

## **Writing Sample: Examine LBE (learning-by-exporting) effect with empirical data**

### **Introduction:**

Whether exporters become more productive once they start exporting, which is referred to as the learning-by-exporting effect (LBE), has been an issue attracting much attention in the literature of productivity. Opposing the existence of LBE, some literatures claim that firms with higher efficiency choose to export, while firms with low efficiency choose not. However, no consensus has been reached regarding whether LBE exists. By using the Olley-Pakes Method and Propensity Score Matching, I show significant LBE effects after 2 years of exporting (productivity gains are 35.1% in the second year of exporting).

### **Data:**

I use an unbalanced panel data from 2000 to 07 of Chinese manufacturing firms, including 36 different industries. Variables I focus on are annual output value, number of labors, capital values, ownership, export dummy variable (=1 if export), and investment. There are also variables such as wage, added value, intermediate input value, and so on. For further analysis, I also define different types of firms by its' export status:

- Starter: Firms which do not export at first, but start to export during 2000 to 07.
- Quitter: Firms which export at first, but stop to export during 2000 to 07.
- Always: Firms which export consistently.
- Never: Firms which do not export in any of the time periods.
- Mix: Firms which change their export status multiple times.

Basically, I am concerned about the productivity improvement in the group of Starter versus the other groups.

## Methodology:

I primarily use two statistical models: Olley-Pakes Method, and Propensity Score Matching (PSM). The Olley-Pakes Method provides robust estimation of productivity, and PSM estimates the productivity improvement after the firms start exporting.

### *Olley-Pakes Method:*

To give the consistent and unbiased estimation of efficiency (through productivity) of each firm, I use the Olley-Pakes approach. Since my data is an unbalanced panel data (firms may quit, join or rejoin the market at different time periods), simply estimating the productivity with least squares regression and ignoring those informative droppings and entering, will probably lead to biased estimations.

Olley-Pakes Method allows for:

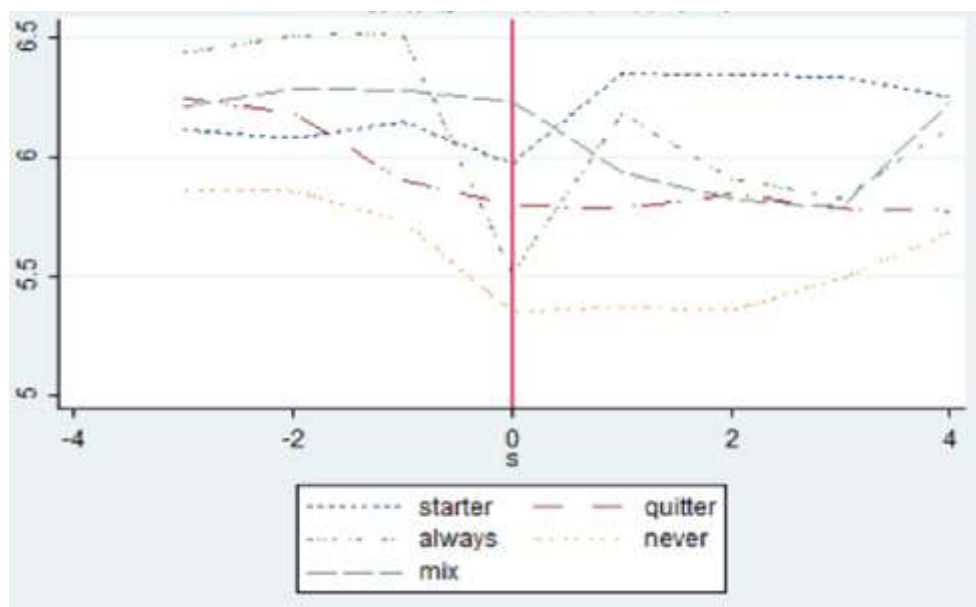
- Simultaneity between output and input variable, which breaks one of the assumptions of the ordinary least squares regression.
- Informative entering and exiting. That is, there is probably information unrevealed when observations quit or enter the market.
- Unobserved permanent differences across firms.

Hence, I use the Olley-Pakes Method to obtain robust estimation of productivity. Overall, Olley-Pakes estimation can be expressed as following:

$$y_{i,t} = \beta_l l_{i,t} + \beta_k k_{i,t} + E[w_{i,t}|w_{i,t-1}, survive\ to\ t] + \xi_{i,t} + \eta_{i,t}$$

where  $y_{i,t}$  is the total output of the firm,  $l_{i,t}$  is the number of labor,  $k_{i,t}$  is the total value of the capital,  $w_{i,t}$  denotes the current efficiency which is also a function of labor and investment,  $\xi_{i,t}$  is the efficiency surprise for surviving firms, and  $\eta_{i,t}$  is the error term.

The figure below provides a quick overview of the productivity of firms over 8 years, 2000 to 07. The x-axis is the time span, where I set 2003 as the middle point ( $s = 0$ ), and y-axis is the productivity level.



As the figure shown above, among the five types of firms, although starters might not be the most efficient type of firms at the beginning, their productivity surpasses others at the end. This might indicate the LBE effect does exist. However, further analysis is required for the detailed and statistically meaningful outcome.

### *Propensity Score Matching (PSM)*

I use propensity score matching (PSM) to examine the causal relation between export and productivity. If I simply test the productivity difference between exporters and non-exporters, I

probably will get biased estimation because chances are high productivity firms are more intended to be exporters, while low productivity firms are more conservative with regards to the international market. This is called self-selection bias.

