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Exports and Economic Performance: Evidence from a Panel of Chinese Enterprises

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Abstract: This paper investigates whether firms learn from exporting, using a panel of 2105 Chinese industrial enterprises between 1988 and 1992. I find that, controlling for past performance and unobserved firm characteristics, past exports lead to significant improvements in enterprise performance. Interestingly, these learning effects are most pronounced among established exporters. For new entrants to export markets, learning effects are insignificant and occasionally negative.

Keywords: China, productivity, learning-by-exporting, dynamic panel data estimation

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1. Introduction

This paper investigates whether firms learn from exporting, using a panel data set of 2105 Chinese industrial enterprises between 1988 and 1992. I find that, controlling for past firm performance and unobserved firm characteristics, past exports are a significant predictor of current enterprise performance. These learning effects can be quite large: the estimated coefficients indicate that a ten percentage point increase in a firm's export to output ratio in a given year leads to 13 percent higher labour productivity, 2 percent higher total factor productivity, and 6 percent lower unit costs in the following year. Interestingly, these learning effects are most pronounced among established exporters. For new entrants to export markets, learning effects are insignificant and occasionally negative.

Although the superior economic performance of exporting firms relative to non-exporters has been extensively documented in number of developed and developing countries,¹ the question of causality between exports and firm performance has only recently begun to receive attention. After all, the better average performance of exporters may simply be due to exporters self-selecting into export markets precisely because they are more efficient. On the other hand, it is also possible that firms might learn from exporting through a variety of channels. Somewhat informally, it is often argued that exposure to global markets elicits greater entrepreneurial effort on the part of managers, forcing them to become more "competitive". More concretely, there is evidence that developing-country exporters benefit from a range of trade-related linkages with their developed-country customers, such as production or managerial advice embedded in supplier specifications.²

Recent papers by Bernard and Jensen (1995,1999a,1999b) and Clerides, Lach and Tybout (1998) present attempts to disentangle the direction of causation between exports and firm performance, using panel data on a sample of U.S. firms and Colombian, Moroccan, and Mexican firms respectively. In contrast with the present paper, both these papers find that there is little evidence that past exports are

¹ See among others, Chen and Tang (1987) (Taiwan), Haddad (1993) (Morocco), Aw and Hwang (1995) (Taiwan), Bernard and Jensen (1995) (United States), Djankov and Hoekman (1997) (Bulgaria).

associated with improvements in future firm performance, casting doubt on the existence of learning effects. This paper extends the work of these authors in two directions. First, I consider a different panel data set of 2105 large and medium-sized Chinese industrial enterprises between 1988 and 1992. The experience of these firms is of considerable independent interest given China's swift growth and the rapid expansion of its trade from a very low base during the 1980s. Although China's opening to world markets is often cited by many observers as one of the key factors responsible for China's growth, there is little evidence on the effects of trade on economic performance at the firm level.³

Second, I employ a somewhat different empirical methodology than these earlier papers. For a partial correlation between past exports and current performance to constitute evidence of learning from exporting, it is necessary to employ a methodology which rules out two alternative sources of this correlation: (i) unobserved firm-specific factors which are correlated with both exports and firm performance, and (ii) the confluence of persistence in firm performance and self-selection of better firms into export markets. Accordingly, I employ a dynamic panel specification in which firm performance depends on lagged performance and lagged exports. I address the difficulty of unobserved firm-specific effects by working with a first-differenced specification, while the presence of lagged performance and an appropriate choice of instruments rules out the second explanation.⁴ Finally, unlike these earlier papers, I

² See Clerides, Lach and Tybout (1998) for examples and a theoretical model.

³ There is a vast literature on estimating the productivity performance of Chinese enterprises (see Jefferson, Rawski and Zheng (1996) for an overview). This literature has primarily been concerned with the effects of China's incremental reforms on the productivity performance of state- and non-state-owned enterprises. Perkins (1996, 1997) are among the few papers in this literature which explicitly consider the role of exports at the firm level, and concludes that exporting firms enjoy higher productivity. Wei (1993) using city-level data finds that exports are associated with higher growth.

⁴ The model estimated by Clerides et. al. (1996) allows for individual effects, but requires them to be independent of explanatory variables such as lagged exports. They address the problem of persistence and self-selection by jointly estimating a system which regresses firm performance on lagged performance and a sequence of lagged dummy variables indicating export market participation, and a probit equation to describe the decision to participate in export markets. Although the joint estimation of the performance and participation equations will yield more efficient estimates than the single-equation instrumental variables estimator employed here, it requires more restrictive distributional assumptions on the disturbances and individual effects. The evidence on causation from exports to firm performance in Bernard and Jensen (1995) consists of regressions of employment growth and wage growth on initial export status, controlling for observable firm characteristics. Initial export status is a poor predictor of wage

allow the coefficient on lagged exports to vary with the export history of the firm, and so allow learning effects to depend on how long firms have been in export markets. I find that there are large differences in learning effects between recent entrants and established exporters. This raises the possibility that the failure of earlier studies to find learning effects may be simply because these studies pool information across firms with different export histories.

