The Effect of Exchange Rates on Foreign Direct Investment: A Look at the New Millennium

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Abstract

The goal of this paper is to determine the effects of exchange rate volatility and appreciation/depreciation of select East Asian currencies on foreign direct investment. An autoregressive time series analysis is used to understand the correlation between these exchange rate measures on foreign direct investment. In order to control for the time period, data is collected specifically for years after the break into the 2000s. The observed effect of higher volatility shows a negative correlation with foreign direct investment into these East Asian economies. An appreciation in the currency also shows a similar negative correlation with foreign direct investment flows.

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Introduction

In this new millennium, the advancements in technology and communications have created a more globalized world. As a result, foreign direct investment has become an increasingly important form of global business pursued by many multinational enterprises. This growth of foreign direct investment has become a driving force of economic development in many growing countries.

For the investing firm, foreign direct investment allows for more efficient allocation of resources. This can be seen through examples of horizontal and vertical FDI in different countries. Whether the objective is to gain profits by transplanting a working system into a developing market or taking advantage of more cost efficient labor, the benefits of FDI are apparent. Furthermore, for the receiving country, FDI can be a strong catalyst for development. This is because technology transfer and increased productivity resulting from this added investment base could help bolster the overall well being of the host economy.

There are many factors that can be considered when looking to invest in a foreign economy. Some of these may include the size of the economy, trade barriers, language barriers, education levels of the country and ease of government transactions, just to name a few. More specifically, in this paper, exchange rates will be the factor that will be in focus.

Exchange rates can affect future profits of multinational firms through uncertainty. As exchange rates fluctuate, the value of the transferred profits may be affected adversely. Therefore, exchange rates can factor in greatly for firms making

FDI decisions. Through my analysis, I expect to see a positive correlation between the host country's depreciation and foreign direct investment. Also, I expect to see a negative correlation between exchange rate volatility and foreign direct investment.

Data

The data for this analysis targets seven East Asian economics including China, Hong Kong, Japan, Singapore, Taiwan, Thailand and the Republic of Korea within the time span of 2000-2008. These countries were chosen for the variety they provided in terms of the relative amounts of foreign direct investment levels and the growth of this foreign direct investment within the nine-year time span as seen in Figure 1. The foreign direct investment data was taken from the bureau of economic analysis' website. This information was annual data, calculated on a historical cost basis, targeting United States direct investment specifically in the manufacturing sector for the stated countries.

The exchange rate data was collected from X-Rates.com. This data was collected monthly for the years 2000-2008. In order to normalize the data, the exchange rates for each country were divided by the means. The standard deviation was then taken for each one-year period in order to create the measure for the volatility. Furthermore, the average of the normalized data was taken for each year in order to create a measure for the depreciation or appreciation of the exchange rate over time. The data for the gross domestic product of each country was also taken in order to control for the other factors of the host economy such as market size. This GDP data was gathered from the World Trade Organization website.

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Methodology

In order to measure the effect of exchange rate volatility and fluctuations on United States foreign direct investment, an autoregressive time-series analysis was used. This model was chosen in order to take into account the lagged variables, which are directly connected in this time series dataset. For these regressions, the dependent variable was the log of the target country's foreign direct investment levels. The independent variables for these regressions included the exchange rate volatility (XV_c), the average exchange rate (XA_c) and the log country (C) gross domestic product. Also, variables for the lags were included depending on the choice of the best-fit model AR (1) or AR (2).

$$Y_{logCFDI} = ß_0 + ß_1 \, AR\,(1) + ß_2 \, AR\,(2) + ß_3 \, XV_C + ß_4 \, XA_C + ß_5 \, logGDP_{Country} + \varepsilon$$

In order to determine the model of best fit, the Akaike Information Criterion and Schwarz Bayesian Information Criterion were used. Through the analysis of a variety of regressions the model with the lowest AIC and SBIC statistics were used in order to determine the appropriate number of lags for the regressions.

