International Review of Economics and Finance 25 (2013) 185–201

Contents lists available at SciVerse ScienceDirect

International Review of Economics and Finance

journal homepage: www.elsevier.com/locate/iref

Trade exposure, survival and growth of small and medium-size firms

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ARTICLE INFO

Article history:
Received 20 October 2011
Received in revised form 11 July 2012
Accepted 12 July 2012
Available online 20 July 2012

JEL classifications:
L11
L25
F13

Keywords:
SMEs
Trade liberalization
Survival
Firm growth

ABSTRACT

In this paper we analyze the relationship between survival, employment growth and firm size in Chile, an economy that has reduced largely its trade barriers in the last three decades. We are particularly interested in analyzing whether the small and medium sized enterprises (SMEs) in the manufacturing sector have experienced negative effects on their survival probability and employment growth over time. Our results do not suggest that higher trade exposure affects negatively the SMEs performance. To better identify these effects, we exploit differences in trade flows across manufacturing industries. We find that SMEs are more likely to survive in industries with higher exposure to international trade. In terms of employment growth, we do not find that SMEs are more negatively affected by higher international competition.

1. Introduction

The ongoing process of globalization and the increasing international competition generates interesting questions on their effects on the performance of small and medium sized enterprises (SMEs). It has been argued that the theoretical impact of higher competition, driven by trade liberalization, on the performance of SMEs is unclear (Asiedu & Freeman, 2007; Colantone, Coucke, & Sleuwagen, 2010). Some have discussed that these firms could be negatively affected by the higher trade exposure because of their disadvantaged position to face competition in domestic markets, especially in developing countries which are characterized by weak development of capital markets. On this regard, UNCTAD (2004) has indicated that: "Trade liberalization increases the ability of well-established foreign manufacturers and retailers to penetrate remote and underdeveloped markets and makes it increasingly difficult for SMEs to survive or maintain their business position in the local and, if applicable, the global market."

This view is consistent with the idea that trade liberalization and competition is more hostile to SMEs. This belief is associated mainly to the disadvantages of "being small", among them, the high relative costs of learning about foreign markets and adopting new technologies and lower potential of taking advantage of economies of scale. In fact, most of the empirical literature on export performance shows that smaller firms are less likely to export than larger firms (see, for example, Roberts & Tybout, 1997; Bernard & Jensen, 1999).

Additionally, there are arguments regarding information asymmetries affecting the abilities of SMEs to access financial markets (Cooley & Quadrini, 2001). It is well known in the literature since Stiglitz and Weiss (1981) that financial constraints can be originated by the existence of adverse selection and moral hazard. These problems arise because debtors have better

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doi:10.1016/j.iref.2012.07.010

information about her project quality and effort. SME lending would be more affected by financial constraints because, compared to large firms, SMEs are commonly more opaque, less likely to have collateral and often do not have audited financial statements (Beck, 2007). The evidence across countries provided by Beck, Demirgüç-Kunt, and Martínez Pería (2011) and Beck, Demirgüç-Kunt, and Maksimovic (2005) show that small firms have less access to finance and this contributes to slower firm growth.[2] Hall and Lerner (2010) review the literature on innovation and financing and they conclude that small and innovative firms face higher costs of capital than old and large firms. These financing constraints for small firms are only partly mitigated by the presence of venture capital.

By contrast, other authors have highlighted some advantages of SMEs for adapting to the global economy. Audretsch (2004) argues that SMEs would be in better position from competing in the globalized market as comparative advantage has shifted toward knowledge based economy. Given that small firms have a less bureaucratic environment relative to large firms, they are more able to promote the generation of new process and products needed to survive in more competitive markets.[3] In a related view, Buckley (1997) discusses that SMEs can be a source of international technology transfers of small scale technologies, labour intensive technologies and specialized high-technology know-how.

Colantone et al. (2010) indicates two specific reasons why foreign competition can have heterogeneous effects depending on firm size. First, small firms can adapt to changing demand conditions more easily than large firms because they are normally characterized by higher output flexibility. Second, small firms can avoid direct competition through products specialization in specific niche markets. These ideas have been formalized by Holmes and Stevens (2010) in a model where industries are made up of large plants producing standardized goods and small plants making custom or specialty goods. They find evidence consistent with the predictions of the model, using the huge increment of imports from China in the U.S. manufacturing as proxy for foreign competition, showing that large-scale standardized plants were relatively more impacted than small-scale specialty plants.[4]

The empirical evidence on these issues is, however, largely related to developed countries, while empirical analysis for developing countries is quite scant. In the collection of 24 papers on SMEs and globalization edited by David B. Audretsch (2003), none of them address the issue of how trade liberalization has affected SME's performance in a developing country. Some exceptions are, for example Peres and Stumpo (2000), who compare the performance of SMEs in terms of production, employment and productivity for a sample of Latin America countries before and after the adoption of economic reforms. They conclude that, despite the heterogeneity in SMEs performance across countries, these firms are not the "losers" under the new economic model. These authors, however, only analyze aggregate data and little is known about firm behavior.

There are many other papers studying firm growth and survival in developing countries.[5] Most of these studies, however, are cross-section analysis and do not explore whether the relationship between firm size and survival and growth has changed overtime. Moreover, only few of them incorporate explicitly the role of trade related variables. Hence, this paper has more in common with Baggs (2005) and Greenaway, Gullstrand, and Kneller (2008). Baggs (2005) analyzes the effects of the Canada-US Free Trade Agreement on the survival rates of Canadian manufacturing firms. The empirical evidence suggests that the net effect of the free trade agreement is positive for most of the firms.[6] Greenaway et al. (2008) investigates the impact of international competition on Swedish firm's exit. The empirical results shows that higher levels of competition increases the probability of exit by merger and closedown, and that probability of switching industries is higher for firms operating in comparative disadvantages industries.[7]

These empirical studies, however, only focus on survival and do not address issues related to employment growth. In this paper we try to fill some of the gaps in the literature regarding how SMEs adapt to a higher international competition. In particular, we are interested in studying the impact of international trade exposure on firm survival and employment growth in a country that have undertaken a profound process of economic liberalization. To do so, we employ data for Chilean manufacturing firms over the period 1979 to 1999. Along this period, trade barriers were significantly reduced and trade flows increased consistently. Fig. 1 illustrates how reductions in average tariffs from 35% in 1984 to 10% in 1999 were accompanied by increases in manufacturing trade flows (export plus imports over output) from less than 40% to almost 60% in the same period.

In this paper we are interested in answering two main questions. First, how the probability of survival and employment growth have changed over time for different firm sizes? Second, how the probability of survival and growth for SMEs differ across industries? To shed light on the effects of trade liberalization, we follow the literature on treatment effects and choose, consistently with an increase in trade flows during the last decade, a treated group — sectors with high trade exposure and a control group — sectors with low trade exposure. Using these two groups of industries, we analyze how trade exposure has affected SMEs survival and growth.

Our findings reveal that SMEs are more likely to exit than large firms, but once they survive they tend to growth faster. This is consistent with most of previous empirical evidence on firm growth and survival (*e.g.*, Bartelsman, Scarpetta, & Schivardi, 2005; Lotti & Santarelli, 2004; Audretsch, Santarelli, & Vivarelli, 1999). What is novel in our results is that we are able to find evidence

[2] For a theoretical model on the effects of credit rationing on firm decisions, see Das (2004).

[3] Acs, Morck, Shaver, and Yeung (1996), focusing on property rights, argue that smaller firms are usually more able to promote innovation as innovators in these firms are more likely to appropriates benefits. By contrast, innovators have a very limited property rights protection in large corporations, thus, new process and products usually belong to the firm.

[4] Colantone et al. (2010) find similar evidence of the impact of foreign competition on firm exit for eight European countries.

[5] See, for example, Van Biesebroeck (2005), Correa, Acosta, González, and Medina (2005), Sleuwaegen and Goedhuys (2002), Bechetti and Trovato (2002), Mead and Liedholm (1998) and McPherson (1996).

