INDIAN FIRM HETEROGENEITY IN INTERNATIONAL TRADE

ABSTRACT

We aim to review the empirical evidence on firm heterogeneity in international trade. This paper depicts the characteristics of Indian firm heterogeneity in international trade. Many existing models of international trade are subjected to change with the Indian context taken into account, with a collection of empirical information from microdata on firms. We examine the impact of variables like wages, productivity, location, Ellison-Glaeser Index, etc on the exporting ability of the firm and try to find differentiating factors between exporting firms and non-exporting firms in the Indian trade sector.

INTRODUCTION

Over the past 20 years, participation in international trade has changed dramatically. The primary reason for this is the rise of more and more firms and products. But not all firms have the ability to participate in exports and imports. It depends on a lot of factors ranging from the labor force of the firm, the capital of the firm among others. These factors make these firms unique and this is defined as Firm Heterogeneity. The emergence of a wide range of microdata sets exhibiting the sharp differences in the attributes of the firms has helped us in categorizing these firms.

The purpose of this study to find out which variables affect the ability of a firm to export and which variables are more important as compared to others.

For this paper, we study a dataset of Indian Manufacturing firms in the year 2016. In this particular case, we are leaning more towards the manufacturing firms as they contribute more towards trading. All the data has been downloaded from the CMIE (Centre for Monitoring Indian Economy) Prowess database for Indian Firms. CMIE Prowess Database contains data from firms across the country except for a few small firms as it's not mandatory for the firms to produce their data to the database. On this dataset, we run certain equations (see methodology section), and find out how a certain variable affects the export variable (the dependent variable), which is a binary variable, meaning it is 1 for a firm that exports and 0 for a firm which does not export. Our motivation behind this study is that papers on this topic exist for western companies, but we are interested to know whether the same results will be also seen in India. We want to find out more about the behavior of firms in India and how the economic and geographical conditions of India influence these firms.

For our research in the Indian Trade market, we introduce some new variables (not covered in existing papers) which we believe might play a role in determining Exporting firms. These variables are: Age of the firm, Importing Intensity of the firm, Ellison-Glaeser(EG) Index, Foreign

Ownership of the Firm, and the Location of the Firm. The variables, which we think may affect the exportability of a firm, are defined as below:

Variables
1. Sales: Sales of an Exporting firm plays an essential role in small to medium-sized firms. The article by Robert G. Cooper & Elko J. Kleinschmidt about The Impact of Export Strategy on Export Sales Performance Reports that the firms change their export strategy accordingly.
2. Gross Fixed Assets: Gross fixed assets help calculate the TFP and give us a 0brief idea about the firm's size and performance. Gross Fixed Assets measures the original investments made in assets currently owned or operated. It is calculated as the average value of original investments made in Property, Plant, And Equipment (PP&E).
3. Total Assets: It is observed that firms that have a huge asset base can do international trade when this trade is a net loss in the initial years, Thus allowing them to capture the international market.
4. Wage bill and Raw Material Expense: Labor productivity As an alternate measure of productivity, we follow Tabrizy and Trofimenko (2010), who use the same dataset to build a proxy for labor productivity. CMIE Prowess does not report the number of employees or the number of hours worked, and hence we use the wage bill as a proxy for labor input while calculating TFP using the 1.Levinsohn-Petrin model.
5. Export Dummy: 0 if the firm does not Export goods(has zero export revenue) 1 if the firm exports goods(has non zero export revenue)
6. Age: As firms grow older, they gain more experience and they learn how to export. For testing whether age actually matters or not, we include it in our research by Subtracting its incorporation year from its exporting year
7. TFP (LP): Calculated by using Levinson and Petrin Model of Total Factor Productivity. As pointed out by Bernard and Jensen(2012) and Melitz(2003), Firms with higher productivity tend to export more than firms with lower productivity. Bernard and Jensen(2012) used Caves et al (1982) to calculate TFP in their Paper whereas we use the Levinson and Petrin model to calculate TFP.
8. Import Intensity: Calculated as the fraction of raw material and intermediate goods imported out of total raw material and intermediate goods. Pant (1993), Export-Import Bank of India (1996), and Dholakia and Kapur (1999) find a positive influence but Siddharthan (1989) and Patibandla (1992) find a negative relationship between import intensity and firm-level export performance in India. i.