Technical Analysis

The regression for China was an AR (2) process that showed significant results for the exchange rate volatility and log China GDP variables. The exchange rate volatility variable follows the intuition that higher volatility would decrease the amount of incoming US foreign direct investment. Also, the log China GDP variable follows the expected sign that an increase in GDP would produce more foreign

direct investment. Furthermore, the average exchange rate variable also follows the intuition that a depreciation of the Chinese Yuan would result in more foreign direct investment through its positive sign. But, this average exchange rate result is insignificant.

The regression for Hong Kong similarly had an AR (2) process in order to generate the coefficient estimates. Similar to China, the sign of the exchange rate volatility was negative while the signs for the average exchange rate and log Hong Kong GDP were both positive. These coefficient estimates reveal similar results that follow the intuition that exchange rate volatility will decrease FDI while depreciation and a growing economy will fuel more FDI. Although, this is the case for Hong Kong, the variables for exchange rate volatility and average exchange rate were not significant.

The regression for Japan provides some variability in the results. The average exchange rate variable and log GDP variables for Japan are both positive and significant. But, the exchange rate volatility variable is positive instead of negative, which goes against the stated intuition. However, this exchange rate volatility variable is not significant.

The regression for the Republic of Korea gives more evidence that reinforces the effects of exchange rate volatility on foreign direct investment. This is because the exchange rate volatility coefficient is negative while the average exchange rate and log GDP variables are both positive, with all three being significant.

The next regression is for the country of Singapore. The full regression failed to produce any results. Therefore, in order to gain some perspective on the appropriate signs for the chosen variables three separate regressions were ran. The first regression was an AR (1) process, regressed on exchange rate volatility and log Singapore GDP. Both these variables had the opposite sign that was expected, the volatility being a positive sign while the GDP being a negative sign. Furthermore, the second regression was a similar AR (1) process, but this regression was regressed on the variables average exchange rate and log Singapore GDP. Once again these variables opposed the expected results producing negative coefficients for both average exchange rate and log Singapore GDP. The last regression that was run removed the lags and simply regressed the three independent variables of Singapore exchange rate volatility, Singapore average exchange rate and log Singapore GDP on US log FDI in Singapore. The end result of this third regression once again backed up the coefficient signs that opposed the expected values. As a result, this finding may prove interesting to investigate in order to determine what types of factors would cause such a shift in results.

The last two regressions are on Taiwan and Thailand. The regression on Taiwan is an AR (1) and produces the expected negative coefficient on Taiwan exchange rate volatility. This regression also produces the expected positive results for the average Taiwan exchange rate and the log Taiwan GDP variables. Furthermore, the latter two variables are both significant while the volatility variable is insignificant. For the Thailand regression, the signs of the variables follow that of the Taiwan regression, containing a negative coefficient for the

exchange rate volatility and positive signs for the average exchange rate and log GDP variables. The difference is that only the log GDP variable was significant for the Thailand regression.

Conclusion

Overall, it seems that the majority of the regressions show that exchange rate volatility has a negative effect on the amount of US foreign direct investment. Also, it follows that changes in the average exchange rate, which can represent depreciation or appreciation of the currency would result in a larger amount of US foreign direct investment. Although there were a lot of results that were not significant in the 95% confidence interval, the majority of the regressions follow the intuition that more exchange rate volatility or an appreciation of exchange rates will result in a larger amount of foreign direct investment.

Furthermore, in the case of Singapore it seems that this country has something more going on that would cause an increase in US FDI under the circumstances of higher exchange rate volatility, appreciation of the currency as well as a weakening in the GDP. This result may result from a variety of factors such as lighter trade barriers or favorable treatment to FDI. But, overall, higher exchange rate volatility and an appreciating currency will generally drive away foreign direct investment, especially in this new globally interconnected millennium.

