FDI modes of market entry, relative wealth and relative access to credit: Evidence from a zero-inflated Poisson model

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Abstract

Imperfect capital markets in the presence of asymmetric information results in costly external financing. Froot and Stein (1991) propose the relative wealth hypothesis explaining the rise of inward FDI in the United States in the 1980s. However, the relative wealth hypothesis cannot explain the sharp decline of US inward FDI from Japan in the early 1990s. Klein, Peek and Rosengren (2002) propose the relative access to credit hypothesis to explain the anomaly. They hypothesize that the deteriorating financial health of Japanese banks hampered FDI activities as many Japanese firms rely heavily on bank loans as the main source of external financing.

We use the zero-inflated Poisson model to examine Japanese merger and acquisition FDI (M&A FDI) and greenfield FDI (GF FDI) in the United States. We find effects of relative wealth, relative access to credit and firm size significantly affect the probability that a firm invests in either M&A or GF FDI. The results are consistent with Froot and Stein (1991) and Klein Peek and Rosengren (2002). However, firm size affects the rate of M&A FDI but not the rate of GF FDI. Declines in the financial health of banks affect the rate of GF FDI but not M&A FDI.

Keywords: Merger and acquisition FDI, greenfield FDI, relative access to bank credit, relative wealth, zero-inflated Poisson

JEL Codes: F31, F36, G21

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1. Introduction

Firms with sizable firm-specific advantages reap economies of scale when they produce abroad. Under the industrial organization view of FDI, it makes no difference how FDI is financed because all firms have access to the same international capital markets. When the US dollar depreciates, the United States (US) becomes a less costly place for any firm to produce. It does not change the opportunities of foreign firms relative to firms in the US.

However, the surge of Japanese FDI in the US during the 1980s is significantly correlated with the appreciating value of the Japanese Yen relative to the US dollar. In addressing the phenomenon, Froot and Stein (1991, hereafter FS) propose the relative wealth hypothesis. By including the role of imperfect capital markets, they build on the idea that asymmetric information about an investment's payoffs makes it more costly for firms to finance FDI solely with external funds. The more internal funds a firm can bring to the investment, the lower will be its total cost of capital. Because of costly external finance, the currency appreciation of the investing firm brings about an increase in relative wealth. To broaden the measure of relative wealth, Klein and Rosengren (1994) include the relative stock value of firms.

After 1990 and despite a non-depreciating Japanese yen, Japanese FDI in the US declined. To explain the observation, Klein, Peek and Rosengren (2002, hereafter KPR) propose the relative access to credit hypothesis. When lenders are unable to provide credit, firms become constrained by their inability to obtain external financing. Using logit regression analysis, KPR show that declining financial health of Japanese banks between 1987 and 1994 severely affected firms' ability to undertake FDI in the US.

In this paper, we pursue two goals. First, we investigate the robustness of findings in KPR by considering two modes of market entry --- merger and acquisition (M&A) and greenfield (GF) FDI; and using a different empirical specification --- the zero-inflated Poisson (ZIP) model. In the model, an observed M&A or GF FDI can be analyzed as two separate stages of the firm's investment process. The first stage occurs when the firm does not intend to undertake any M&A or GF FDI and these investments typically will not occur. At this point, we estimate the probability of non-investment. The same firm would not always be in the first stage. At some interval in time when conditions become favorable, the firm plans to undertake an M&A or GF FDI. The firm then moves to the second stage where the investments could materialize. We then estimate the rate of investment.

Second, we explore the implications of the empirical results on Japanese firms that undertake M&A and GF FDI in the US. Regardless of entry modes, firms that were reliant on financially troubled banks are less likely to undertake an M&A or GF FDI. Severe decline in banks' health significantly reduces the rate of GF FDI but not the rate of M&A. Furthermore, the probabilities but not the rates of undertaking M&A and GF FDI are significantly affected by relative wealth of firms.

