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Export Growth and Firm Survival*

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Abstract

This paper uses plant–level data from Chile to show that an increase in sector–wide exports decreases the survival probability of exporters, but not that of non–exporters. We argue that this result can be explained by the fact that exporters and non–exporters use factors of production in different intensities.

JEL classification numbers: F14, F16, L11, O54.
Keywords: Firm survival, Chile, manufacturing sectors, firm heterogeneity in factor intensities.

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1 Introduction

Trade models with firm heterogeneity in total factor productivity (TFP) predict that trade liberalization forces the least productive non–exporters to exit the market. This follows from the assumption that there is only one factor of production (e.g., Melitz 2003), or that all firms in a sector produce with the same factor intensities (e.g., Bernard et al. 2007). Thus, rising factor market competition due to trade liberalization increases per–unit costs of all firms by the same proportion, and the sector's least productive firms cease production.

At the same time, empirical evidence suggests that exporters are also more skilled labor intensive than non–exporters even within narrowly defined sectors (e.g., Bernard and Jensen 1999). In addition, exporters tend to produce a higher quality version of their good for exports, at least in developing countries.[1] More recent contributions build on this evidence to allow also for heterogeneity in factor intensities (Harrigan and Resheff 2011, Vannoorenberghe 2011). Still, by assuming that skill intensity and total factor productivity are strongly positively correlated, the theoretical predictions of these models concerning firm selection closely resemble those of Melitz (2003). Emami Namini et al. (2012) consider instead a more general setting in which heterogeneity in TFP and in factor intensities are not necessarily correlated, and can thus separately highlight the effects of the latter on the firm selection process that follows a trade liberalization. Importantly, they show that rising sector–wide exports increase competition for those factors (e.g., skilled labor), which are used intensively by exporters, negatively affecting their profits. For some of the exporters this effect may completely offset the benefits of serving a foreign market, and if the exported (high quality) version of their good cannot be sold domestically at a profit, some of them are forced to exit. The survival of non–exporters, which produce with different factor intensities, is instead unaffected.

The goal of this paper is to empirically assess the role of heterogeneity in factor intensities on firm survival. To this end we use data from Chile covering the years 1990–1999, a period during which the country signed several free trade agreements, which significantly reduced

[1] See Keesing and Lall (1992) and Hallak and Sivadasan (2011) for firm–level evidence and Schott (2004) for sector–level evidence. Fajgelbaum et al. (2011), Hallak and Sivadasan (2011) and Kugler and Verhoogen (2012) also develop theoretical models that can rationalize this choice.

the trade barriers faced by Chilean exporters.[2]

2 Data and methodology

The manufacturing plant–level data come from the Annual Survey of Manufacturing Industries carried out by the National Institute of Statistics of Chile and cover the universe of manufacturing plants with 10 or more workers for the period 1990–1999. The data set includes information on sales, value added, employment, wages, exports, imports of intermediate inputs, industry affiliation (ISIC Rev. 2), and other plants' characteristics. Each plant has a unique identifier which allows us to track plant exit. Table 1 shows the number of plants, exporters and non–exporters in the data set. Table 2 presents descriptive statistics for exporters, non–exporters and the entire sample and simple correlation coefficients among the variables of interest. Plants that export are larger, more productive,[3] more likely to use imported intermediate inputs and to be foreign owned. Importantly, they are also more skill intensive than non–exporters,[4] and as argued by Schott (2004) this is likely to be due to the fact that exporting firms tend to sell higher quality products than their non–exporting counterparts.[5]

To analyze how export growth affects survival we estimate the following probit model:

$$Pr(S_{ij,t+\tau} = 1) = \Phi\left[\beta_1 \log(Exp_{jt}) + \beta_2 \log(Exp_{jt}) \times X_{ij,t} + \lambda' \Omega_{ijt} + \delta_j + \delta_t\right], \qquad (1)$$

where $S_{ij,t+\tau}$ is equal to 1 if plant i from sector j survived between year t and year $t+\tau$. Φ

[2]During the 1990s Chile signed free trade agreements with Canada, Central America, Mercosur and Mexico. It also signed partial free trade agreements with Argentina, Bolivia, Colombia, Ecuador and Venezuela.