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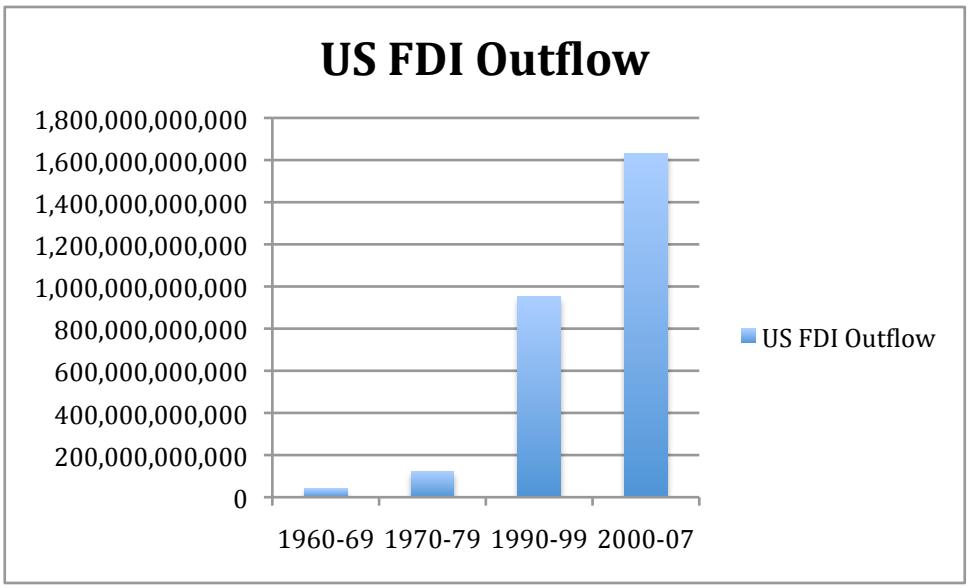
Appendix

Figure 1



Source: http://en.wikipedia.org/wiki/Foreign_direct_investment

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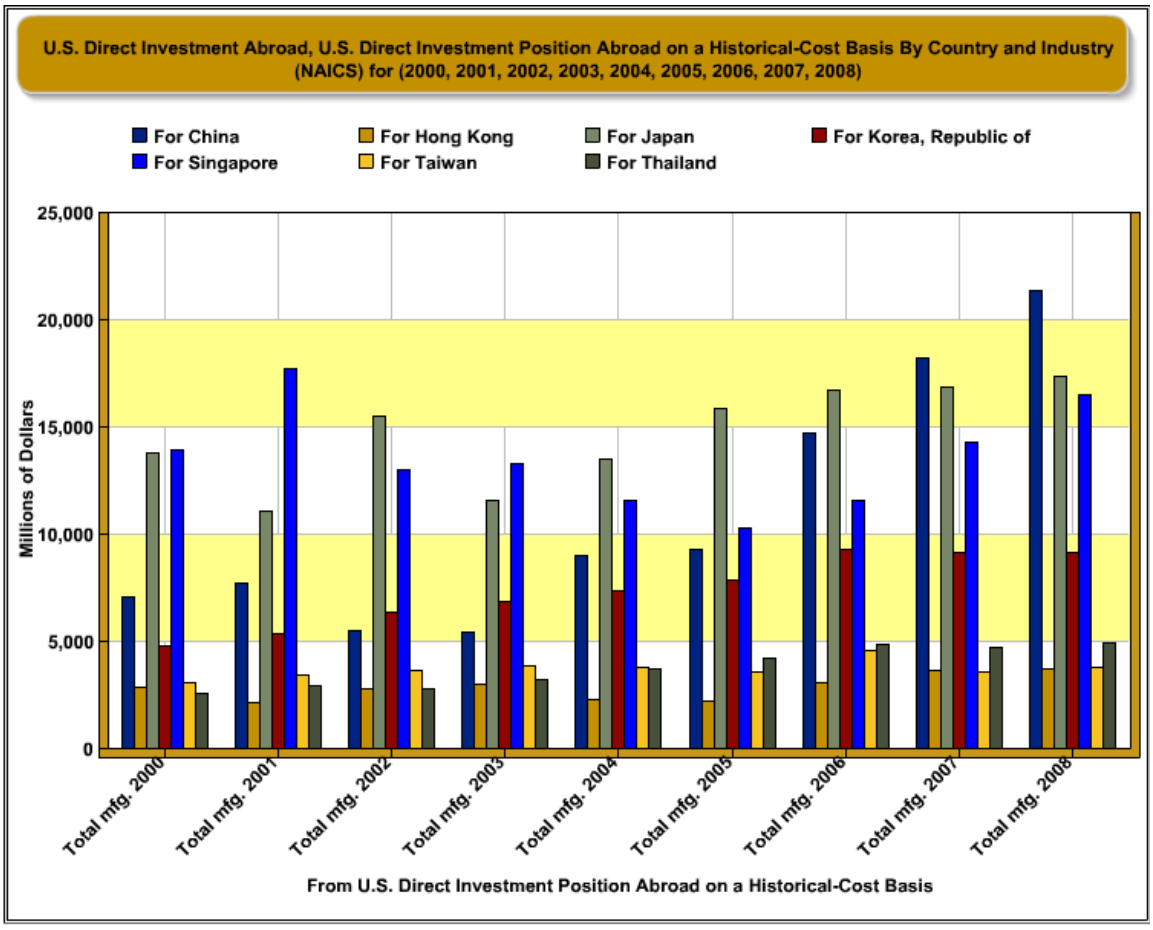
Figure 2