Our findings also indicate larger Japanese firms are more likely to undertake M&A than GF FDI. While firms that undertake FDI tend to be large, larger firm size is more important for M&A than GF FDI. We interpret the findings to suggest that greater firm size with more sophisticated management system allows for integration of acquired firms at lower costs. In addition, large firms that undertake FDI have better credit risk

and alternative sources of financing. Thus, they are less dependent on bank loans compared to comparatively smaller firms that undertake GF FDI.

2. Data and Empirical Specification

The sample consists of Japanese firms that have at least one FDI project in the US between 1987 and 1994. We identify the main bank using the Japan Company Handbook which lists the first bank among the firm's reference banks as the main bank. There are eleven banks that serve as main bank to at least a firm in the sample[1]. Each firm is a unit of observation and each observation records the number of FDI projects that a firm undertakes for a given year. The number of FDI projects that a firm undertakes is compiled from the US International Trade Administration (ITA) publication[2].

There are 2,057 observations in the data set. Each non-zero observation records the number of FDI projects undertaken by a firm. Because a firm can undertake more than one FDI project in a given year, a total of 1,070 FDI projects were undertaken by 317 firms between 1987 and 1994. Of the 1,070 FDI projects, 274 are M&A FDI and 169 are GF FDI. The remaining FDI projects are categorized as plant expansion, equity increase, joint ventures, real estate and others. The number of M&A FDI projects has a sample mean and variance of 0.13 and 0.18 and the number of GF FDI has a sample mean and variance of 0.08 and 0.11. Of the 2,057 observations, 1,430 observations are zeros constituting 69.5% of all observations. With high proportions of observations as

[1] Consistent with Klein, Peek and Rosengren (2002), the eleven banks are the Industrial Bank of Japan, Dai-Ichi Kangyo Bank, Sakura Bank, Mitsubishi Bank, Fuji Bank, Sumitomo Bank, Sanwa Bank, Tokai Bank, Asahi Bank, Long-Term Credit Bank and Daiwa Bank.

[2] Because of missing observations on the values of FDI projects in the ITA publication, we use observations on the number of FDI projects The ITA also lists the name and nationality of the foreign investor and the type of investment indicating entry modes from 1973 to 1994. Following Klein, Peek and Rosengren (2002), we use only data from 1987 to 1994.

zero counts with the sample variances exceeding the sample means, overdispersion in the data is evident. To account the excess zeros and overdispersion in the data, we use the ZIP model[3].

We distinguish among firms according to their intention to undertake FDI_j in the US by defining a partially observable binary random variable D_{ij} where j denotes either an M&A or GF FDI:

$$D_{ij} = \begin{cases} 0 & \text{if firm } i \text{ does not intend to undertake } FDI_j \text{ in the United States; and} \\ 1 & \text{if firm } i \text{ intends to undertake } FDI_j \text{ in the United States.} \end{cases} \quad (1)$$

The probability that firm i does not intend to undertake FDI_j in the US is given by:

$$P_{ij} \equiv \Pr(D_{ij} = 0) = \frac{\exp(\tilde{\beta}' Z_{ij})}{1 + \exp(\tilde{\beta}' Z_{ij})} \equiv \text{logit}\,(\tilde{\beta}' Z_{ij}), \quad (2)$$

where P_{ij} is a logit function of a vector of explanatory variables (Z_{ij}). If firm i has no intention to invest ($D_{ij} = 0$) for a given year, it will not have any FDI_j project. However, if firm i has an intention to undertake FDI_j ($D_{ij} = 1$), the number of FDI_j projects follows a Poisson distribution with a mean of λ_{ij}. Thus, the probability of observing a zero FDI_j project is:

$$\text{Prob}[FDI_{ij} = 0] = P_{ij} + (1 - P_{ij})\, Poisson(0; \lambda_{ij}) \quad (3)$$

and the probability of observing a non-zero FDI_j project is:

$$\text{Prob}[FDI_{ij} > 0] = (1 - P_{ij})\, Poisson(FDI_{ij}; \lambda_{ij}) \quad (4)$$

