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EXCHANGE-RATE EXPOSURE OF MULTINATIONALS: FOCUSING ON EXCHANGE-RATE ISSUES

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Abstract: This paper examines exchange-rate exposure of multinationals (MNEs) in light of detailed exchange rate data. Specifically, using MNE-specific exchange rates and accounting for the possibility that exchange-rate crises may impact a firm differently than periods of normal fluctuations, estimates suggest ¼ of all MNEs had significant exchange rate exposure between 1995 and 1999. On average, significant exposure is estimated to be 0.68, indicating that a firm's monthly return falls, on average, by 0.68 percentage points when the dollar appreciates one percent. This encompasses periods where there are normal fluctuations in the exchange rate and the average exposure is estimated to be 0.55, as well as crisis periods where the average exposure is estimated to be 2.8. Finally, results illustrate that MNEs operating in more than 20 countries (having more than 30 subsidiaries) have twice the exposure of MNEs operating in one country (having one subsidiary).

Keywords: crisis indicators, MNE-specific exchange rate

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Introduction

Estimating exchange-rate exposure began with a very simple model, such as Jorion (1990), where a firm's return was regressed on the market return and exchange rate movement. Results suggested that there was not much exposure, which was unsatisfying given the casual evidence heard in the media. As a result, the literature evolved to more detailed analysis such as Allayannis and Ihrig (2001) bringing in trade shares and markups and, Bodnar, Dumas and Marston (2001) examining pass-through effects. These studies found more significant exposure, but in the process added a lot of bells and whistles.

Here I step back to the simple Jorion framework and focus on more detailed exchange rate issues. Using a sample of U.S. nonfinancial multinationals (MNEs) over the 1995:1-1999:12 period, I estimate monthly exchange-rate exposure accounting for two items. First, I construct a more accurate exchange rate basket for each MNE based on the number and location of their subsidiaries. Second, I allow for months with exchange-rate crises to affect a firm differently than months of normal exchange rate fluctuations. Results suggest that accounting for both these items increases the evidence of significant exchange-rate exposure to ¼ of the firms in the sample.

In most existing studies of exposure a broad measure of the exchange rate is used in the analysis, where bilateral exchange rates are typically weighted by U.S. trade flows. One can easily understand how a broad exchange rate may not be relevant for a firm, especially an MNE that has operations in only a few countries. By creating firm-specific exchanges for each MNE in the sample and using these exchange rates in the simple Jorion model, I find the number of U.S. MNEs' with significant exposure rises from 10 percent in the standard Jorion estimate to 16 percent, this is a significant change in the number of firms with significant exposure.

Next I consider the fact that small movements in the exchange rate may not be very significant to a firm's balance sheet, but, perhaps, large movements in the exchange rate are costly to a firm. One often hears about companies whose operations are affected by an exchange-rate crisis quite rapidly after a onset of a crisis.[1] This is suggestive that firms' returns are affected by drastic changes in the exchange rate because of the large impact on their cashflow. This idea differs from Chow, Lee and Solt (1997) who argue changes in the exchange rate affect short-term and long-term cashflows, but current exchange-rate changes can be hedged or the cashflow effects are offset by interest-rate effects. They conclude that cashflow effects are important only in the long term and find significant measures of long-horizon exposure. However, it isn't hard to believe that a crisis differs from a period of normal exchange rate fluctuations in many regards. As a result, one might suspect firms' returns are affected by drastic changes in the exchange rate even in the short horizon.

To account for the possibility that a crisis is what is important in estimating exposure, I add an early warning system crisis indicator to the model. That is, I allow returns to be affected by exchange rate movement during crises differently than in months of normal exchange rate fluctuations. Allowing for this, I find firms are either significantly exposed to normal exchange rate fluctuations or crisis fluctuations, not both, and, the percent of the firms in the sample with significant exposure rises to 24 percent.