[6] This evidence is not conclusive regarding the effect of competition by firm size. It is found that larger firms were better able to adapt to increased competition with U.S. firms when sales is used for measuring size. However, if size is measured by employment, the opposite result is obtained.

[7] In the case of Chile Álvarez and Görg (2009) explore a related issue focusing on the effect of foreign ownership on firm exit. They conclude that foreign plants are more likely to exit the economy only during the late 1990s, when the Chilean economy experienced a massive slowdown.

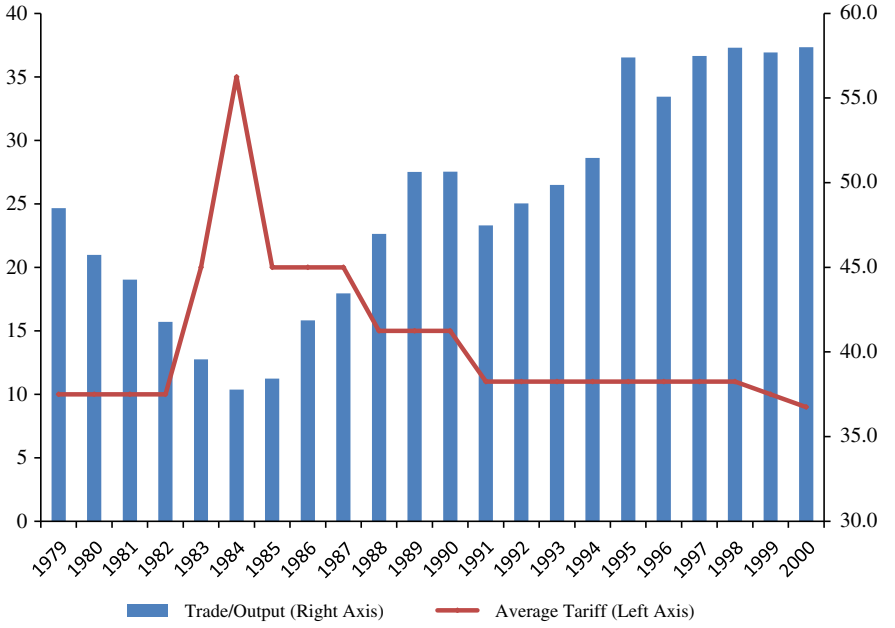

Fig. 1. Average tariff and trade flows.
(Source: Authors' elaboration based on Industrial Dynamics Analysis Program (ECLAC-UN).)

that chances of survival and growth have not been significantly reduced by trade liberalization. When controlling for industry-differences in trade exposure, we find that SMEs are more likely to survive in high-trade industries. In terms of employment growth, we do not find that SMEs are negatively affected by more intense external competition.

The remainder of this paper is structured as follows. In the second section we describe our dataset and motivate our empirical exercise by showing how survival and employment growth varies by firm size and over time. In the third section, we present the empirical approach and discuss the main hypotheses. In the fourth section we show our results. Finally, the fifth section concludes.

2. Data and main patterns

Our empirical analysis is based on the Annual National Industrial Survey (ENIA) carried out by the National Institute of Statistics of Chile (INE) for the years 1979 through 1999. This survey covers all Chilean manufacturing firms with 10 or more workers.[8] This sampling criterion implies that our results are only valid for a segment of small and medium-sized firms. It may be possible that smaller firms are more affected by trade liberalization that we could find in this paper. Unfortunately, we do not have data to assess the evidence on micro firms (those with employment lower than 10 workers). However, as we a do in this paper, a comparison of results for small and medium firms may shed light on the relevance of this issue.

The INE updates the survey annually by incorporating firms that started operating during the year and by excluding those firms that stopped operating. Each firm has a unique identification number which allow us to identify entry and exit. We define exit between year t and t + s as the case in which a firm appears in period t, but not in period t + s. Given that existing firms in t may be not surveyed in t + s because employment was reduced below 10 workers, we do not consider exit in the case firms appear again later on the sample. Then, our definition of exit considers firm closures and some firms that permanently reduced their employment below the sample criterion.[9]

For each firm and year, ENIA collects data on production, value added, sales, employment and wages (production and non-production), exports, investment, depreciation, energy usage, foreign licenses, and other firm characteristics. In addition, firms are classified according to the International Standard Industrial Classification (ISIC) rev. 2. In Table 1, we show the industry classification study and the distribution of observation across industries. Using 3-digit industry level price deflators, all monetary variables were converted to constant pesos of base year 1985.

[8] ENIA collects the statistical information at plant level. Unfortunately, we only have information of plants belonging to a same firm from 1979 to 1985. This is a limitation for addressing issues regarding how plant closures or employment growth is a consequence of strategic decisions or shocks at firm level. However, we think our results are not affected by this problem. First, most of the plants are single-plant firms. For the period where we have this information, more than 92% of plants are single-plant firms. Second, we have estimated our models for this period for all plants and for single-plant firms. The results, available upon request, are very similar to those presented here.

[9] Firms that drop out of the dataset but then reappear later are not included in the analysis.

We use two dummy variables for small and medium-sized firms, which are defined according to total employment. We consider as small-sized firm to those with less than or equal to 50 workers, and medium-sized firms to those with more than 50 workers and less than 150 workers.

One potential advantage of this dataset is that we are able to identify firm exit and employment growth for each year. Thus, we could work with an annual panel of firms. Some reasons prevent us from choosing such a short time interval. First, it may be argued that the effect of international competition may take time to materialize. Whenever firms do not immediately internalize changes in profitability in their decisions, we need some period of time for identifying such impact. Hence, we allow for an adjustment lag. Second, using five-year periods to define firm survival and employment growth, we may exploit interesting changes in trade liberalization and aggregate economic performance. The first period, 1979–1984, is characterized by an increase in tariffs from 11 to 35%, and a two-year recession. It is worthy to note that since 1979 tariffs in Chile are uniform across industries. In contrast, the two intermediate periods (1984–1989 and 1989–1994) are those where the economy jointly continued with their process of trade liberalization and experienced high rates of economic growth. Between 1984 and 1989, tariff was reduced from 35 to 15%, and GDP growth expanded annually at 6.5% per year. During 1989–1994, tariff –always across the board- was reduced again from 15 to 11%, and GDP grew at 6.6% per year. In the final period, 1994–1999, the tariff was reduced only from 11 to 10%, but the economy experienced its first recession in almost two decades.

In Table 2 (panel A), we show the survival probability for all manufacturing firms for each of the 5-year periods under study. It can be appreciated that there is not a monotonic relationship between survival and time. Compared to the period 1979–1984, the two following periods (19841989 and 1989–1994) display an increase in the chances of survival. In the final period, there is a huge increment in the exit of firms; only about 58% of manufacturing firms were able to survive between 1994 and 1999. This behavior in firm survival is fairly consistent with aggregate shocks hitting the Chilean economy. As we discussed above, both the initial and final periods the economy were affected by a recession. In 1982 the GDP growth was −12.0%, and in 1999 was −0.5%.

In Table 2 we also show the survival probability for different periods according to firm size. Three main facts are worthy to mention. First, survival rate decreases with firm size. The simple average for survival probability is 66.3 per cent for small firms, it increases to 75.5 for medium-sized firms, and to 82.0 per cent for large firms. Second, for all firm sizes, survival probability tends to be lower in extreme periods, and higher in the two intermediate ones. Third, firms indeed tend to behave different during the periods of economic expansions. Comparing 1984–1989 and 1989–1994, it can be appreciated that survival probability increased for small firms, but it decreased for medium and large firms.

