong evidence of an indirect link between foreign-exchange sensitivity and the rate at which earnings are capitalized. However, there is some weak evidence that foreign-exchange sensitivity may affect the pricing of earnings when a strong proxy for exchange rates is used and in years when exchange-rate changes are substantial.

For my husband, Earl,

and our sons, Robert and Ben:

You make it fun,

challenging, and,

most of all, worthwhile.

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I. Introduction

In 1992, the European Community faced a crisis in its development. High interest rates in Germany created pressure on the currencies of the European Community's other members. Great Britain and Italy abandoned their adherence to the European Currency Unit (ECU). Their currencies subsequently plunged. The Spanish currency was devalued, and the French currency was threatened. U.S. multinational firms with European subsidiaries stood to be affected by such fluctuations.

How would the earnings of U.S. multinationals (MNCs) be impacted by substantial exchange-rate adjustments in their foreign subsidiaries? It is widely acknowledged that MNCs may face an additional level of risk because of exchange-rate volatility. What is seldom considered is the effect of exchange-rate sensitivity on the time-series behavior of MNC earnings and the pricing implications of these effects.

MNCs face a unique set of circumstances which may cause the time-series behavior of their earnings to differ from purely domestic corporations. When the functional currency of a foreign subsidiary depreciates (appreciates), *ceteris paribus*, the subsidiary's local income translates into fewer (more) dollar earnings for the multinational parent. This *translation effect* of a foreign-exchange rate change appears quickly in accounting earnings but may be followed by an *operating effect*, which alters the local income of the subsidiary. The direction and magnitude of the operating effect depend on the competitive situation of the subsidiary and the elasticity of demand for its outputs and inputs.

This study examines the direction and magnitude of the operating effect relative to the translation effect, referred to as the *foreign-exchange sensitivity*, of MNCs. The relationship between this foreign-exchange sensitivity and the persistence of the MNC's earnings is examined. No significant relationship is observed; however, methodological problems and weak proxies for the dependent or independent variables may lead to this lack of evidence.

Since it is expected that higher persistence should lead to higher earnings response coefficients (ERCs), the indirect relationship between foreign-exchange sensitivity and ERCs is also examined. There is weak evidence of a link between foreign-exchange sensitivity and ERCs in situations where the proxies for exchange rates are strong and in periods when there are substantial exchange-rate changes.

Some descriptive evidence is also provided in this study. This evidence suggests that operating effects tend to eventually offset, as opposed to magnifying, translation effects for the majority of firms in the sample.

In the following section, a theory is developed which links foreign-exchange sensitivity, persistence, and ERCs. In Section II, details are provided about sample selection and data sources. The empirical models and their results are also discussed. Section III summarizes the findings and their implications.

II. Persistence and Pricing of Foreign-Source Earnings

The persistence levels associated with foreign-source earnings of MNCs may vary from domestic earnings persistence. These differences may exist, in part, because of the impact of foreign-exchange rate changes on the time-series behavior of foreign-source earnings.

Persistence is one of at least two major ingredients affecting earnings capitalization. Boatsman, Behn, and Patz [1992] demonstrate that differences in levels of persistence between foreign-source and domestic earnings can, therefore, be expected to result in different rates of earnings capitalization for firms which have foreign-source earnings (MNCs).

This section reviews the relationship between persistence and ERCs, the nature of persistence, and the factors which affect it. A theory is then developed to link foreign-exchange sensitivity to earnings persistence and, consequently, to capitalization of MNC earnings.

Factors that Directly Affect Earnings Capitalization

Boatsman [1992] derives the relationship between earnings and returns for a given firm as follows (see Appendix A):

$$R_t = \left[1 + \frac{1-\theta}{E(R)}\right]\frac{X_t}{P_{t-1}} + \left[\frac{\theta E(X_t)}{P_{t-1}E(R)} - 1\right] \quad (1)$$

where

1. R_t denotes the firm's market return during period t;
2. θ denotes the moving-average parameter for the firm's earnings series;
3. E(R) denotes the firm's expected return;
4. X_t denotes the firm's earnings during period t; and
5. P_{t-1} denotes the value of the firm's equity at time t-1.

In the preceding equation, the earnings response coefficient (ERC) is

$$1 + \frac{1-\theta}{E(R)}, \quad (2)$$

which represents the rate at which earnings are mapped into returns. In this formulation, two primary factors affect the capitalization of earnings. The first is expected return, and the second is persistence, measured as (1-θ).

Boatsman's model is not unique in suggesting this connection between persistence and ERCs. Miller and Rock [1985] develop a two-period model to demonstrate that the magnitude of the return reaction to an earnings innovation[1] should be a function of the persistence of earnings. The proposition is tested empirically by Kormendi and Lipe [1987], who establish a positive correlation between ERCs and their measure of earnings persistence (PVR). Similar results are produced by Collins and Kothari [1989] and Easton and Zmijewski [1989].

The following subsection discusses the nature of persistence, its traditional measurement, and empirical evidence on patterns of earnings persistence.

The Nature of Persistence

Persistence is generally thought of as the "stickiness" of earnings. Miller and Rock [1985] define it more precisely as the extent to which a current shock or innovation in earnings affects expectations of future earnings.

Typical proxies for persistence involve parameters from time-series models. Beaver, Lambert, and Morse [1980], for example, model the time-series of annual earnings changes as a first-order, moving-average process in first differences (ARIMA(0,1,1)). Given this representation of the earnings process, the change in expected future earnings induced by a curent shock to earnings is derived as follows (see Appendix A):

$$\Delta E(X_{t+k}) = (1-\theta)\,\alpha_t, \qquad \forall\, k > 0, \tag{3}$$

where α_t represents the shock to earnings in the current period, and θ is the moving-average parameter from an ARIMA(0,1,1) model.

In this context, (1-θ) is a measure of persistence, such that the higher the persistence, the

[1]The term *innovation* is used synonomously with *shock* or *forecast error* in this paper.

greater are the implications of current earnings innovations for expected future earnings. If $\theta = 0$, changes in earnings are serially uncorrelated, and the current shock in earnings is expected to become a permanent component of future earnings. If $\theta = 1$, the earnings process is mean-reverting, and current shocks in earnings are one-time events with no implications for future earnings. When $\theta = -1$, the events which caused X_t to be α_t above $E(X_t)$ in period t are expected to induce an additional impact of α_t on earnings of period (t+k). The latter situation might be representative of a firm experiencing positive growth.

Using low-order models, the empirical literature on the time-series properties of annual earnings generally concludes that successive changes in earnings are serially uncorrelated ($\theta = 0$).[2] However, low-order earnings processes of a substantial number of individual firms are found to deviate from such a random-walk process.[3]

Lipe and Kormendi [1991] examine higher-order time-series properties of annual earnings. They measure the present value of revisions (PVR) in expected future earnings induced by a current \$1 earnings shock as follows:[4]

$$PVR = \frac{1}{\left[1 - \frac{1}{1+r}\right]\left[1 - \sum_{j=1}^{p}\left[\frac{1}{1+r}\right]^{j}\phi_j\right]} - 1, \tag{4}$$

where p is the number of autoregressive lags in an ARIMA(p,1,0) model, ϕ_j is the autoregressive

[2]Ball and Brown [1969] find that last period's annual earnings number outperforms an average of the past earnings series as a predictor of current earnings. Ball and Watts [1972] find the mean and median first-order autocorrelation coefficients of firms' net income changes to be near zero. Little and Rayner [1966], Lookabill [1976], and Watts and Leftwich [1977] produce results which also suggest that earnings follow a random-walk-like process.

[3]In the Ball and Watts [1972] study, the first-order autocorrelation coefficients range between -.386 in the lowest decile of firms to .388 in the highest decile. Watts [1970] employs a Box-Jenkins methodology to examine the process of earnings changes for 32 firms, and he finds that the behavior of earnings changes differ from a random walk for more firms than would be expected by chance. Industry appears to be one factor in determining these differences.

[4]This measure was previously used by Kormendi and Lipe [1987] as drawn from Flavin [1981].

coefficient for lag j, and r is the rate at which future earnings are discounted.

Lipe and Kormendi estimate PVR_p for increasing orders of p and find that PVR declines as p increases. Such a decline will occur only if ϕ_j ($j > 1$) tends to offset ϕ_1, i.e., if earnings changes of future periods tend to offset current earnings changes. Lipe and Kormendi consequently interpret this result as evidence of significant mean reversion (low persistence) in earnings for the higher orders.

Regardless of whether persistence is measured in low or high orders, firms which have a more persistent earnings pattern should be expected to have larger earnings response coefficients, since current changes in earnings are expected to have more staying power for these firms.

In summary, there appear to be solid theoretical and empirical links between earnings persistence and ERCs. Since it does not appear that earnings persistence is cross-sectionally constant, the economic factors which influence earnings persistence are of interest. The following section discusses some of these factors.

Factors That May Indirectly Influence ERCs By Directly Impacting Persistence

Boatsman [1992] models persistence and expected return as the factors that directly affect the mapping of earnings into returns. However, other factors may have indirect effects on ERCs by their direct effects on either earnings persistence or expected return.

Lev [1983] examines four economic factors which might affect the persistence of earnings. These include product type (durable vs. nondurable), industry barriers to entry, size, and capital intensity.

Lev posits that since the demand for durable goods (e.g., automobiles) tends to be more cyclical than the demand for nondurables (e.g., food) and services, the earnings of firms producing nondurable goods and services should be more persistent.

Firms in industries where there are high barriers to entry are more likely to maintain the benefits of technological advances and might consequently exhibit more persistent earnings patterns.[5]

Size can be a proxy for the degree of a firm's diversification; therefore, larger size could be correlated with more stable growth and more persistent earnings patterns.[6]

Finally, firms which are capital intensive have high fixed costs and are thus less able to respond to economic downturns. Therefore, higher capital intensity might be associated with lower levels of earnings persistence.

Lev regresses first- and second-order autocorrelation coefficients[7] of annual earnings changes on proxies for these factors and finds that product type, barriers to entry, and capital intensity are significant in explaining the autocorrelation in earnings changes. The coefficient on size is insignificant.

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[5]The link between persistence and barriers to entry seems theoretically supportable when dealing with positive shocks to earnings. However, in the case of negative shocks to earnings, the theoretical links may not be very strong. Suppose, for example, that a firm in a monopolistic industry (high barriers to entry) has a high level of earnings persistence. When the firm experiences a positive earnings shock, it may be able to maintain the increased earnings level for a longer period than would a purely competitive firm, since there is less competitive pressure. However, when a negative shock occurs, is there a reason to expect this decreased earnings level to last longer for the monopolistic firm than it would for the purely competitive firm? Such a result does not seem intuitively obvious. The same observation applies to Lev's theoretical link between persistence and size.

[6]Some factors which are expected to have indirect effects on ERCs through their direct impact on earnings persistence may also have indirect effects on ERCs through their direct impact on expected return. For example, size has been posited by Lev [1983] as a factor which might affect the persistence of earnings. However, it has also been suggested as a proxy for the risk of the information environment (see Atiase [1985] or Grant [1980]), which would link size to the firm's expected return.

[7]Pindyck and Rubinfeld [1976] derive the autocorrelation coefficient for a first-order moving average process of lag one as follows:

$$\rho_1 = \frac{-\theta}{1 + \theta^2}$$

For a mean-reverting process, where $\theta = 1$, the autocorrelation coefficient will be -.5. If $\theta = 0$, as in the random-walk process, the autocorrelation coefficient will equal 0; and where $\theta = -1$, the autocorrelation coefficient will be .5. When persistence is measured by the autocorrelation function, higher persistence will produce higher autocorrelation coefficients (unless the absolute value of θ exceeds one).

Biddle and Seow [1991] examine the indirect link between these four factors and ERCs. They also examine the relationship between financial leverage and ERCs. High levels of financial leverage should have negative indirect effects on ERCs by increasing the discount rate and, consequently, the expected return. Biddle and Seow's results tend to support the link between ERCs and the factors of financial leverage and barriers to entry.