The paper is organized as follows. The next section introduces the data and confirms the empirical regularity that exporting firms enjoy better performance than non-exporting firms in this sample of Chinese enterprises. The next section presents formal tests of learning from exporting. The final section offers concluding remarks.

growth, but has some explanatory power for employment growth. This specification is subject to both of the concerns mentioned in the text.

2. Are Exporters and Non-Exporters Different?

In this section, I first briefly discuss the data set and document the characteristics of the sample of firms. I then summarize some of the features of the exporting firms in the sample, and confirm that in China, as in other countries, exporters tend to be larger and more efficient than non-exporters. The question of causation between exports and firm performance is taken up in the following section.

Data and Sample Characteristics

This paper exploits data from a rich panel data set of over 7000 large and medium-sized Chinese industrial enterprises between 1988 and 1992 compiled by China's State Statistical Bureau. The dataset is a subsample of the annual Chinese industrial survey upon which published aggregate industrial statistics are based, and contains consistent time series for a large number of physical and financial indicators of enterprises, including exports. Unfortunately, there are many missing values in the data, especially for the exports variable, which forces consideration of a much smaller subsample of 2105 enterprises for which it is possible to construct a balanced panel of

Table 1: Summary Statistics for Enterprise Sample

	1988	1989	1990	1991	1992
Gross output value (billions yuan)					
Sample	185.06	220.37	232.94	263.48	320.34
Population <u>a/</u>	1822.40	2201.71	2392.44	2824.80	3706.57
Sample/Population (percent)	10.15	10.01	9.74	9.33	8.64
Employment (thousands)					
Sample	6502.64	6684.83	6724.11	6827.20	6978.28
Population <u>a/</u>	61580.00	62280.00	63780.00	65510.00	66210.00
Sample/Population (percent)	10.56	10.73	10.54	10.42	10.54
Exports (billions yuan)					
Sample	19.71	24.25	27.90	31.90	31.80
Population <u>b/</u>	176.67	195.60	298.58	382.71	467.63
Sample/Population	11.16	12.40	9.34	8.33	6.80

a/ Refers to industry only

b/ Refers to economy-wide exports

Table 2: Distribution of Sample by Ownership and Sector, 1990
(percent)

	Gross Output Value		Employment	
	Sample	Population	Sample	Population
By Ownership: a/				
State-owned units	95.92	54.60	96.07	68.42
Collectively-owned units	2.49	35.62	2.63	29.41
Others	1.59	9.77	1.30	2.16
By Sector: b/				
Textiles	25.69	14.55	29.29	14.05
Garments	1.20	2.63	0.92	3.11
Basic Chemicals	5.59	9.47	4.11	7.20
Pharmaceuticals	5.14	2.26	3.56	1.53
Chemical Fibres	3.77	1.73	2.08	0.64
Construction Materials	1.36	n.a.	1.51	n.a.
Ferrous Metals	32.11	8.25	27.15	5.66
Machinery	13.67	10.63	21.30	18.65
Automobiles	6.94	4.53	6.25	3.79
Electronics	4.52	3.71	3.84	2.96
Other c/		42.24		42.42

Note: Sectoral distribution for population is approximate due to an imperfect concordance between documentation of dataset and published national totals.

a/ Population refers to all of industry (including mining and utilities)

b/ Population refers to manufacturing only

c/ Refers to sectors not represented in sample

observations on all relevant variables. The details of how the variables used in the paper were constructed from the underlying data are given in Appendix 1.

Tables 1 and 2 present an overview of key variables for the sample of 2105 firms. Although the sample represents only a tiny fraction of the hundreds of thousands of Chinese industrial enterprises, the large firms in the sample account for about 10 percent of industrial gross output value and employment, and 11 percent of exports in 1988. Although the share of the sample in total employment is roughly constant over the sample period, the share of the sample in gross output falls to 8.6 percent in 1992, and the share in exports falls precipitously to 6.8 percent. This is primarily due to biases in the composition of the sample of firms relative to the population of Chinese industrial enterprises, as documented in the first panel of Table 2. The sample of firms is heavily skewed towards state-owned enterprises, which have on average experienced slower output and export growth than the rest of the economy (World Bank (1996, 1997)). The

sample is also somewhat skewed in its sectoral composition, with sectors such as textiles and ferrous metals over-represented, and many sectors entirely unrepresented. These compositional biases, as well as any additional selection biases caused by limiting the sample to a balanced panel, suggest that some caution is in order in extending the results of this paper to all firms.

