CEPAL REVIEW 86 • AUGUST 2005

The dynamic of employment in Chilean industry

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This paper uses descriptive and parametric information to analyse the dynamic of employment in Chilean industry at the industrial plant level between 1979 and 2000. It examines job creation, destruction and turnover and investigates the link between these and the business cycle, sectoral characteristics and plant size. It finds evidence of procyclical job creation and countercyclical job destruction; of countercyclical labour turnover associated inversely with size; of marked heterogeneity between sectors; of the great importance of corporate demography in employment changes, and of the predominant role played by large companies in employment flows. It then goes on to analyse the impact of trade liberalization, the exchange rate and comparative advantages on sectoral employment flows. It concludes that a tariff reduction increases job destruction and thence turnover, and that comparative advantages and exchange-rate depreciation have a positive effect on job creation and turnover.

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I

Introduction

Trade liberalization is a crucial part of globalization and has major effects on the production structure. Different theoretical models have highlighted the increased productivity it brings as resources are reallocated from unproductive businesses to more efficient ones (Melitz, 2003). The costs of liberalization, meanwhile, chiefly take the form of labour market adjustments. In recent years, the literature on international trade and liberalization has started to include heterogeneity in its models to capture the different ways in which businesses or sectors respond to market opening. For example, Bernard, Redding and Schott (2004) propose a model in which liberalization raises the productivity of sectors by causing production to be reallocated, and show that this effect is greatest in industries with comparative advantages.

The labour market, meanwhile, is usually analysed on the basis of net changes in employment, which masks a significant part of the phenomenon. Underlying these net changes are processes of job creation and destruction that are constantly affecting a large percentage of workers over the course of the business cycle (Davis, Haltinwanger and Schuh, 1996). Thus, jobs are being created and destroyed all the time as companies grow organically and as they move through their life cycle (birth and death of firms).

This paper uses two approaches to examine the dynamic of industrial employment in Chile between 1980 and 2000. First, it shows the general characteristics of job turnover and its link to the business cycle, industrial sectors and plant size. Second, it uses parametric estimates to investigate the impact of trade liberalization, comparative advantages and the exchange rate on sectoral employment flows. Information for this purpose is available at the industrial plant level for the period 1979-2000 from the Yearly National Industrial Survey (Encuesta Nacional Industrial Anual-ENIA) carried out by the National Institute of Statistics (Instituto Nacional de Estadísticas-INE).

☐ The author is grateful to Stephan Ulrich for his bibliographical assistance and to M. Victoria Espada, Roberto Alvarez, Miguel Torres, Lucas Navarro and an anonymous referee for their comments and suggestions. Any errors are the exclusive responsibility of the author.

In accordance with the analytical framework proposed by Davis and Haltinwanger (1992), the employment dynamic is analysed in terms of four employment flows: creation, destruction, turnover and net creation (see appendix). Job creation in period *t* is defined as the sum of new jobs in plants that increase their payroll between *t-1* and *t*, plus jobs created by plants that begin their operations during *t*. Similarly, job destruction in period *t* is the sum of jobs lost at plants reducing their payroll between *t-1* and *t*, plus jobs lost due to plants terminating their operations during *t*. Net job creation is the difference between job creation and job destruction, while turnover is the sum of the two. The advantage of this method of analysis is that it breaks down net changes, at the national or sectoral level, and thus provides a more in-depth understanding of the labour market dynamic.

A number of studies have analysed the employment dynamic in Chile. Roberts (1996), for example, investigates patterns of industrial job creation and destruction between 1979 and 1986. His results reveal the importance of corporate demography and technological factors at the sectoral level as determinants of employment flows. Levinsohn's (1999) analysis of employment changes differentiates by company size and export orientation. His conclusions suggest that size and sectoral orientation (tradable goods sector or non-tradable goods sector) are important for understanding employment movements. Camhi, Engel and Micco (1997) describe the heterogeneity of employment and productivity flows at the plant level, and Pavcnik (2002) shows that the reallocation of resources between sectors is a major source of productivity growth. Aravena (2003), on the other hand, analyses the impact of wage rigidity on employment by company size; his results suggest that microenterprises and small businesses have higher rates of creation and destruction, and that the ratio between the minimum wage and the average wage is useful for explaining the level of employment in these, but not in large companies. Ferrada and Reinecke (2004) argue that more research is needed to obtain robust findings on the causal relationship between employment and the minimum wage. They also conclude that small and medium-sized enterprises (SMEs) are the firms that contribute most to aggregate employment.

In this context, the present study makes a twofold contribution: it shows stylized patterns of employment flows, and it offers an initial empirical approach to the impact of trade-related variables on these flows. Section II that follows sets forth the main conclusions offered by the empirical literature; section III describes the patterns of the employment dynamic, and section IV uses econometric evidence to examine the impact of tariffs, the exchange rate and comparative advantages on employment flows.