In Table 2 (panel B), we show (simple average) employment growth for each 5-year period and according to firm size. The evidence shows that there are important differences in employment growth over time and across groups of firms. First, consistent with stylized facts for other economies, there is negative relationship between growth and size: smaller firms tend to grow faster than large ones. Second, similar to firm survival, there are two regimes in our dataset. The two intermediate periods are ones with employment growth, and coincide with overall output expansion. The first and fourth period, by contrast, show null or declining employment expansion. It is interesting to note that in these two periods, aggregate negative effects tend to be less pronounced for smaller firms. Indeed small firms are the only ones expanding employment in the period 1979–1984. Note that in Table 2, small firms are also less likely to survive. This would be consistent with the idea that economic crises generate more than proportionately exit in smaller firms, but those that survive are able to grow more rapidly than large firms.

3. Empirical approach

We are interested in analyzing which factors affect firm survival and growth, and especially in how the influence of firm size has changed over time and across industries. To do that, first, we estimate a Probit model for the probability of survival including as explanatory variables firm and industry characteristics. Secondly, we study the determinants of firm employment growth. Given that we only observe surviving firms, we follow Evans (1987a, 1987b) and Doms, Dunne, and Roberts (1995) by using a maximum likelihood Heckman procedure to correct for sample selection.

3.1. Survival probability

For studying the determinants of firm survival, we estimate the following equation:

$$\Pr\left(Survival_{ij\Delta t}\right) = f\left(\alpha + \beta X_{it} + \gamma Z_{jt} + d_j + d_{\Delta t} + \varepsilon_{ij\Delta t}\right)$$

where $\Pr(\text{Survival}_{ij\Delta t})$ is the probability of survival of firm i located in industry j during the period Δt, X_{it} is a vector of firm characteristics and Z_{jt} is a vector of industry characteristics. d_j is an industry-specific effect, and $d_{\Delta t}$ is period-specific effect. All X and Z variables are measured at t, that is, at the beginning of the interval Δt. Industries are classified according to their 4-digit ISIC. Consistent with our choice of a five-year period, a surviving firm is defined as the case of a firm operating in year t and in $t+5$.

Following the previous literature, the vector X of firm-specific variables includes characteristics that are expected to affect survival. We consider the impact of total factor productivity (TFP), capital-labor ratio, skilled ratio, age, and two dummy variables by firm size corresponding to small and medium-sized firms. Then, we are comparing firms respect to a base category corresponding to large firms (more than or equal to 150 workers). To measure productivity at the firm level we estimate a Cobb–Douglas production function for each 3-digit industry using the method proposed by Olley and Pakes (1996) and later modified by Levinsohn and Petrin (2003a, 2003b), which corrects for the simultaneity bias since productivity is not observed by the

Table 1
Industry classification.
Source: Authors' calculation based on ENIA 1979–1999.

ISIC	Description	%
3111	Slaughtering, preparing and preserving meat	2.23
3112	Manufacture of dairy products	1.18
3113	Canning and preserving of fruits and vegetables	1.65
3114	Canning, preserving and processing of fish, crustaceans and similar foods	2.53
3115	Manufacture of vegetable and animal oils and fats	1.05
3116	Grain mill products	1.83
3117	Manufacture of bakery products	17.23
3118	Sugar factories and refineries	0.13
3119	Manufacture of cocoa, chocolate and sugar confectionery	0.51
3121	Manufacture of food products not elsewhere classified	1.08
3122	Manufacture of prepared animal feeds	0.45
3131	Distilling, rectifying and blending spirits	0.35
3132	Wine industries	1.31
3133	Malt liquors and malt	0.23
3134	Soft drinks ad carbonated waters industries	0.51
3140	Tobacco manufactures	0.07
3211	Spinning, weaving and finishing textiles	3.04
3212	Manufacture of made-up textile goods except wearing apparel	0.83
3213	Knitting mills	3.14
3214	Manufacture of carpets and rugs	0.33
3215	Cordage, rope and twine industries	0.09
3219	Manufacture of textiles not elsewhere classified	0.09
3220	Manufacture of wearing apparel, except footwear	6.64
3231	Tanneries and leather finishing	0.67
3232	Fur dressing and dyeing industries	0.02
3233	Manufacture of products of leather and leather substitutes, exc. footwear and wearing apparel	0.41
3240	Manufacture of footwear, except vulcanized or moulded rubber or plastic footwear	3.04
3311	Sawmills, planing and other wood mills	6.73
3312	Manufacture of wooden and cane containers and small cane ware	0.42
3319	Manufacture of wood and cork products not classified elsewhere	0.38
3320	Manufacture of furniture and fixtures, except primarily of metal	2.99
3411	Manufacture of pulp, paper and paperboard	0.38
3412	Manufacture of containers and boxes of paper and paperboard	0.55
3419	Manufacture of pulp, paper and paperboard articles not classified elsewhere	0.51
3420	Printing, publishing and allied industries	4.21
3511	Manufacture of basic industrial chemicals except fertilizers	0.87
3512	Manufacture of fertilizers and pesticides	0.12
3513	Manufacture of synthetic resins, plastic materials and man-made fibres except glass	0.20
3521	Manufacture of paints, varnishes and lacquers	0.53
3522	Manufacture of drugs and medicines	0.93
3523	Manufacture of soap and cleaning preparations, perfumes, cosmetics and other toilet prep.	0.82
3529	Manufacture of chemical products not classified elsewhere	1.36
3530	Petroleum refineries	0.09
3540	Manufacture of miscellaneous products of petroleum and coal	0.33
3551	Tyre and tube industries	0.42
3559	Manufacture of rubber products not classified elsewhere	0.80
3560	Manufacture of plastic products not classified elsewhere	4.28
3610	Manufacture of pottery, china and earthenware	0.32
3620	Manufacture of glass and glass products	0.44
3691	Manufacture of structural clay products	0.47
3692	Manufacture of cement, lime and plaster	1.71
3699	Manufacture of non-metallic mineral products not classified elsewhere	0.49
3710	Iron and steel basic industries	0.73
3720	Non-ferrous metal basic industries	0.76
3811	Manufacture of cutlery, hand tools and general hardware	0.51
3812	Manufacture of furniture and fixtures primarily of metal	0.92
3813	Manufacture of structural metal products	4.95
3819	Manufacture of fabricated metal products exc. Mach. and equip. not classified elsewhere	2.23
3821	Manufacture of engines and turbines	0.04
3822	Manufacture of agricultural machinery and equipment	0.35
3823	Manufacture of metal and woodworking machinery	0.30
3824	Manufacture of special industrial mach. and equip. exc. metal and woodworking mach.	0.65
3825	Manufacture of office, computing and accounting machinery	0.08
3829	Machinery and equipment except electrical not classified elsewhere	2.21
3831	Manufacture of electrical industrial machinery and apparatus	0.41
3832	Manufacture of radio, television and communication equipment and apparatus	0.10
3833	Manufacture of electrical appliances and household goods	0.16

(continued on next page)

Table 1 (*continued*)

ISIC	Description	%
3839	Manufacture of electrical apparatus and supplies not classified elsewhere	0.63
3841	Shipbuilding and repairing	0.42
3842	Manufacture of railroad equipment	0.11
3843	Manufacture of motor vehicles	1.45
3844	Manufacture of motorcycles and bicycles	0.17
3845	Manufacture of aircraft	0.01
3849	Manufacture of transport equipment not classified elsewhere	0.13
3851	Manufacture of prof. and scient., and meas. and controlling equip., not class. elsewhere	0.29
3852	Manufacture of photographic and optical goods	0.10
3853	Manufacture of watches and clocks	0.00
3901	Manufacture of jewellery and related articles	0.06
3902	Manufacture of musical instruments	0.04
3903	Manufacture of sporting and athletic goods	0.12
3909	Manufacturing industries not classified elsewhere	1.04
	Total	100

econometrician but may be observed by the firm. The capital-labor ratio is firm capital stock over total employment. The skilled ratio is the share of non-production workers wages in total wages. Given that our dataset does not include date for the year of firm foundation, we compute age as the number of years since a firm first appears in the database.