Characteristics of Exporting Firms

Table 3 presents summary statistics on the exporting firms in the sample. The first panel reveals that between 64 and 72 percent of all firms report positive exports over the sample period. Exporters account for a somewhat larger share of employment and gross output, reflecting the larger average size of exporters relative to non-exporters. The second panel shows that on average, exporting firms export between 12 and 15 percent of their gross output, but the large standard deviation indicates that there is substantial cross-sectional variation in this ratio across firms. Table 4 highlights the contribution to this variation of differences in export ratios across sectors and forms of ownership. In 1990, the state-owned enterprises which constitute the majority of the

Table 3: Summary Statistics on Exporters

	1988	1989	1990	1991	1992
Number of exporting firms	1348	1410	1490	1509	1492
Exporters' percentage share of:					
Number of Firms	64.04	66.98	70.78	71.69	70.88
Gross output value	73.24	77.14	81.32	83.57	82.14
Employment	72.09	76.52	80.38	82.22	81.27
Exports/Gross output value					
Mean <u>a/</u>	0.145	0.143	0.147	0.145	0.121
Standard deviation	0.218	0.217	0.217	0.225	0.216

a/ Weighted by gross output value

Table 4: Summary Statistics on Exporters by Ownership and Sector, 1990

	<u>Exporter percentage share of:</u>				<u>Exports/Gross output</u>	
	<u>Number of Exporters</u>	<u>Number of Firms</u>	<u>Gross Output Value</u>	<u>Employment</u>	<u>Mean</u>	<u>Standard Deviation</u>
By Ownership:						
State-owned units	1353	70.36	81.45	80.49	0.14	0.21
Collectively-owned units	99	74.44	80.16	77.65	0.25	0.26
Others	38	77.55	75.10	77.86	0.16	0.19
By Sector:						
Textiles	540	87.95	93.47	92.31	0.30	0.24
Garments	19	63.33	62.79	60.13	0.21	0.35
Basic Chemicals	86	68.80	79.81	77.42	0.11	0.13
Pharmaceuticals	139	81.29	90.27	86.71	0.19	0.18
Chemical Fibres	24	40.00	58.71	62.31	0.08	0.13
Construction Materials	22	46.81	53.34	49.12	0.08	0.05
Ferrous Metals	65	60.19	77.95	76.64	0.05	0.12
Machinery	414	62.73	76.27	75.41	0.11	0.17
Automobiles	58	45.67	78.01	72.51	0.03	0.08
Electronics	123	75.46	80.47	80.33	0.11	0.19

sample exported about 14 percent of their output, considerably less than collectively-owned enterprises who exported 25 percent of their output. Textiles, garments, pharmaceuticals are the most export-oriented sectors, exporting 30 percent, 21 percent and 19 percent of GVIO respectively, while automobiles and ferrous metals at 3 and 5 percent respectively are the least export-oriented sectors.

The large sectoral variation in the incidence of exporters documented in the second column of Table 4 suggests that the larger average size of exporters implied by Table 3 could simply be an artifact of the sectoral composition of exporting firms, with exporters being more prevalent in sectors populated by larger firms. However, Table 5, which reports average firm size controlling for the sectoral, regional and ownership composition of exporters, shows that this is not the case.⁵ Even within these groups,

⁵ Specifically, I report the coefficients on dummy variables for exporters and non-exporters in a cross-sectional regression of firm size on these variables and a set of industry, provincial and ownership dummies, for each year in the sample.

exporters tend to be nearly twice as large as non-exporters, both in terms of gross output value and employment, and this difference is highly significant.

Table 6 presents some indicators of the within-firm variation over time in exports between 1988 and 1992. The upper panel documents the fact that a firm's status as an exporter or non-exporter is highly persistent over time, by reporting the probabilities that an exporting (non-exporting) firm continues to export (not export) from one year to the next, averaging over all firms in all periods. Given that a firm exported in a particular year, the probability that a firm continues to export in the following year is 0.905. Similarly, the probability that a firm does not export in a given year, conditional on not having exported in the previous year, is 0.836, and the probability that a non-exporter breaks into export markets is only 0.164. This is not to say, however, that there is little time-series variation in the export ratio itself. The lower panel of Table 6 presents the mean and standard deviation of year-over-year changes in the export to gross output value ratio. The large standard deviations indicate that there is considerable variation around the average change in exports. For example, between 1990 and 1991, these figures indicate that fully half of the firms in the sample experienced a change in their export ratio larger than 7 percent in absolute value, and one quarter experienced changes greater than 12 percent in absolute value.

Table 5: Size of Exporters and Non-Exporters
(Unweighted averages of selected variables a/)

		1988	1989	1990	1991	1992
Gross output value (thousands yuan)	Exporters	100545	120553	127133	145916	176370
	Non-Exporters	65421	72497	70747	72643	93309
	P-value <u>b/</u>	0.00	0.00	0.00	0.00	0.00
Employment	Exporters	3478	3628	3627	3720	3801
	Non-Exporters	2397	2259	2145	2036	2133
	P-value <u>b/</u>	0.00	0.00	0.00	0.00	0.00

a/ Controlling for ownership, sector and province effects

b/ P-value is for test of null hypothesis that the means for exporters and non-exporters are equal

Table 6: Persistence and Volatility of Export Status

Persistence: Transition matrix for export status

	<u>Export at time t+1</u>	<u>Don't export at time t+1</u>
Export at time t	0.905	0.095
Don't export at time t	0.164	0.836

Volatility: Change in exports/gross output value a/

	<u>1988-89</u>	<u>1989-90</u>	<u>1990-91</u>	<u>1990-92</u>
Mean	0.010	0.017	0.007	-0.020
Standard deviation	0.093	0.106	0.122	0.121

a/ Refers to firms with positive exports in both of the two years over which change is calculated.