Another factor which has been associated with ERCs is growth (e.g., see Collins and Kothari [1989]). Growth is usually discussed as though it is a factor that directly affects the mapping of earnings into returns. However, positive growth can also be thought of as a special form of persistence; for a firm experiencing positive growth, positive shocks in earnings lead to positive revisions of expectations about future earnings.

To date, suggested economic factors do not explain earnings persistence very well. For example, the factors examined by Lev [1983] explain only about 8 percent of the variation in first-order autocorrelation coefficients. The higher-order mean-reverting patterns discovered by Lipe and Kormendi [1991] are largely unexplained. While model misspecification may be a cause of this low explanatory power, the door is still open to other factors which may influence earnings persistence. One such factor is the unique pattern in foreign-source earnings which can be induced by foreign-exchange rate changes. This factor is developed in the following section.

Persistence in the Multinational Corporation

Foreign-source earnings of U.S.-based MNCs are subject to a unique set of circumstances which may cause the earnings persistence of their foreign segments to differ from that of the domestic entity. Changes in foreign-exchange rates can affect the dollar earnings of MNCs through both translation and operating effects, and differences in the timing of these two effects can impact the time-series behavior or persistence of these earnings. Following is an explanation of these effects and their timing.

Translation Effects. A depreciation of the functional currency of a foreign subsidiary, assuming local earnings of the subsidiary are unchanged, will result in lower dollar-equivalent earnings for the consolidated entity. An appreciation will have the opposite effect. This change in consolidated earnings resulting from a foreign-exchange rate change will be called the "translation effect."[8]

Even though the subsidary may not remit cash to the parent in the current year, the translation effect is a real economic effect. It is presumed that eventually the parent will realize some cash flow benefit from owning the subsidiary, whether in the form of dividends or capital gains. Because foreign-exchange rate changes are generally believed to be serially uncorrelated (see Adler and Lehmann [1983]), the currently realized exchange rate provides an unbiased estimate of the exchange rate which will be in effect when the subsidiary eventually remits cash flows to the parent. *Ceteris paribus*, an appreciation of a foreign subsidiary's currency should cause a positive change in expectations of future cash flows and, consequently, a positive change in firm value. The opposite will be true for a depreciation of the currency.

Operating Effects. Locally denominated earnings of the subsidiary may also be affected by a currency change, and this impact is termed the "operating effect." For subsidiaries which compete in international markets, a change in foreign-exchange rates between their functional currency and the currency of their trading partners or competitors can result in changes in their sales volume, sales prices, input costs, and consequently earnings. For example, if the subsidiary exports its product, an appreciation of the subsidiary's currency makes the product more expensive to foreign purchasers, which may cause the subsidiary to reduce its price in order to remain competitive in international markets. The outcome will be reduced profits. The concern of Japanese auto manufacturers about the weakening of the dollar against the yen provides anecdotal evidence that the magnitude of operating effects may indeed be significant.

[8]This *translation effect* is not synonomous with the *translation gain or loss* that is reported in the financial statements as a result of consolidating foreign-source earnings. The translation effect refers to the change in value of the foreign subsidiary's cash flows to the parent as a result of a foreign-exchange rate change, while the translation gains and losses are the accounting adjustments made to balance the firm's financial statements once all financial statement elements have been translated at the prescribed rates.

Levi [1990] derives the change in locally-denominated profits of a purely *exporting* subsidiary in response to a change in exchange rates as follows (see Appendix B):

$$\frac{d\pi}{dS} = \eta p^{t} q - \frac{cq\eta}{S} = \eta q\left(p^{t} - \frac{c}{S}\right) \tag{5}$$

where π represents total profits; S is the exchange rate between the functional currency and the currency of the trading partner; η is the absolute value of the elasticity of demand for the subsidiary's product; q is the number of units sold; p^t is the selling price per unit in the currency of the trading partner; and c is the cost per unit. The factor in parentheses represents the "markup" per unit in the currency of the trading partner. Since this markup is presumed to be positive, and since the absolute value of demand elasticity is positive, the operating effect of a depreciation of the functional currency for an exporting subsidiary should be positive.

For a subsidiary which *imports* its inputs, Levi [1990] derives the change in profits due to a change in exchange rate as follows:

$$\frac{d\pi}{dS} = q(1 - \eta)\left(\frac{p}{S} - c^{t}\right) \tag{6}$$

where c^t is the cost per unit in the currency of the trading partner. Again, the second term in parentheses, which represents the markup per unit in the currency of the trading partner, should be positive. The first term in parentheses is negative, since firms are presumed to be operating where elasticity of demand exceeds unity in order to be maximizing profits. Consequently, a depreciation of the functional currency for a pure importer will result in a reduction of locally-denominated earnings.

Operating effects can also be derived for firms which are not exporters or importers. If a firm competes with exporters for the sale of its product (export competing) or competes with importers for the purchase of its inputs (import competing), it will be subject to operating effects.

For example, if a British subsidiary sells its product locally but is vulnerable to competition from a French firm (i.e., is export-competing), the exchange rate between the French franc and the British pound will affect the extent to which the French firm can compete on British soil and will, consequently, affect the British subsidiary's profitability.

Firms which are not even export- or import-competing can also experience operating effects. The sales of a resort hotel chain, for example, are likely to increase when the local currency depreciates, since the depreciation makes travel in that country more attractive to foreign customers.

Timing of Translation Effects in Earnings. Current accounting standards allow earnings of foreign subsidiaries to be translated into the consolidated income statement by one of two methods. If the subsidiary operates relatively autonomously of the parent and in not experiencing hyper-inflation, the current rate method is employed. Translation of financial statements under the current rate method is generally accomplished by multiplying all income statement elements by a current average exchange rate. This treatment therefore impounds an approximation of the translation effect of foreign-exchange rate changes in current earnings.

The temporal method also translates income statement elements at a current average exchange rate except when those elements relate to assets and liabilities that are recorded at historical cost on the balance sheet. Such elements include depreciation, cost of goods sold relating to inventory purchased in prior years, and amortization of goodwill. Consequently, the temporal method also impounds a translation effect of foreign-exchange rate changes in current earnings, but the amount of the translation effect may differ from that which would be produced by the current rate method. Consolidated financial statements generally do not enable users to distinguish the portion of foreign earnings that is accounted for by the current rate method from that which is accounted for by the temporal method.

The translation effect consequently appears in earnings in the year in which the exchange rate changes. It is important to recognize that only foreign-source earnings are subject to translation effects. The domestic portion of earnings will never experience a translation effect from foreign-exchange rate changes, since one dollar will always translate into one dollar.

Timing of Operating Effects in Earnings. The operating effect of an exchange-rate revision is the change in sales volume, sales price, input costs, and, consequently, profitability, that result from the interaction of the foreign-exchange rate change with the competitive position of the subsidiary and the elasticity of demand for its outputs and inputs. Eiteman and Stonehill [1989] indicate that it is often difficult to change sales prices or renegotiate costs in the short run; so the operating effect may not appear in earnings in the year of the foreign-exchange rate change. The domestic entity, as well as foreign-based operations, can be vulnerable to operating effects.

Pattern of Translation and Operating Effects. Suppose that a shock occurs in foreign-exchange rates such that a foreign subsidiary's functional currency appreciates. The translation effect of this appreciation, which is positive, will appear in current-period earnings and should persist in future periods. An operating effect may also occur but may not appear until subsequent periods. If the subsidiary is an exporter or is export-competing, this operating effect should be negative, and earnings will exhibit a pattern of low persistence; a positive shock from the translation effect will be offset by future downturns in earnings due to unfavorable operating effects. If the subsidiary is an importer or is import-competing, the operating effect should be positive, resulting in a pattern of high earnings persistence; a positive shock from the translation effect will be magnified by future upturns in earnings due to favorable operating effects. If the foreign subsidiary is not vulnerable to operating effects, its earnings should display a random-walk like pattern; a positive translation effect will persist in future earnings and will not be magnified or offset by future operating effects.

While domestic earnings are subject to operating effects, they are not subject to translation effects. Consequently, while exchange rate changes may affect future levels of domestic earnings, these earnings would display a different time-series behavior than foreign-source earnings because of the lack of a first-year translation effect.

Patterns of earnings persistence for foreign subsidiaries will, therefore, differ from the domestic entity if the subsidiaries are susceptible to operating effects. These varying levels of persistence for foreign subsidiaries will impact the earnings persistence of the multi-national parent and, potentially, the capitalization of the MNC's earnings.

The Law of One Price and Purchasing Power Parity

The significance of operating effects and their ability to impact earnings persistence are somewhat dependent on the validity of the economic theories of the Law of One Price (LOP) and Purchasing Power Parity (PPP). The LOP states that in the absence of frictions, such as shipping costs, tariffs, etc., the price of a product stated in a common currency, such as the U.S. dollar, is the same in every country [Levi, 1990]. For example, the pound price of a British product, multiplied by the $/£ exchange rate, would equal the dollar price of the same product in the United States. If LOP held for every good and service then *absolute* PPP would hold, so that the dollar cost of a U.S. basket of goods would equal the pound cost of the same British basket of goods times the $/£ exchange rate. The *relative* (or dynamic) form of PPP anticipates that changes in the annual exchange rate between two countries will be equivalent to the ratio of changes in their annual inflation rates.

If LOP and PPP were valid in the short run, currency changes could not affect the persistence of annual earnings. Market forces would quickly ensure that goods were effectively priced the same in all countries. Therefore, the translation effect of a currency change would be immediately offset by operating effects of the market-induced price changes. No significant translation or operating effects would appear in earnings, as they would be immediately offsetting.

There are theoretical reasons why LOP would not always hold, at least in the short run. These include the existence of tariffs, quotas, governmental intervention to manipulate exchange rates, and differential transportation costs. Additionally, goods which are not traded internationally, such as real estate and human labor, are difficult to arbitrage.

Empirical research suggests that LOP probably does not hold in the short run, even for traded goods. Protopadakis and Stoll [1986] examine spot and futures prices for twelve commodities that are traded internationally in organized commodities markets. They conclude that LOP almost never holds in the short run and that deviations from LOP take from 1 to 120 weeks to be eliminated. Richardson [1978] examines prices of commodities in the U.S. and Canada and finds that even between these countries, where few market frictions exist, LOP does not appear to hold in the short run.

Levi [1990] points out that it is difficult to test absolute PPP empircally, because national price indexes, which are usually employed in such tests, use different baskets of goods in each country. The relative form of PPP is deemed more testable. Adler and Lehmann [1983] summarize the current consensus of the literature as concluding "that PPP is inadequate as a short-run hypothesis." They further challenge the long-run PPP hypothesis by demonstrating that changes in real exchange rates are not serially correlated, suggesting that established short-run deviations from purchasing power parity are likely to persist.

The seeming inability of LOP and PPP to hold in the short-run, and potentially even in the long run, leave open the possibility that operating effects can affect firm earnings. In combination with translation effects, these operating effects can impact the persistence of earnings.

Summary of Predicted Effects

A theory has been developed to suggest that foreign subsidiaries experience translation effects of foreign-exchange rate changes and can be vulnerable to operating effects from these currency changes as well. The combination of these translation and operating effects can cause the persistence of the MNC's foreign-source earnings to differ from the earnings persistence of its domestic component, thereby impacting the overall earnings persistence of the MNC. Because higher levels of earnings persistence are generally associated with higher rates of earnings capitalization, the vulnerability of foreign-source earnings to exchange rate changes may also affect the magnitude of ERCs for MNCs. The following section develops models to test these propositions.

III. Data Sources, Sample Selection, and Results

This section discusses the sample utilized to test the relationship between foreign-exchange sensitivity, persistence, and ERCs. The development of proxies for foreign-exchange sensitivity and persistence is explained. Variable definitions are provided for other controlling variables as well. The empirical models are also detailed, as well as the results produced by these models.