In the absence of a specific theoretical model, we include these control variables to verify several previous findings in the literature. In the spirit of market selection hypotheses, it is expected that only more productive firms are able to survive. Then, a larger TFP should increase the survival probability (Baily, Campbell, & Hulten, 1992).[10] Both factor intensities – capital per worker and skilled ratio – are included to control for differences in the unobserved firm output mix. As it has been found recently by Bernard and Jensen (2007) both variables increase the chances of survival. They argue that more physical and human capital intensive firms produce higher quality products, and then they are able to compete more successfully in domestic and external markets. The inclusion of age is determined by theoretical models in which firms learn about its efficiency (Jovanovic, 1982). In such a case, older firms have more accumulated knowledge and are more likely to survive.

We also control for market structure variables such as average firm size, advertisement intensity, and Herfindahl index. Following models of industry dynamics, these variables aim to capture the impact of differences in entry costs across industries. Hopenhayn (1992) shows in a general equilibrium model that increases in entry costs lower both entry and exit rates. For this reason, we expect that firm exit is less likely in high entry-cost industries. Median firm size, expenditures in advertisement, and the Herfindahl index of sales concentration are used as proxy variables for entry costs. Median firm size controls for differences in efficient minimum scale, expenditures in advertisement for the extent of product differentiation, and sales concentration for differences in domestic competition.

In the case of size, we test if SMEs have higher or lower chances of survival. Most of previous evidence has found that smaller firms are less likely to survive. Complementing this literature, we study how the probability of survival for SMEs is affected by trade exposure. As we discussed in the introduction, there are two main hypotheses. In the line of arguments provided by UNCTAD (2004), SMEs would be relatively more affected by higher international competition. By contrast, Audretsch (2004) and Acs et al. (1996) argue that SMEs could be indeed benefited from the new environment.

3.2. Firm employment growth

We are particularly interested in studying if firm growth differs across size categories and, more importantly, whether SMEs are more or less affected by the growing liberalization of the economy. Since the pioneering work by Robert Gibrat, several papers have analyzed the relationship between firm initial size and growth. The *Gibrat's Law* postulates that posterior growth rate is independent of initial size. Most of empirical works, however, have rejected this hypothesis (see, *e.g.*,Acs & Audretsch, 1987; Coad, Rao, & Tamagni, 2011; Dunne, Roberts, & Samuelson, 1988; Hall, 1987; Mata, 1994). Then, based on this evidence, we expect a negative relationship between employment growth and initial size, *i.e.*, SMEs would tend to grow more quickly than large firms.

Our main question is, however, whether or not this relationship between growth and size has changed overtime. To do that, we estimate an equation for employment growth that incorporates interactive terms between size dummies and period-specific effects. As long as competitive pressures from trade liberalization affect negatively the growth perspectives of SMEs, these interactive coefficients should be negative and increasing (in absolute value) over time.

Following previous literature we incorporate other determinants of employment growth. Theoretical models of industry dynamics founded on productivity uncertainty and learning imply that age should be negatively associated with employment growth. These same models would also predict a positive relationship between productivity and growth (Jovanovic, 1982). Incorporating the role for these variables, we estimate first the following equation by Ordinary Least Squares (OLS):

$$g_{ij\Delta t} = \log\left(L_{ijt+5}\right) - \log\left(L_{ijt}\right) = \alpha + \beta X_{it} + d_j + d_{\Delta t} + \varepsilon_{ij\Delta t}.$$

[10] García-Vega, Guariglia, and Spaliara (2012) develop a model and present evidence on the positive effect of productivity on survival.

Table 2
Probability of survival and employment growth.
(Source: Authors' calculation based on ENIA 1979–1999.)

Period	All firms	Small	Medium	Large
A. Survival probability				
1979–1984	0.63	0.60	0.73	0.83
1984–1989	0.77	0.74	0.84	0.93
1989–1994	0.79	0.77	0.81	0.86
1994–1999	0.58	0.54	0.64	0.66
Simple average	0.69	0.66	0.76	0.82
B. Employment growth				
1979–1984	0.00	0.06	−0.16	−0.29
1984–1989	0.30	0.31	0.30	0.21
1989–1994	0.05	0.09	0.02	0.08
1994–1999	−0.17	−0.12	−0.20	−0.29
Simple average	0.05	0.09	−0.01	−0.11

Our dependent variable is employment growth, computed as the first-difference of employment (in logs). X is a vector of firm's characteristics, and ds are fixed effects for industries and time periods.[11] As well recognized since pioneering works by Hall (1987), Evans (1987a, 1987b), this estimation requires to deal with sample selection problem. Econometricians only observe employment growth for surviving firms, which may bias the estimations because the probability of survival is not independent of firm characteristics, such as size and productivity. In our estimations, we employ a MLE-Heckman procedure that corrects by this sample selection problem.

4. Main results

4.1. Firm survival

The results for Probit model estimation are shown in Table 3. To check the robustness of our results, we estimate three specifications. Our base model does not include industry characteristics neither industry growth. In columns (2) and (3) both variables are added sequentially. Our results are fairly consistent with other studies on the subject; more productive and older firms are more likely to survive. In terms of factor intensities, skilled labor does not affect survival probability but more capital intensive firms are less likely to shutdown. We are interested in two parameters, those for small and medium-sized firms. Our results show that both are negative and significant. Compared to large firms, small and medium firms are about 16 and 8% less likely to survive. Note that the parameters are very robust to the inclusion of other covariates. In sum, consistent with other studies, SMEs are more likely to exit, even controlling for other firm and industry characteristics.

Our main question, however, is whether the effect of firm size has changed over time. If, like it is argued for some authors, firms have to be large for competing successfully, we would expect that the negative impact of both size dummy variables should be increasing overtime, once the economy has reduced their trade barriers. To test for this effect, we take advantage of nonlinearity in Probit model, and we compute the effect of firm size for four different periods. It is also possible that the impact of other variables has changed over time. In this paper, as we are interested in the performance of SMEs, we focus on the impact of size.

The effect of size and their corresponding z-statistics are shown in Table 4. These results show evidence that the probability of survival has reduced in the latter periods, especially for small firms. Between the periods 1979–1984 and 1994–1999, the negative effect of being small, compared to large firms, increased from 13 to 20%. For medium firms, probability of survival is regularly between 8 and 6% lower than large firms.[12] This is consistent with the idea that aggregate shocks have tended to affect more negatively the survival of small firms, but not with a negative impact of trade liberalization. First, comparing the intermediate periods – where tariffs reduction were accompanied by an economic expansion – there is no evidence that small firms tend to be affected differently (the point marginal effect is practically identical). Second, at 95% of confidence, we cannot reject that all marginal coefficients are statistically the same.

4.2. Employment growth

In this subsection, we present the evidence for the relationship between firm growth and size. Our results are shown in Table 5. As a benchmark we present in column (1) the OLS results. In columns (2) and (3) we present results correcting for sample selection. In the last column, interactions between size dummy variables and period fixed effects are included. The results presented in the first column are as expected; more productive and younger firms tend to grow more rapidly. In terms of size, both dummy also have the expected sign and magnitude, revealing that smaller firms grow faster than large firms. Indeed, the parameter for medium firms is smaller than the parameter for small firms. Results from MLE-Heckman procedure in columns (2) and (3) confirm this evidence.

Looking at the results for interaction effects between firm size and period-specific effects, we find only significant and large differences for small firms but not for medium firms. In general, compared to the base period (1979–1984), small firms tend to grow

[11] Table A.1 in the Appendix A displays the correlation matrix of the independent variable used in the regressions.
[12] The parameter is not significant different across periods.

Table 3
Firm survival, probit regressions, marginal effects.