9. Ellison-Glaeser(EG) Index: An index developed for the assessment of industrial agglomeration. The method to calculate the EG Index is given in the Methodology part of the Synopsis.
10. Location: For distinguishing between firms located in different areas. According to Freeman, J., and Styles, C. (2014), "Does location matter to export performance?", location effects do indeed present challenges to firms in Australia. Since our dataset only shows the location of the head office of the firm, we observe that all the head offices are located in cities. For distinguishing between the type of the location we have used a Dummy Variable Li, and Li=0, for tier1-city Li=1, for tier-2 city Li=2, for tier-3 city
11. Foreign Ownership: Fraction of shares held by foreign promoters. According to Mihai, Iuliana Oana; Mihai, Cosmin (2013): The impact of foreign ownership on the performance of Romanian listed manufacturing companies, Significant differences can exist between companies with foreign ownership and companies with domestic ownership. Companies with foreign shareholders presumably have superior access to technical and financial resources. According to Thomson and Pedersen (2000) and Kirchmaier and Grant (2006), different types of shareholders have different incentives and different goals and these incentives and goals have different implications for the strategy and performance of the company
12. Spending on technology: An investment in new technologies will lead to lower costs and higher profits. Keep up with the latest advances in information management and communications technology so that the company can make the best decisions. Effective management of business technology will make all the difference.

*** Variables 1-6 are taken from Bernard and Jensen(2012) -Empirics of Firm Heterogeneity**

*** Variables 7-12 recommended by Prof. S K Mathur**

Assumptions: We assume that there exists a linear relationship between the export variable and the other independent variables. We also assume that there does not exist any sample selection bias.

Limitations: Earlier, our dataset had over 2000-3000 entries of firms, but this data was of different forms and had to be shortened because we wanted intersecting data. Another limitation is that for most of the firms, the location of only head office is given, so, the data for where the major operations of the firm take place is missing. Many firms didn't even have the location of the head office so we had to remove them. In the end, we had a dataset of 427 Indian manufacturing firms.

We aim to answer the following **questions**:

1) Whether variables like sales, wages, assets, have a positive influence on the exporting ability, as seen in the western countries?
2) How new variables, like location, importing intensity, Ellison-Glaeser Index, affect these firms?

An interesting result of the microdata is that the participation of firms in international trade is quite rare. Among the tons of firms, only a very few out of them indulge in exports and imports. This pattern follows a certain trend. Studies find that firms that export and import are usually more productive, and more capital-intensive, this is because to enter foreign markets, capital is required to cover the huge transports and to obtain land, licenses among others in foreign shores. Other firms do not have this ability and thus, are restricted to their home countries.
We explain our findings more below.

LITERATURE REVIEW

Krugman (JIE(1979), AER(1980)) in his model assumes production function to have increasing returns to scale to show that the impact of trade is an increase in welfare due to availability of larger variety to the consumers.
This model (Krugman(1979)) also described the pro-competitive effect of trade i.e. competition from foreign firms reduces the markup of domestic firms.
After this model, it came to notice that export is a rare activity, in any industry only a small fraction of firms export. Exporters sell most of their output domestically.

Bernard and Jensen (1995, 1999) find that among US-based manufacturing firms, exporters are relatively rare and quite large.

Pavcnik(2002) studies Chile's trade liberalization to find an increase in exporter's productivity due to trade liberalization. Trefler(2004) finds that CUSTFA(the Canada-United States Free Trade Agreement) increased the labor productivity in Canada's manufacturing sector. Khandelwal and Topalova(2011) find that trade reforms of 1991 in India increased the productivity of Indian firms.

MacGarvie (2003) reports some features of large importers using French firm data in her study of the patenting behavior of trading firms.

The work by **Eaton et al. (2004)** extends the analysis of exporting manufacturing firms.