Sample Selection

Firms are included in this study if they are listed on the geographic segment tape of the 1991 Compustat Business Information file and disclose geographical segments to which an individual exchange rate can be ascribed. Further criteria are that the parent firm be incorporated in the United States, have publicly traded stock, have a December 31 fiscal-year end, and have twenty years of continuous earnings data available on Compustat from 1971 to 1990. Specific segments are excluded from this study if nonsensical measures of their earnings sensitivity to foreign-exchange rate changes are produced (to be discussed later). A total of 129 firms with 147 useable segments meet these criteria, as shown in Table 1.

Insert Table 1 About Here

There are more useable segments than there are firms because some firms have more than one segment to which an exchange rate can be ascribed. Of the 129 total firms, 112 firms have 1 useable segment, 16 firms have 2 useable segments, and 1 firm has 3 useable segments.

A distribution of the segments in the sample by primary geographic location is shown in Table 2. Almost 67% of the useable segments are in Europe, with another 24% in Canada. Other segment locations include Great Britain, Germany, Japan, Mexico, and Australia.

Insert Table 2 About Here

Foreign-Exchange Rates

The exchange-rates used in this study are the period-average exchange rates between the U.S. dollar and the local currency of the segment being examined.[9] These exchange rates are listed in the International Monetary Fund's *International Financial Statistics* [1991]. For segments identified as "European," the European Currency Unit (ECU) is used as a proxy for the segment's currency, since many European currencies are pegged to the ECU.

Measure of Earnings Sensitivity to Foreign-Exchange Rate Changes (FXSENS)

In order to examine the relationship between persistence and the sensitivity of earnings to foreign-exchange rate changes, a proxy for this sensitivity must be developed. One approach to measuring this sensitivity is to compute the present value of exchange-rate induced earnings changes as a result of a current $1 exchange-rate induced shock. The first step in this process is to measure exchange-rate induced earnings changes for each segment, in the current and future periods, as the result of a current exchange-rate shock. The second step is to compute the present value of the future changes for each segment. This present value is then divided by the current exchange-rate induced shock. The result is the present value of operating effects per dollar of translation effect. The final step is to convert this segment sensitivity measure into a company measure by calculating a weighted average of the segment sensitivities for each useable segment in the company.

To achieve the first step, the percent changes in segment earnings are regressed on percent changes in the exchange rate The following regression is run for each of the 147 segments,

$$\%\Delta SE_{ig,t+k} = \lambda_{0ig,t+k} + \lambda_{1ig,t+k}\%\Delta FX_{igt} + \upsilon_{ig,t+k} \qquad (7)$$

[9]End-of-period exchange rates and exchange rates from the Multinational Exchange Rate Model (MERM) were also examined. These exchange rates did not prove to be as significant as the period-average rates in explaining changes in segment earnings. Also, period-average exchange rates should be more closely associated with translation effects, because firms are required to translate foreign earnings at a weighted-average exchange rate, as opposed to an end-of-period rate.

where

1. $\%\Delta SE_{ig,t+k}$ denotes the percent change in the segment earnings of geographic segment g of firm i for period t+k;

2. $\lambda_{0ig,t+k}$ is the regression intercept;

3. $\lambda_{1ig,t+k}$ is a coefficient which measures the sensitivity of earnings of segment g of firm i in period t+k to the exchange rate change for the same segment in period t;

4. $\%\Delta FX_{igt}$ measures the period t annual percentage change in exchange rate between the dollar and the local currency of geographic segment g of firm i; and

5. $\upsilon_{ig,t+k}$ is an error term.

This regression is run six times for each useable segment, with values of k changed each time, starting with k = 0 and ending with k = 5. When k = 0, the $\lambda_{1ig,t+k}$ coefficient measures the sensitivity of current-period segment earnings to the current-period exchange-rate change. When k = 1, this coefficient measures the sensitivity of next period's segment earnings to the current-period exchange-rate change, etc.[10]

Only seven years (1984-90) of geographic segment earnings data are available for each of these regressions. Since changes in earnings are required for the regressions, each time series has only six observations.

Descriptive statistics for the $\lambda_{1ig,t+k}$ coefficients are provided in Panel A of Table 3. If no operating effects occur in the year of an exchange-rate change, one would expect the $\lambda_{1ig,t+k}$ coefficient for k = 0 to be about 1; i.e., a 1% appreciation of the subsidiary's exchange rate would lead to about a 1% increase in translated segment earnings in the year of the exchange-rate change. The mean value of this coefficient in Table 3 is positive (.314), as expected, but lower than 1. The

[10]Other functional forms of the relationship between segment earnings and exchange-rate changes were also examined. These included changes in segment earnings (unscaled) regressed on changes in the exchange rate; changes in segment earnings, scaled by segment assets, regressed on exchange rate changes; and changes in segment earnings, scaled on market value of equity, regressed on exchange rate changes. The coefficients on these regressions were not as significant as they were in the regression of percent change in segment earnings on percent change in exchange rate. Also, the approach used is consistent with the anticipated functional form of the translation effect of exchange rate changes; i.e., a 1% appreciation of the exchange rate should lead to a 1% increase in translated segment earnings.

median value, .88, comes closer to the expected value. The means and medians of the $\lambda_{1ig,t+k}$ coefficients suggest that the majority of firms experience positive effects of exchange rate appreciations in the year of the change (k=0) and in the following year (k=1); negative effects appear to dominate in the subsequent two years (k=3 and 4). Timing differences between the exchange rates used for this study and those actually used by the firms in performing the translation process may lead to the appearance of some translation effect in the year following the exchange-rate change.

Insert Table 3 About Here

Some of the $\lambda_{1ig,t+k}$ coefficients are extreme, probably as a result of the short time series used in their calculation. Based on an examination of their distributions and some economic intuition, observations which produce $\lambda_{1ig,t+k}$ coefficients with absolute values in excess of 50 are deleted from the sample. These coefficients would suggest that a 1% exchange-rate change would lead to a 50% or greater change in segment earnings for any one year. The Table 3 results do not include these observations.

Panel B of Table 3 provides some information about the significance level of these coefficients. For example, the average t-value of the 147 $\lambda_{1ig,t+k}$ coefficents for k = 0 is 1.27, and the median t-value is .93. The t-values are even lower in subsequent years. Given the low degress of freedom in these regressions, low levels of significance are not surprising but do lead to some concern about whether the coefficients convey any information.

The direction of these coefficients for the first four years (k=0 to 3) is examined in Table 4. If the coefficients are purely a result of chance and contain no information, then one would expect the direction of these coefficients to be equally dispersed among sixteen possible patterns as shown in Table 4. The actual proportion of segments fitting each pattern is quite different than the 6.25% that would be expected by chance. A total of 98 segments (66.7%) have positive coefficients for k=0. This outcome is significantly different than the 50% that would be expected by chance ($p < .005$) and is consistent with the theory which predicts positive (negative) translation effects in the first year of an exchange-rate appreciation (depreciation).

Insert Table 4 About Here

It is noteworthy that almost a fourth of the firms follow a mean-reverting type of pattern (Pattern 4), with positive (negative) earnings effects in the first two years of an exchange-rate appreciation (depreciation) and negative (positive) effects in the subsequent two years. The other two most frequently followed patterns (2 and 8) are also somewhat mean reverting in nature. These results may suggest that for many segments, exchange rate appreciations appear to be good news when they first occur but are eventually offset or may even revert to bad news over longer terms. The opposite would be implied for depreciations.

The second step in computing foreign-exchange sensitivity is to take the present value of the sensitivities and divide it by the current sensitivity for each segment. Because the significance of these sensitivities seems to decline after the fourth year ($k>3$), a present value is calculated only for the first three years, and the segment sensitivity measure is computed as follows:

$$FXSENS_{ig} = \frac{\sum_{k=1}^{3} \lambda_{1ig,t+k} \, / \, (1.10)^k}{\lambda_{1ig,t+0}} \tag{8}$$

where

1. $FXSENS_{ig}$ denotes the present value of the next three years of exchange-rate induced earnings changes in response to a current \$1 exchange-rate induced shock for segment g of firm i; and

2. $\lambda_{1ig,t+k}$ measures the sensitivity of period (t+k) earnings in the gth geographic segment of firm i to exchange rate changes of period t.

The final step converts segment measures of foreign-exchange sensitivity to company measures. The firm measure of foreign-exchange sensitivity ($FXEENS_i$) is a weighted average of the segment sensitivities, with each segment weighted according to its average sales from 1984-90 as compared to the average total sales of the firm for the same period.

$$FXSENS_i = \sum_{g=1}^{G} \frac{AVSSALES_{ig}}{AVTSALES_i} FXSENS_{ig} \quad (9)$$

where:

1. $FXSENS_i$ is the foreign-exchange sensitivity of firm i;
2. G is the total number of useable segments for the firm;
3. $AVSSALES_{ig}$ is the average segment sales for segment g of firm i from 1984-90;
4. $AVTSALES_i$ is the average total sales for firm i from 1984-90; and
5. $FXSENS_{ig}$ is the foreign-exchange sensitivity of segment g of firm i, as measured in Equation (8).

The theoretical development in this study requires that this measure of foreign-exchange sensitivity be related to a measure of persistence for the firm.

Measure of Persistence (PERSIST)

Lipe and Kormendi's [1991] measure of persistence (PVR) includes a calculation of the present value of expected future changes in earnings as the result of a current shock. The lag coefficient, ϕ_j, from an ARIMA(p,1,0) model is used to estimate the expected change in earnings in period j as the result of a current $1 shock.

In this study, persistence for firm i ($PERSIST_i$) is measured as the present value of the first three lag coefficients from an ARIMA(4,1,0) model. The ARIMA model is run on income available for common for firm i from 1971-90.

Measures of Other Control Variables

An empirical model which examines the relationship between persistence and foreign-exchange rate sensitivity should allow for effects by other variables that have been found to impact persistence. Consequently, three other variables are included in this model. They include barriers to entry, product type, and average capital intensity.

One approach to assessing the degree of entry barriers for an industry is simply to determine the number of firms in the industry. Therefore, the barriers to entry proxy (BTE_i) is estimated as the total number of companies in firm i's major SIC code as listed in *Ward's Directory of U.S. Private and Public Companies* [1990].[11]

The product type variable ($PRODTYPE_i$) is a dummy variable which is set to 1 if the firm's major product type is durable or 0 for nondurables and services. Definitions of durability by industry are indicated in the *Survey of Current Business* [1990].

The average capital intensity ratio ($CAPINTAV_i$) is the average ratio of depreciation and interest to total expenses for 1984-90. Further details of all of these definitions are provided in Table 5.

Insert Table 5 About Here

Empirical Model of Persistence and Exchange Rate Sensitivity

The relationship between persistence and exchange-rate sensitivity is examined with a simple regression model as follows:

$$PERSIST_i = \beta_0 + \beta_1 FXSENS_i + \beta_2 BTE_i + \beta_3 PRODTYPE_i + \beta_4 CAPINTAV_i + \mu_i \quad (10)$$

where:

1. $PERSIST_i$ denotes the persistence of firm i's income available for common;
2. $FXSENS_i$ denotes the sensitivity of foreign segment earnings to exchange-rate changes;
3. BTE_i denotes barriers to entry;
4. $PRODTYPE_i$ denotes product type (1 for durable and 0 for nondurable); and
5. $CAPINTAV_i$ denotes average capital intensity.[12]

[11]Other proxies for barriers to entry were exmined. These include the two-firm concentration ratio, the four-firm concentration ratio, the Herfindahl-Hirschmann Index, and the entry rate of firms into the industry. None of these proved as significant as the first proxy, however.

[12]See Table 5 for detailed variable definitions.