Do exporters perform better than non-exporters?

In order to investigate differences in enterprise performance between exporters and non-exporters, I require indicators of economic performance over time for all firms. I consider three measures: labour productivity, total factor productivity and unit costs. I measure labour productivity as gross output per worker in constant 1990 prices, and unit costs as the current price ratio of cost of goods sold to sales revenue. Total factor productivity is constructed as the residual from a three-factor constant returns Cobb-Douglas gross output production function using capital, labour and materials as inputs. Capital is measured as the net value of fixed assets, labour input is measured as the annual average number of workers, and materials are measured in constant 1990 prices. The output elasticities are simply measured as the current-price shares of factor payments in gross output, and are allowed to vary across sectors and over time. In particular, the output elasticity of labour in each sector and year is estimated as the sectoral average of wage payments (including bonuses) to gross output, while the output elasticity of materials is measured as materials consumption divided by gross output.

Given the assumption of constant returns to scale, the capital output elasticity is one minus the other two elasticities.⁶

It is worth noting in passing that considerable controversy surrounds various measures of enterprise productivity in China.⁷ Much of this controversy results from efforts to reconcile the anomalous behaviour of various published price indices for output and material inputs, and the consequences of different reconciliations for the relative productivity performance of state and non-state industry. Since I am not interested in comparisons between state- and non-state industry, but rather between exporters and non-exporters in a sample consisting primarily of state-owned enterprises, I am able to sidestep much of this controversy surrounding the choice of appropriate deflators. Moreover, in the empirical work in the following sections, I enter the firm performance variables in logarithms and include ownership dummies interacted with period dummies, which has the effect of sweeping out any variation in deflators across ownership forms.

Table 7 summarizes the differences in firm performance between exporting and non-exporting firms. The first panel reports the simple averages of labour productivity, total factor productivity, and unit costs in exporting and non-exporting firms, pooling the data for all firms and years. Both measures of productivity are significantly higher in exporting firms, with exporters enjoying a productivity advantage between 2 and 9 percent over non-exporters. In terms of unit costs, exporters appear to have slightly worse performance than non-exporters, but this is an artifact of the sectoral composition of exporters. The lower panel presents the same averages as the upper panel, but now controlling for the sectoral, regional and ownership distribution of exporters. The

⁶ It is well-known that measures of total factor productivity constructed in this simple manner will overstate productivity if there are increasing returns and/or firms have market power. Since I will be identifying learning effects from the within-firm variation in firm performance, these concerns are only relevant if there are changes in the extent of increasing returns and/or firms' market power varies over time, and moreover is correlated with export activity in the right way. It seems reasonable to think of the extent of increasing returns as a fairly stable feature of technology which is unlikely to vary much over time. It is however possible that firms' market power declines as firms break into export markets, as they are less able to charge markups over unit costs. As a result, export market participation may be associated with falls in measured total factor productivity. This will have the effect of obscuring, rather than exaggerating, any learning effects on this measure of firm performance.

⁷ See Jefferson, Rawski and Zheng (1992, 1996) and Woo, Hai, Jin and Fan (1993, 1994) for a review of these issues. In this paper I use deflators for output and materials advocated by Jefferson, Rawski and Zheng (1992, 1996), which are based on indexes of factory-gate prices of industrial products and material inputs, rather than the implicit gross output deflator.

Table 7: Comparing Performance of Exporters and Non-Exporters

	Exporters	Non-Exporters	p <u>a/</u>
Unconditional			
Labour Productivity	36.652	33.694	0.000
Total Factor Productivity	2.014	1.965	0.000
Unit Costs	0.922	0.912	0.001
Conditional <u>b/</u>			
Labour Productivity	45.819	42.844	0.000
Total Factor Productivity	2.105	2.057	0.000
Unit Costs	0.949	0.961	0.000

a/ P-value is for test of null hypothesis that the means for exporters and non-exporters are equal.

b/ Conditioning on sector, ownership and regional effects.

productivity advantage of exporters persists, and exporters now also enjoy slightly lower unit costs than non-exporters.

In summary, the empirical regularities observed in this sample of predominantly state-owned Chinese industrial enterprises are consistent with those documented in several other countries. Exporting firms tend to be larger than non-exporting firms, and enjoy higher productivity and lower unit costs. Although a firm's status as an exporter is very persistent over time, there is substantial time-series variation in the export to gross output ratio of exporting firms. This last feature of the data is important, because in the next section I will use the within-firm time-series variation in exports and performance measures to identify learning effects.