Source: U.S. Bureau of Economic Analysis

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Table 1

Variable	N	Mean	Std Dev	Minimum	Maximum
Year	9	2004	2.7386128	2000	2008
China_FDI	9	10962000000	5791333957	5499000000	21428000000
Hong_Kong_FDI	9	2896555556	569624462	2212000000	3742000000
Japan_FDI	9	14727888889	2306824844	11142000000	17380000000
Korea_FDI	9	7397888889	1662360629	4845000000	9345000000
Singapore_FDI	9	13617111111	2376802077	10322000000	17734000000
Taiwan_FDI	9	3702444444	305526231	3126000000	4221000000
Thailand_FDI	9	3794444444	931563351	2627000000	4945000000
Total	9	57098333333	10862111708	47557000000	77020000000
China_XV	9	0.0066603	0.0074983	0.000029043	0.017932
Hong_Kong_XV	9	0.0015982	0.0010597	0.000039496	0.0027399
Japan_XV	9	0.0325557	0.0127812	0.0159873	0.0482041
Korea_XV	9	0.0368214	0.0440729	0.007578	0.1493128
Singapore_XV	9	0.0179196	0.0061196	0.0100426	0.0304038
Taiwan_XV	9	0.018334	0.0086998	0.0081394	0.0308166
Thailand_XV	9	0.0329909	0.0121512	0.0206856	0.0607699
China_XA	9	1	0.0573382	0.8671748	1.0334923
Hong_Kong_XA_	9	0.9231999	0.0012843	0.9207172	0.9247755
Japan_XA	9	0.9255812	0.0578249	0.8405394	1.0176062
Korea_XA	9	1	0.1125412	0.834554	1.1603485
Singapore_XA	9	1	0.0784971	0.853679	1.0816394
Taiwan_XA	9	1	0.0360978	0.9492941	1.0487304
Thailand_XA	9	1	0.1070798	0.8216777	1.1350634
China_GDP	9	2.24E+12	1.05E+12	1.20E+12	4.33E+12
Hong_Kong_GDP	9	1.79342E+11	20315919620	1.58572E+11	2.15355E+11
Japan_GDP	9	4.42E+12	3.06E+11	3.92E+12	4.91E+12
Korea_GDP	9	7.50514E+11	2.00268E+11	5.04586E+11	1.05E+12
Singapore_GDP	9	1.19843E+11	35640349356	85654885655	1.81948E+11
Taiwan_GDP	9	5.16544E+11	1.3618E+11	3.57E+11	6.986E+11
Thailand_GDP	9	1.70317E+11	51684957385	1.15536E+11	2.60693E+11
logChinaFDI	9	23.0026986	0.4994007	22.4278321	23.7879643
logHongKongFDI	9	21.7695399	0.1973121	21.5171629	22.0428861
logJapanFDI	9	23.4014061	0.1641336	23.1339876	23.578586
logKoreaFDI	9	22.7004084	0.2369583	22.3012131	22.9581073
logSingaporeFDI	9	23.3213087	0.1722902	23.0575434	23.5987495
logTaiwanFDI	9	22.0291675	0.0839122	21.8630201	22.1633379
logThailandFDI	9	22.0293028	0.2502741	21.6891083	22.3216428
logChinaGDP	9	28.348308	0.4378003	27.8120755	29.0957077
logHongKongGDP	9	25.9071228	0.1093198	25.789475	26.0955516
logJapanGDP	9	29.1139505	0.069737	28.996688	29.2221467
logKoreaGDP	9	27.3116928	0.2711778	26.9470039	27.6790833
logSingaporeGDP	9	25.4727857	0.2822666	25.1735921	25.9269887
logTaiwanGDP	9	26.9388299	0.267924	26.6010016	27.2723442
logThailandGDP	9	25.8222182	0.2912811	25.4728515	26.2866086