The coefficient on $FXSENS_i$ is expected to be positive. A high value of this variable suggests that a current translation shock in earnings will not tend to be offset by future operating effects, i.e., it will be more "persistent."

A high BTE_i value is indicative of low barriers to entry. Firms in very competitive industries (high BTE_i value) are less able to capitalize on technological advances and may expect lower earnings persistence as a result. Consequently, a negative coefficient is expected for BTE_i.

Negative coefficients are also expected for product type and capital intensity since durable products and high fixed costs are associated with firms that are more vulnerable to economic downturns.

Results of this regression are shown in Table 6, along with results of univariate regressions with each independent variable. Only 81 observations are included in this regression, because consistent time-series coefficients (needed for calculation of the $PERSIST_i$ variable) could not be estimated for 48 of the firms shown in Table 1. Foreign-exchange sensitivity does not appear to explain the firm's persistence; and the only variables which have any explanatory ability are barriers to entry and product type.

Insert Table 6 About Here

Descriptive statistics and correlations are provided for these variables in Table 7, panels A and B respectively. Note that no significant correlations exist between any of the independent variables.

Insert Table 7 About Here

There are several reasons why foreign-exchange sensitivity may not be significant in this regression. It is possible that there is no significant relationship between persistence and foreign-exchange sensitivity. It is also possible that the proxy for foreign-exchange sensitivity is contaminated by too much noise. Additionally, the proxy for persistence may be weak, because only 20 years of data are included in the autoregressive model used to calculate the persistence variable.

Another compelling possibility has to do with the relative time periods over which persistence and foreign-exchange sensitivity are measured. The persistence variable, $PERSIST_i$, is produced from a time-series model on 20 years of data, while the foreign-exchange sensitivity variable, $FXSENS_i$, is based on the most recent 7 of those years. Foreign investment by U.S.-based firms has increased dramatically over the last 30 years; so it may be that instability in levels of foreign involvement makes these two measures incompatible. The following models, which examine the indirect relationship between current measures of foreign-exchange sensitivity and current ERCs, are not subject to this drawback.

Empirical Model of Persistence and ERCs

The theory developed in this paper suggests that foreign-exchange sensitivity should affect persistence, and persistence should impact ERCs. A model is therefore developed to examine the indirect relationship between foreign-exchange sensitivity and ERCs.

Boatsman's [1992] model of ERCs expresses them as the coefficient which maps levels of earnings into returns, e.g.,

$$RETURN_{it} = \psi_{0i} + \gamma_{1i} EARN_{it} + \nu_{it} \qquad (11)$$

where

1. $RETURN_{it}$ denotes dividends plus change in market value of equity over period t, scaled on beginning-of-period market value of equity, for firm i;
2. Υ_{1i} denotes the ERC;
3. $EARN_{it}$ denotes earnings of firm i for period t, scaled on market value of equity; and
4. ν_{it} is an error term.

The ERC has been hypothesized to be a function of factors which may affect persistence, including foreign-exchange sensitivity, barriers to entry, product type, and capital intensity. It may also be a function of a major factor linked to expected return, which is financial leverage. Therefore, the ERC in the preceding equation could be expressed as

$$\gamma_{1i} = \psi_1 + \psi_2 FXSENS_i + \psi_3 BTE_i + \psi_4 PRODTYPE_i + \psi_5 CAPINT_{it} + \psi_6 FINLEV_{it} \qquad (12)$$

where

1. $FXSENS_i$, BTE_i, and $PRODTYPE_i$ are measures of foreign-exchange sensitivity, barriers to entry, and product type already described (details in Table 5);

2. $CAPINT_{it}$ denotes capital intensity for firm i in year t, measured as the average ratio of depreciation and interest to total expenses for years t and t-1; and

3. $FINLEV_{it}$ denotes financial leverage for firm i in year t, measured as the average ratio of total debt to market value of equity for years t and t-1.

Equations (11) and (12) are combined and tested in the following varying-parameters model.

$$\begin{aligned} RETURN_{it} = \psi_0 &+ \psi_1 EARN_{it} + \psi_2 (FXSENS*EARN_{it}) + \psi_3 (PRODTYPE_i*EARN_{it}) \\ &+ \psi_4 (BTE_i*EARN_{it}) + \psi_5 (CAPINT_{it}*EARN_{it}) \\ &+ \psi_6 (FINLEV_{it}*EARN_{it}) + \nu_{it} \end{aligned} \qquad (13)$$

A related model is also estimated. Boatsman [1992] demonstrates that if earnings and returns are not scaled by beginning-of-period market value of equity, the explanatory power of these regressions is markedly increased. For this reason, an alternate model is run, as follows:

$$\begin{aligned} RET\_UNS_{it} = \psi_0 &+ \psi_1 EARN\_UNS_{it} + \psi_2 (FXSENS*EARN\_UNS_{it}) \\ &+ \psi_3 (PRODTYPE_i*EARN\_UNS_{it}) + \psi_4 (BTE_i*EARN\_UNS_{it}) \\ &+ \psi_5 (CAPINT_{it}*EARN\_UNS_{it}) + \psi_6 (FINLEV_{it}*EARN\_UNS_{it}) + \nu_{it} \end{aligned} \qquad (14)$$

where

1. RET_UNS_{it} denotes dividends and stock price change for firm i during period t (unscaled by beginning-of-period market value of equity); and

2. $EARN\_UNS_{it}$ denotes the level of earnings available for common for firm i in year t (unscaled by market value of equity).

The preceding two models are estimated in a pooled time-series regression for three years of data (1988-90) on the sample specified in Table 1. The magnitudes of the coefficients on all but the earnings variable indicate the average change in the ERC for every one-unit change in the variable being investigated (all others held constant). Because higher persistence implies higher ERCs, the hypothesized directions of the coefficients are the same as in the previous model. The coefficients on $EARN_{it}$ and $FXSENS_{it}$ are expected to be positive, while coefficients on all other variables are expected to be negative. Results of the Equation (13) and (14) regressions are shown in Tables 8 and 9 respectively.

Table 8 contains the pooled results for Model (13), as well as results for the individual years. Foreign-exchange sensitivity does not emerge in this model as a significant factor in explaining ERCs, although it is a significant variable in 1989.

Insert Table 8 About Here

While BTE_i, $PRODTYPE_i$, and $CAPINT_{it}$ appear to be significant in the pooled model, it is worth noting that none of the variables, other than $EARN_{it}$, is consistently significant across all years.

Table 9 contains the results for the unscaled model (14). Here, $FXSENS_i$ appears significant in all years. Barriers to entry is also a consistently significant variable in this model. The model provides a great deal more explanatory power (adjusted R^2 = .870) than the scaled model (adjusted R^2 = .234). This higher explanatory power may be due, at least in part, to greater skewness in the dependent variable. When an influential observation for 1988 (Ford Motor Co.) is deleted from this sample, the 1988 and pooled results indicate an insignificant coefficient on $FXSENS_i$. The 1989 and 1990 results are not affected by this deletion.

Insert Table 9 About Here

Note that White's heteroscedastic adjustment is made for both models, due to high Breusch-Pagan statitistics for the unadjusted models. However, these adjustments do not generally alter conclusions about the significance level of the variables.

In the preceding models the foreign-exchange sensitivity of the firm is computed as a weighted average of the sensitivity of the firm's segments. Some concern exists about the appropriateness of this weighted average, since some segments may experience substantial currency changes in a year when others may not. If a segment's earnings are highly sensitive to exchange-rate changes but no such changes occur in a given year, then the foreign-exchange sensitivity would not be expected to explain much of the returns for that year.

Revised versions of the preceding models are developed which eliminate the weighting procedure. These models disaggregate earnings into three components--domestic, segment, and other. *Domestic* earnings are U.S. earnings. *Segment* earnings are the earnings of Canadian segments only (in one version) or European segments only (in the other version). *Other* earnings are any earnings other than the U.S. or Canadian (European) earnings. The domestic ERC is expressed as a function of barriers to entry, product type, capital intensity, and financial leverage. The segment ERC is expressed as a function of foreign-exchange sensitivity. The following varying parameters model is estimated:

$$\begin{aligned} RETURN_{it} = \ & \gamma_0+\gamma_1 EARN\_DOM_{it} + \gamma_2 BTE_i * EARN\_DOM_{it} \\ & + \gamma_3 PRODTYPE_i * EARN\_DOM_{it} + \gamma_4 CAPINT_{it} * EARN\_DOM_{it} \\ & + \gamma_5 FINLEV_{it} * EARN\_DOM_{it} \\ & + \gamma_6 EARN\_SEG_{it} + \gamma_7 FXSENS_{ig} * EARN\_SEG_{it} \\ & + \gamma_8 EARN\_OTH_{it} + v \end{aligned} \tag{15}$$

Variable definitions are identical to Model (13) except that income available for common is disaggregated into the following variables.

1. $EARN\_DOM_{it}$ denotes domestic (U.S.) earnings of the MNC scaled on market value of equity;

2. $EARN\_SEG_{it}$ denotes segment earnings of Canada (in one version) or Europe (other version) scaled on market value of equity;

3. $EARN\_OTH_{it}$ denotes components of income available for common that are not classified as $EARN\_DOM_{it}$ and $EARN\_SEG_{it}$.

Also, $FXSENS_{ig}$ is the foreign-exchange sensitivity of the Canadian or European segment only and is not weighted.

A similar model is run in which returns and earnings are not scaled on beginning market value of equity:

$$\begin{aligned} RET\_UNS_{it} = \gamma_0 &+ \gamma_1 EARN\_DUNS_{it} + \gamma_2 BTE_i * EARN\_DUNS_{it} \\ &+ \gamma_3 PRODTYPE_i * EARN\_DUNS_{it} + \gamma_4 CAPINT_{it} * EARN\_DUNS_{it} \\ &+ \gamma_5 FINLEV_{it} * EARN\_DUNS_{it} \\ &+ \gamma_6 EARN\_SUNS_{it} + \gamma_7 FXSENS_{ig} * EARN\_SUNS_{it} \\ &+ \gamma_8 EARN\_OUNS_{it} + \nu_{it} \end{aligned} \quad (16)$$

Variable definitions are identical to Model (15), except that RET_UNS, EARN_DUNS, EARN_SUNS, and EARN_OUNS are unscaled values of returns, domestic earnings, segment earnings, and other earnings respectively.

Results of the scaled model (15) for the Canadian segment are shown in Panel A of Table 10. $FXSENS_{ig}$ does not appear to be significant in the pooled version of this model, although it is significant for 1988 and 1989. Once again, no variable emerges as significant across all years.

Insert Table 10 About Here

Panel B of Table 10 provides similar results for the European segments. $FXSENS_{ig}$ is not significant in the pooled regression or in any one year. No variable is significant in all years.

The unscaled versions of these models (16) produce significant results. For the Canadian segments (Panel A of Table 11), $FXSENS_{ig}$ is significant in the pooled model and in the first two years (1988 and 1989). This variable is most significant in 1988, when the Canadian exchange rate experienced a 7.7% change against the U.S. dollar. $FXSENS_{ig}$ is somewhat less significant in 1989, when the Canadian dollar changed by 3.9% against the U.S. dollar; and it is insignificant in 1990, when the Canadian dollar changed by only 1.5% against the U.S. dollar. The mean and median values of $FXSENS_{ig}$ are negative (-.035 and -.022 respectively) in this pooled model. Consequently, the positive coefficient on the $FXSENS_{ig}$ variable suggests that the Canadian segment ERC would be lower than the domestic ERC for the majority of firms, *ceteris paribus*.

Insert Table 11 About Here

There are some bothersome aspects of these results, however. First of all, in 1990 the coefficient for the $FXSENS_{ig}$ variable is not significant but would have been so if the opposite direction had been hypothesized. In 1989, the coefficient on segment earnings ($EARN\_SUNS_{it}$) is negative, which leaves some question as to the meaning of a significantly positive coefficient on $FXSENS_{ig}$. The use of the interactive terms in the varying-parameters model induces high correlations between variables which are not otherwise correlated and causes some difficulty in interpreting any of these coefficients.