[3]We measure TFP as the residual of a regression that estimates a Cobb–Douglas production function for each 3–digit sector using the method proposed by Olley and Pakes (1996) and later modified by Levinsohn and Petrin (2003), which corrects for the simultaneity bias associated with the fact that productivity is not observed by the econometrician, but it may be observed by the firm. In some cases the production functions were estimated at the 2–digit level due to the small number of observations for some sectors at the 3–digit level of disaggregation. We estimated the production function separately for exporters and non–exporters to account for the fact that these two types of firms may produce with different factor intensities.

[4]Notice that, while there is substantial heterogeneity in skill–intensity among exporting firms, both those exporters that survive and those that do not are significantly more skilled labor intensive than non–exporters. These statistics are available on request.

[5]Verhoogen and Kugler (2012) point also to a quality story providing evidence that exporting firms tend to purchase higher quality intermediate goods, which are used to produce higher quality final products.

is the standard normal distribution function, Exp_{jt} measures the exports of sector j in year t and $X_{ij,t}$ is a dummy variable which equals one if plant i exported in year t.[6] Ω_{ijt} is a vector of plant characteristics that includes size (log of employment), TFP (in logs), age (in logs), skill intensity (the share of skilled labor wages in the total wage bill), and dummy variables for plants that import intermediate inputs, have foreign ownership, and those that use foreign technology licenses.[7] δ_t is a year fixed effect that controls for unobserved heterogeneity over time, and δ_j is a 3–digit sector fixed effect that is included in some specifications to control for unobserved heterogeneity at the sector level. All specifications include a measure of multinational corporations presence (the share of foreign–owned plants in value added in each sector and year).[8] Some specifications also include a measure of the size of the sector (either total employment or total value added) to control for the potential effect of market competition on survival, and the Herfindahl index to control for the role of market concentration.

A negative sign for β_2 would suggest that an exporter is less likely to survive τ periods ahead if sector–wide exports increase. The analysis focuses on three–year survival rates ($\tau = 3$), but we have also considered one– and five–year survival rates obtaining similar results.

3 Empirical analysis

Table 3 presents the results of estimating equation (1). We start by including only year fixed effects in columns (1)–(4), and thus exploit the variation across sectors. In columns (5)–(8) we introduce sector fixed effects. Our results are remarkably robust across specifications. Consistent with previous studies,[9] larger, older, more productive plants, those that use imported intermediate inputs and those who use foreign technology licenses are more likely to survive. Plants with foreign ownership are more likely to exit, consistent with the findings of Alvarez and Görg (2009). As in Bernard et al. (2006), skill intensity is negatively correlated with

[6]Since the manufacturing data set includes only plants with at least 10 workers, we use customs data to measure exports of each sector. Using export data reported by the plants leads to virtually identical results.

[7]We have included foreign ownership as a control variable since it is typically found to impact a single plant's survival probability; see, e.g., Bernard and Jensen (2007) or Alvarez and Görg (2009).

[8]As a robustness check, the analysis also uses inflows of FDI at the 2–digit level. The results are not significantly affected when this alternative measure is used.

[9]E.g., Dunne et al. (1989), Salvanes and Tveteras (2004) and López (2006).

plant survival. The proxy for the presence of multinational corporations in the sector has a positive significant effect only in the specifications without sector fixed effects. Market size does not appear to have an independent effect on survival. Columns (4) and (8) include also the sectoral Herfindahl index. The estimate for the Herfindahl index is negative when the sector fixed effects are not included, but positive when included.[10]

Concerning the impact of sector–wide exports on plant survival, Table 3 shows that a higher export volume at the sector level negatively affects the survival probability of exporters, but it does not affect that of non–exporters. The magnitude of the effect on exporters' survival is also economically significant: a 10–percent increase in sector–wide exports today decreases the survival probability of exporters three years ahead by 0.35 to 0.42 percentage points. To put these numbers in perspective, a 10–percent decrease in employment at the plant level decreases the survival probability by 0.40 percentage points.[11]