The median (mean) monthly exposure of U.S. MNEs between 1995 and 1999 is -0.25 (-0.37), which says a one percent appreciation of the U.S. dollar against the currencies where the MNE has operations causes the monthly returns to fall by ¼ (a) percentage points. This result is consistent

[1]For example, this headline is from Reuters on February 26, 2001: "Procter & Gamble Sees Hit by Turkish Lira". The major devaluation occurred on February 22, 2001.

with other studies (e.g., Allayannis and Ihrig). Focusing solely on significantly exposed firms, the median (mean) exposure rises to -0.63 (-0.68) , saying a one percent appreciation of the dollar causes returns to fall by more than ½ percentage points.

These exposure estimates hide the fact that there is a huge difference in the value of exposure for firms during normal periods of exchange rate movement and periods of crises. Considering the significantly exposed firms, exposure averages -0.55 during periods of normal exchange rate fluctuations, but during a crisis, exposure jumps to -2.79. Since the average appreciation of the MNE-specific dollar during a crisis is 1.6 percent, this implies the average decline in a firm's monthly return is 4.4 percent during a crisis month. This is consistent with Forbes (2001) who finds returns fall 15 (10) percentage points through the duration of the Asian (Russian) crisis.

Focusing on MNE characteristics, one finds that the more subsidiaries and/or more countries of operation, the higher a firm's exposure.[2] MNEs with only one subsidiary have an average exposure of -0.03, but MNEs with at least 30 subsidiaries have an average exposure of -0.07. Similarly, MNEs that only operate in one country besides the United States have an average exposure of -0.04, while MNEs operating in at least 20 countries have an exposure of nearly -0.12. This is consistent with the view that the more foreign operations an MNE has the larger is its exchange-rate exposure, because it is more likely that its balance sheet is affected by exchange rate movement since it is more likely to be located in a country with a crisis.

The remainder of this paper is organized as follows. Section 1 describes the models used to estimate exposure, building off the Jorion (1990) model. Section 2 discusses the data, highlighting

[2]One might think MNEs can operational hedge exchange-rate exposure by operating in countries with negatively correlated exchange rates. See Allayannis, Ihrig and Weston (2001) for more discussion on this issue.

the MNE-specific exchange rate and crisis variables. Exposure estimates are presented in Section 3. Section 4 concludes the paper.

I. Model

The starting point for estimating exposure is the Jorion (1990) model. For each MNE, exchange-rate exposure is estimated by regressing the MNE's return on the market return and exchange rate movement. Specifically,

$$R_t^i = \alpha_0^i + \alpha_1^i R_t^m + \beta^i \Delta e_t + \varepsilon_t^i \qquad (1)$$

where R^i is firm i's return, R^m is the market return and Δe is the change in the exchange rate. In this regression the exchange rate is typically a trade-weighted exchange rate that is the same series used for each firm. Exposure is the estimated value of β and, generally, studies find 10 percent of the firms have significant exposure when considering the 10 percent significance level.

The first adjustment to the Jorion model allows for an MNE-specific exchange rate. It is not too hard to believe that MNEs may not disburse their operations in the same manor of U.S. trade flows (which is how most broad U.S. exchange rates base their weighting schemes on). Hence, instead of using the same exchange rate for each MNE, I use an MNE-specific exchange rate, Δe^i. More discussion of the MNE-specific exchange rate is found in the data section. So the model becomes:

$$R_t^i = \alpha_0^i + \alpha_1^i R_t^m + \beta^i \Delta e_t^i + \varepsilon_t^i \qquad (2)$$