Antràs (2003) developed a trade model with firm boundaries set by incomplete contracts and property rights to examine the variation in intra-firm trade across destinations and sectors in U.S. trade. Antràs and Helpman (2004) study the importance of within-sector heterogeneity and industry characteristics on the prevalence of integrated versus arm's length organizational forms in a model North-South trade.

A seminal work in this field is **Melitz's (2003)** model, which shows that when firms are exposed to trade, high productive firms enter the market and expand while lower productivity firms exit the market. It yields a gravity equation for total bilateral trade flows while considering firm productivity is Pareto distributed.

Melitz (Econometrica, 2003) used Krugman's model(AER(1980)) with **Hopenhayn's model (Econometrica, 1992)**, to introduce the selectivity criteria for firms to produce and export, to show that the trade makes less productive local firms exit the market, whose resources are then allocated to high productivity firms.
It assumes monopolistic competition as a market structure. For production, it suggests that each variety of goods should be produced by a separate firm and there is free entry and exit of firms from the market.
The production function in this model exhibits increasing returns to scale.

According to this model, welfare gains can be seen in 2 ways:
a)From a utility point of view: there is availability of more productive foreign varieties therefore less productive domestic firms have to exit.
b)Aggregate output is increased by reallocation of resources.

Goldberg et al. (2010a) show that Indian firms substantially gained from trade liberalization through access to new imported inputs.
Papers that have examined Slovenia (De Loecker, 2007), Sub-Saharan Africa (Van Biesebroeck, 2005), and Indonesia (Blalock and Gertler, 2004) report gains in firm productivity after exporting commenced.

Eaton-Kortum-Kramarz(2011) adopts a model of firm heterogeneity and export participation to extend the Melitz model and explain the several regularities found in French firm-level data. This model finds that more than half of the variation across firms in the market entry can be associated with the productivity of a firm. But productivity explains less variation in exports conditional on entry into the market.

Arkolakis, Costinot, Rodriguez-Clare(2012) show that for a broad class of models, change in the welfare of a country can be related to change in the fraction of a country's expenditure on its own goods and elasticity of imports on the trade costs.

Existing literature like **Bernard et al. 2012**, finds that firms that export are very rare, and exporting firms are larger, more productive, more capital, and skill intensive. Studies have explored the interaction between comparative advantage and heterogeneous firms (Bernard et al. 2007b), variable markups and market size (Melitz & Ottaviano 2008), country asymmetries (Arkolakis et al. 2008), multiproduct firms (Bernard et al. 2011, Eckel & Neary 2010, Mayer et al. 2011).

Melitz and Redding (AER, 2015) show that for the same exogenous parameters, heterogenous and homogenous firms generate different amounts of trade share. In the Homogenous firm model, welfare gains are lesser than those in the heterogeneous firm model.

METHODOLOGY AND METHODS

To measure firm-level productivity, we assume that the production function at the firm level is the logarithm of the Cobb-Douglas function. We use the

$$y_{it} = \beta_0 + \beta_1 k_{it} + \beta_2 l_{it} + \omega_{it} \quad (1)$$

where y_{it} represents the logarithm of firm output, k_{it} and l_{it} represent the logarithm of capital and labor respectively, and ω_{it} is the productivity component.
We calculate TFP using the Levinsohn And Petrin method. For computational purposes, we will use the LEVPET Library in STATA.
Reference: Production function estimation in Stata using inputs to control for unobservables, The Stata Journal (2004) 4, Number 2, pp. 113–123

To calculate Ellison-Glaeser(EG) Index and Herfindahl-Hirschman Index(HHI):
We have N exposures E_k summing up to a total exposure of

$$E_T = \sum_{k=1}^{N} E_k$$

Each exposure is associated with one industry (business sector) and one geography. The total HHI index capturing single exposure concentration across the entire portfolio is

$$H = \sum_{k=1}^{N} \left(\frac{E_k}{E_T}\right)^2$$

Business Sectors

We have I industries (business sectors) $i = 1,2,\ldots\ldots,I$. Each industry comprises N^iexposures. The total exposure per industry is

