Prevalence of Intra Industry Trade: Analysis of Firm Level Total Factor Productivity in Pakistan's Manufacturing Sector

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Introduction

Trade in today's world has moved away from inter industry trade and towards intra-industry trade. Consumers in France can buy both French made Peugeot cars and imported German Mercedes. Similarly, consumers in Germany can also import Peugeot and many other cars from around the world while Mercedes is exported all over the globe. This represents a perfect example of intra industry trade that is marked by product differentiation and the ability of firms which produce essentially similar products to compete in the international market. The underlying mechanism that enables such trade to take place is productivity at the firm level. This is different than the concept of comparative advantage where countries as a whole specialized in industries for which they had abundance of relevant factors of production such as labor, land, technology and skilled human and financial capital.

On the other hand, the concept of trade originating from differences in firm level productivity means that within a country, all those firms export which have a sufficiently high rate of total factor productivity that enables them to compete at the international market. This is exogenous of the economy's overall comparative advantage and a firm may be exporting products in which the country in general may not have the best factors of production. This can happen if the firm proactively improves its method of production through import of technology, develops human capital, takes advantage of economies of

scale and moves along its learning curve through learning by doing. With an ideal mix of such factors, it is possible for any firm producing any product anywhere in the world to become an exporter. A second explanation of intra industry trade analyzes the effect of product differentiation. Consumers may be willing to pay extra for a product if a firm creates a market niche for its brand.

Most of the existing literature found that increase in total factor productivity (TFP) leads to increase the exports (e.g., Baldwin and Gu 2015; Haider, 2012; Wagner, 2005; Girma et al., 2004; Bernard and Jensen, 1999) Moreover, Krugman (1979) sets up a model of non-comparative advantage trade. But he does not directly examine the causal relationship between TFP and exports. He found that trade and trade gains occur even between countries that have similar technology, taste and factor capabilities. Melitz (2003) examine how intra-industry trade is incorporated into world trade. He shows how trade leads to less productive firms exiting the export market and only the more productive firms remain. Taken together, the results indicate that a relationship exists between TFP and exports. Hence, this paper will analyze how improvement in productivity affects exports.

Objective

This paper attempts to illustrate highly pertinent relationship between Total Factor Productivity (TFP) of manufacturing firms and their exports. This paper verifies the relation between TFP levels and exports, as posited by Melitz (2003).

Methodology

We collect data from 402 manufacturing firms varying over numerous industries namely; textiles, food, garments, sports goods, surgical instruments etc. All the data were extracted from World Bank. They used questionnaire for manufacturing sector for the year 2002 and 2007.

In first step of the estimation procedure, we estimate TFP for all the firms. To that aim we used Beveren (2008) method. TFP is measured by the residuals and is essentially the level of efficiency of input utilization in a production process. However, when we calculate TFP there is a possibility of certain biases in the estimated results, namely: (i) endogeneity of attrition or selection bias, (ii) endogeneity of input choice or simultaneity bias, and (iii) endogeneity of the product mix. These all were taken care in our model.

Once we estimated the TFP, next we test hypothesis, which is the effect of TFP on the level of exports of a firm. To that aim we construct fixed effect regression model. Because if fixed effects are not taken into consideration there may be correlation between the entity's error term and independent variables. Therefore fixed effects leads to assessing the net effects of independent variables on the dependent variable. To factorize the fixed effect we included age, availability of credit, involvement of private foreign individuals, companies or organizations and total expenditure on both production and non-production workers in our fixed effects function.

Results and Discussions

The regression results show that labor, capital and material inputs have a significant and positive effect on the total sales of the firms. The largest effect came from material inputs whereas capital and labor has a smaller effect. That is 1% increase in material inputs, capital and labor raises the sale by 0.75%, 0.12% and 0.11% respectively. These all results were consistent with theory and expectations. Moreover, when labor was decomposed into production and nonproduction labor, its effect on sales has changed. Production labor became insignificant whereas non production labor showed positive relation with sales at first; however it showed negative returns when squared. The insignificance of production labor implies that sales may point towards over employment of workers in firms and each additional worker may not be in a position to increase production much. On the other hand, while the effect of nonproduction or managerial labor is positive, the

negative value for its square term implies that diminishing returns set in for managerial labor after a certain time.

Overall, model F-value of 14.96 and fitness level of 82% implying a highly robust model, which means that the estimate for TFP through the residual method was properly implemented (see Appendix Table 1). The estimates for the TFP values gave interesting results. Although mean value is 1.911 there is a high standard deviation value of 6.5. Similarly, the range of TFP is from 0.01 to 98.2, which implies that wide variance in firm level productivity in Pakistan. These results also imply that the industry in Pakistan is not sufficiently competitive as competition theory implies that firms converge in terms of their productivity levels.