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Table 2

China Regression:	LogChinaFDI = AR(2) + ChinaXV + ChinaXA + LogChinaGDP						
Number of Observations	9						
R-Square	0.904						
Total Sum of Squares	1.99521						
Mean Square Error	0.0213						
AIC	-22.64						
SBIC	-21.4566						
	Estimate	Std. Error	T	Prob>:T:			
Intercept	-22.7483	14.3347	-1.5869	0.2107			
Autoregressive, Lag 1	0.91606	0.2795	3.2769	0.0465	**		
Autoregressive, Lag 2	-0.91091	0.1323	-6.8853	0.0063	***		
China XV	-32.9674	7.7317	-4.2639	0.0237	**		
China XA	0.20339	3.172	0.0641	0.9529			
LogChinaGDP	1.61261	0.4026	4.0054	0.0279	**		
Hong Kong Regression:	LogHongKongFDI = AR(2) + HongKongXV + HongKongXA + HongKongGDP						
Number of Observations	9						
R-Square	0.718						
Total Sum of Squares	0.31146						
Mean Square Error	0.009756						
AIC	-29.6692						
SBIC	-28.4858						
	Estimate	Std. Error	T	Prob>:T:			
Intercept	-29.7888	40.2179	-0.7407	0.5126			
Autoregressive, Lag 1	-0.18589	0.2916	-0.6376	0.5691			
Autoregressive, Lag 2	-0.84137	0.2058	-4.0883	0.0264	**		
HongKongXV	-40.3142	45.3469	-0.889	0.4395			
HongKongXA	16.11857	39.9582	0.4034	0.7137			
LogHongKongGDP	1.41831	0.3472	4.0848	0.0265	**		

Table 2 (continued)

Japan Regression:	LogJapanFDI = AR(1) + JapanXV + JapanXA + JapanGDP				
Number of Observations	9				
R-Square	0.725				
Total Sum of Squares	0.21552				
Mean Square Error	0.006595				
AIC	-35.1934				
SBIC	-34.2073				
	Estimate	Std. Error	T	Prob>:T:	
Intercept	-213.732	0.4505	-3.2895	0.0302	**
Autoregressive, Lag 1	-0.45217	3.6468	-1.0036	0.3724	
JapanXV	5.34537	2.6846	1.4658	0.2166	
JapanXA	8.42107	2.6846	3.1368	0.035	**
LogJapanGDP	7.87134	2.1485	3.6636	0.0215	**
Republic of Korea Regression:	LogKoreaFDI = AR(1) + KoreaXV + KoreaXA + KoreaGDP				
Number of Observations	9				
R-Square	0.987				
Total Sum of Squares	0.44919				
Mean Square Error	0.00065				
AIC	-56.0445				
SBIC	-55.0584				
	Estimate	Std. Error	T	Prob>:T:	
Intercept	-18.8593	3.9341	-4.7939	0.0087	***
Autoregressive, Lag 1	-0.76375	0.4225	-1.8077	0.1449	
KoreaXV	-1.28902	0.5439	-2.3701	0.0768	*
KoreaXA	1.61246	0.3154	5.1128	0.0069	***
LogKoreaGDP	1.46427	0.1332	10.9968	0.0004	***