European results for the unscaled model (16) are shown in Panel B of Table 11. Again, $FXSENS_{ig}$ is significant in the pooled model, but this seems to be driven by results for one year only (1988). BTE_i and $FINLEV_i$ stand out as consistently significant variables in the unscaled European model.

The European results seem to be consistently weaker than the Canadian results. Some consideration may be given to reasons for these differences. One such reason may have to do with the motives of U.S. MNCs for locating subsidiaries in Europe. The compelling motive for creating a European subsidiary may be to facilitate trade within Europe.[13] If European subsidiaries of U.S. MNCs do most of their trading within Europe, they may not be highly sensitive to exchange rate changes, since most European currencies are pegged to the ECU and will not fluctuate widely from each other. To the extent that they do fluctuate against each other, these effects will not be captured in a study which uses the ECU as a proxy for their currency.

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[13] I am grateful to Bruce Behn for this insight.

IV. Conclusions and Suggestions

Investors are warned to beware of the effects of exchange-rate changes on earnings (e.g., Donnelly [1990]). Such admonishments are worthwhile under at least three scenarios. First, if exchange-rate changes affect the persistence of earnings, then it is possible that they can and should affect the rate at which earnings are capitalized by investors. Secondly, if exchange-rate volatility affects the risk and, consequently, the expected return on earnings, then differential rates of earnings capitalization can be expected. Finally, translation methodologies may cause price-irrelevant shocks to be introduced into earnings as a result of exchange rate changes. Such price-irrelevant shocks should not be capitalized, and their appearance could impact ERCs.

This study concentrates on the first scenario and posits a relationship between the foreign-exchange sensitivity of foreign subsidiaries, the persistence of MNC earnings, and the pricing of these earnings. The results fail to support the existence of a direct relationship between foreign-exchange sensitivity and earnings persistence. This lack of evidence may be the result of weak proxies for persistence or foreign-exchange sensitivity, or it may be related to instabilities in the level of foreign involvement by U.S. firms over the period examined.

The findings also do not suggest a strong indirect link between foreign-exchange sensitivity and the pricing of earnings, as measured by ERCs. However, there is some weak evidence of such a relationship in cases where a strong proxy for the exchange rate is employed (e.g., the exchange rate between the Canadian and U.S. dollars, as opposed to the ECU) and in periods when exchange-rate changes are substantial. Subject to the limitations of methodological problems, it appears that foreign-exchange sensitivity does little to explain the persistence or pricing of earnings.

Cheng, Hopwood, and McKeown [1992] outline numerous specification problems that appear to exist in models that relate returns to earnings. While they concentrate on a different functional form of the earnings-returns relationship than is used in this paper, many of the specification problems appear here as well. These include, in particular, heteroscedasticity, multicollinearity, and skewness in the dependent variable. The conclusions of this study could be enhanced by an approach which would better overcome these methodological problems and produce stronger proxies for persistence and foreign-exchange sensitivity.

References

Adler, M., and B. Lehmann. 1983. Deviations from purchasing power parity in the long run. *The Journal of Finance* 38 (December): 1471-1487.

Atiase, R. 1985. Predisclosure information, firm capitalization and security price behavior around earnings announcements. *Journal of Accounting Research* 23 (Spring): 21-36.

Ball, R., and P. Brown. 1969. Portfolio theory and accounting. *Journal of Accounting Research* 7 (Autumn): 300-323.

____, and R. Watts. 1972. Some time-series properties of accounting income. *The Journal of Finance* 27 (June): 663-682.

Beaver, W., R. Lambert, and D. Morse. 1980. The information content of security prices. *Journal of Accounting and Economics* 2 (March): 3-28.

Biddle, G. C., and G. S. Seow. 1991. The information content of earnings: evidence from cross-industry comparisons. *Journal of Accounting, Auditing, and Finance* 6 (Spring): 183-232.

Boatsman, J. R. 1992. The returns/earnings relationship. Working paper, Arizona State University, Tempe, AZ.

____, B. K. Behn, and D. H. Patz. In press. A test of the usefulness of geographic segment disclosures. *Journal of Accounting Research.*

Cheng, C. S., W. S. Hopwood, and J. C. McKeown. 1992. Non-Linearity and Specification Problems in Unexpected Earnings Response Regression Model. *The Accounting Review* (July): 579-598.

Collins, D. W., and S. P. Kothari. 1989. An analysis of intertemporal and cross-sectional determinants of earnings response coefficients. *Journal of Accounting and Economics* (July): 117-141.

Donnelly, B. 1990. Investors May Need to Scrutinize Reported Profits for Their Quality. *The Wall Street Journal* (September 18): C1-2.

Easton, P. D., and M. E. Zmijewski. 1989. Cross-sectional variation in the stock market response to accounting earnings announcements. *Journal of Accounting and Economics* (July): 117-141.

Eiteman, D. K., and A. I. Stonehill. 1989. *Multinational Business Finance*. 5th ed. Reading, MA: Addison-Wesley.

Flavin, M. 1981. The adjustment of consumption to changing expectations about future income. *Journal of Political Economy* 89: 974-1009.

Grant, E. 1980. Market implications of differential amounts of interim information. *Journal of Accounting Research* 18 (Spring): 255-268.

International Monetary Fund. 1991. *International Financial Statistics* 44 (September): 6-7.

Kormendi, R. C., and R. C. Lipe. 1987. Earnings innovations, earnings persistence, and stock returns. *Journal of Business* (July): 323-345.

Lev, B. 1983. Some economic determinants of time-series properties of earnings. *Journal of Accounting and Economics* 5 (April): 31-48.

Levi, M. 1990. *International Finance: The Markets and Financial Management of Multinational Business*. 2d ed. New York, NY: McGraw-Hill.

Lipe, R., and R. Kormendi. 1991. The implications of the higher-order properties of annual earnings for security valuation. Working paper, University of Michigan, Ann Arbor, MI.

Little, I. M. D., and A. C. Rayner. 1966. *Higgledy Piggledy Growth Again*. New York, NY: A. M. Kelley.

Lookabill, L. L. 1976. Some additional evidence on the time series properties of accounting earnings. *Accounting Review* 51 (October): 724-738.

Miller, M. and K. Rock. 1985. Dividend policy under asymmetric information. *Journal of Finance* (December): 1031-1051.

Pindyck, R. S., and D. L. Rubinfeld. 1976. *Econometric Models and Economic Forecasts*. New York, NY: McGraw-Hill.

Protopapadakis, A. A., and H. R. Stoll. 1986. The law of one price in international commodity markets: a reformulation and some formal tests. *Journal of International Money and Finance* 5 (September): 335-360.

Richardson, J. D. 1978. Some empirical evidence on commodity arbitrage and the law of one price. *Journal of International Economics* 8 (May): 341-351.

U.S. Department of Commerce, Bureau of Economic Analysis. *Survey of Current Business*. Washington, DC: U.S. Government Printing Office.

Ward's Business Directory of U.S. Private and Public Companies. Detroit, MI: Gale Research Inc.

Watts, R. 1970. Information content of dividends. Unpublished working paper, University of Chicago, Chicago, IL.

____, and R. W. Leftwich. 1977. The time series of annual accounting earnings. *Journal of Accounting Research* 15 (Autumn): 253-271.

APPENDIX A

Relationship Between Earnings and Returns

Relationship Between Market Value of Equity and Earnings

Boatsman [1992] expresses the cum-dividend value of the firm's common equity as

$$P_t + D_t = D_t + \sum_{\tau=1}^{\infty} \frac{E(D_{t+\tau})}{[1 + E(R)]^{\tau}} \qquad \text{(A.1)}$$

where P_t denotes the market value of common equity at time t; D_t denotes the common dividend during period t; R denotes return; and E is the expectations operator.

Suppose that all future earnings are distributed as dividends when they occur. Also assume that some portion (π) of current period earnings (X_t) will not be distributed currently, but will be reinvested at an annual return of R and paid out next period. Under these assumptions, Boatsman concludes that (A.1) can be rewritten as

$$P_t + D_t = \pi X_t + \frac{(1-\pi) X_t[1+E(R)]}{1+E(R)} + \sum_{k=1}^{\infty} \frac{E(X_{t+k})}{[1+E(R)]^{k}} \qquad \text{(A.2)}$$

Equation (A.2) simplifies to

$$P_t + D_t = X_t + \sum_{k=1}^{\infty} \frac{E(X_{t+k})}{[1+E(R)]^{k}} \qquad \text{(A.3)}$$

Given any assumptions about the portion of current or future earnings that are distributed in the year earned, the same result will be obtained, as long as it is assumed that the undistribuated portion earns an annual rate of return equal to the required return of R.

Derivation of Expected Future Earnings

Beaver, Lambert, and Morse [1980] and others model the time series of annual earnings as a first-order, moving-average process in first differences (ARIMA(0,1,1)) of the following form:

$$X_t = X_{t-1} + \alpha_t - \theta \alpha_{t-1}, \qquad \text{(A.4)}$$

where X represents annual earnings, t is a time subscript, θ is the moving-average coefficiennt, α is an earnings innovation, and

and

$$E(\alpha_t) = 0, \qquad \sigma^2(\alpha_t) = \sigma^2 \qquad \forall t,$$

$$\sigma(\alpha_t, \alpha_s) =$$

Given this process, BLM derive the change in expected future earnings given the observation of current earnings as follows:

$$\begin{aligned} \Delta E(X_{t+k}) &= E(X_{t+k}|X_t, \ldots) - E(X_{t+k}|X_{t-1}, \ldots), \\ E(X_{t+k}|X_{t-1}, \ldots) &= X_{t-1} - \theta\alpha_{t-1}, \quad \forall k>0, \\ E(X_{t+k}|X_t, \ldots) &= X_t - \theta\alpha_t, \quad \forall k>0, \\ \Delta E(X_{t+k}) &= X_t - \theta\alpha_t - X_{t-1} + \theta\alpha_{t-1}, \\ \Delta E(X_{t+k}) &= (1-\theta)\alpha_t, \quad \forall k>0. \end{aligned} \tag{A.5}$$

The earnings innovation of the current period, α_t, represents the difference between actual and expected earnings, i.e., the unexpected earnings. Therefore, expected changes in future earnings as a result of current-period unexpected earnings can be expressed as

$$\Delta E(X_{t+k}) = (1 - \theta)\, UE_t, \qquad \forall k>0, \tag{A.6}$$

where UE_t denotes unexpected earnings of period t.

Relationship Between Abnormal Returns and Unexpected Earnings

The unexpected change in value for a firm during period t (UV_t) can be expressed as the difference between the realized and expected total of price and dividends, or

$$UV_t = P_t - E(P_t) + D_t - E(D_t) \tag{A.7}$$

The present value of unexpected earnings changes, as a result of a current-period shock, is equal to the unexpected earnings of the current period, plus the present value of changes in expected earnings of future periods from Equation (A.6), or

$$PV(UE) = UX_t + \frac{(1-\theta)\, UE_t}{E(R)}, \tag{A.8}$$

where PV(UE) is the present value of current and future-period unexpected earnings.