3. Do Exporters Learn from Exporting?

In this section, I formally test whether the better average performance of exporting firms documented in the previous section can be attributed to exporters learning from exporting. In contrast to other work, I find a statistically and economically significant effect of lagged exports on current firm performance, suggesting the presence of learning from exporting.

Specification and Identification

The empirical strategy in this section is to test whether a firm's performance, as measured by labour productivity, total factor productivity, and unit costs, depends on its past export experience. For such a test to constitute evidence in favour of learning by exporting, it is necessary to rule out two alternative explanations for any observed correlation between past exports and current enterprise performance.

First, current enterprise performance may depend on past export experience due to unobserved enterprise characteristics that affect both performance and exports. For example, certain firms might have more energetic managers who run efficient operations with lower unit costs than their competitors, and also aggressively seek out foreign markets, while other firms might be run by more conservative managers who are unwilling to implement efficiency-enhancing reforms and also prefer to rely on traditional domestic markets. Such unobservable firm characteristics may give rise to spurious correlations between lagged exports and current enterprise performance. Second, firm performance is itself likely to be persistent over time, and is jointly determined with a firm's export performance. For example, if production is characterized by scale economies, an expansion of plant size today may result in lower unit costs for many periods in the future. If firms with better performance self-select into export markets, and if firm performance is correlated over time, then current performance will be correlated with past export behaviour even in the absence of learning effects.

To distinguish the learning hypothesis from these two alternative explanations, I estimate a series of regressions of firm performance on lagged exports and lagged firm performance. The estimation technique is selected so as to yield consistent estimates of the coefficient on lagged firm performance and lagged exports even in the presence of unobserved firm-specific time-invariant effects that are correlated with the explanatory

variables.⁸ To the extent that unobserved firm characteristics such as managerial ability do not vary over time, this rules out the first explanation for the correlation between lagged exports and current firm performance. The inclusion of lagged firm performance in the regression controls for serial dependence in this variable, and the appropriate choice of lagged variables as instruments addresses the problem that exports and firm performance are jointly determined. Hence, I can also distinguish the learning hypothesis from the second explanation mentioned above.

Specifically, I estimate variants on the following equation:

$$y_{ijt} = \beta \cdot y_{ij,t-1} + \gamma \cdot x_{ij,t-1} + \eta_i + \lambda_{jt} + \varepsilon_{ijt} \quad (1)$$

where y_{ijt} and x_{ijt} denote the logarithm of firm performance and the export to gross output value ratio of firm i of ownership form j at time t , η_i is an unobserved firm-specific effect, and λ_{jt} is an unobserved period-specific effect which may also vary across ownership forms. Finally, ε_{ijt} is a well-behaved zero-mean disturbance term.

To eliminate the individual- and period-specific effects from Equation (1), I take deviations of all variables from period- and ownership-specific means, and then difference these deviations to obtain:

$$\Delta \tilde{y}_{ijt} = \beta \cdot \Delta \tilde{y}_{ij,t-1} + \gamma \cdot \Delta \tilde{x}_{ij,t-1} + \Delta \tilde{\varepsilon}_{ijt} \quad (2)$$

where Δ is the first difference operator and \tilde{y}_{ijt} , $\tilde{x}_{ij,t-1}$, and $\tilde{\varepsilon}_{ijt}$ denote deviations from period- and ownership-specific averages.⁹

Two assumptions on the structure of the disturbances are required to identify the parameters of the model. First, I assume that there is no serial dependence in ε_{ijt} , i.e.

⁸ I use a dynamic panel instrumental variables estimator proposed by Arellano and Bond (1988, 1991). For applications of this technique to cross-country growth regressions, see for example Caselli, Esquivel and Lefort (1996), and Easterly, Loayza and Montiel (1996).

⁹ That is, I regress each variable on a set of time dummies interacted with a set of ownership dummies, and retrieve the residuals from this regression as deviations from period- and ownership-specific means.

$E[\varepsilon_{ijt} \cdot \varepsilon_{ijs}] = 0$ for all $s \neq t$. Second, I assume that, although firm performance and exports are jointly determined, exports are predetermined with respect to ε_{ijt} , i.e. $E[x_{ijt} \cdot \varepsilon_{ijs}] = 0$ for all $s > t$. Although the first-differencing introduces a correlation between the transformed residual and the first difference of lagged firm performance, the assumption of no serial dependence in the untransformed residual ensures that second and higher lags of firm performance are available as instruments for $\Delta \tilde{y}_{ij,t-1}$. The assumptions of no serial correlation and predeterminedness of exports imply that second and higher lags of exports are valid instruments for $\Delta \tilde{x}_{ij,t-1}$.