What drives these findings? Emami Namini et al. (2012) suggest a mechanism that highlights the role of increased competition in factor markets for those factors that are used more intensively by exporters. Table 4 assesses this argument. In column (1) we start by looking at the impact of sectoral exports on the relative wage of skilled labor (in log), and find that an increase in exports positively affects the relative wage exporters pay to skilled labor. In column (2) we show instead that an increase in exports reduces profitability more for exporters than non–exporters. The result of both these specifications provide support for the channel highlighted by Emami Namini et al. (2012).[12] Furthermore, these authors also show that a greater heterogeneity in factor intensities between exporters and non–exporters within a sector magnifies the adverse effect of exports on the survival probability of exporters compared to non–exporters. We study this possibility by introducing a triple interaction term

[10]This result is consistent with the idea that firms in more concentrated sectors may be less likely to survive because they are more exposed to aggressive behavior by their rivals. But within a sector, an increase in concentration may increase price–cost margins and therefore increase survival probability.

[11]In two alternative specifications available upon request, we have also controlled for sector–wide imports and restricted the sample to plants which employed at least 20 workers during all their years of operation, respectively. The first specification allows us also to capture the impact of increased competition in the domestic goods market due to trade liberalization. The second specification corrects for the bias that might result from exporters falling out of the sample just because they fall below the survey's threshold of 10 employees, not because they die. The underlying assumption is that no exporter will release more than half of its workforce, and continue with production. The key results are qualitatively unaffected.

[12]We would like to thank an anonymous referee for suggesting these specifications.

between sector exports, a firm's export status, and a dummy variable equal to 1 for sectors in which the difference in skill intensity (the share of skilled wages in the total wage bill)[13] between the median exporter and the median non–exporter is larger than that of the median sector. The total effect of a change in sector exports on the survival probability of exporters in sectors with a high skill intensity gap is the sum of the direct effect of exports on the survival of exporters, plus the additional effect of exports on survival probability in sectors with high skill intensity gap. Columns (3)–(6) of Table 4 show the results. We see that the estimates for the interaction terms between exports and the export dummy are still negative and significant. The estimated coefficients suggest that a 10–percent increase in exports today reduces the probability of survival of exporters three years later by about 0.17–0.28 percentage points, but the effect is larger for exporters that operate in sectors with a high skill intensity gap, as indicated by the negative and significant estimate of the triple interaction term. Including the additional effect of exports in sectors with a high skill intensity gap, we obtain that a 10–percent increase in exports reduces the survival probability of exporters in these sectors by 0.48–0.56 percentage points, thus doubling the overall effect of export growth. In summary, an increase in exports reduces exporters' survival probability, and the effect is larger in sectors in which the skill intensity gap between exporters and non–exporters is large.

One concern with our results is the possibility that the survival probability of exporters might influence sector–wide exports. If this is the case, our estimates may suffer from an endogeneity bias. To address this issue, we instrument exports in equation (1) using a measure of the level of foreign income relevant for each 3–digit sector.[14] The exclusion restriction requires foreign income to be correlated with exports but not with any other factors that affect the exporters' survival probability. This assumption is likely to be satisfied as changes in foreign income directly affect the demand for Chilean products and, thus, exports, but do not affect the survival probability of exporters other than through exports. The instrument, on the other hand, is likely to be correlated with the level of exports. Indeed, the estimate

[13]This measure has been used by, amongst others, Pavcnik (2003).

[14]This is computed as a weighted average of the per capita GDP of the 15 main export destination countries of each sector. The 15 main destination countries of each sector receive the majority of Chilean exports. Their share in total exports of the sector ranges from 81.2% to 99.5%. The average share across all sectors is 92%.

for the instrument in the first stage is positive and significant, and it passes the F–test for the exclusion restriction (Staiger and Stock 1997). Table 5 shows the results of using this IV procedure, which confirm our previous findings.[15]

4 Conclusions

This paper has found that an increase in exports at the sector level reduces the survival probability of exporters but not that of non–exporters. This finding is puzzling in the light of the existing theoretical literature which, following Melitz (2003), has focused on firm heterogeneity in total factor productivity. In a standard setting à la Melitz, an increase in sector–wide exports leads exporting plants to become larger, without reducing their number. Similar results have been obtained by recent models that allow also for heterogeneity in factor intensities, but assume that skill intensity and total factor productivity are strongly positively correlated (Harrigan and Resheff 2011, Vannoorenberghe 2011). The empirical evidence we have uncovered suggest instead that heterogeneity in factor intensities does play a separate role on firm survival, that needs to be studied more closely.