Last, to account for the fact that exchange-rate crisis periods may affect a firm's balance sheet, and hence return, more dramatically than normal exchange rate movements, an additional term is introduced in the model that captures the effect of a crisis on exposure. The model is:

$$R_t^i = \alpha_0^i + \alpha_1^i R_t^m + (\beta_1^i + \beta_2^i I_t^i)\Delta e_t^i + \varepsilon_t^i \qquad (3)$$

where I^i is an exchange-rate crisis indicator function. When none of an MNE's subsidiaries are in crisis countries, the indicator function is set to zero and the model reduces to (2). The indicator function used in the analysis takes on a value between zero and one, where the value indicates the proportion of its subsidiaries in crisis countries. More details of the indicator variable are found in the data section below. Now firm i's exposure at date t is given by $\beta^i_1 + \beta^i_2 * I^i_t$. Notice exposure varies though time as I^i fluctuates between zero and one. If one believes that the probability that an MNE faces a crisis increases with the number of subsidiaries and/or countries it operates in, then exposure is a function of the MNE's foreign operations.

II. Data

The data for this project is the standard variables in exchange-rate exposure research except that I adjust the exchange-rate data to capture more detailed data about MNE-specific location characteristics in (1) the definition of the exchange rate and (2) in incorporating exchange-rate crisis information. The sample contains monthly data on 226 MNEs that I use to estimate exposure over the 5-year interval 1995-1999, so that there are 13560 firm-year observations in the sample. Table 1A presents summary statistics for the basic regressions.

Returns: Monthly nonfinancial industry returns are retrieved from the University of Chicago Center for Research in Security Prices (CRSP) database. Dividends are included in the prices used to calculate firm returns. The CRSP monthly value-weighted market index is used as the market portfolio.

Multinational data: For each MNE (ticker symbol) from the CRSP dataset, I use the 1998 National Registry to find the locations and number of level-1 subsidiaries. The number and locations of subsidiaries is very disperse, see the histogram in Table 1B. An MNE, on average, has 20.6 subsidiaries, with the minimum number of subsidiaries being one for 27 firms and the maximum number of subsidiaries is 402 for Hewlett-Packard Company. On average, an MNE is located in 11.4 countries, with the minimum being one and the maximum being 94.

Exchange rate: As a reference exchange rate, I consider the JPMorgan Broad exchange rate index. This "broad" type of exchange rate is consistent with what is used in most other studies of exposure (e.g. Jorion, Allayannis and Ihrig, Bodnar, Dumas and Marston).

Alternatively, and what one may think is more appropriate, I create MNE-specific exchange rates. For each MNE, I create an exchange rate that is a weighted average of the U.S. dollar bilateral exchange rates for where its subsidiaries are located. The weight given to a country's exchange rate is associated with the number of subsidiaries located in that country relative to the total number of subsidiaries of the MNE.[3] Specifically, for each month, the subsidiary-weighted exchange rate, sub-ER, is defined as:

$$sub-ER_i = \sum_{j=1}^{N} \frac{\#subsidiaries_j}{Total\#subs_i} ER_j$$

[3]Ideally one would want sales data of the subsidiaries so that the weights not only account for each foreign operation but weigh them appropriately. The National Registry does not provide detailed subsidiary data. As a sensitivity analysis, I also created country-specific exchange rates where each country the MNE operates in gets equal weight in the exchange rate. The correlation of the country weighted exchange rate with the sub-ER is 0.97. Estimation results using the country-weighted exchange rates were similar.

where N is the total number of countries that MNE i operates in, and ER is the bilateral exchange rate between the U.S. dollar and the currency of country j. If the MNE operates in only one country other than the United States, then sub-ER is just a bilateral exchange rate.

Crisis indicators: Associated with the early warning system literature, various measure of exchange rate pressure have emerged. I consider three such measures: Frankel and Rose (1996), Kaminsky, Lizondo, and Reinhart (1998), and Kamin, Schindler and Samuel (2001). Each of the three studies creates monthly country indicators that take on values of zero or one. A zero means that there is no exchange-rate pressure in the country for that date. A one indicates that, based on the authors' criteria, there was above normal exchange rate pressure (i.e., a crisis). Edison (2000) provides a good overview of and more research on the early warning systems and, extends the former two indicators through the 1990s.