Table 2 (continued)

Singapore Regression (A):	LogSingaporeFDI = AR(1) + SingaporeXV + SingaporeGDP				
Number of Observations	9				
R-Square	0.594				
Total Sum of Squares	0.23747				
Mean Square Error	0.01071				
AIC	-32.8289				
SBIC	-32.04				
	Estimate	Std. Error	T	Prob>:T:	
Intercept	30.80329	4.1867	7.3574	0.0007	***
Autoregressive, Lag 1	-0.35532	0.504	-0.705	0.5123	
SingaporeXV	29.64982	10.5303	2.8157	0.0373	**
LogSingaporeGDP	-0.31469	0.1686	-1.8664	0.121	
Singapore Regression (B):	LogSingaporeFDI = AR(1) + SingaporeXA + SingaporeGDP				
Number of Observations	9				
R-Square	0.384				
Total Sum of Squares	0.23747				
Mean Square Error	0.01625				
AIC	-29.0764				
SBIC	-28.2875				
	Estimate	Std. Error	T	Prob>:T:	
Intercept	87.82227	38.7774	2.2648	0.0729	*
Autoregressive, Lag 1	-0.02762	0.4833	-0.0572	0.9566	
SingaporeXA	-8.09733	4.7916	-1.6899	0.1518	
LogSingaporeGDP	-2.21426	1.3363	-1.657	0.1548	
Singapore Regression (C):	LogSingaporeFDI = SingaporeXV + SingaporeXA + SingaporeGDP				
Number of Observations	9				
R-Square	0.717				
Total Sum of Squares	0.23747				
Mean Square Error	0.00747				
AIC	-36.0718				
SBIC	-35.2829				
	Estimate	Std. Error	T	Prob>:T:	
Intercept	71.11963	25.2575	2.8158	0.0373	**
SingaporeXV	20.11006	8.292	2.4252	0.0597	*
SingaporeXA	-5.33169	3.2123	-1.6597	0.1579	
LogSingaporeGDP	-1.68128	0.8662	-1.9411	0.1099	

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Table 2 (continued)

Taiwan Regression:	LogTaiwanFDI = AR(1) + TaiwanXA + TaiwanGDP				
Number of Observations	9				
R-Square	0.796				
Total Sum of Squares	0.05633				
Mean Square Error	0.00128				
AIC	-49.9488				
SBIC	-48.9627				
	Estimate	Std. Error	T	Prob>:T:	
Intercept	14.09675	2.5969	5.486	0.0054	***
Autoregressive, Lag 1	-0.68688	0.5144	-1.3352	0.2527	
TaiwanXV	-2.23747	3.4973	-0.6398	0.5571	
TaiwanXA	1.58984	0.6287	2.5288	0.0647	**
LogTaiwanGDP	0.23689	0.075	3.1591	0.0342	**
Thailand Regression:	LogThailandFDI = AR(1) + ThailandXA + ThailandGDP				
Number of Observations	9				
R-Square	0.954				
Total Sum of Squares	0.5011				
Mean Square Error	0.002543				
AIC	-43.769				
SBIC	-42.7828				
	Estimate	Std. Error	T	Prob>:T:	
Intercept	-13.2686	10.6535	-1.2455	0.2809	
Autoregressive, Lag 1	0.35936	0.6471	0.5331	0.6222	
ThailandXV	-0.37576	3.35	-0.1122	0.9161	
ThailandXA	1.56064	1.1315	1.3793	0.2399	
LogThailandGDP	1.30688	0.3686	3.5456	0.0239	**
Significant at					
1%	***				
5%	**				
10%	*				

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