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[15] In an additional specification available upon request, we have also controlled for the direct effect of foreign tariff changes on the survival probability of Chilean manufacturing plants. Including this measure does not affect the sign and significance of our results on export volumes. We have decided not to include tariffs in our benchmark specification as in the case of the preferential agreements signed by Chile during our sample period, reductions in non–tariff barriers have most likely played a bigger role than tariff reductions, but we cannot precisely measure them.

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TABLE 1: Number of Plants by Export Status

	Exporters	Non–Exporters	Total	% of Exporters
1990	758	3,816	4,574	16.6
1991	910	3,848	4,758	19.1
1992	979	3,952	4,931	19.9
1993	1,053	3,983	5,036	20.9
1994	1,112	3,966	5,078	21.9
1995	1,129	3,978	5,107	22.1
1996	1,163	4,284	5,447	21.4
1997	1,101	3,859	4,960	22.2
1998	1,052	3,763	4,815	21.8
1999	917	3,483	4,400	20.8
Average 1990–99	1,017	3,893	4,911	20.7

TABLE 2: Descriptive Statistics: Mean Values and Correlation Coefficients (1990–1999)

	Mean Values							
	Export dummy	Employment (log)	Importer intermediate inputs dummy	TFP (log)	Share of skilled wages in wage bill	Foreign ownership dummy	Foreign technology licenses dummy	Age (log)
All Plants	0.23	3.75	0.26	7.03	0.38	0.06	0.06	2.14
Exporters	1	4.67	0.56	7.26	0.47	0.15	0.15	2.21
Non–Exporters	0	3.48	0.18	6.83	0.35	0.03	0.03	2.11
	Correlation Coefficients							
	Export dummy	Employment (log)	Importer intermediate inputs dummy	TFP (log)	Share of skilled wages in wage bill	Foreign ownership dummy	Foreign technology licenses dummy	Age (log)
Export dummy	1							
Employment (log)	0.48	1						
Importer intermediate inputs dummy	0.37	0.39	1					
TFP (log)	0.24	0.33	0.22	1				
Share of skilled wages in wage bill	0.22	0.22	0.32	0.23	1			
Foreign ownership dummy	0.20	0.18	0.19	0.13	0.17	1		
Foreign technology licenses dummy	0.20	0.24	0.20	0.13	0.16	0.17	1	
Age (log)	0.05	0.16	0.12	0.07	0.09	-0.01	0.05	1