The three indicators differ in the variables they use to identify periods of greater than normal exchange-rate pressure. Frankel and Rose (FR) focus on movement in the nominal exchange rate, Kaminsky et al. (KLR) consider the nominal exchange rate and international reserves and, Kamin et al. (KSS) use the real exchange rate and international reserves. These three measures differ in their dating of crises and, hence, the correlation between the series is not as high as one might think. For example, the correlation between FR and KLR is 0.47, while the correlation between FR and KSS is 0.42 (KSS and KLR are more highly correlated at 0.59).

I take these indicators and create a MNE-specific crisis indicator using the same method as for sub-ER.[4] Specifically, the subsidiary weighted crisis indicator, sub-I, is defined as:

$$sub-I_i = \sum_{j=1}^{N} \frac{\#subsidiaries_j}{Total\#subs_i} I_j$$

where N is the total number of countries that MNE i operates in, and I is the crisis indicator (FR, KLR or KSS) of country j. Sub-I can take on a value between zero and one. If none (all) of the countries where the MNE has operations has a crisis, then sub-I is zero (one).

The analysis below uses sub-I data derived from the FR indicator; however, KRL and KSS are used in sensitivity analysis and show the results are not sensitive to the choice of crisis indicator. Focusing on the FR crisis indicator between 1995 and 1999, 12 countries had at least one month where the early warning system indicated a crisis. For sub-I, this translates into 89 MNEs with none of their subsidiaries in countries with a crisis any month and, at the opposite extreme, there are four MNEs that had 10 of the 60 months with at least one of their subsidiaries in a crisis country. On average, an MNE had two months where some of its subsidiaries are in crisis countries between 1995:1 and 1999:12.

III. Exposure Estimates

To begin, I run the standard Jorion regressions, equation (1), on the data using the JP Morgan broad exchange rate. The results, presented in the first column of Table 2, are consistent with standard estimates. The median value of exposure if -0.23, suggesting a one percent appreciation of the dollar reduces returns by 0.23 percentage points. I find approximately 10 percent of the sample has

[4]Alternatively, I created a crisis indicator that was one if any of the countries the MNE was located in has a crisis and, I created a country weighted crisis as well. The correlation between sub-I and these alternatives 0.65 and 0.96, respectively.

significant exposure at the 10 percent level. The quartile values of exposure are also consistent with other studies.

Next I run the Jorion exchange-rate adjusted regressions, equation (2), where the MNE-specific exchange rates are used. Table 2, column 2, shows there is only minor change in the median exposure, with it rising from -0.23 to -0.20. As the quartiles suggest, most values of exposure are near the median value, with a small proportion of exposure values at the tails of the distribution. The number of firms with significant exposure rises to 16 percent at the 10 percent level, this is a significant change in the number of firms with significant exposure. The median exposure of significantly exposed firms is -1.2.

Finally I estimate exposure allowing for crisis periods to affect a firm's return differently than normal exchange rate fluctuations, as in equation (3). Table 3 reports the coefficients of the regression equation in the left panels and the implied exposure estimate on the right panel. Notice that the number of firms drops from 226 (as in the first regressions) to 137. This reduction in firms reflects the fact that 89 MNEs did not have any one of their subsidiaries located in a crisis country in the 1995-1999 period.

Column 1 reports β_1, the standard exposure estimate in a Jorion regression. The median value, -0.23, is approximately the same as that of the Jorion exchange-rate adjusted regression. Approximately 15 percent of the sample's returns are significantly affected by normal fluctuations of the exchange rate. Turning to column 2, the crisis term, β_2 , is reported. About 13 percent of the sample's returns are significantly affected by exchange rate crises. The median value of β_2 is -7.09, where the negative coefficient suggests that an appreciation of the dollar causes the firm's return to fall by more during a crisis than normal periods of exchange rate movement. To calculate the

additional effect of the exchange-rate crisis on firm i's return, one has to multiply β_2^i by I^i. If all the MNE's subsidiaries are in crisis countries, then I^i=1 and exposure is quite negative (-0.23-7.09*1= -7.32). On the other hand, if an MNE has one subsidiary located in each of 11 different countries (11 is the average number of countries an MNE operates in), and only one of these countries has a crisis, then I^i=1/11 and exposure is much less (-0.23-7.09*1/11=-0.87).