Variables	(1)	(2)	(3)
TFP	0.079	0.079	0.078
	(12.71)**	(12.58)**	(12.78)**
K/L	0.019	0.019	0.019
	(3.75)**	(3.77)**	(3.77)**
Skill	0.007	0.007	0.010
	(0.19)	(0.19)	(0.27)
Age	0.056	0.056	0.055
	(10.16)**	(10.18)**	(9.79)**
Small size	−0.164	−0.163	−0.165
	(8.21)**	(8.22)**	(8.20)**
Medium size	−0.075	−0.074	−0.076
	(3.66)**	(3.62)**	(3.72)**
Herfindahl index		0.424	0.312
		(2.89)**	(2.09)*
Median employment		0.040	0.074
		(1.01)	(2.00)*
Advertisement to sales		−7.831	−5.033
		(1.90)	(1.52)
Industry growth			0.176
			(6.78)**
1984–1989	0.049	0.046	0.088
	(1.62)	(1.34)	(3.25)**
1989–1994	0.038	0.021	0.060
	(1.65)	(0.64)	(2.05)*
1994–1999	−0.232	−0.249	−0.251
	(7.20)**	(5.47)**	(5.56)**
Observations	16752	16752	16752

Notes: Dependent variable equal to 1 if firm is in year t and in year t + 5, and zero otherwise. It is computed for the following four time intervals (1979, 1984), (1984, 1989), (1989, 1994), and (1994, 1999). All explanatory variables are measured in the first year of the interval. TFP is log of total factor productivity. K/L is log of capital per worker. Skill is non-production wages over total wages. Age is log of (1 + yearfirst year a firm is observed). The Herfindahl index measures the concentration at 4-digit ISIC, and it is defined as the sum of the square participation of every firm. Median employment is defined for all firms operating at 4-digit ISIC. Industry growth is the value added growth at 4-digit ISIC. Industry-specific effects at 4-digit are included but not reported. z statistics with robust standard errors adjusted by clustering at 4-digit ISIC industries in parentheses.

* Significant at 5%.

** Significant at 1%.

slowly in the last three periods. The difference is between 17 and 25%. However, in contrast to the idea that trade liberalization would increase the negative impact on small firms, this negative coefficient does not increase, in absolute value, monotonically over time. It is again interesting to compare the two intermediate and more homogeneous periods. At similar economic growth rate but lower tariffs, the interactive coefficient reduces in absolute value from 0.25 to 0.17. Then, our results show that once the economy intensified its trade openness the negative effect on employment growth for small firms was indeed reduced by about 8%.

In sum, our results are consistent with the idea that SMEs tend to grow more rapidly than large firms. We find that this relationship has changed over time, but only for the segment of small firms. If there are negative effects of trade liberalization on growth opportunities of these firms, our results show that they have not increased dramatically between periods characterized by tariff reductions.

Given that employment growth is not necessarily a measure of firm performance, we have estimated the model also using sales growth as an alternative indicator of firm growth. In general, the results are similar to those using employment. During the periods where tariffs were greatly reduced (1984–1989 and 1989–1994), we are not able to find any significant differences in SMEs sales growth compared to large firms. According to these results, during these two periods the sales growth of medium sizes firms was, similarly, 16.5 and 13.5% lower than growth sales for large firms. For medium size firms, the results show that growth

Table 4
Change in probability of survival by firm size and each 5-year period.

Period	Small			Medium		
	dy/dx	95% interval		dy/dx	95% interval	
1979–1984	−0.13	−0.16	−0.10	−0.06	−0.10	−0.02
	(−8.48)**			(−3.46)**		
1984–1989	−0.18	−0.22	−0.14	−0.08	−0.12	−0.03
	(−8.54)**			(−3.68)**		
1989–1994	−0.17	−0.21	−0.13	−0.08	−0.12	−0.03
	(−8.48)			(−3.66)**		
1994–1999	−0.20	−0.25	−0.15	−0.08	−0.13	−0.04
	(−8.30)**			(−3.73)**		

** Significant at 1%.

Table 5
Employment growth: OLS and MLE-Heckman.

Variables	OLS	MLE-Heckman	MLE-Heckman
Age	−0.071	−0.094	−0.097
	(7.56)**	(9.02)**	(8.52)**
TFP	0.048	0.020	0.019
	(6.65)**	(2.35)*	(2.21)*
Small	0.216	0.279	0.427
	(7.08)**	(9.07)**	(10.25)**
Medium	0.093	0.119	0.153
	(3.65)**	(4.36)**	(3.84)**
1984–1989	0.437	0.423	0.624
	(8.27)**	(10.40)**	(12.72)**
1989–1994	0.227	0.221	0.357
	(8.69)**	(9.54)**	(6.07)**
1994–1999	0.003	0.089	0.221
	(0.11)	(3.44)**	(4.48)**
Small* (1984–1989)			−0.252
			(5.20)**
Small* (1989–1994)			−0.170
			(2.94)**
Small* (1994–1999)			−0.169
			(3.30)**
Medium* (1984–1989)			−0.072
			(1.26)
Medium *(1989–1994)			−0.040
			(0.72)
Medium* (1994–1999)			−0.028
			(0.54)
Constant	−0.361	−0.116	−0.227
	(9.28)**	(2.16)*	(4.01)**
Observations	11644	16752	16752

Notes: Dependent variable is log differences in employment between year t and t + 5. It is computed for the following four time intervals (1979, 1984), (1984, 1989), (1989, 1994), and (1994, 1999). All explanatory variables are measured in the first year of the interval. Age is log of (1 + yearfirst year a firm is observed). TFP is log of total factor productivity. Industry-specific effects at 4-digit ISIC are included but not reported. z-statistics with robust standard errors adjusted by clustering at 4-digit ISIC industries in parentheses.

* Significant at 5%.

** Significant at 1%.

sales was 4.2 and 9.2% lower compared to large firms. However, we find that most of these differences are not statically significant. There are only large and significant differences for the last period 1994–1999 where small and medium size firms grew 30.0 and 17.2% less than large firms. Nevertheless, as we discussed previously, this was the period where the economy was hit by the Asian financial crisis and trade liberalization played a minor role.[13]

For employment growth and survival regressions, some of the variables included are an indirect proxy for their determinants. For this reason, the interpretation of the results deserves some comments. In the case of unobservable variables related with product differentiation or entry costs, we have shown results including and not including median size, Herfindahl index and the advertisement to sales ratio. In general, our main findings do not change when these variables are excluded from the regressions. In the case of firm characteristics, for example the skilled ratio, we have followed other papers using similar measures. However, there can be alternative ways of measuring this variable. In most of our regressions, the skilled ratio is not a significant determinant of firm growth, but we acknowledge that a better proxy for this variable could give different results.

5. Exploiting differences across industries

In this section we explore more in detail the relationship between survival, growth and trade liberalization. To do that, we exploit differences in the degree of international competition across industries. Our identification strategy is based on the idea that not all industries are affected in the same way for trade liberalization, because identical changes in tariffs may have different impact on trade flows. To shed light on the effects of trade liberalization, we follow the literature on treatment effects and choose, according to trade flows during the period under study, two groups of industries; (i) treatment group are those industrial sectors with high trade flows, and (ii) control group are those industrial sectors with low trade flows-. Then, we ask whether SME's survival and growth differ across these industries, and within these industries according to firm size.

There is long discussion in the literature of trade liberalization and growth on how to measure the degree in which an economy is open to international trade (Edwards, 1993). Trade flows as percentage of GDP has been criticized because this variable may depend

[13] We do not show these results due to space considerations, but they are available upon request.

on country structural characteristics such as size and distance to world markets (Frankel & Rose, 1999). In our case, as we exploit within-country differences, these structural factors tend to be of minor relevance. In the case of Chile, there are also practical reasons for using this measure. During this period, Chilean trade policy has not used non-tariff barriers and tariff has been uniform across industries. Then, we cannot use policy instruments because they vary only over time and not across industries.

We define the treatment and control group industries (4-digit ISIC) according to the average ratio of trade (export plus imports) over total production during the period 1990 through 1999.[14] The treatment group, high-trade industries, is defined as those industries ranked in the top third according to this ratio, and the control group as those industries in the bottom third. Hence, we estimate survival and employment growth models including a dummy variable for industries with higher trade exposure and, in the case of employment growth we include its interaction with firm size.