Since we estimated TFP, next we establish a link between productivity and exports of a firm. Total labor, which is proxies for the size of the firm, was positive and significant. That is 1% increase in labor size increases the exports by 0.95%. Age of firm, used to control for the effect of learning by doing, was also positive and significant as a 1% rise in age emerge the exports by 5.7%, thus giving the largest effect on exports. Moreover, even though availability of credit has a positive impact on exports, which is not statistically significant at any level. Further foreign ownership of a firm has negative but insignificant effect on exports. This may be because only 30 firms across both years were foreign owned in our sample and so adequate representation was not given to foreign owned firms.

Finally, the effect of productivity was high and significant on the exports of firms, i.e. 1% increase in TFP level raises the exports by 1.3% which clearly shows that high productivity was imperative to compete in the international markets (see Figure 1). Modified Wald test for group wise heteroskedasticity shows that there is no heteroskedasticity. As a result, overall the regression was a good fit.

Conclusion

The motivation behind this paper was to determine whether Melitz's TFP and intra industry trade model was applicable to the Pakistani manufacturing industry. Our findings verified the Melitz model to the extent that we established that there is a threshold TFP level, above which firms begin to export their products.

The results suggest that the government wish to encourage exports. That is they should pursue policies that aim to increase the TFP of firms. Our data was also cross industry, so upon further analysis, to determine what will affect TFP most in a particular industry, specific industry (textile, food etc) policy implications can be found. We do not go this far however, because the data set we utilized was slightly outdated, however, our results can be replicated by undertaking the questionnaire again and obtaining up to date data, which will lead to valuable insight in the Pakistani context.

References

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Appendix

Table 1: Results of Regression Model

```
. xtreg  logexp logtfp logtotl credit for logage, fe

Fixed-effects (within) regression               Number of obs      =       564
Group variable: id2002                          Number of groups   =       372

R-sq:  within  = 0.2856                         Obs per group: min =         1
       between = 0.0426                                        avg =       1.5
       overall = 0.0579                                        max =         2

                                                F(5,187)           =     14.96
corr(u_i, Xb)  = -0.4508                        Prob > F           =    0.0000
```

logexp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logtfp	1.282855	.4342249	2.95	0.004	.4262465	2.139465
logtotl	.9469733	.3868889	2.45	0.015	.1837457	1.710201
credit	1.324647	.9238223	1.43	0.153	-.4978061	3.1471
for	-7.162904	5.53392	-1.29	0.197	-18.07984	3.754033
logage	5.769199	1.298037	4.44	0.000	3.208521	8.329878
_cons	-24.28077	5.916947	-4.10	0.000	-35.95332	-12.60822
sigma_u	8.2325452					
sigma_e	5.5046256					
rho	.69104578	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(371, 187) =     2.41            Prob > F = 0.0000
```

Table 2: Dispersion Statistics:

```
. univar logexp logtfp logtotl logage, vlabel
                                        -------------- Quantiles --------------
Variable       n     Mean     S.D.      Min      .25      Mdn      .75      Max
------------------------------------------------------------------------------
  logexp     758     6.17     8.36     0.00     0.00     0.00    16.30    22.78

  logtfp  Residuals
  logtfp     583     0.00     0.87    -4.45    -0.34    -0.03     0.26     4.57

 logtotl     747    14.48     1.70     8.59    13.30    14.40    15.42    20.39

  logage     788     2.82     0.84     0.00     2.40     2.89     3.37     7.60
------------------------------------------------------------------------------
```

Figure 1: Kernel Density Estimate

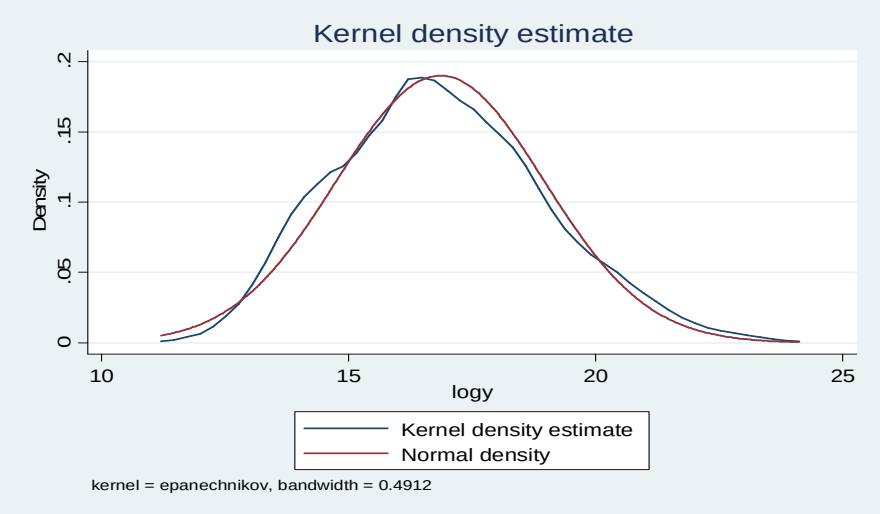

Figure 2: Results of Residual