

**Does Technological Investment have an impact on Outward Foreign
Direct Investment?-A Microeconometric Analysis of Indian
Manufacturing Firms**

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Literature Review

- Bhattacharya, Pathnik, Shah (2011) showed firm heterogeneity effect (that more productive firms choose FDI and less productive firms export their goods) varies across industries. In the chemical sector, the more productive firms end up investing abroad while the assumption alters for software industry.
- Helpman, Melitz and Yeaple (HMY;2004) create a theoretical model that explains the decision between FDI and trade in order to get into foreign market.
- They find that firm heterogeneity plays an important role in making decision to be engaged in international market. The most productive firms engage themselves with foreign exposure, while the better ones among them invest abroad through FDI; the less productive ones sell their products in foreign market

Literature Review

- Lancheros and Demirel (2012) used a micro-econometric analysis of Indian firms to demonstrate the relation between finance and export along with some other firm level characteristics. The results show total factor productivity, technological investment, firms' size are the significant motivation factors for firms to export.

Theoretical framework

- The Relationship:

$$Y_i = \mathbf{x}'_i +$$

(94% firms taking 0 or limit observation)

- The dependent variable Y_i is the intensity of outward FDI.
- X'_i is a vector of independent variables, which consists of technological investment, knowledge investment, amount of export, debt-equity ratio, total-factor productivity, firms' profit, age and size .

Theoretical framework

- Standard Tobit Model:

$$\text{OFDI}_{it} = \max(0, \beta_1 \text{Intech}_{it} + \beta_2 \mathbf{X}'_{it} + \beta_3 \mathbf{D}_{it} + c_i)$$

D_{it} consists of time dummy and ownership dummy. Ownership is divided into five categories; subsidiary, private-indian, private-foreign, state government, central government. Lastly, C_i is the time-invariant and firm-specific error term, consisting of unobserved heterogeneity.

Theoretical framework

- Accounting for Endogeneity :

$$\text{OFDI}_{it} = \max(0, \beta_1 \text{Intech}_{it-1} + \beta_2 \mathbf{X}'_{it-1} + \beta_3 \mathbf{D}_{it} + c_i)$$

In order to account for potential endogeneity, this paper's econometric model considers one year lag of all independent variables.

- Accounting for Time-Invariant Unobserved Heterogeneity:

Dealing with unobserved heterogeneity both correlated and uncorrelated with the explanatory variables. (Addressing for fixed effect and random effect)

Explaining the 3rd model

- Accounting for unobserved heterogeneity which are correlated with the explanatory variables should be dealt with cautiously. In order to reduce the fixed effect problem, proper measure should be taken into account for unbiased result.
- There are many papers that have talked about time-varying individual specific effect in linear models but the area of time-invariant individual effect in non-linear models has not been explored much.

Explaining the 3rd model

- In this paper, both random effect and the correlation between unobserved heterogeneity and the explanatory variables will be addressed. In this study, the approach developed by Mundlak Chamberlain (1980, 1982) is used to control for the correlation existing in c_i (unobserved heterogeneity) and X_i (all covariates).
- He proposed taking the time averages of the independent variable and assume the C_i is correlated with the time averages.
- The distribution for fixed effect is $D(c_i|x_{i1} \dots x_{it})$ and by taking the time averages it is assumed that $D(c_i|x_i) = D(c_i|\bar{x})$.

Explaining the 3rd model

- To implement this approach, time averages of all independent variables, such as means of technological investment, means of knowledge investment, means of age, means of size, means of debt-equity ratio, means of productivity, means of profit are included as controls suggested by Woolridge (2008,2009) .
- This model also takes random effect to address the heterogeneity which are not correlated with explanatory variables.

Robustness Check

- Checking relationship across sub-population:

The regressions in Standard Tobit model will be run by taking interaction term of different ownership with technological investment.

Data Source

- The dataset used in my study is a compiled version of Prowess Database, which is built with various financial sources by Centre of Monitoring Indian Economy Private Limited. Prowess database consists of over 27,000 companies in India, unlisted and listed public and private limited companies.
- Using Prowess Database, my study is going to focus on the longitude of unbalanced panel from year 1999 to 2007 for Indian Manufacturing firms.
- Taking only manufacturing firms, the total number of observations is 25,287.

Variable Names	(1) Standard Tobit	(2) Standard Tobit with one-year time lags of the independent variables	(1) Standard Tobit controlling for unobserved heterogeneity (both correlated and uncorrelated with independent variables)
Technological Investment	0.037** (0.015)	0.037** (0.015)	0.010** (0.005)
Investment in Knowledge	0.040** (0.017)	0.040** (0.017)	0.017*** (0.006)
Export Intensity	0.302*** (0.034)	0.302*** (0.034)	-0.011 (0.013)
Age	-0.000 (0.001)	-0.000 (0.001)	-0.001*** (0.000)
Size	0.196*** (0.019)	0.196*** (0.019)	-0.008** (0.003)
Total Factor Productivity	0.020 (0.015)	0.020 (0.015)	0.000 (0.000)
Debt-equity-ratio	-0.000 (0.001)	-0.000 (0.001)	-0.007*** (0.001)

Profitability	-0.017*** (0.004)	-0.017*** (0.004)	0.003 (0.004)
Observations	25,285	25,285	25,284
Year Dummy	Yes	Yes	Yes
Ownership Dummy	Yes	Yes	Yes
Time Averages	No	No	Yes

Results

- In all the models, there is a statistically significant and positive correlation between technological investment and outward FDI.
- Other significant variables are investment in knowledge, age, size, debt-equity ratio.

Results for robustness check

Subsidiary	Private Indian	Private Foreign	Central Government	State Government
0.120*** (0.000)	-0.315 (0.951)	0.393 (0.996)	0.008 (0.827)	- 0.840*** (0.000)

Results for robustness check

- It is seen that the interaction term of private, private foreign and central government are statistically insignificant, implying that there is no different impact of technological investment under these forms of ownership.
- On the other hand, the interaction term has statistical significance with subsidiary and state government.
- This implies that, for a subsidiary, technological investment has different and positive impact than others. In other words, the impact of technological investment on outward FDI is higher in subsidiaries relative to other firms under different ownership.

Conclusion

- To answer the main research question, the paper has employed different models controlling for different econometric problems.
- It is proved that the more firms invest in technology, it lends them a better platform to invest abroad when it comes to manufacturing industry.
- Firms with more technological investment find it convenient to explore a new market and earn more revenue.
- The other reason that could explain the positive relation is that firms may invest abroad with the sole purpose of transferring their technology in their foreign subsidiary which will help them produce their goods in a low cost production process and sell in a market where it is less competitive than the home market.