To discuss the robustness of our findings, we also estimate both models using directly the average ratio of trade over total production. In such a case, column (2) in Tables 6 and 7, the variable is a continuous one. As a further check of robustness, we also use the change in the trade ratio. It can be argued that, even the trade patterns may be stable over time, industries may experience changes in trade exposure. Then, in column (3) we show the results using changes in trade ratio rather than average.

For survival probability (Table 6), the evidence is similar using three different measure of trade exposure. In contrast to negative views on the impact of trade liberalization on firm survival, we find that the parameters for trade variables are positive and significant. This implies that firms located in industries with higher trade exposure are more likely to survive. The difference between high-trade and low-trade industries is indeed economically significant. As it may be inferred from column (1) in Table 6, firms in high-trade industries are 12.2% more likely to survive than firms in low-trade industries. As it is shown in columns (2) and (3) for both continuous variable – trade measured as average and changes over the period – there is also a positive relationship between the degree of trade exposure and the survival probability.

What is interesting to analyze is how the size effect differs across industries. To do that, we compute the "marginal effect" of small and medium size for both groups of industries.[15] As evidenced by the negative sign for both size parameters, we find that small and medium firms are less likely to survive. However, comparing each parameter for high-trade and low-trade industries, we do not find evidence that chances of survival are lower for smaller firms in high-trade industries. In fact, the negative impact of size, in absolute value, tends to be smaller in high-trade industries. Then, our evidence suggests that higher international competition does not have a disproportionate negative effect on survival of smaller firms. Moreover, in comparison with firms of the same size in low-trade industries, SMEs are more likely to survive in industries more exposed to external competition.

Table 7 presents our results for employment growth. The dummy for high-trade industries is negative and significant suggesting that firms tend to grow more slowly in sectors where international competition is stronger. However, the positive parameter for the interaction between trade variables and firm size reveals that SMEs are not those suffering the most negative effects of external competition. In fact, column (1) reveals that SMEs seem to grow faster in high-trade industries, although both parameters are only significant at 10%. Our robustness check in column (2) shows also a negative impact of trade exposure on employment growth. However, similarly to column (1) the parameters associated to interactive terms for SMEs are positive and significant at 10%. Using the change in trade exposure – column (3) – does not change our main findings.[16]

For the same reason discussed in the previous section, we have estimated the model using sales growth. The results are consistent with those for employment growth. The dummy for high-trade industries interacted with medium and small size is positive and significant, suggesting that sales growth was larger for SMEs in those industries compared to large firms. Using the continuous variables (similar to column (2) in Table 7), the results indicate a positive value for the interaction with the dummy variable for small and medium firms. Similarly to results in column (3), for sales growth we do not find any significant effects of changes in trade exposure across firm size. Then, our results do not change using an alternative measure of firm performance.

Finally, given that using five-year intervals can be considered arbitrary, we check the robustness of the results by using three-year periods. In general, our main findings remain unchanged (see Appendix A). Then, we have confidence that they are not specific to the way in which we divide the sample. There is only one difference when we use changes in trade exposure across industries. The interaction of this variable with medium-size firms turns out to be significant negative, suggesting that these firms could be potentially more affected by an increase in trade flows. However, for the rest of the variables, we do not find evidence that smaller firms are negatively more affected by trade exposure than larger firms.

6. Conclusions

There are different views on the effect of global competition on SMEs, which generate diverse pressures on government policies aimed to enhance the competitiveness of this group of firms. The empirical evidence, however, is not very abundant for developing countries that have undertaken a profound process of structural reforms and liberalization. In this paper we have presented evidence on SME's survival and employment growth in a long period of time in order to shed light on how the performance of these firms have changed over time and for different industries.

[14] Ideally we should have used the average for the whole period, but information is not available at 4-digit industries before 1990. However, it may be argued that the ranking of industries would not be significantly altered by incorporating information on previous years.

[15] See last rows in column (1) of Table 5.

[16] This variable and its interaction with size dummies are not significant.

Table 6
Firm survival and trade exposure, probit regressions, marginal effects.

Variables	(1)	(2)	(3)
Productivity	0.081	0.080	0.080
	(15.85)**	(12.56)**	(12.23)**
Capital per worker	0.018	0.019	0.018
	(1.77)	(3.66)**	(3.44)**
Labor skill	−0.063	−0.020	−0.018
	(0.95)	(0.49)	(0.45)
Age	0.058	0.058	0.057
	(7.88)**	(10.00)**	(9.49)**
Small size	−0.167	−0.164	−0.161
	(7.20)**	(7.96)**	(7.96)**
Medium size	−0.090	−0.076	−0.073
	(2.78)**	(3.53)**	(3.34)**
1984–1989	−0.133	−0.095	−0.103
	(3.94)**	(3.61)**	(3.94)**
1989–1994	−0.078	−0.066	−0.072
	(2.00)*	(2.23)*	(2.43)*
1994–1999	−0.273	−0.250	−0.252
	(3.36)**	(5.14)**	(5.07)**
Herfindahl index	−0.077	0.353	0.230
	(0.48)	(2.30)*	(0.96)*
Median employment	0.059	0.075	0.077
	(1.05)	(1.93)	(1.99)*
Advertisement to sales	−3.686	−5.607	−5.181
	(0.92)	(1.69)	(1.55)
Industry growth	0.235	0.185	0.197
	(9.71)**	(6.67)**	(6.50)**
High trade	0.122		
	(3.21)**		
Trade exposure		0.035	0.029
		(7.36)**	(8.29)**
Observations	7361	15976	15976
"Marginal effect" — small size			
High trade	−0.03		
	(3.23)**		
Low trade	−0.18		
	(8.26)**		
"Marginal effect" — medium size			
High trade	−0.02		
	(1.78)		
Low trade	−0.10		
	(2.69)**		

Notes: Dependent variable equal to 1 if firm is in year t and in year t + 5, and zero otherwise. It is computed for the following four time intervals (1979, 1984), (1984, 1989), (1989, 1994), and (1994, 1999). All explanatory variables are measured in the first year of the interval. TFP is log of total factor productivity. K/L is log of capital per worker. Labor skill is non-production wages over total wages. Age is log of (1 + yearfirst year a firm is observed). The Herfindahl index measures the concentration at 4-digit ISIC, and it is defined as the sum of the square participation of every firm. Median employment is defined for firms operating at 4-digit ISIC. Industry growth is the value added growth at 4-digit ISIC. High trade is a dummy equal to 1 for firms in industries in the top third according to the trade variable (average ratio of trade (export plus imports) over total production during the period 1990 through 1999) and 0 for firms in industries in the bottom third. In column (2) trade exposure correspond to the trade variable in levels; while in column (3) trade exposure corresponds to the variation of the trade variable between 1990 and 1999. z statistics with robust standard errors adjusted by clustering at 4-digit ISIC industries in parentheses.

* Significant at 5%.

** Significant at 1%.

Our primary interest has been to investigate whether the process of liberalization was accompanied for a disproportionate negative effect on SMEs. Most of those claiming that for competing international markets firms have to be "big" would agree that SMEs would be the most negatively affected by liberalization. Nevertheless, the evidence presented in this paper is not consistent with this view. In terms of survival and employment growth, we do not find that SMEs have been dramatically affected by international trade competition.

Studying differences across industries depending on their trade exposure, our results do not support some claims that SMEs are highly damaged by international competition. We have found that, compared to firms of the same size in industries with higher trade exposure, SMEs are not more likely to exit and they do not experience lower employment growth than similar firms in industries with lower trade exposure. These findings are similar to recent evidence provided by Holmes and Stevens (2010) and Colantone et al. (2010), suggesting that small firms can have some relative advantages in terms of higher flexibility or niche filling capacities through custom or specialty goods.

There are, of course, alternative explanations for our findings. First, small firms may self-select in industries where international competition is weaker and for this reason we are not able to uncover a higher impact of international trade on survival and firm

Table 7
Employment growth and trade exposure: MLE-Heckman.