Column 3 reports the exposure distribution across the 137 firms. Exposure for firm i at date t is calculated as $\beta_1^i + \beta_2^i I_t^i$. Exposure is significant if either β_1 and/or β_2 is significant. The analysis shows that firms are either significantly exposed to exchange rate movement through β_1 or β_2, only one firm is effected through both terms. Hence, 27 percent of the sample (37/137) is significantly exposed to exchange rate movements. One would expect that this model more accurately estimates exposure than the Jorion type models since the latter have to capture the effects of both the extreme and modest fluctuations in the exchange rate on returns in one coefficient estimate. To give some perspective on this, if one takes the 137 MNE sample and reruns the Jorion exchange-rate adjusted model, less than 7 percent of the sample (9/137 firms) are significantly exposed, in comparison with the 27 percent when the crisis period effect is separated.

For the MNEs that experienced a crisis between 1995 and 1999, the median (mean) exposure was -0.25 (-0.37). For the significantly exposed firms, the median (mean) exposure was more than twice as large, at -0.63 (-0.68). This suggests an appreciation of the dollar decreased a firm's return, on average, 0.67 percentage points.

Given that the MNEs experienced a limited number of crises, the average exposure value is not suggestive of the value of exposure during a crisis. On average MNEs experienced two months

of crises over the 60 months between 1995:1 and 1999:12, although four firms (DE, HWP, JNJ, UN) had ten months with subsidiaries in crisis countries. The significantly exposed firms had exposure that averaged -0.55 during periods of normal exchange rate fluctuations, but during a crises, exposure averaged -2.79. Since the average appreciation of the MNE-specific dollar during a crisis was 1.6 percent, the average decline in a firm's monthly return was 4.4 percent solely from the impact of movement in the dollar. Hence results in Table 3 suggest crisis periods are just as important as non-crisis periods in terms of number of significant firms but even more important in terms of the magnitude of the effect on returns.

Figures 1 and 2 present two examples of MNEs' returns and crisis indicators (these firms have significant exposure). Figure 1 plots Becton, Dickinson and Company (BDX), while Figure 2 plots Honeywell International's (HON). Each figure has three series: the firm's monthly return, the market return and the crisis indicator series, where the value of the indicator represents the percent of the firm's subsidiaries in crisis countries. Both firms are affected by crises in multiple months and, both had subsidiaries in a crisis country in January of 1999. For BDX, 6.25 of its subsidiaries where located in crisis countries in January 1999. In this month BDX's dollar exchange rate appreciated nearly 2 percent and their stock return fell 16.25 percent (BDX's estimated exposure is -8.4 in January 1999), while the market return rose 3.8 percent.

For HON, 2.2 percent of its subsidiaries where located in countries with a crisis in January of 1999. In this month HON's dollar exchange rate appreciated over 1.5 percent and their stock return fell nearly 12 percent (HON's estimated exposure is -3.7 in January 1999), while the market return rose 3.8 percent. Looking across periods with crises, one sees that HON's return rose less than the market return, fell more than the market return or fell when the market return rose. Each

of these three outcomes is consistent with the story that an appreciation of the dollar causes subsidiaries' profits, in terms of foreign currency, to lose value in terms of U.S. dollars (this assumes HON cannot adjust their prices to counter the effect of the crisis, which seems reasonable in periods of exchange rate crises).