$$E^{i*} = \sum_{k=1}^{N^i} E_k$$

where the bullet denotes the implied summation over all areas. The fraction of each exposure within an industry is

$$Z_{ki} = \frac{E_k}{E_i}$$

The HHI index *within* each industry is defined as

$$H^i = \sum_{k=1}^{N^i} Z_{ki}^2$$

The fraction of each industry as part of the total exposure is

$$w^i = \frac{E^{i*}}{E_T}$$

The HHI index capturing concentration in the distribution of the different industry sectors

$$H^I = \sum_{i=1}^{I} \left(w^i\right)^2$$

The aggregate HHI is connected with the industry-specific indexes via

$$H = \sum_{i=1}^{I} w_i^2 H^i$$

EG Index per industry

The EG industrial concentration index (per industry i) is given by

$$\gamma^{i} = \frac{G^{i}/(1-H^{G})-H^{i}}{1-H^{i}}$$

Where:

$$G^{i} = \sum_{a=1}^{M} (S^{ia} - X^{a})^{2} = \sum_{a=1}^{M} (\frac{E^{ia}}{E^{i*}} - \frac{E^{*a}}{E_{T}})^{2}$$

H^{G} : The geographic concentration is captured by an HHI type metric

H^{I}: The HHI index capturing concentration in the distribution of the different industry sectors

For the computation of the EG Index, we will use a Python Package called concentration metrics which is an open-source Python library.

Concentration metrics is a python library for the computation of various concentration, diversification, and inequality indices. The library implements the computation of all well-known indexes of inequality and concentration.

Github Repository: https://github.com/open-risk/concentrationMetrics

The literature has established that exporters are different from non-exporters in important ways (Bernard et al., 1995). We replicate this analysis with our dataset using the following specification.

$$Export_{i} = \beta_{0} + \beta_{1}(EG_{i}) + \beta_{2}(IMP_{i}) + \beta_{3}(L_{i}) + \beta_{4}(TFP_{i}) + \beta_{5}(FRG_{i}) + \beta_{6}(TECH_{i}) + \gamma_{j}(FC_{ij}) + e_{i}$$

$Export_{i}$: Dummy Variable Indicating the Export status of the firm(1 if the firm is an exporter, 0 otherwise)

FC_{ij}: Firm characteristics are variables such as wages, sales, assets, and productivity of a firm (productivity as calculated from the equation given earlier)

EG_{i}: Ellison Glaeser Index

IMP_i: Import Intensity of the Firm
L_i: Dummy Variable for the location of the firm
TFP_i: Total Factor Productivity
FRG_i: Foreign Ownership in the firm
$TECH_i$: Spending on Technology
e_i: Error term

HYPOTHESIS

- Firms that export are usually more productive than non-exporting firms
- Firms that export pay higher wages have higher sales and higher assets.
- Firms that export are located in tier-1 cities export much more than firms located in tier-2 or tier-3 cities
- Firms that have some form of foreign ownership also export more than firms with only domestic ownership