Variables	(1)	(2)	(3)
Age	−0.02	−0.02	−0.05
	(1.15)	(1.16)	(3.07)
TFP	0.03	0.03	0.04
	(3.05)*	(2.85)*	(3.37)**
Small	0.21	0.19	0.26
	(5.20)**	(4.97)**	(8.84)**
Medium	0.04	0.03	0.12
	(1.49)	(1.33)	(4.21)**
1984–1989	0.26	0.26	0.33
	(5.58)**	(5.57)**	(5.88)**
1989–1994	0.05	0.05	0.11
	(0.91)	(0.93)	(2.01)*
1994–1999	−0.08	−0.07	−0.05
	(1.45)	(0.93)	(1.27)
High trade	−0.16		
	(4.44)**		
High trade* small	0.07		
	(1.66)		
High trade* medium	0.07		
	(1.91)		
Trade exposure		−0.06	(0.02)
		(1.87)	0.70
Trade exposure* small		0.07	−0.05
		(2.23)*	(1.39)
Trade exposure* medium		0.06	−0.05
		(1.75)	(1.70)
Constant	3.24	−0.12	−0.20
	(2.59)*	(1.34)	(2.06)*
Observations	9593	16752	16752

Notes: Dependent variable is log differences in employment between year t and t + 5. It is computed for the following four time intervals (1979, 1984), (1984, 1989), (1989, 1994), and (1994, 1999). All explanatory variables are measured in the first year of the interval. Age is log of (1 + yearfirst year a firm is observed). TFP is log of total factor productivity. High trade is a dummy equal to 1 for firms in industries in the top third according to the trade variable (average ratio of trade (export plus imports) over total production during the period 1990 through 1999) and 0 for firms in industries in the bottom third. In column (2) trade exposure corresponds to the trade variable in levels; while in column (3) trade exposure corresponds to the variation of the trade variable between 1990 and 1999. z statistics with robust standard errors adjusted by clustering at 4-digit ISIC industries in parentheses.

* Significant at 5%.

** Significant at 1%.

growth. We can not rule out this explanation completely, but in all of our regressions we control for industry-specific effects that control in part by the self-selection of SMEs in some industries. Second, there can be other reasons why SMEs are less exposed to international competition. The arguments developed by Audretsch (2004), Holmes and Stevens (2010) and Colantone et al. (2010) indicate that SMEs are able to compete due to higher flexibility or niche filling capacities through custom or specialty goods, but we were not able to confirm these hypotheses with the data at hand. We believe that further research is needed to identify the precise mechanism behind these results.

There can be relevant differences in the impact of global competition in developing countries compared to more industrialized ones. Since a theoretical point of view, the higher flexibility or innovation intensity of SMEs in some industries can be affected adversely by the existence of more regulations, deficient institutional quality, and the lower levels of financial development and financial inclusion in developing countries. These factors can affect negatively the possibilities of SMEs adjustments to changes in international competition in developing compared to industrialized countries. Nevertheless, based on these findings, the overall conclusion of this paper is that Chilean SMEs – as it has been found for other SMEs in developed countries – are not necessarily damaged by international trade competition. Even in a less developed country, these firms would be able to find strategies for competing successfully.

However, further generalizations from the Chilean experience to other developing countries are not necessarily warranted. Since the middle of the 1980s Chilean trade liberalization was accompanied by macroeconomic stability and several measures aimed to develop domestic financial markets. Then, the importance of these complementary aspects should not be underemphasized and they are an interesting research area for a better understanding of how small firms are able to survive and grow in highly competitive markets.

Acknowledgments

We thank Gustavo Crespi and Jose Miguel Benavente for generously sharing their dataset with us. We have benefited from comments and suggestions by Lucas Navarro, attendants to seminars at Business School at University of Chile, University Adolfo Ibanez and Friedrich-Schiller University of Jena.

Appendix A

A.1 Correlation matrix of estimation independent variables.

Variables	TFP	K/L	Skill	Age	Small	Medium	Advertisements to sales	Median employment	Herfindahl index	Industry growth	High trade	Trade exposure	Δ trade exposure
TFP	1												
K/L	−0.103	1											
Skill	−0.028	0.281	1										
Age	0.075	−0.144	0.0557	1									
Small	−0.050	−0.065	−0.277	−0.140	1								
Medium	−0.000	0.001	0.146	0.073	−0.755	1.000							
Advertisements/sales	−0.044	0.083	0.246	0.064	−0.116	0.085	1						
Median employment	0.163	0.138	0.278	0.266	−0.375	0.204	0.304	1					
Herfindahl index	−0.032	0.158	0.191	0.017	−0.076	0.026	0.210	0.171	1				
Industry growth	−0.014	−0.022	−0.003	0.006	0.0014	−0.007	−0.001	0.016	−0.215	1			
High trade	−0.160	0.014	0.103	−0.013	−0.021	0.035	−0.032	0.020	0.299	−0.193	1		
Trade exposure	−0.205	0.016	0.092	−0.015	−0.016	0.041	−0.021	0.009	0.307	−0.196	0.935	1	
Δ trade exposure	−0.185	−0.001	−0.049	−0.008	0.044	−0.023	0.009	−0.058	0.036	−0.079	0.195	0.315	1

Notes: TFP is log of total factor productivity. K/L is log of capital per worker. Labor skill is non-production wages over total wages. Age is log of (1 + yearfirst year a firm is observed). The Herfindahl index measures the concentration at 4-digit ISIC, and it is defined as the sum of the square participation of every firm. Median employment is defined for firms operating at 4-digit ISIC. Industry growth is the value added growth at 4-digit ISIC.

A.2 Firm survival, probit regressions (marginal effects, 3-year intervals).

Variables	(1)	(2)	(3)
TFP	0.058	0.058	0.06
	(15.69)**	(15.62)**	(16.30)**
K/L	0.014	0.014	0.015
	(4.82)**	(4.82)**	(4.23)**
Skill	−0.011	−0.010	−0.005
	(−0.57)	(−0.55)	(−0.26)
Age	0.035	0.035	0.037
	(8.89)**	(9.19)**	(10.38)**
Small size	−0.123	−0.121	−0.134
	(−10.15)	(−10.37)**	(−10.23)**
Medium size	−0.056	−0.055	−0.069
	(−4.59)**	(−4.61)**	(−5.25)**
Herfindahl index		0.329	0.225
		(3.34)**	(2.22)*
Median employment		0.051	0.069
		(1.73)	(2.20)*
Advertisement to sales		0.365	0.559
		(0.13)	(0.21)
Industry growth			0.05
			(4.31)**
1982–1985	0.006	0.001	−0.021
	(0.60)	(0.15)	(−1.90)*
1985–1988	0.031	0.020	−0.025
	(2.13)*	(1.19)	(−1.19)
1988–199	0.004	0.029	−0.021
	(4.76)**	(1.76)	(−0.99)
1991–1994	0.023	−0.001	−0.056
	(1.73)	(−0.08)	(−2.09)*
1994–1997	−0.103	−0.135	−0.191
	(−6.07)**	(−5.17)**	(−5.86)**
1997–1999	−0.214	−0.245	0.172
	(−10.93)**	(−9.20)**	(4.12)**
Observations	28391	28391	28391

Notes: Dependent variable equal to 1 if firm is in year t and in year t + 3, and zero otherwise. It is computed for the following seven time intervals (1979, 1982), (1982, 1985), (1985, 1988), (1988, 1991), (1991, 1994), (1994, 1997) and (1997, 1999). All explanatory variables are measured in the first year of the interval. TFP is log of total factor productivity. K/L is log of capital per worker. Skill is non-production wages over total wages. Age is log of (1 + yearfirst year a firm is observed). The Herfindahl index measures the concentration at 4-digit ISIC, and it is defined as the sum of the square participation of every firm. Median employment is defined for all firms operating at 4-digit ISIC. Industry growth is the value added growth at 4-digit ISIC. Industry-specific effects at 4-digit are included but not reported. z statistics with robust standard errors adjusted by clustering at 4-digit ISIC industries in parentheses. * significant at 5%; ** significant at 1%.