TABLE 3: Three–year Survival Probability: Probit (Marginal Effects)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
3–digit sector exports	0.006	0.004	0.004	0.004	-0.012	-0.011	-0.005	-0.010
	(2.93)**	(1.28)	(1.18)	(2.05)*	(1.59)	(1.44)	(0.60)	(1.29)
3–digit sector exports × Export dummy	-0.030	-0.030	-0.030	-0.030	-0.030	-0.030	-0.030	-0.030
	(6.61)**	(6.61)**	(6.60)**	(6.60)**	(6.34)**	(6.34)**	(6.30)**	(6.33)**
Export dummy	0.300	0.299	0.300	0.301	0.300	0.300	0.300	0.300
	(6.31)**	(6.31)**	(6.30)**	(6.30)**	(6.05)**	(6.05)**	(6.01)**	(6.04)**
Employment	0.040	0.040	0.041	0.040	0.040	0.040	0.040	0.040
	(12.11)**	(12.10)**	(12.14)**	(12.07)**	(11.84)**	(11.82)**	(11.83)**	(11.85)**
Imports intermediate inputs dummy	0.053	0.053	0.053	0.052	0.055	0.055	0.055	0.055
	(8.41)**	(8.43)**	(8.41)**	(8.35)**	(8.30)**	(8.30)**	(8.31)**	(8.31)**
Total factor productivity (TFP)	0.037	0.037	0.037	0.038	0.041	0.041	0.042	0.042
	(13.64)**	(13.56)**	(13.60)**	(13.37)**	(14.04)**	(13.97)**	(14.01)**	(14.07)**
Share skilled wages total wage bill	-0.050	-0.049	-0.050	-0.050	-0.046	-0.046	-0.046	-0.046
	(3.76)**	(3.65)**	(3.85)**	(3.76)**	(3.55)**	(3.55)**	(3.55)**	(3.55)**
Foreign ownership dummy	-0.128	-0.128	-0.128	-0.129	-0.126	-0.126	-0.126	-0.126
	(9.18)**	(9.14)**	(9.17)**	(9.29)**	(9.46)**	(9.47)**	(9.46)**	(9.47)**
Foreign technology licenses dummy	0.019	0.019	0.019	0.019	0.022	0.022	0.022	0.022
	(1.91)+	(1.90)+	(1.87)+	(1.86)+	(2.31)*	(2.31)*	(2.32)*	(2.32)*
Age	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
	(12.71)**	(12.74)**	(12.71)**	(12.78)**	(12.66)**	(12.59)**	(12.65)**	(12.65)**
3–digit share of MNC in value added	0.094	0.099	0.092	0.109	-0.004	-0.012	-0.008	-0.003
	(3.43)**	(3.29)**	(3.38)**	(3.49)**	(0.08)	(0.21)	(0.14)	(0.06)
3–digit sector employment		0.004				-0.036		
		(0.65)				(1.18)		
3–digit sector value added			0.003				-0.027	
			(0.63)				(1.23)	
Herfindahl Index				-0.145				0.397
				(2.23)*				(1.88)+
Sector FE	No	No	No	No	Yes	Yes	Yes	Yes
Pseudo R–squared	0.080	0.080	0.080	0.080	0.085	0.085	0.085	0.085
Observations	29,968	29,968	29,968	29,968	29,968	29,968	29,968	29,968

Robust *z*–statistics in parentheses. + significant at 10%; * significant at 5%; ** significant at 1%. Standard errors were clustered at the 3–digit sector–year level. All regressions include year dummy variables. Exports, productivity, age, employment, and value added are in logs.

Table 4: Export Growth and Survival – Understanding the Mechanisms

	(1)	(2)	(3)	(4)	(5)	(6)
	Skilled Wage / Unskilled Wage	(Sales–Payroll)/ Sales	Survival Prob.	Survival Prob.	Survival Prob.	Survival Prob.
3–digit sector exports	0.005	-0.007	-0.010	-0.008	0.001	-0.008
	(0.37)	(1.80)+	(1.17)	(0.95)	(0.10)	(0.93)
3–digit sector exports × Export dummy	0.054	-0.008	-0.018	-0.018	-0.018	-0.018
	(4.73)**	(3.58)**	(2.65)**	(2.66)**	(2.60)**	(2.64)**
Export dummy	-0.811	0.143	0.208	0.208	0.205	0.207
	(4.40)**	(3.61)**	(2.35)*	(2.36)*	(2.29)*	(2.34)*
High skill gap sector			0.011	0.022	0.033	0.001
			(0.17)	(0.31)	(0.49)	(0.01)
3–digit sector exports × High skill gap sector			-0.001	-0.002	-0.003	-0.001
			(0.33)	(0.46)	(0.66)	(0.21)
High skill gap sector × Export dummy			0.229	0.228	0.230	0.229
			(3.08)**	(3.07)**	(3.11)**	(3.09)**
3–digit sector exports × High skill gap sector × Export dummy			-0.027	-0.027	-0.028	-0.027
			(3.07)**	(3.07)**	(3.10)**	(3.09)**
Employment	0.121	-0.021	0.040	0.040	0.040	0.040
	(14.49)**	(14.49)**	(11.88)**	(11.86)**	(11.87)**	(11.89)**
Imports intermediate inputs dummy	-0.090	0.032	0.054	0.054	0.054	0.054
	(6.70)**	(7.27)**	(8.18)**	(8.18)**	(8.16)**	(8.19)**
Total factor productivity (TFP)	0.035	0.042	0.042	0.042	0.042	0.042
	(4.92)**	(17.72)**	(13.63)**	(13.56)**	(13.58)**	(13.65)**
Share skilled wages total wage bill	1.323	0.004	-0.047	-0.047	-0.047	-0.047
	(25.83)**	(0.61)	(3.74)**	(3.75)**	(3.76)**	(3.74)**
Foreign ownership dummy	-0.034	-0.005	-0.127	-0.127	-0.127	-0.127
	(3.17)**	(1.10)	(9.56)**	(9.56)**	(9.56)**	(9.57)**
Foreign technology licenses dummy	-0.109	0.012	0.021	0.021	0.021	0.021
	(6.53)**	(3.57)**	(2.28)*	(2.28)*	(2.29)*	(2.29)*
Age	0.007	-0.003	0.040	0.040	0.040	0.040
	(1.20)	(1.61)	(12.57)**	(12.49)**	(12.55)**	(12.54)**
3–digit share of MNC in value added			-0.013	-0.021	-0.019	-0.012
			(0.25)	(0.39)	(0.35)	(0.23)
3–digit sector employment				-0.038		
				(1.24)		
3–digit sector value added					-0.040	
					(1.89)+	
Herfindahl Index						0.483
						(2.20)*
R–squared / Pseudo R–squared	0.262	0.147	0.085	0.085	0.085	0.085
Observations	29,968	29,968	29,968	29,968	29,968	29,968