The unexpected change in value in (A.7) should equal the present value of unexpected earnings from (A.8), leading to the following equality:

$$P_t - E(P_t) + D_t - E(D_t) = UX_t + \frac{(1-\theta)\,UX_t}{E(R)} = \left[1 + \frac{1-\theta}{E(R)}\right]UX_t \qquad (A.9)$$

When both sides of (A.9) are divdided by beginning market value of equity, the left-hand side becomes the abnormal return (AR_t).

$$\frac{P_t - E(P_t) + D_t - E(D_t)}{P_{t-1}} = AR_t = \left[1 + \frac{1-\theta}{E(R)}\right]\frac{UX_t}{P_{t-1}} \qquad (A.10)$$

Relationship Between Raw Returns and Earnings

The relationship between raw returns and earnings can be derived by substituting [X_t - $E(X_t)$] for UX_t in Equation (A.9):

$$\begin{aligned} P_t-E(P_t)+D_t-E(D_t) &= [X_t-E(X_t)]+\left[\frac{1-\theta}{E(R)}\right][X_t-E(X_t)] \\ &= \left[1+\frac{1-\theta}{E(R)}\right]X_t-\frac{1-\theta}{E(R)}E(X_t)-E(X_t) \\ &= \left[1+\frac{1-\theta}{E(R)}\right]X_t-\frac{E(X_t)}{E(R)}+\frac{\theta E(X_t)}{E(R)}-E(X_t) \end{aligned} \qquad (A.11)$$

If

$$E(P_t) = \frac{E(X)}{E(R)} \qquad (A.12)$$

and

$$E(D_t) = E(X_t), \qquad (A.13)$$

then Equation (A.11) can be expressed as

$$P_t + D_t = \left[1 + \frac{1-\theta}{E(R)}\right]X_t + \frac{\theta E(X_t)}{E(R)} \qquad (A.14)$$

Finally, Boatsman demonstrates that (A.14) can be converted to a raw-return formulation by dividing both sides by beginning-of-period market value and subtracting one from both sides.

$$R_t = \left[1 + \frac{1-\theta}{E(R)}\right]\frac{X_t}{P_{t-1}} + \left[\frac{\theta E(X_t)}{P_{t-1}E(R)} - 1\right] \qquad (A.15)$$

APPENDIX B

Derivation of Operating Effects

Levi [1990] derives the change in locally-denominated profits of a domestic enterprise in response to a change in foreign-exchange rates. This derivation can be applied to the locally denominated profits of a foreign subsidiary as follows:

Exporting and Export-Competing Subsidiaries

The total revenue of the foreign subsidiary can be described as

$$TR = Sp^{t}q, \tag{B.1}$$

where TR is the total revenue of the subsidiary (stated in its functional currency), S is the exchange rate between the functional currency of the subsidiary and that of its trading partner, p^t is the per-unit selling price of the subsidiary's product in the functional currency of the trading partner, and q is the number of units sold.

The total production costs of the subsidiary can be written as

$$TC = cq, \tag{B.2}$$

where TC is the total cost in the functional currency of the subsidiary and c is the cost per unit. This derivation assumes constant costs. An assumption of increasing marginal costs will affect the magnitude of the impact on profits but not the direction.

Since profit-maximizing firms are presumed to be operating where marginal revenues equal marginal costs, it is assumed that

$$\frac{dTR}{dq} = \frac{dTC}{dq}. \tag{B.3}$$

Utilizing the equality in equation (B.3), Equations (B.1) and (B.2) can be differentiated with respect to q and set equal to each other. Since changes in quantity are not expected to affect exchange rates, $dS/dq = 0$, and the following result is produced:

$$Sp^t + Sq\frac{dp^t}{dq} = Sp^t\left[1 + \frac{q}{p^t}\frac{dp^t}{dq}\right] = c. \tag{B.4}$$

Elasticity of demand is the percent change in quantity that results from a one-percent change in price. This value is normally negative, so η is set equal to the absolute value of demand elasticity, such that

$$\eta = -\frac{dq/q}{dp/p}. \tag{B.5}$$

The definition in (B.5) allows simplification of (B.4) to

$$Sp^t\left(1 - \frac{1}{\eta}\right) = c. \tag{B.6}$$

Selling price can therefore be described as

$$p^t = \frac{c}{S\left(1 - \frac{1}{\eta}\right)}. \tag{B.7}$$

The preceding equation can be differentiated with respect to S to identify the effect of an exchange rate change on selling price:

$$\begin{aligned} \frac{dp^t}{dS} &= -\frac{c}{S^2\left(1 - \frac{1}{\eta}\right)} \\ &= -\frac{p^t}{S}. \end{aligned} \tag{A.8}$$

Now total revenues in Equation (B.1) can be differentiated with respect to a change in exchange rate:

$$\frac{dTR}{dS} = p^t q + Sp^t \frac{dq}{dp^t}\frac{dp^t}{dS} + Sq\frac{dp^t}{dS}, \qquad (B.9)$$
$$= p^t q + Sq(1 - \eta)\frac{dp^t}{dS}.$$

Substituting (B.8) into (B.9) produces

$$\frac{dTR}{dS} = p^t q - Sq(1 - \eta)\frac{p^t}{S} \qquad (B.10)$$
$$= \eta p^t q.$$

Total costs can also be differentiated with respect to the exchange rate, such that:

$$\frac{dTC}{dS} = c\frac{dq}{dS}$$
$$= c\frac{dq}{dp^t}\frac{dp^t}{dS} \qquad (B.11)$$
$$= - c\frac{dq}{dp^t}\frac{p^t}{S}.$$

Equation (B.11) can be simplified by substituting in η from Equation (B.5):

$$\frac{dTC}{dS} = \frac{\eta c q}{S}. \qquad (B.12)$$

Since total profits (π) can be expressed as total revenues minus total costs, the effect of an exchange rate change on total profits is

$$\frac{d\pi}{dS} = \frac{dTR}{dS} - \frac{dTC}{dS}. \qquad (B.13)$$

Using equations (B.10) and (B.12), the preceding equation can be simplified to

$$\frac{d\pi}{dS} = \eta p^t q - \frac{cq\eta}{S} \qquad (B.14)$$
$$= \eta q(p^t - \frac{c}{S}).$$

Importing and Import-Competing Subsidiaries

For an import-competing subsidiary, total revenue can be written as

$$TR = pq, \tag{B.15}$$

where p is the per-unit selling price in the functional currency of the subsidiary. Total costs can be written as

$$TC = Sc^t q, \tag{B.16}$$

where c^t is the cost per unit of output in the functional currency of the trading partner.

By using the equality in (B.3) and the definition in (B.6), total revenue and total cost can be differentiated with respect to q and set equal to each other, as follows:

$$p + q\frac{dp}{dq} = p\left(1 - \frac{1}{\eta}\right) = Sc^t. \tag{A.17}$$

Selling price is therefore set equal to

$$p = \frac{Sc^t}{1-\frac{1}{\eta}}, \tag{B.18}$$

and since the import cost is presumed to be fixed,

$$\frac{dp}{dS} = \frac{c^t}{1 - \frac{1}{\eta}} = \frac{p}{S}. \tag{A.19}$$

Total revenue can now be differentiated with respect to the exchange rate:

$$
\begin{aligned}
\frac{dTR}{dS} &= p\frac{dq}{dS} + q\frac{dp}{dS}, \\
&= q(1 - \eta)\frac{dp}{dS}, \\
&= \frac{pq}{S}(1 - \eta).
\end{aligned} \tag{B.20}
$$

The same can be done for total costs:

$$
\begin{aligned}
\frac{dTC}{dS} &= c^t q + Sc^t\frac{dq}{dS}, \\
&= c^t q + S'c^t\frac{dq}{dp}\frac{dp}{dS}, \\
&= c^t q - c^t q\eta, \\
&= c^t q(1 - \eta).
\end{aligned} \tag{B.21}
$$

The operating effect of an exchange rate change for an import-competing firm can now be estimated using (B.20) and (B.21) as follows:

$$
\begin{aligned}
\frac{d\pi}{dS} &= \frac{dTR}{dS} - \frac{dTC}{dS}, \\
&= q(1 - \eta)\left(\frac{p}{S} - c^t\right).
\end{aligned} \tag{B.22}
$$

TABLE 1

Identification of Initial Sample

Criteria for Inclusion (Exclusion)	Number of Segments	Number of Firms
Segment is primarily located in an area to which an exchange rate can be ascribed and has earnings data available for 1984-90 on Compustat geographic segment tape. The parent firm is a publicly traded company that is incorporated in the United States and has a 12/31 fiscal year end.	220	188
Parent firm does not have continuous earnings data available on Compustat from 1971-90.	(38)	(33)
Estimates of segment's sensitivity to exchange rate changes produce economically nonsensensical results. Specifically, a 1% exchange-rate change is calculated to produce a 50% or greater change in segment earnings in any one year.	(35)	(26)
Initial Sample	147	129

TABLE 2

Distribution of Geographical Segments by Primary Location[a]

Primary Location of Geographic Segment	Associated Exchange Rate is Between U.S. Dollar and Currency Unit Shown Below	Firms Reporting Geographic Segments in This Primary Location	
		Number	Percent
Europe	European Currency Unit	98	66.7%
Canada	Canadian Dollar	35	23.8
Great Britain	British Pound	5	3.4
Germany	German Deutsche Mark	3	2.0
Japan	Japanese Yen	3	2.0
Mexico	Mexican Peso	2	1.4
Australia	Australian Dollar	1	0.7
Total geographic segments		147	100.0

[a]Distribution is based on the primary location of the geographic segment. A segment is included only if it is located in an area to which an individual exchange rate can be ascribed. Furthermore, earnings data for the segment must be available on the Compustat Business Information file for the years 1984-90; and earnings data for the parent must be available on Compustat for 1971-90. In addition, the parent firm must be a public company that is incorporated in the United States and has a December 31 fiscal-year end. Finally, firms were excluded from the study if estimates of the sensitivity of their segment earnings to exchange rate changes produced nonsensical values. Specifically, estimates were deemed nonsensical if they suggested that a 1% exchange rate revision would cause a 50% or greater change in a firm's segmental earnings for any one year.

TABLE 3

Descriptive Statistics Measuring Sensitivity of Segment Earnings To Exchange Rate Changes of Current and Previous Five Years

Panel A: Sensitivity of Segment Earnings to Exchange-Rate Changes

Descriptive Statistics on the 147 $\lambda_{1ig,t+k}$ Coefficients Produced by the Time-series Regression of:

$$\%\Delta SE_{ig,t+k} = \lambda_{0ig,t+k} + \lambda_{1ig,t+k}\%\Delta FX_{igt} + \nu_{ig,t+k}$$

Value of k	Mean Value	Standard Deviation	Maximum Value	Median Value	Minimum Value
k=0	.314	8.140	35.51	.88	-37.69
k=1	.211	6.867	21.48	.30	-35.68
k=2	-.501	6.839	38.32	-.55	-44.25
k=3	-.895	6.873	29.48	-.86	-31.12
k=4	.527	7.909	36.67	-.13	-41.08
k=5	-.006	10.890	45.65	-.67	-47.83

Variables in the regression are defined as follows:

1. $\%\Delta SE_{ig,t+k}$ denotes the percent change in earnings for segment g of firm i in period t+k.
2. $\lambda_{0ig,t+k}$ is an intercept term.
3. $\lambda_{1ig,t+k}$ denotes the sensitivity of period (t+k) earnings in segment g of firm i to period t exchange-rate changes.
4. $\%\Delta FX_{igt}$ is the percent change in foreign-exchange rate between the dollar and the local currency of segment g of firm i in period t.
5. $\nu_{ig,t+k}$ denotes an error term.

TABLE 3 (CONTINUED)

Descriptive Statistics Measuring Sensitivity of Segment Earnings To Exchange Rate Changes of Current and Previous Five Years

Panel B: Significance of Earnings Sensitivity to Exchange-Rate Changes

Descriptive Statistics on the Absolute Values of the T-Statistics for the 147 $\lambda_{1ig,t+k}$ Coefficients Produced by the Time-series Regressions of:

$$\%\Delta SE_{ig,t+k} = \lambda_{0ig,t+k} + \lambda_{1ig,t+k}\%\Delta FX_{igt} + \nu_{ig,t+k}$$

Value of k	Mean Value	Maximum Value	Median Value	Minimum Value
k=0	1.27	6.10	.93	.05
k=1	.95	5.15	.77	.00
k=2	1.08	4.85	.77	.00
k=3	1.07	4.28	.87	.02
k=4	.96	9.38	.62	.00
k=5	1.06	4.79	.77	.00

Variables in the regression are defined as follows:

1. $\%\Delta SE_{ig,t+k}$ denotes the percent change in earnings for segment g of firm i in period t+k.
2. $\lambda_{0ig,t+k}$ is an intercept term.
3. $\lambda_{1ig,t+k}$ denotes the sensitivity of period (t+k) earnings in segment g of firm i to period t exchange-rate changes.
4. $\%\Delta FX_{igt}$ is the percent change in foreign-exchange rate between the dollar and the local currency of segment g of firm i in period t.
5. $\nu_{ig,t+k}$ denotes an error term.