How valid are these identifying assumptions? If firm performance exhibits higher than first-order serial dependence, the residual term in Equation (1) will also be serially correlated, invalidating the first identifying assumption. Since the short available time span of the dataset makes it difficult to include several lags of the dependent variable, the only alternative is to test whether the estimated differenced residuals in Equation (2) exhibit second-order serial dependence. It will turn out that they do not, providing some comfort for the first identifying assumption. The assumption that exports are predetermined with respect to ε_{ijt} would arise naturally in any model in which both exports and firm performance depend on their own and the other's lagged values (as well as other exogenous variables).¹⁰

Basic Results

The results of this basic specification are presented in Table 8. The model is estimated using one lag of firm performance and one lag of exports over the period from 1990 to 1992, since the differencing and choice of twice lagged variables as instruments eliminates the first two years from the estimation period. As instruments, I use only the second lags of firm performance and exports. Results using the full set of all available second and higher lags as instruments are quite similar, and are not reported for brevity.¹¹

¹⁰ Only if exports depend on future performance will this identifying assumption be invalid. In this case, only sufficiently-lagged exports will be valid instruments.

¹¹ To allow for the possibility that exports depend on one-period ahead productivity, I also estimated the specification using thrice-lagged variables as instruments. This again yielded similar results, with even larger and more significant learning effects.

Table 8: Basic Model Results

	Labour Productivity	Total Factor Productivity	Unit Costs
Lagged Performance	1.037*** (.087)	.541*** (.032)	0.221*** (.031)
Lagged Exports	1.321*** (.252)	.233*** (.079)	-.647** (.108)
P-value for no serial correlation test	0.003**	0.947	0.264

Note: Model estimated over the period 1990-1992, using second lags of firm performance and exports as instruments
Standard errors in parentheses. * (**) (***) indicates significance at the 10% (5%) (1%) level.

The highly significant and positive coefficients on lagged firm performance in the first row of the table confirm that firm performance is persistent over time. More interestingly, there is statistically significant evidence of learning from exporting. Past exports are positively associated with current labour productivity and total factor productivity, and negatively associated with unit costs. The magnitude of these effects are also economically significant. Recalling that the performance measure is expressed in logarithms, the magnitudes of the coefficients on lagged exports imply that an increase of 0.1 in a firm's export ratio (roughly one sample standard deviation) causes a 13 percent increase in labour productivity, a two percent increase in total factor productivity, and a six percent reduction in unit costs in the following year.

The last row of Table 8 reports the p-value associated with a test of the null hypothesis that there is no second-order serial correlation in the differenced residuals in Equation (2). In the case of unit costs and total factor productivity productivity, this null hypothesis not rejected at five percent level, suggesting that the identifying assumptions are indeed valid. In the case of labour productivity, the null is rejected at the five percent level. However, if I augment this specification with an additional lag of labour productivity, the null is no longer rejected, and the coefficient on lagged exports actually becomes much larger.

The rather large estimates of learning using these measures should be interpreted with some caution. Both exports and some measures of firm performance are quite persistent over time. As a result, lagged levels of these variables will not be very highly correlated with contemporaneous changes in these variables. This suggests that lagged levels may be weak instruments for the right-hand side variables in Equation (2). In this case of weak instruments, it is well-known that in finite samples the instrumental variables estimates are biased towards the probability limits of the OLS estimates of Equation (2). Therefore, the instrumental variables procedure I employ may only imperfectly address the endogeneity problems which motivate its use, and hence the learning effects may be somewhat overstated.¹²

Controlling for Export Histories

One shortcoming of the above regressions is that they do not control for the export history of a firm. The relationship between lagged exports and current firm performance may depend on the export history of a firm for a number of reasons. Suppose for example that learning from exporting is a one-shot affair in the sense that breaking into export markets is associated with a one-time improvement in firm performance. In this case, lagged exports should be positively correlated with firm performance only in the first few years after a firm enters the export market, but not if a firm has been exporting for many years.

If on the other hand learning is an on-going process, then lagged exports will be positively associated with current performance even in firms that have been exporting for many years. Moreover, if there are high entry costs which must be incurred before a firm can begin to export, then measured firm performance may initially deteriorate as it breaks into export markets. Only as the firm recoups these start-up costs will exports eventually be associated with better firm performance. Finally, it is even possible that firms choose to exit from export markets because they have exhausted all the learning benefits from exporting.

This raises the possibility that the basic regressions of the previous subsection are misspecified since they impose the same coefficient on lagged exports for all firms,

¹² See Blundell and Bond (1998) for a further discussion of these issues, and possible remedies.

regardless of their export history. I address this concern by re-estimating Equation (1), allowing the coefficient on lagged exports to vary with the export history of the firm. Specifically, the export history of a firm may be thought of as a sequence of indicator variables for each firm in each year, which take on the value one if a firm exports in that year and zero if it does not. Even with only five years of data, a very large number of distinct export histories are represented in our sample of firms, which would result in a very large number of different coefficients on lagged exports to be estimated. In order to conserve on degrees of freedom and impose some structure on the problem, I instead consider five types of export histories: -- firms that export over the entire sample period (established exporters), firms that initially do not export but at some point during the sample begin exporting and continue to export through the end of the sample period (entrants), firms that initially export but leave the export market for the duration of the sample period (exiters), firms that switch between exporting and not exporting more than once over the sample (switchers), and firms that never export (non-exporters).¹³ As shown in Table 9, slightly over half of the firms in the sample fall in the first category. Relatively few firms are classified as either entrants or exiters (252 and 113 respectively, representing 12 and 5 percent of the total sample), and the remainder are switchers (279) or never export at all (343).