To get the entire picture of what exposure looks like, one should combine the exposure estimates of the MNEs who experienced a crisis with the 89 other MNEs that did not experience a crisis in the 1995-1999 period. Doing this (results not shown), 25 percent of the sample is significantly exposed to exchange rate movement, with a median exposure of -0.46. For those who are significantly exposed, the median exposure is -0.42 and the mean is -0.54. So by adjusting the model to account for some basic exchange rate issues, one finds much more significant exposure than the Jorion model finds. This is of interest since the model excludes issues of trade shares, markups, or pass-though, all of which have been used in previous studies to argue there is more exposure than found by the Jorion model, but measures of which are hard to obtain and, perhaps, poorly estimated.[5] In addition, the average value of exposure estimate with these exchange rate considerations is larger than previous estimates suggest. This is because the current framework separates the effect of exchange rate movements on returns during crisis periods and periods of normal exchange-rate fluctuations and, therefore, estimate exposure more precisely.

[5]It is common in the exposure literature (e.g., see Goldberg and Campa (1999) on the topic of investment exposure or Allayannis and Ihrig (2001) on return exposure) to need markup data for domestic sales and foreign sales of the same good. Unfortunately, researchers cannot observe distinct markups for sales in domestic and foreign markets and therefore assume domestic and foreign markups of the final good are equal. With respect to trade shares, import data by SIC is the imports of that SIC's good, not imports of various goods by that SIC so Allayannis and Ihrig had to construct this series from I/O tables.

Focusing on the MNE characteristics of the data sample, Table 4 summarizes exposure for MNEs with the most and least number of subsidiaries and most and least number of countries of operations. Looking at number of subsidiaries, one sees the average exposure of MNEs with only one subsidiary is -0.03, while the average exposure of MNEs with 30 or more subsidiaries is -0.07. MNEs operating in only one country have an average exposure of -0.04, while exposure is -0.12 for MNEs operating in at least 20 countries. So, one can say MNEs with more foreign operations (in terms on number of subsidiaries and/or countries) are more exposed to exchange rate fluctuations. These results suggest exposure is a function of foreign operations.

Last I test the sensitivity of my analysis to a different sample period and different crises indicators.[6] Each sensitivity analysis is reported in Table 5 and each suggests the results are robust. Column 1 reports estimation coefficients of the Jorion exchange-rate adjusted regression for the 1990-1994 sample period, with the caveat that the MNE subsidiary location information is for 1998 and may be slightly out of date. Estimation suggests 19 percent of the sample has significance exposure, with the median exposure of -0.04. This is a slightly larger number of firms that have significant exposure than found in Table 1, column 2, and again illustrates that having a more appropriate exchange rate suggests more exposure than previously estimated. Columns 2 and 3 report the estimation results when the KRL and KSS crisis indicators are used in the analysis. In both cases the median exposure is in line with the FR analysis and, the significantly exposed MNEs represents over 20 percent of the sample, similar to the results using the FR crisis indicator. Hence both tests suggest the implied conclusions are robust.

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[6]I also tested my results using a country weighted MNE exchange rate. The results were similar to what is reported; however, since the subsidiary weighting seems superior to the country weighting these results are not reported.

IV. Conclusion

This paper took the basic Jorion (1990) model for estimating exposure and adapted it to incorporate two specific exchange-rate issues. First I introduced MNE-specific exchange rates in the analysis. Second, I adjusted the model to allow exposure to differ between periods of normal exchange rate fluctuations and during crises. These two simple modifications suggest that exposure is much more prevalent than the Jorion (1990) estimates suggest.

Estimation results suggests ¼ of all U.S. nonfinancial MNEs have significant exchange rate exposure between 1995 and 1999. On average, significant exposure is estimated to be 0.68, indicating that these firms find their monthly returns fall, on average, by 0.68 percentage points when the dollar appreciates one percent. This encompasses periods where there are normal fluctuations in the exchange rate and the average exposure is 0.55, as well as crisis periods where the average exposure is 2.8. Given that the average appreciation of the MNE-specific dollar during a crisis between 1995-99 was 1.6 percent, the average decline in a firm's monthly return was 4.4 percent, solely from the impact of movement in the dollar. These results are robust to the time period and early warning system indicator used in the analysis. I conclude that crisis periods are just as important as non-crisis periods in terms of having a significant impact on firms' returns, but even more important in terms of the magnitude of the effect on returns.