TABLE 4

Distribution of Segments by Pattern of Exchange Rate Effects on Segmental Earnings

Pattern Number	Directional Effect of Year t Exchange Rate Change on Segment Earnings of Year t+k[a]				Segments Fitting Pattern	
	k=0	k=1	k=2	k=3	Number	Percent
1	+	+	+	+	7	4.8
2	+	+	+	-	17*	11.6
3	+	+	-	+	0	0.0
4	+	+	-	-	36**	24.5
5	+	-	+	+	4	2.7
6	+	-	+	-	0	0.0
7	+	-	-	+	7	4.8
8	+	-	-	-	27**	18.4
9	-	+	+	+	11	7.5
10	-	+	+	-	9	6.1
11	-	+	-	+	0	0.0
12	-	+	-	-	4	2.7
13	-	-	+	+	11	7.5
14	-	-	+	-	0	0.0
15	-	-	-	+	5	3.4
16	-	-	-	-	9	6.1
Total Segments					147	100.0

[a]Measured by direction of $\lambda_{1ig,t+k}$ coefficient in regression of $\%\Delta SE_{ig,t+k}$ on $\%\Delta FX_{igt}$, where $\lambda_{1ig,t+k}$ denotes the percent change in segment g earnings of firm i for year t+k and $\%\Delta FX_{igt}$ denotes the percent change in the exchange rate for year t.

*Significant at $p < .10$.

**Significant at $p < .005$.

TABLE 5

Variable Definitions

Variable	Definition
BTE_i	The proxy for barriers to entry for firm i. This variable is estimated as the total number of companies in firm i's major SIC code as listed in the 1990 edition of *Ward's Directory of U.S. Private and Public Companies*.
$CAPINT_{it}$	The capital intensity of firm i in year t. This variable is calculated as depreciation and interest (Compustat variables V14 + V15) to total expenses (V14 + V15 + V189) and averaged for years t and t-1.
$CAPINTAV_i$	The average capital intensity of firm i from 1984-90. This variable is calculated as depreciation and interest (Compustat variables V14 + V15) to total expenses (V14 + V15 + V189) and averaged for all years from 1984-90.
$EARN_{it}$	Earnings available for common for firm i during period t (Compustat variables V18-V19), scaled by market value of equity (Compustat variables V24 x V25).
$EARN\_DOM_{it}$	The domestic earnings of firm i for year t (from the Compustat geographic segment tape) scaled by the market value of equity (Compustat variables V24 x V25).
$EARN\_DUNS_{it}$	The unscaled domestic earnings of firm i for year t (from the Compustat geographic segment tape).
$EARN\_SEG_{it}$	Specified segment earnings (Canada or Europe) of firm i for year t (from the Compustat geographic segment tape) scaled by the market value of equity (Compustat variables V24 x V25).
$EARN\_SUNS_{it}$	The unscaled segment earnings (Canada or Europe) of firm i for year t (from the Compustat geographic segment tape).
$EARN\_OTH_{it}$	Other earnings of firm i for year t. This variable is calculated as total earnings available for common (Compustat variables V18 - V19) less the domestic and segment earnings (Canada or Europe) from the Compustat geographic segment tape. The variable is scaled on the market value of equity (Compustat variables V24 x V25).
$EARN\_OUNS_{it}$	Unscaled other earnings of firm i for year t, calculated as total earnings available for common (Compustat variables V18-V19) less the domestic and segment earnings (Canada or Europe) from the Compustat geographic segment tape.
$EARN\_UNS_{it}$	Earnings available for common for firm i during period t (not scaled by market value of equity).
$FINLEV_{it}$	Financial leverage of firm i in year t. This variable is calculated as total debt (Compustat variables V5 + V9 + V75) to equity (V24 x V25) and averaged for years t and t-1.

TABLE 5 (CONTINUED)

Variable Definitions

Variable	Definition
$FXSENS_i$	The foreign exchange sensitivity of firm i's geographic segments, weighted by average segment sales to average total sales of firm i. This variable is calculated as follows: $$FXSENS_i = \sum_{g=1}^{G} \frac{AVSSALES_{ig}}{AVTSALES_i} \frac{\sum_{k=1}^{3} \lambda_{1ig,t+k}/(1.10)^k}{\lambda_{1ig,t+0}}$$ where: A. $\lambda_{1ig,t+k}$ measures the sensitivity of period (t+k) earnings in the gth geographic segment of firm i to exchange rate changes of period t (see Table 3 for further details of this coefficient); B. $AVSSALES_{ig}$ is the average segment sales of segment g of firm i from 1984-90, as taken from the Compustat geographic segment tape; C. $AVTSALES_i$ is the average total sales of firm i from 1984-90 (Compustat variable V12); and D. G is the total useable geographic segments for firm i, as defined in Table 1.
$PERSIST_i$	The persistence of firm i's income available for common. This variable is calculated as the present value of the first three lag coefficients from an ARIMA(4,1,0) time-series model run on earnings available for common (Compustat variables V18-V19) from 1971-90. A 10% discount factor is used in determining present value.
$PRODTYPE_i$	The major product type for firm i. This variable is a dummy variable denoting whether the major product type is durable (1) or nondurable (0), as indicated in the July, 1990, edition of the *Survey of Current Business*.
$RETURN_{it}$	The cumulative daily return (from CRSP) on firm i's common stock from January 1 to December 31 of year t.
RET_UNS_{it}	The unscaled return on firm i's common stock for year t. This variable is calculated as year-end market value of equity plus annual dividends (Compustat variables V24 x V25 plus V21).

TABLE 6

Properties of Cross-Sectional Regression of Earnings Persistence ($PERSIST_i$) On Foreign-Exchange Sensitivity ($FXSENS_i$), Barriers to Entry (BTE_i), Product Type ($PRODTYPE_i$), and Capital Intensity ($CAPINTAV_i$)[a]

Variable		All Variables	$FXSENS_i$ Only	BTE_i Only	$PRODTYPE_i$ Only	$CAPINTAV_i$ Only
Intercept	Coeff.	-.22	-.55	-.36	-.43	-.51
	t-stat.	(-1.31)	(-8.03)	(-3.41)	(-4.41)	(-3.98)
$FXSENS_i$	Coeff.	-.07	-.05			
	t-stat.	(.78)	(-.60)			
BTE_i	Coeff.	-.001**		-.001**		
	t-stat.	(-2.001)		(-2.185)		
$PRODTYPE_i$	Coeff.	-.15			-.18*	
	t-stat.	(-1.16)			(-1.37)	
$CAPINTAV_i$	Coeff.	-.22				-.09
	t-stat.	(-.65)				(-.26)
n		81	81	81	81	81
Adj. R^2		.032	-.008	.045	.011	-.011

[a]Number of observations was 81 for each regression. This includes the 129 firms in the initial sample (as outlined in Table 1) minus 48 firms for which reliabile time series parameters could not be calculated for the $PERSIST_i$ variable. Detailed variable definitions are provided in Table 5.

*Significant at $p < .10$.

**Significant at $p < .05$.

TABLE 7

Correlations and Descriptive Statistics

Panel A: Correlations of Independent Variables Used in Regression of Persistence on Foreign-Exchange Sensitivity ($FXSENS_i$), Barriers to Entry (BTE_i), Product Type ($PRODTYPE_i$), and Capital Intensity ($CAPINTAV_i$)[a]

Variable	$FXSENS_i$	BTE_i	$PRODTYPE_i$	$CAPINTAV_i$
FXSENSi	1.0000	-.0208	-.0177	-.1777
BTE_i	-.1499	1.0000	.1569	-.0377
$PRODTYPE_i$	.0425	.1573	1.0000	-.1517
$CAPINTAV_i$	.0140	-.0343	-.0553	1.0000

[a]Pearson correlations are shown above the diagonal; and Spearman correlations are shown below the diagonal. Number of observations was 81. Detailed variable definitions are provided in Table 5. None of the correlations were significant at $p < .10$.

Panel B: Descriptive Statistics for Variables Used in Regression of Persistence ($PERSIST_i$) on Foreign-Exchange Sensitivity ($FXSENS_i$), Barriers to Entry (BTE_i), Product Type ($PRODTYPE_i$), and Capital Intensity ($CAPINTAV_i$)[b]

Variable	Mean	Standard Deviation	Maximum	Median	Minimum
$PERSIST_i$	-.538	.594	.584	-.462	-2.191
$FXSENS_i$	-.181	.747	1.698	-.058	-4.192
BTE_i	224	176	652	167	8
$PRODTYPE_i$	.556	.500	1	1	0
$CAPINTAV_i$	.318	.195	.999	.245	.051

[b]Number of observations was 81 for each variable. Detailed variable definitions are provided in Table 5.

TABLE 8

Properties of Pooled Time-series Cross-sectional Regression of Returns ($RETURN_{it}$) on Earnings ($EARN_{it}$) Varying by Parameters of Foreign-exchange Sensitivity ($FXSENS_{it}$), Barriers to Entry (BTE_{it}), Product Type ($PRODTYPE_{it}$), Capital Intensity ($CAPINT_{it}$), and Financial Leverage ($FINLEV_{it}$)[a]

Variable		1988	1989	1990	Pooled 1988-90
Intercept	Coefficient t-statistic	.056 (1.314)	-.111 (2.251)	-.171 (5.287)	-.027 (1.112)
$EARN_{it}$	Coefficient t-statistic	2.402*** (2.873)	5.650**** (6.557)	3.040**** (4.355)	3.654**** (6.643)
$FXSENS_i$ * $EARN_{it}$	Coefficient t-statistic	.028 (.225)	1.302*** (2.467)	-.909 (1.540)	.206 (.505)
BTE_i * $EARN_{it}$	Coefficient t-statistic	-.002*** (2.419)	-.001 (.778)	-.000 (.077)	-.003**** (3.835)
$PRODTYPE_i$ * $EARN_{it}$	Coefficient t-statistic	.038 (.120)	-1.479*** (2.715)	-.900** (1.923)	-.644** (2.162)
$CAPINT_{it}$ * $EARN_{it}$	Coefficient t-statistic	-1.312 (1.093)	-1.598 (1.104)	-3.832*** (2.595)	-2.920**** (4.182)
$FINLEV_{it}$ * $EARN_{it}$	Coefficient t-statistic	- .046 (1.008)	-.258**** (3.371)	-.027 (.900)	-.018 (.849)
n		119	109	109	337
Adj. R^2		.262	.483	.158	.234

[a]The t-statistics are calculated using White's heteroscedastic adjustment. Detailed variable definitions are included in Table 5.

*Significant at $p < .10$.