¹³ Clearly, since I do not have a full export history for every firm, but only five years of data, this categorization may misclassify some firms. For example, some firms which are identified as always having exported may have entered export markets in 1987, and hence should be classified as entrants.

Table 9: Export Histories

	Number of Firms	Share of Total (percent)
Always Export	1118	53.1
Entrants	252	12.0
Enter in 89	79	3.8
Enter in 90	67	3.2
Enter in 91	63	3.0
Enter in 92	43	2.0
Exiters	113	5.4
Exit in 89	26	1.2
Exit in 90	15	0.7
Exit in 91	36	1.7
Exit in 92	36	1.7
Switchers	279	13.3
Never Export	343	16.3

Next, I specify a more general form of Equation (1) in which the coefficients on lagged exports are allowed to vary with the export history of the firm. In particular, for $t=1991$ and $t=1992$, the following pair of equations relate performance to lagged performance and lagged exports:

$$y_{i91} = \beta \cdot y_{i90} + \left[\gamma^{\text{ENT}} \cdot D_{i89}^{\text{ENT}} + \gamma^{\text{EXT}} \cdot (D_{i89}^{\text{EXT}} + D_{i90}^{\text{EXT}}) + \gamma^{\text{ALW}} \cdot D_i^{\text{ALW}} + \gamma^{\text{SWI}} \cdot D_i^{\text{SWI}} \right] \cdot x_{i90} + \eta_i + \lambda_{91} + \varepsilon_{i91}$$

$$y_{i92} = \beta \cdot y_{i91} + \left[\gamma^{\text{ENT}} \cdot (D_{i89}^{\text{ENT}} + D_{i90}^{\text{ENT}}) + \gamma^{\text{EXT}} \cdot D_{i91}^{\text{EXT}} + \gamma^{\text{ALW}} \cdot D_i^{\text{ALW}} + \gamma^{\text{SWI}} \cdot D_i^{\text{SWI}} \right] \cdot x_{i91} + \eta_i + \lambda_{92} + \varepsilon_{i92}$$

(3)

where γ^j , $j=\text{ENT, EXT, ALW, SWI}$ is the coefficient on lagged exports for entrants, exiters, established exporters, and switchers, respectively; D_{it}^{ENT} (D_{it}^{EXT}) is a dummy variable which takes on the value 1 if entrant (exiter) firm i enters (exits) the export

market in year t ; and D_i^{ALW} and D_i^{SWI} are dummy variables which take on the value 1 if the firm always exports or is a switcher. Firms that do not export are excluded.

Although Equation (3) differs slightly from Equation (2) in the sense that there are different right-hand-side variables in the two time periods, it can be estimated in the same manner as before. That is, I first take deviations of all variables from period- and ownership-specific means to eliminate period effects, and then take first-differences to eliminate firm-specific effects. Then, the assumptions that exports are predetermined and that there is no serial correlation in the residual again imply that second and higher lags of firm performance and exports interacted with the various indicator variables are

Table 10: Basic Model Controlling for Export Histories

	Labour Productivity	Total Factor Productivity	Unit Costs
Restricted Model			
Lagged Performance	0.811*** (0.134)	0.474*** (0.046)	0.195*** (0.039)
Lagged Exports	1.188*** (0.254)	0.227** (0.101)	-0.687*** (0.150)
Unrestricted Model			
Lagged Performance	0.778*** (0.145)	0.469*** (0.046)	0.196*** (0.039)
Lagged Exports in Entrants	-5.428* (3.153)	-1.082 (0.667)	-0.275 (0.579)
Lagged Exports in Exitors	0.982 (2.974)	0.236 (1.353)	0.094 (1.758)
Lagged Exports in Established Exporters	1.477*** (0.295)	0.293*** (0.110)	-0.688*** (0.164)
Lagged Exports in Switchers	0.735 (0.743)	0.151 (0.309)	-.801* (0.414)

Note: Model estimated over the period 1991-1992, using second lags of firm performance and exports as instruments.

Standard errors in parentheses. * (**) (***) indicates significance at the 10% (5%) (1%) level.

available as instruments in each period. Note that there is no variation in twice-lagged exports of entrants for $t=1990$ (since exports in 1988 are by definition zero for this group of firms). For this reason, I can only estimate this specification for $t=1991$ and $t=1992$.