Finally, the results illustrate that MNEs operating in more than 20 countries (having more than 30 subsidiaries) have twice the exposure of MNEs who operate in one country (having one subsidiary). So one can say MNEs with more foreign operations are more exposed to exchange rate fluctuations and, perhaps, exposure is a function of foreign operations.

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Table 1A - Basic Summary Statistics

	N	Mean	Std Dev	Minimum	Maximum
R^i	13560	0.0158	0.0952	-0.528	0.640
R^m	13560	0.021	0.041	-0.127	0.081
JPMorgan Broad ER	13560	0.003	0.012	-0.034	0.036
Δsub- ER	13560	0.005	0.022	-0.079	1.016
sub-I	13560	0.002	0.024	0.0	1.0

Table 1B - Histograms of MNEs characteristics

# subsidiaries	Frequency
0-1	27
2-5	70
6-10	36
11-15	28
16-20	23
21-25	16
26-50	43
51-75	9
76-100	9
>100	5

# countries	Frequency
0-1	35
2-5	86
6-10	36
11-15	39
16-20	20
21-25	24
26-50	23
51-75	2
76-100	1
>100	0

Table 2- Jorion Regressions, 1995:1-1999:12

	Jorion regression Equation (1)	Jorian Exchange-rate Adjusted Equation (2)
β		
Minimum	-4.11	-5.82
First Quartile	-0.86	-0.76
Median	-0.23	-0.20
Third Quartile	0.37	0.26
Max	1.96	3.48
# Significant at 10%	23	36
• Median Exposure	-1.80	-1.16
• Mean Exposure	-1.33	-0.61
# MNEs	226	226

Table 3 - Exchange Rate Exposure with Crisis Indicators, Equation (3)

	Coefficients		**Exposure** $\beta_1+\beta_2*I$	
	(1)	**(2)**	**(1)**	**(2)**
	β_1	**β_2**	**All**	**Significantly Exposed MNEs**
Minimum	-3.59	-3965.57	-306.39	-34.04
First Quartile	-0.69	-47.65	-0.8	-1.57
Median	-0.23	-7.09	-0.25	-0.63
Third Quartile	0.18	17.11	0.19	0.04
Max	2.12	6989.3	198.37	10.99
# Significant at 10%	20	18	37	37
• Median Exposure	n/a	n/a	-0.63	-0.63
• Mean Exposure	n/a	n/a	-0.68	-0.68
# MNEs	137	137	137	137

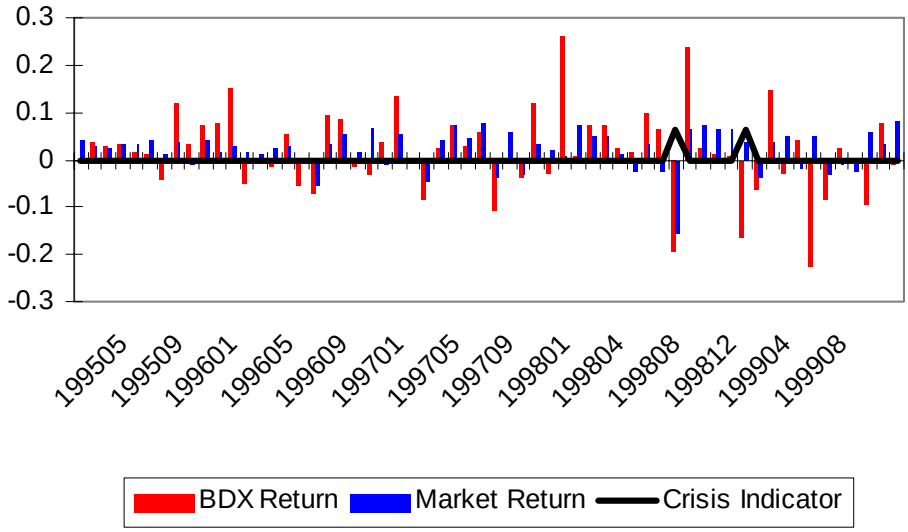
Table 4 - Exposure of Large and Small MNEs