Firm i's rate of FDI_j which is the mean of the Poisson distribution (λ_{ij}) is expressed as the vector of explanatory variables X_{ij}:

[3] Greene (1994) discusses dealing with excess zeros in count data.

$$\lambda_{ij} = e^{\beta' X_{ij}} \tag{5}$$

For a firm with intention to invest in the US, the conditional mean of FDI_i is given by:

$$E(FDI_{ij} \mid D_{ij} = 1) = \lambda_{ij} . \tag{6}$$

The conditional variance of FDI_i for firm i with intention to invest in the US is given by:

$$Var\ (FDI_{ij} \mid D_{ij} = 1) = \lambda_{ij} . \tag{7}$$

3. Determinants

The explanatory variables in the vector Z_i of equation 2 affecting P_{ij} are past year's rating of the firm's main bank, the firm's size, profits and relative wealth. Macroeconomic variables representing business cycles in the US and Japan are excluded from the estimating equations as they are significantly correlated to each other and with the included explanatory variables. This creates problems of multicollinearity among explanatory variables.[4]

The financial health of the firm's main bank is measured by the rating according to Moody's long-term deposit ratings.[5] To determine the effect of the rating of the firm's main bank relative to the best rating of Aaa on P_{ij}, each Moody's rating is assigned a dummy variable. Relative wealth which captures the effects of exchange rate and relative stock price movements is calculated by multiplying the stock price index of the Japanese

[4] Although we do not report the results, we ran regressions with the business cycle variables in the model. As expected of regressions with multicollinearity problems, the coefficients of the regressors had large standard errors with the wrong signs.

[5] Klein, Peek and Rosengren (2002) summarize Moody's long-term deposit ratings for the eleven banks from 1986 to 1994 (Table 2, page 670) including the lowest rating of A3. In our case, out of 2065 observations, there are only 8 observations in which a firm's main bank had a rating of A3. Because of the very small number of observations for a rating of A3, the coefficient of the dummy variable for A3 had a very large standard error. Hence, we exclude these observations in our analysis.

firm by the nominal US dollar-yen exchange rate and dividing by the S&P 500 index. The effect of firm size measured by the real asset value of firms considers the industrial organization view on FDI. Firm profitability which controls for the financial health of the firms is measured by the firm's profit-to-asset ratio.

For firms with intention to invest in the US, the conditional rate of a firm's FDI_j (λ_{ij}) is determined by the change in the rating of the firm's main bank and the annual changes in the firm's relative wealth, size and profitability. They are in the vector X_i of equation 5. The changes in Moody's ratings of the firm's main bank, indicated as single downgrade and multiple downgrades are dummy variables[6]. Data on firm characteristics are from the Pacific-Basin Capital Markets Databases (PACAP). Bilateral exchange rates are from the International Financial Statistics. The S&P 500 index is from Bloomberg.

4. Results

Table 1 shows the ZIP regression estimates on M&A and GF FDI. In both regressions, the Vuong test statistics show strong evidence of excess zeros relative to the Poisson distribution. P_{i_GF} is significantly affected by Moody's rating of Aa1 relative to Aaa and $P_{i\_M\&A}$ is significantly affected by ratings of Aa2 and Aa3 relative to Aaa. The results suggest that firms associated with financially troubled main banks are less likely to undertake FDI. In addition the effects of firm size and relative wealth on $P_{i\_M\&A}$ and P_{i_GF} are correctly signed and significant at 5% level. Conditioned on firms with intention to invest, firm size affects the rate of M&A, $\lambda_{i\_M\&A}$ but not the rate of GF FDI λ_{i_GF} The

[6] Single downgrade occurs when a firm's main bank is downgraded by one level in a given year and multiple-downgrades occur when the rating of a firm's main bank is downgraded by two or more levels in a given year.

contrasting effects of firm size between M&A and GF FDI could be explained by the nature of different FDI activities. When a large firm with diversified business activities undertakes an M&A, the assets of the acquired firm are more "digestible" (Hennart and Reddy, 1997). Assets are "digestible" when the acquiring firm finds them complementary and compatible with the assets it owns. As a result, post merger integration cost associated with an M&A is less costly for larger than smaller firms. On the contrary, GF FDI that requires building new facilities would need investment in physical capital. Using external loans to finance FDI becomes inevitable. Thus a change in relative wealth can significantly impact a firm's rate of GF FDI.