Findings

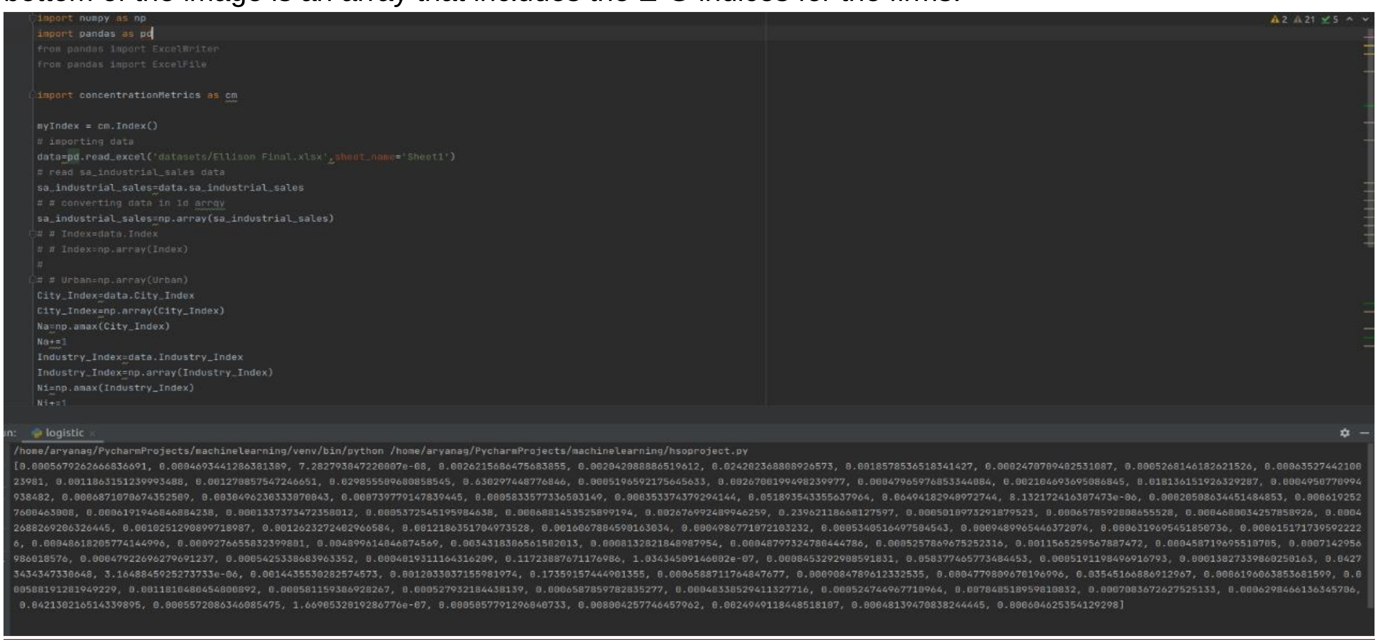
Total Factor Productivity: Calculated using Levpet library in STATA. For calculating TFP using Levpet, panel data is required. So we used Panel data containing Gross Fixed Assets, Raw material expenses, Total Sales of the firm.
We use raw material expenses as the proxy in the TFP-LP methodology. Output is calculated as sales and capital is calculated as gross fixed assets. Labour is estimated by calculating the total wage bill which is used as a free variable.
Attached below is the image of STATA Output for levpet.
As one can see, the p-value is equal to 0.0080 which is less than 0.05. Therefore, we reject the null hypothesis of the Wald test of constant returns to scale.

```
Levinsohn-Petrin productivity estimator

Dependent variable represents revenue.          Number of obs      =     76951
Group variable (i): CompNumber                  Number of groups   =     12789
Time variable (t): year
                                                Obs per group: min =         1
                                                               avg =       6.0
                                                               max =        11

--------------------------------------------------------------------------------------
        LN_RealSales |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
---------------------+----------------------------------------------------------------
         LN_Realwage |   .2286664   .0043805    52.20   0.000     .2200808    .2372519
        LN_RealAsset |   .3289929    .057849     5.69   0.000      .215611    .4423749
LN_realRawMaterial   |   .6957205    .057867    12.02   0.000     .5823032    .8091378
--------------------------------------------------------------------------------------
Wald test of constant returns to scale: Chi2 =    7.04 (p = 0.0080).
```

Ellison-Glaeser Index:
As stated earlier, a python package called ConcentrationMetrics has been used to calculate the Ellison-Glaeser Index. Below, we have attached an image of the Python file which was run to calculate the E-G Indices for all the companies included in our dataset. The output shown at the bottom of the image is an array that includes the E-G indices for the firms.



Linear regression computed through stata with standard error type as robust, the dependent variable is export, and all other variables mentioned above are taken as independent variables.