	N	**Average Exposure**	**# Significant at 10%**
MNEs with only 1 subsidiary	22	-0.033	5
MNEs with $\geq$30	49	-0.072	12
MNEs in only 1 country	29	-0.039	8
MNEs in $\geq$20 countries	47	-0.116	12

Table 5 - Exposure Sensitivity

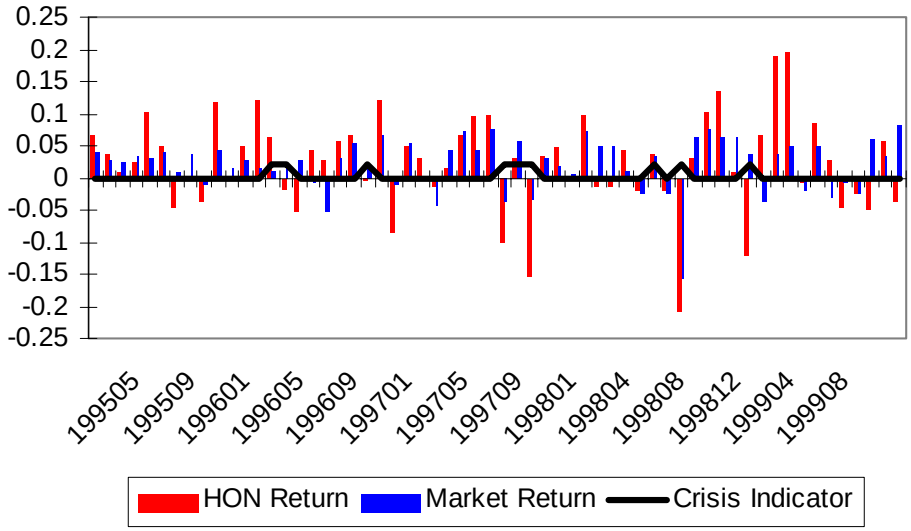
	Jorion Exchange-rate Adjusted Model Sample Period 1990:1-1994:12 (1)	**Model with Crisis Indicators equation (3) 1995:1-1999:12 (2)**	**(3)**
		KLR	KSS
Exposure			
Minimum	-1.89	-15.63	-5.81
First Quartile	-0.33	-0.80	-1.13
Median	-0.04	-0.25	-0.21
Third Quartile	0.45	0.30	0.38
Max	2.7	10.13	8.41
# Significant at 10%	43	30	29
# MNEs	226	137	137

Figure 1 - Becton, Dickinson and Company (BDX): BDX's return and periods of crises.



The severity of the crisis (in terms of percent of its subsidiaries in crisis countries) is indicated by the value of the indicator. For example, in January 1999, 6.25 percent of BDX's subsidiaries were in countries with a crisis. In this month BDX's dollar exchange rate appreciated nearly 2 percent and their stock return fell 16.25 percent (BDX's estimated exposure is -8.4 in January 1999), while the market return rose 3.8 percent.

Figure 2 - Honeywell International Inc. (HON): HON's return and periods of crises.



The severity of the crisis (in terms of percent of its subsidiaries in crisis countries) is indicated by the value of the indicator. For example, in January 1999, 2.2 percent of HON's subsidiaries were in countries with a crisis. In this month HON's dollar exchange rate appreciated over 1.5 percent and their stock return fell nearly 12 percent (HON's estimated exposure is -3.7 in January 1999), while the market return rose 3.8 percent.