The results of this more general specification are presented in Table 10 for the three measures of firm performance. For comparison purposes, the first panel presents the results of re-estimating the restricted model in Equation (1) over the period 1991-1992, which are quite similar to those obtained for the full period. The lower panel allows the coefficient on lagged exports to vary with the export history of the firm. The most striking result which emerges is that learning effects are consistently positive and significant only for established exporters. Among entrants, there is weakly significant evidence that lagged exports are associated with lower current productivity, consistent with the view that entry into export markets is initially costly.

It is somewhat puzzling that learning effects seem to be most pronounced among established exporters -- firms that report positive exports in all five years of the sample. This runs counter to the common intuition that new entrants to export markets should benefit most from exposure to the competitive pressures of global markets. One possible explanation for this relies on the structure of China's trade and foreign exchange institutions, which may have given the exporting firms in the sample preferential access to foreign exchange.¹⁴ If this foreign exchange was used to purchase superior-quality imported capital goods and other inputs, it may account for the association between exports and enterprise performance documented above. However, this explanation is not entirely convincing during the sample period of the late 1980s and early 1990s, at which time a foreign exchange swap market was relatively well-established. Another explanation may simply be that the classification of "established exporters" is misleading. If many of these firms began exporting shortly before the beginning of the sample period in 1988, and if learning from exporting occurs for several years after breaking in to export markets, then the learning effects observed in the

¹⁴ During the 1980s, trade and foreign exchange continued to be subject to considerable regulation. Firms were subject to foreign exchange surrender requirements and had to rely on planned allocations of foreign exchange to finance imports. However, beginning in the early 1980s, firms were allowed to retain limited amounts of above-quota foreign exchange for their own use. See World Bank (1994) for details.

sample may be representative of those experienced by new entrants into export markets.

4. Conclusions

This paper has examined whether firms learn from exporting, in the sense that past exports lead to improvements in current firm performance. In contrast to the findings of other authors for different countries, I find that in this sample of Chinese industrial enterprises, past exports are in fact significantly associated with higher labour productivity and total factor productivity, and with lower unit costs, suggesting that firms do in fact reap efficiency benefits from exporting. It is particularly interesting to note that these sizeable learning effects are present in a sample consisting primarily of state-owned enterprises, which have been widely viewed as being slow to respond to and benefit from China's move to a more market-oriented economy.

These results raise a number of questions for future research. Although the correlation between past exports and current firm performance provides interesting and suggestive evidence of learning from exporting, it is less clear what exactly firms are learning, from whom, and how. Do firms become better at producing their outputs (perhaps thanks to supplier specifications provided by their clients), or do firms simply learn to be better exports (as they develop familiarity with export markets and distribution channels)? Do the benefits of learning accrue solely to the exporting firm, or are their external effects from one firm's exports to another's performance? How long does it take for the benefits of exporting to appear? Answers to these questions will require more detailed investigation and also better data with longer time-series coverage on the precise nature of exporting firms' relationships with their clients and with each other.

Appendix: Data Construction

The variables used in the paper were constructed as follows. Gross output value and materials consumption in current prices are taken directly from the original data set, and their constant 1990 values are obtained using the gross output and materials deflators for state industry reported in Table 3 of Jefferson, Rawski and Zheng (1996). Employment is defined as the period-average workforce, and no attempt is made to adjust for non-production workers. Capital input is measured as the net value of fixed assets, as reported in the data set. This constitutes a very rough measure of capital, particularly because it is likely that firms simply cumulate undeflated annual investments to arrive at this stock.

Total factor productivity is constructed as

$$tfp_{ijt} = q_{ijt} \cdot \left(k_{ijt}^{\alpha_{kjt}} \cdot n_{ijt}^{\alpha_{njt}} \cdot m_{ijt}^{\alpha_{mjt}} \right)^{-1} \quad (A1)$$

where tfp_{ijt} , q_{ijt} , k_{ijt} , n_{ijt} , m_{ijt} , represent total factor productivity, gross output, capital input, labour input and materials input of firm i in sector j respectively. The output elasticities for labour and materials in sector j at time t , α_{njt} and α_{mjt} , are measured as the current price ratios of wages (including bonuses) and materials to gross output in that sector and year. The capital output elasticity is measured as one minus the other two elasticities. Unit costs are constructed as sales revenues divided by cost of goods sold, in current prices.

Constructing export to gross output ratios is complicated by the fact that the data reports exports in current prices for certain years, and in constant prices for other years. For 1988-1990, I take the ratio of exports to gross output at 1980 prices, while for 1991-92 I use the current price ratio. While this splicing of two different measures is undesirable, it may not be too serious. For 1990, it is possible to construct both the current and constant 1980 price ratios, and the correlation across firms in this ratio is very high (0.97).

The original data set consists of 7252 firms. Restricting the sample to those firms with a complete time series on all variables of interest reduces the sample by about two-thirds. The sample of remaining firms was reduced to the final sample of 2105 firms by eliminating firms with obvious coding errors or other extreme outliers in the variables of interest.

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