PSM provides a very simple but effective way to get around with self-selection problems. In short, PSM estimates the productivity differences between exporters and non-exporters within firms that have similar characteristics. That is, the PSM model groups the observations with similar attributes except for a difference in export status. Then in each group, PSM runs the regression model to see if there are significant productivity differences. It can be shown as following:

$$E\{w_i^1 - w_i^0 | Start_i = 1\} = E\{w_i^1 | Start_i = 1\} - E\{w_i^0 | Start_i = 1\}$$

where  $w_i^1$  is the productivity of exporters,  $w_i^0$  is the productivity of non-exporters, and  $Start_i = 1$  means that the firms are very likely to become an exporter.

The statistical findings are shown in the following table:

<i>time</i>	0	1	2	3	4
<b><math>\beta</math></b>	0.206	0.351**	0.364**	0.388**	0.384*
	(0.183)	(0.115)	(0.193)	(0.223)	(0.268)

$\beta$ : productivity improvement, firms start to export when time = 0, \* p < 0.1, \*\* p < 0.05

This table suggests that once a firm starts to export and join the international market, the productivity of that firm will significantly improve in the following years, and the improvement is consistent. This result supports the idea of LBE.

To understand which type of firms benefit the most from LBE, I group the observations into three categories: foreign owned companies, state owned companies, and private or joint companies. Then I do the analysis again to see the LBE effect in each group. The table below shows an interesting fact: among three types of ownership companies, only private or joint companies acquire a statistically significant LBE effect.

<i>time</i>	0	1	2	3	4
<i>(a) Foreign Owned Companies</i>					
$\beta$	-0.003 (0.309)	0.101 (0.422)	0.141 (0.554)	0.188 (0.433)	0.176 (0.455)
<i>(b) State Owned Companies</i>					
$\beta$	0.529 (0.673)	0.507 (0.750)	0.695 (0.642)	0.694 (0.728)	0.850 (0.750)
<i>(c) Private or Joint Companies</i>					
$\beta$	0.199 (0.228)	0.364** (0.156)	0.373* (0.228)	0.406* (0.283)	0.435* (0.315)

$\beta$ : productivity improvement, firms start to export at time = 0, \*  $p < 0.1$ , \*\*  $p < 0.05$

### Conclusion:

Causal effect is not simply correlation or association. Although there is plenty of evidence showing that exporting firms are usually more efficient than non-exporting firms, this is not enough to support the idea of the LBE effect. In this research, I reveal and verify the LBE effect with empirical data. I also show that not all types of firms experience the LBE effects. In fact, firms experiencing productivity gains after exporting are those with private or joint owned companies.

### References:

- Becker, S.O., Ichino, A., 2002. *Estimation of average treatment effects based on propensity scores. STATA Journal* 2, 358–377.
- Bernard, A.B., Jensen, J.B., 1999. *Exceptional exporter performance: cause, effect or both? Journal of International Economics* 47(1), 1–25.
- Bryla, J., 2010. *Exports and productivity – learning by exporting in Denmark. School of Economics and Management, Aarhus University.*

- Castellani, D., 2002. *Export behaviour and productivity growth: Evidence from Italian manufacturing firms.* *Weltwirtschaftliches Archiv* 138, 605–628.
- Clerides, S., Lach, S. and Tybout, J., 1998. *Is learning by exporting important? Micro-dynamic evidence from Colombia, Mexico, and Morocco.* *Quarterly Journal of Economics* 113, 903–947.
- De Loecker, J., 2007. *Do exports generate higher productivity? Evidence from Slovenia.* *Journal of International Economics* 73, 69–98.
- Eliasson, K., Hansson, P., Lindvert, M., 2012. *Do firms learn by exporting or learn to export? Evidence from small and medium-sized enterprises* *Small Business Economics* 39, 453–472.
- Fernandes, A., Isgut, A., 2005. *Learning-by-Doing, Learning-by-Exporting, and Productivity: Evidence from Colombia.* *The World Bank, Policy, Research Working Paper WPS3544.*
- Girma, S., Greenway, D. and Knerller, R., 2004. *Does exporting increase productivity? A microeconomic analysis of matched firms.* *GEP Research Paper*, vol. 02/09.
- Isgut, A., 2001. *What's different about exporters? Evidence from Colombian manufacturing.* *Journal of Development Studies* 37, 57–82.
- Kraay, A., 1999. *Exports and economic performance: Evidence from a panel of Chinese enterprises.* *Revue d'Economie du Developpement*, 1(2), 183–207.
- Levinsohn, J., Petrin, A., 2003. *Estimating production functions using inputs to control for unobservables.* *Review of Economics Studies* 70, 317–342.
- Mukim, M., 2011. *Does exporting increase productivity? Evidence from India.* *London School of Economics, working paper.*
- Olley, S., Pakes, A., 1996. *The dynamics of productivity in the telecommunications equipment industry.* *Econometrica* 64 (6), 1263–1298.
- Petrin, A., Levinsohn, J., Poi, B., 2004. *Production function estimation in Stata using inputs to control for unobservables.* *The Stata Journal*, 4(2), 113–123.
- Rosenbaum, P., Rubin, D., 1983. *The central role of the propensity score in observational studies for causal effects.* *Biometrika* 70 (1), 41–55.
- Van Biesebroeck, J., 2006. *Exporting raises productivity in sub-Saharan African manufacturing firms.* *Journal of International Economics* 67 (2), 373–391.
- Yasar, M., Raciborski, R. and Poi, B., 2008. *Production function estimation in Stata using the Olley and Pakes method.* *The Stata Journal*, 8(2), 221–231.