Robust *t*–statistics in parentheses (*z*–statistics for probit). +, *, ** significant at 10%, 5%, 1%, respectively. Standard errors were clustered at the 3–digit sector–year level. Regressions include sector and year dummies. Exports, productivity, age, employment, and value added are in logs. Columns (3)–(6): Marginal effects from probit estimation.

TABLE 5: Three–year Survival Probability: IV Probit (Two–Step Estimation)

	(1)	(2)	(3)	(4)
3–digit sector exports	-0.009	0.008	0.009	-0.029
	(0.10)	(0.09)	(0.09)	(0.37)
3–digit sector exports × Export dummy	-0.137	-0.137	-0.137	-0.138
	(5.14)**	(5.20)**	(4.90)**	(5.80)**
Export dummy	2.223	2.224	2.220	2.238
	(5.00)**	(5.08)**	(4.76)**	(5.67)**
Employment	0.151	0.151	0.151	0.151
	(13.10)**	(13.88)**	(11.96)**	(14.95)**
Imports intermediate inputs dummy	0.215	0.215	0.214	0.214
	(8.11)**	(8.70)**	(8.88)**	(8.31)**
Total factor productivity (TFP)	0.158	0.157	0.159	0.158
	(15.15)**	(16.09)**	(17.05)**	(16.85)**
Share skilled wages total wage bill	-0.173	-0.173	-0.174	-0.174
	(3.65)**	(3.55)**	(3.80)**	(3.35)**
Foreign ownership dummy	-0.412	-0.412	-0.412	-0.412
	(10.48)**	(10.37)**	(10.86)**	(10.75)**
Foreign technology licenses dummy	0.082	0.082	0.082	0.082
	(1.75)+	(1.65)+	(2.02)*	(1.93)+
Age	0.151	0.151	0.151	0.151
	(14.67)**	(15.79)**	(15.70)**	(13.70)**
3–digit share of MNC in value added	-0.020	-0.052	-0.035	-0.014
	(0.09)	(0.26)	(0.18)	(0.08)
3–digit sector employment		-0.155		
		(1.26)		
3–digit sector value added			-0.131	
			(0.88)	
Herfindahl Index				1.514
				(1.57)
Observations	29,968	29,968	29,968	29,968

z–statistics in parentheses, based on bootstrapped standard errors (200 reps.) + significant at 10%; * significant at 5%; ** significant at 1%. Standard errors were clustered at the 3–digit sector–year level. Sector and year dummy variables included. Exports, Sales, Productivity, Age, Employment, and Value Added in logs.