Linear regression

Number of obs	=	427
F(11, 415)	=	10.48
Prob > F	=	0.0000
R-squared	=	0.1996
Root MSE	=	.37013

Export	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
LN_RealSales	-.0501812	.0589622	-0.85	0.395	-.166083	.0657205
LN_RealAsset	.0224411	.0455131	0.49	0.622	-.0670238	.1119061
LN_Real_Total_Asset	.0066704	.035069	0.19	0.849	-.0622646	.0756054
LN_realRawMaterial	.1153587	.0449139	2.57	0.011	.0270717	.2036458
ln_real_tech	-.0213473	.0283779	-0.75	0.452	-.0771295	.034435
Age	-.0005629	.0009923	-0.57	0.571	-.0025135	.0013876
Urban	.02626	.0332374	0.79	0.430	-.0390747	.0915947
tfp	3.427654	1.664067	2.06	0.040	.156604	6.698705
ImportIntensity	.0014584	.0006653	2.19	0.029	.0001507	.0027662
offoreignOwnership	.1725864	.0540061	3.20	0.002	.0664268	.2787461
EGIndex	.5303677	.0807583	6.57	0.000	.3716214	.689114
_cons	-1.039724	.7848729	-1.32	0.186	-2.582546	.5030984

Conclusion

In the linear regression model, if the coefficient of a certain independent variable is positive, it means that an increase in that variable will result in an increase in the Export (dependent variable) as well, and similarly decrease in that variable will result in a decrease in export.
If the coefficient is negative, the increase in that variable will result in a decrease in export and vice versa.

1) **Sales:** The coefficient is negative, so an increase in real sales will have a negative impact on export. But, as the t value is less this result is quite insignificant.
2) **Gross Assets:** The coefficient is positive, so an increase in gross assets will have a positive impact on export.
3) **Total Assets:** The coefficient is positive, so an increase in total assets will have a positive impact on export.
4) **Raw Materials Expenses:** The coefficient is positive and significant as well, so an increase in real assets will have a positive impact on export.
5) **Technology Expenses:** The coefficient is negative, so an increase in technology expenses will have a negative impact on export. But, as the t value is less this result is quite insignificant.
6) **Age:** The coefficient is negative, so an increase in age will have a negative impact on export. But, as the t value is less this result is quite insignificant.
7) **Urban:** The coefficient is positive, so it shows that the firm which has a head office in tier 1 cities has better exports followed by tier-2 followed by tier-3.
8) **TFP:** The coefficient is positive, so an increase in tfp will have a positive impact on export.
9) **Import Intensity:** The coefficient is positive, so an increase in import intensity will have a positive impact on export.
10) **Foreign Ownership:** The coefficient is positive, so an increase in foreign ownership will have a positive impact on export.
11) **EG-Index:** The coefficient is positive, so an increase in EG-index will have a positive impact on export.

KEY INSIGHTS FROM THE FINDINGS:
As was concluded in Bernard et Al(2012) that exporters are usually more capital intensive, more productive, pay higher wages, and have higher sales, our findings are consistent with it. The coefficient of the sales variable, however, is negative which is not consistent with Bernard et Al(2012)
A possible argument for variables such as assets and sales being not very significant in the Linear Regression Model is that the variable of Total Factor Productivity(TFP) has been calculated using these variables which makes them correlated and thus, leads to them not being very significant.

The new variables that we introduced (not a part of Bernard et Al) were E-G Index, Age, Urban Index, Import Intensity, Technology Spending, and Foreign Ownership.

E-G Index has a positive coefficient and is highly significant, which proves our Hypothesis that highly agglomerated industries are exporting much more than other industries due to better availability of services like transportation, a better competition which leads to only highly productive firms survival.
Import Intensity has a positive coefficient which proves our hypothesis that firms that import more have higher exporting ability. This effect is mainly due to the availability of better equipment for the production of goods.
Foreign Ownership has a positive coefficient as well which proves our hypothesis that firms having some form of foreign ownership have a higher exporting ability because of better connection with foreign firms and easier communication with them.
The urban index also has a positive coefficient which proves our hypothesis that firms located in better cities like tier-1 and tier-2 cities have higher exporting ability than the firms located in tier-3 cities. This is due to the availability of better services and better transportation facilities available in metropolitan cities and other well-developed cities.

Future Research: One important aspect of firms that decides the productivity of firms is the quality of the employees of the firm. Their experience and skill set are very important in the functioning of a firm. More research can be done on this topic.

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