A.3 Change in probability of survival by firm size and each 3-year period.

Period	Small			Medium		
	dy/dx	95% interval		dy/dx	95% interval	
1979–1982	−0.11	−0.13	−0.09	−0.05	−0.07	−0.02
	(−12.45)**			(−4.38)**		
1982–1985	−0.12	−0.14	−0.09	−0.05	−0.08	−0.02
	(−9.75)**			(−4.28)**		
1985–1988	−0.110	−0.13	−0.08	−0.05	−0.07	−0.02
	(−9.44)**			(−4.33)**		
1988–1991	−0.10	−0.12	−0.08	−0.04	−0.06	−0.02
	(−10.83)**			(−4.43)**		
1991–1994	−0.11	−0.13	−0.08	−0.05	−0.07	−0.02
	(−9.01)**			(−4.23)**		
1994–1997	−0.15	−0.19	−0.12	−0.06	−0.10	−0.03
	(−9.16)**			(−4.35)		
1997–1999	−0.18	−0.22	−0.14	−0.07	−0.11	−0.04
	(9.65)**			(−4.48)**		

Notes: ** significant at 1%.

A.4 Employment growth: OLS and MLE-Heckman (3-year intervals).

Variables	OLS	MLE-Heckman	MLE-Heckman
Age	−0.037	−0.046	−0.049
	(−7.07)**	(−7.16)**	(−6.96)**
TFP	0.043	0.030	0.029
	(10.36)**	(5.54)**	(5.47)**
Small	0.150	0.181	0.343
	(9.12)**	(10.43)**	(10.07)**
Medium	0.062	0.074	0.093
	(4.20)**	(4.57)**	(2.80)*
1982–1985	0.266	0.265	0.376
	(6.82)**	(7.12)**	(6.75)**
1985–1988	0.359	0.354	0.518
	(7.45)**	(7.99)**	(9.81)**
1988–199	0.240	0.233	0.380
	(10.01)**	(10.85)**	(7.39)**
1991–1994	0.203	0.200	0.354
	(8.14)**	(8.76)**	(7.32)**
1994–1997	0.089	0.115	0.247
	(3.50)**	(4.66)**	(5.27)**
1997–1999	−0.006	0.043	0.198
	(−0.30)	(1.75)	(5.20)**
Small*(1982–1985)			−0.148
			(−2.47)*
Small*(1985–1988)			−0.217
			(−3.57)**
Small*(1988–1991)			−0.188
			(−3.45)**
Small*(1991–1994)			−0.192
			(−4.10)**
Small*(1994–1997)			−0.170
			(−3.69)**
Small*(1997–1999)			−0.196
			(−5.16)**
Medium*(1982–1985)			0.013
			(0.27)
Medium*(1985–1988)			−0.004
			(−0.07)
Medium*(1988–1991)			−0.029
			(−0.57)
Medium*(1991–1994)			−0.038
			(−0.84)
Medium*(1994–1997)			−0.011
			(−0.25)
Medium*(1997–1999)			−0.039
			(−0.79)
Observations	22640	28391	28391

Notes: Dependent variable is log differences in employment between year t and in year t + 3. It is computed for the following seven time intervals (1979, 1982), (1982, 1985), (1985, 1988), (1988, 1991), (1991, 1994), (1994, 1997) and (1997, 1999). All explanatory variables are measured in the first year of the interval. Age is log of (1 + yearfirst year a firm is observed). TFP is log of total factor productivity. Industry-specific effects at 4-digit ISIC are included but not reported. z-statistics with robust standard errors adjusted by clustering at 4-digit ISIC industries in parentheses. * significant at 5%; ** significant at 1%.

A.5 Firm survival and trade exposure, probit regressions (marginal effects, 3-year intervals).

Variables	(1)	(2)	(3)
Productivity	0.016	0.017	0.061
	(4.63)**	(3.62)**	(15.51)**
Capital per worker	0.001	0.003	0.014
	(0.52)	(1.32)	(3.81)**
Labor skill	−0.013	0026	−0.005
	(−0.40)	(0.86)	(−0.29)
Age	0.028	0.046	0.037
	(5.44)**	(7.46)**	(9.76)**
Small size	−0.108	−0.092	−0.131
	(−7.09)**	(−6.95)**	(−10.45)**
Medium size	−0.045	−0.033	−0.065
	(−2.15)*	(−2.83)*	(−4.87)**

(*continued on next page*)

A.5 (*continued*)

Variables	(1)	(2)	(3)
High trade	0.020		
	(1.22)		
Trade exposure		0.006	
		(2.00)*	
Δ trade exposure			0.020
			(6.14)**
Observations	12487	27042	27042
"Marginal Effect" — small size			
High trade	−0.09		
	(−7.33)**		
Low trade	−0.10		
	(−7.97)**		
"Marginal effect" — medium size			
High trade	−0.04		
	(−2.01)*		
Low trade	−0.04		
	(−2.02)*		

Notes: Dependent variable equal to 1 if firm is in year t and in year t + 3, and zero otherwise. It is computed for the following seven time intervals (1979, 1982), (1982, 1985), (1985, 1988), (1988, 1991), (1991, 1994), (1994, 1997) and (1997, 1999). All explanatory variables are measured in the first year of the interval. TFP is log of total factor productivity. K/L is log of capital per worker. Labor skill is non-production wages over total wages. Age is log of (1 + yearfirst year a firm is observed). The Herfindahl index measures the concentration at 4-digit ISIC, and it is defined as the sum of the square participation of every firm. Median employment is defined for firms operating at 4-digit ISIC. Industry growth is the value added growth at 4-digit ISIC. High trade is a dummy equal to 1 for firms in industries in the top third according to the trade variable (average ratio of trade (export plus imports) over total production during the period 1990 through 1999) and 0 for firms in industries in the bottom third. In column (2) Trade exposure correspond to the trade variable in levels; while in column (3) trade exposure corresponds to the variation of trade variable during the period 1990 through 1999. z statistics with robust standard errors adjusted by clustering at 4-digit ISIC industries in parentheses. * significant at 5%; ** significant at 1%.

A.6 Employment growth and trade exposure: MLE-Heckman (3-year intervals).

Variables	(1)	(2)	(3)
Age	−0.047	−0.056	−0.047
	(−5.17)**	(−8.71)**	(−6.83)**
TFP	0.004	0.006	0.032
	(0.84)	(1.20)	(5.28)**
Small	0.104	0.126	0.184
	(3.07)*	(3.96)**	(9.38)**
Medium	0.053	0.061	0.082
	(2.14)*	(2.83)*	(4.48)**
High trade	−0.080		
	(−2.43)*		
High trade *small	0.098		
	(1.87)*		
High trade *medium	0.022		
	(0.48)		
Trade exposure		−0.027	
		(−2.10)*	
Trade exposure*small		0.030	
		(1.76)	
Trade exposure*medium		0.014	
		(0.99)	
Δ trade exposure			0.230
			(3.25)*
Δ trade exposure*small			−0.031
			(−1.64)
Δ trade exposure*medium			−0.043
			(−2.39)*
Observations	22640	28391	28391

Notes: Dependent variable is log differences in employment between year t and in year t + 3. It is computed for the following seven time intervals (1979, 1982), (1982, 1985), (1985, 1988), (1988, 1991), (1991, 1994), (1994, 1997) and (1997, 1999). All explanatory variables are measured in the first year of the interval. Age is log of (1 + yearfirst year a firm is observed). TFP is log of total factor productivity. High trade is a dummy equal to 1 for firms in industries in the top third according to the trade variable (average ratio of trade (export plus imports) over total production during the period 1990 through 1999) and 0 for firms in industries in the bottom third. In column (2) Trade exposure correspond to the trade variable in levels; while in column (3) trade exposure corresponds to the variation of trade variable during the period 1990 through 1999. z statistics with robust standard errors adjusted by clustering at 4-digit ISIC industries in parentheses. * significant at 5%; ** significant at 1%.

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