5. Conclusion

The results have two primary implications. First, evidence of relative access to credit in KPR is robust to empirical specification. Second, the results suggest that Japanese firms undertaking M&A in the US are larger in size than firms undertaking GF FDI. Because of sizable resources and sophistical management systems, larger firms are better able to integrate acquired units more efficiently. Consequently, smaller firms that incur higher integration costs when they undertake M&A prefer GF FDI. Thus, smaller firms that depend heavily on bank loans are significantly more affected by deteriorating financial health of banks.

References

Froot, K. & J. Stein, (1991) Exchange rates and foreign direct investment: an imperfect capital markets approach, *Quarterly Journal of Economics*, **106**, 1191-1217.

Greene, W. (1994) Accounting for excess zeros and sample selection in Poisson and negative binomial regression models, Working Paper EC-94-10, Department of Economics, New York University.

Hennart, J-F. & S. Reddy, (1997) The choice between mergers / acquisitions and joint ventures: the case of Japanese investors in the United States, *Strategic Management Journal*, **18**, 1-12.

Klein, M., J. Peek, & E. Rosengren, (2002) Troubled banks, impaired foreign direct investment: the role of relative access to credit, *American Economic Review*, **92**, 664-682.

Klein, M., & E. Rosengren, (1994) The real exchange rate and foreign direct investment in the United States: relative wealth vs. relative wage effects, *Journal of International Economics*, **36**, 373-389.

Table 1
Estimates of the Zero-inflated Poisson Model

Variable	Parameter Estimate	Standard Error	P-value		Parameter Estimate	Standard Error	P-value
	M&A FDI (conditional on firm intending to invest in M&A FDI)				**GF FDI (conditional on firm intending to invest in GF FDI)**		
Constant	-0.877	0.145	0.000		-0.867	0.188	0.000
Single downgrade	-0.039	0.202	0.845		0.161	0.244	0.511
Multiple downgrades	-0.332	0.380	0.382		**-0.938**	0.485	**0.053**
Change in relative wealth	-0.099	0.220	0.652		0.158	0.276	0.567
Change in profitability	4.399	7.617	0.564		-0.850	6.866	0.901
Change in firm size	**1.659**	0.743	**0.026**		0.059	0.873	0.946
	Probability that firm does not intend to invest in M&A FDI				**Probability that firm does not intend to invest in GF FDI**		
Constant	-0.587	2.551	0.818		4.482	2.790	0.108
Aa1	0.254	0.329	0.439		**0.804**	0.378	**0.033**
Aa2	**1.087**	0.675	**0.078**		-0.178	0.721	0.805
Aa3	**0.612**	0.342	**0.074**		0.516	0.390	0.186
A1	0.721	0.491	0.142		0.004	0.520	0.994
A2	0.736	0.729	0.313		0.144	0.722	0.842
Relative wealth	**-1.499**	0.393	**0.000**		**-0.967**	0.427	**0.024**
Firm profitability	-8.796	7.506	0.241		-10.425	7.097	0.142
Firm size	**-0.603**	0.092	**0.000**		**-0.699**	0.100	**0.000**
Vuong test statistic	**5.250**		**0.000**		**4.110**		**0.000**
Number of firms			317				317
Log-likelihood			-760				-537

Notes: Relative wealth is the log of the firm's market value plus the log of the US dollar-Japanese yen exchange rate minus the log of the S&P 500 index. Firm profitability is the ratio of the firm's profit to assets. Firm size is the log of the firm's assets deflated by the wholesale price index. The probability of the firm intending to invest in the US equals one minus the probability of a firm not intending to invest in the US. Numbers in brackets are the standard errors.