**Significant at $p < .05$.

***Significant at $p < .005$.

****Significant at $p < .001$.

TABLE 9

Properties of Pooled Time-series Cross-sectional Regression of Unscaled Returns (RET_UNS_{it}) on Unscaled Earnings ($EARN\_UNS_{it}$) Varying by Parameters of Foreign-exchange Sensitivity ($FXSENS_{it}$), Barriers to Entry (BTE_{it}), Product Type ($PRODTYPE_{it}$), Capital Intensity ($CAPINT_{it}$), and Financial Leverage ($FINLEV_{it}$)[a]

Variable		1988	1989	1990	Pooled 1988-90
Intercept	Coefficient t-statistic	627.960 (4.265)	306.870 (2.257)	618.930 (2.843)	671.890 (5.138)
$EARN\_UNS_{it}$	Coefficient t-statistic	12.494**** (22.050)	15.041**** (12.286)	17.777**** (13.922)	14.897**** (20.002)
$FXSENS_i$ * $EARN\_UNS_{it}$	Coefficient t-statistic	.583**** (4.685)	1.037**** (3.230)	.644** (1.793)	.889**** (3.269)
BTE_i * $EARN\_UNS_{it}$	Coefficient t-statistic	-.003**** (6.415)	-.005**** (9.780)	-.002** (2.074)	-.003**** (6.348)
$PRODTYPE_i$ * $EARN\_UNS_{it}$	Coefficient t-statistic	-2.004**** (3.555)	-2.824* (1.583)	1.178 (.537)	-1.560 (1.042)
$CAPINT_{it}$ * $EARN\_UNS_{it}$	Coefficient t-statistic	-2.033* (1.616)	-3.140 (.964)	-.871 (.444)	-1.525 (.625)
$FINLEV_{it}$ * $EARN\_UNS_{it}$	Coefficient t-statistic	-1.031**** (3.381)	-.521 (.688)	-7.382**** (4.302)	-2.306** (2.250)
n		119	109	109	337
Adj. R^2		.940	.921	.880	.870

[a]The t-statistics are calculated using White's heteroscedastic adjustment. Detailed variable definitions are provided in Table 5.

*Significant at $p < .10$.

**Significant at $p < .05$.

***Significant at $p < .005$.

****Significant at $p < .001$.

TABLE 10

Properties of Pooled Time-series Cross-sectional Regression of Returns ($RETURN_{it}$) on Domestic Earnings ($EARN\_DOM_{it}$) Varying by Parameters of Barriers to Entry (BTE_{it}), Product Type ($PRODTYPE_{it}$), Capital Intensity ($CAPINT_{it}$), and Financial Leverage ($FINLEV_{it}$); Segment Earnings ($EARN\_SEG_{it}$) Varying with Foreign-Exchange Sensitivity ($FXSENS_{it}$); and Other Earnings ($EARN\_OTH_{it}$)

Panel A: Firms With Canadian Geographic Segments

Variable		1988	1989	1990	Pooled 1988-90
Intercept	Coefficient t-statistic	-.010 (.147)	.202 (2.621)	-.186 (5.287)	-.002 (.039)
$EARN\_DOM_{it}$	Coefficient t-statistic	2.436*** (1.945)	1.877* (1.349)	1.107 (.871)	1.470* (1.509)
BTE_i * $EARN\_DOM_{it}$	Coefficient t-statistic	-.002 (.993)	-.003* (1.479)	.004 (.279)	-.001 (1.066)
$PRODTYPE_i$ * $EARN\_DOM_{it}$	Coefficient t-statistic	.802 (.930)	-.026 (.038)	.822 (1.374)	.738 (1.307)
$CAPINT_{it}$ * $EARN\_DOM_{it}$	Coefficient t-statistic	-1.807 (1.183)	3.846 (2.023)	-1.030 (.563)	-.578 (.508)
$FINLEV_{it}$ * $EARN\_DOM_{it}$	Coefficient t-statistic	.227 (.732)	-.627** (2.209)	.138 (.563)	.171 (.673)
$EARN\_SEG_{it}$	Coefficient t-statistic	.983 (.823)	-12.384 (4.701)	4.239** (1.817)	.612 (1.205)
$FXSENS_i$ * $EARN\_SEG_{it}$	Coefficient t-statistic	.435* (1.461)	.993** (2.089)	-.050 (.106)	.007 (.291)
$EARN\_OTH_{it}$	Coefficient t-statistic	.995* (1.376)	-.591 (.763)	1.889** (2.921)	1.307*** (2.433)
n		37	30	31	98
Adj. R^2		.053	.244	.195	.273

[a]The t-statistics are calculated using White's heteroscedastic adjustment. Detailed variable definitions are included in Table 5.

*Significant at $p < .10$.

**Significant at $p < .05$.

***Significant at $p < .005$.

****Significant at $p < .001$.

TABLE 10 (CONTINUED)

Properties of Pooled Time-series Cross-sectional Regression of Returns ($RETURN_{it}$) on Domestic Earnings ($EARN\_DOM_{it}$) Varying by Parameters of Barriers to Entry (BTE_{it}), Product Type ($PRODTYPE_{it}$), Capital Intensity ($CAPINT_{it}$), and Financial Leverage ($FINLEV_{it}$); Segment Earnings ($EARN\_SEG_{it}$) Varying with Foreign-Exchange Sensitivity ($FXSENS_{it}$); and Other Earnings ($EARN\_OTH_{it}$)

Panel B: Firms With European Geographic Segments

Variable		1988	1989	1990	Pooled 1988-90
Intercept	Coefficient t-statistic	.194 (3.421)	.004 (.760)	.073 (1.347)	.142 (3.440)
$EARN\_DOM_{it}$	Coefficient t-statistic	-.629 (.768)	2.323* (1.566)	-.817 (1.365)	.257 (.436)
BTE_i * $EARN\_DOM_{it}$	Coefficient t-statistic	-.005 (.488)	-.000 (.050)	.000 (.366)	.000 (.588)
$PRODTYPE_i$ * $EARN\_DOM_{it}$	Coefficient t-statistic	-.376 (1.135)	-1.779** (2.361)	-.283 (1.046)	-.621** (2.065)
$CAPINT_{it}$ * $EARN\_DOM_{it}$	Coefficient t-statistic	-.805 (.870)	-.805 (.453)	.234 (.272)	.259 (.336)
$FINLEV_{it}$ * $EARN\_DOM_{it}$	Coefficient t-statistic	1.369 (2.851)	-.203 (.339)	.052 (.824)	.032 (.421)
$EARN\_SEG_{it}$	Coefficient t-statistic	1.537** (1.793)	-2.960* (1.420)	.736* (1.284)	.801 (1.038)
$FXSENS_i$ * $EARN\_SEG_{it}$	Coefficient t-statistic	-.008 (.083)	-.199 (1.160)	-.257 (1.879)	-.175 (1.799)
$EARN\_OTH_{it}$	Coefficient t-statistic	1.570 (1.218)	.773 (.455)	.934*** (2.997)	1.115** (1.879)
n		91	85	84	260
Adj. R^2		.119	.059	.252	.073

[a]The t-statistics are calculated using White's heteroscedastic adjustment. Detailed variable definitions are included in Table 5.

*Significant at $p < .10$.

**Significant at $p < .05$.

***Significant at $p < .005$.

TABLE 11

Properties of Pooled Time-series Cross-sectional Regression of Unscaled Returns (RET_UNS_{it}) on Unscaled Domestic Earnings ($EARN\_DUNS_{it}$) Varying by Parameters of Barriers to Entry (BTE_{it}), Product Type ($PRODTYPE_{it}$), Capital Intensity ($CAPINT_{it}$), and Financial Leverage ($FINLEV_{it}$); Unscaled Segment Earnings ($EARN\_SUNS_{it}$) Varying with Foreign-Exchange Sensitivity ($FXSENS_{it}$); and Unscaled Other Earnings (EARN_OUNSit)

Panel A: Firms with Canadian Geographic Segments

Variable		1988	1989	1990	Pooled 1988-90
Intercept	Coefficient t-statistic	78.477 (.625)	118.930 (.748)	73.451 (.840)	42.850 (.363)
$EARN\_DUNS_{it}$	Coefficient t-statistic	10.565**** (5.216)	9.950*** (2.788)	12.084**** (8.084)	13.632**** (6.161)
BTE_i * $EARN\_DUNS_{it}$	Coefficient t-statistic	.007 (2.826)	.003 (1.582)	-.004** (1.659)	.006 (2.316)
$PRODTYPE_i$ * $EARN\_DUNS_{it}$	Coefficient t-statistic	-1.906** (1.973)	-3.059*** (2.759)	-.229 (.298)	-3.878**** (3.185)
$CAPINT_{it}$ * $EARN\_DUNS_{it}$	Coefficient t-statistic	-4.876* (1.463)	12.500 (1.839)	1.379 (.403)	-7.298** (2.073)
$FINLEV_{it}$ * $EARN\_DUNS_{it}$	Coefficient t-statistic	2.057 (3.351)	.481 (.954)	-1.104** (2.045)	1.947 (2.540)
$EARN\_SUNS_{it}$	Coefficient t-statistic	1.464 (.935)	-2.233 (.357)	32.934**** (4.473)	2.836 (.757)
$FXSENS_i$ * $EARN\_SUNS_{it}$	Coefficient t-statistic	3.391**** (3.591)	1.622** (2.140)	-1.384 (2.174)	3.610**** (5.649)
$EARN\_OUNS_{it}$	Coefficient t-statistic	6.858**** (13.746)	14.631**** (20.599)	11.639**** (24.061)	9.511**** (6.031)
n		37	30	31	98
Adj. R^2		.970	.984	.993	.929

[a]The t-statistics are calculated using White's heteroscedastic adjustment.

*Significant at $p < .10$.

**Significant at $p < .05$.

***Significant at $p < .005$.

****Significant at $p < .001$.

TABLE 11 (CONTINUED)

Properties of Pooled Time-series Cross-sectional Regression of Unscaled Returns (RET_UNS_{it}) on Unscaled Domestic Earnings ($EARN\_DUNS_{it}$) Varying by Parameters of Barriers to Entry (BTE_{it}), Product Type ($PRODTYPE_{it}$), Capital Intensity ($CAPINT_{it}$), and Financial Leverage ($FINLEV_{it}$); Unscaled Segment Earnings ($EARN\_SUNS_{it}$) Varying with Foreign-Exchange Sensitivity ($FXSENS_{it}$); and Unscaled Other Earnings (EARN_OUNSit)

Panel B: Firms with European Geographic Segments

Variable		1988	1989	1990	Pooled 1988-90
Intercept	Coefficient t-statistic	773.480 (5.622)	111.300 (.678)	287.100 (1.751)	655.160 (4.644)
$EARN\_DUNS_{it}$	Coefficient t-statistic	8.460**** (6.679)	13.544**** (8.201)	14.913**** (8.066)	9.140**** (5.236)
BTE_i * $EARN\_DUNS_{it}$	Coefficient t-statistic	-.002** (1.855)	-.004**** (3.848)	-.003**** (3.241)	-.002*** (2.679)
$PRODTYPE_i$ * $EARN\_DUNS_{it}$	Coefficient t-statistic	-.655 (.975)	-.548 (.460)	-2.040** (1.586)	-1.136* (1.531)
$CAPINT_{it}$ * $EARN\_DUNS_{it}$	Coefficient t-statistic	2.470 (1.437)	1.637 (.624)	-.918 (.241)	4.126 (1.533)
$FINLEV_{it}$ * $EARN\_DUNS_{it}$	Coefficient t-statistic	-2.075**** (2.647)	-3.721**** (3.011)	-5.222**** (3.843)	-3.336**** (4.660)
$EARN\_SUNS_{it}$	Coefficient t-statistic	8.635**** (5.193)	10.000**** (3.606)	7.193*** (2.806)	11.241**** (6.283)
$FXSENS_i$ * $EARN\_SUNS_{it}$	Coefficient t-statistic	.364**** (4.869)	-.232 (.803)	-.432 (.097)	.398*** (2.795)
$EARN\_OUNS_{it}$	Coefficient t-statistic	3.780*** (2.576)	1.932 (.772)	2.577 (.086)	2.278* (1.442)
n		91	85	84	260
Adj. R^2		.936	.942	.877	.884

[a]The t-statistics are calculated using White's heteroscedastic adjustment.

*Significant at $p < .10$.

**Significant at $p < .05$.

***Significant at $p < .005$.

****Significant at $p < .001$.