II

A glance at the publications on the subject

In the last 10 years there has been a great expansion in the number of empirical studies on job creation and destruction, usually based on establishment-, company- or plant-level information, with periodic employment data (Bockerman, 1999; Schreyer, 1996). More studies are now starting to come out on the link between trade-related variables (exchange rate, comparative advantages, tariffs) and employment flows, but they are still few and far between, particularly in developing countries. For example, Davis, Haltinwanger and Schuh (1996) investigate employment flows in United States manufacturing industry between 1973 and 1986 and argue that no systematic relationship exists between job turnover levels and sectoral trade exposure. Klein, Schuh and Triest (2003a) show that in the United States the exchange rate plays an important role in employment flows and that its impact is growing in more open industries. The main contribution of the latter study is that it analyses the impact of cyclical changes and trend movements in the exchange rate separately.

Gourinchas (1998) also deals with industrial sectors in the United States, using autoregressive vectors to estimate the effect of the exchange rate on job creation and destruction. He concludes that an exchange-rate appreciation has a positive effect on both in tradable sectors, but zero impact in non-tradable sectors.[1] Bentivogli and Pagano (1999) study the manufacturing sectors of four European countries and find no evidence of any substantive impact from international trade. Klein, Schuh and Triest (2003b) examine the impact of the North American Free Trade Agreement (NAFTA) on three specific United States industries (textiles, chemicals and automobiles), and their results show that NAFTA has had very little impact either on net employment or on job turnover. Prominent among the few studies dealing with Latin America is the one conducted by Haltinwanger, Kuegler and others (2004), who investigate the impact of trade liberalization on net employment growth and job turnover in six countries of the region. To do this, they estimate a function for job creation and turnover over their own lags, tariffs, gross domestic product and exchange rate, plus a proxy variable for job security. The estimates show that tariff reductions and exchange-rate appreciations increase the degree of job turnover, although they also suggest that net employment growth diminishes as trade exposure rises.

While the basic premise of these studies is roughly the same, the objective being to ascertain whether market opening leads to greater job turnover, there are large differences in methodology. First, the econometric approach is specific to each study. Second, the analytical framework focuses on different factors in each case: greater competition, exchange-rate movements, tariff changes or trade agreements. What these studies show is that, on the whole, greater liberalization means greater employment flows, sometimes with net effects, although the evidence is still preliminary and there are no stylized patterns.

Employment flows do have some general characteristics, however. Thus, for example, while job creation is procyclical, destruction is countercyclical (i.e., it tends to diminish during economic upswings), although there is no symmetry between the two and destruction tends to be more volatile (Campbell and Fisher, 1998). There is no clear link between the job turnover rate and the business cycle: whereas in the United States there is evidence that it is countercyclical (Schuh and Triest, 1998), in some European countries and in Colombia and Morocco the evidence shows the

[1] In a similar study for France between 1984 and 1992, Gourinchas (1999) concludes that the exchange rate affects employment flows even more there than in the United States.

opposite (Stigelbauer, Stahl and others, 2002; Boeri, 1996; Roberts, 1996). The entry and exit of firms, meanwhile, are major components of the employment dynamic and account for a significant share of employment flows (Castillo, Cesa and others, 2002; Barnes and Haskel, 2002). Furthermore, there is evidence that the entry and exit of firms affect employment flows more in developing countries than in developed ones (Roberts and Tybout, 1996).

There are sectoral patterns too. Manufacturing, for instance displays systematically lower levels of turnover than services. Furthermore, there is a great deal of heterogeneity within manufacturing (Davis, Haltinwanger and Schuh, 1996), which suggests that specific sectoral factors such as capital intensity, optimum production scale, entry and exit costs, sunk costs and patterns of technological innovation and progress are very influential. In fact, the greater capital intensity and the optimum production scale are, the smaller employment flows will be.[2] At the company level, meanwhile, there is an inverse relationship between job creation/destruction and size, company age, wages and human capital: the smaller and younger companies are, and the lower their wage and human capital levels, the more volatile employment will tend to be, with higher levels of both creation and destruction (Acs, Armington and Robb, 1999; Davis, Haltinwanger and Schuh, 1996; Schreyer, 1996; Castillo, Cesa and others, 2002).

The role of small and medium-sized enterprises (SMEs) in job creation is still disputed. The claim that "SMEs are the largest source of new jobs" is often based on questionable specifications of methodological aspects. These aspects have to do primarily with changes in company size over time and the significant difference between working with net job creation and gross job creation. Indeed, opposite conclusions can be reached about the importance of SMEs, depending on how these aspects are defined. Since Birch's (1979) study established that about 80% of job creation in the United States resulted from the activities of small and medium-sized enterprises, different studies have been brought out to uphold or reject this conclusion. For example, Davis, Haltinwanger and Schuh (1996) conclude that it is large enterprises that dominate job creation in the United States, whereas both Barnes and Haskel (2002) and Picot, Baldwin and Dupuy (1994) stress the importance of SMEs in the United Kingdom and Canada, respectively. The curious thing is that the disagreement is due not only to conceptual differences but to methodological ones as well, as Kirchhoff and Greene (1995) show.

III

Industrial employment patterns

In recent decades, the Chilean economy has undergone major changes as it has passed through different stages of the business cycle. Indeed, the country has implemented reforms that have made the market increasingly dominant in resource allocation and consolidated an export model in a context of trade liberalization, deregulation and privatization. These reforms began in the 1970s, but have been broadened and deepened in the decades since. Chile was also a pioneer in trade liberalization and in the application of the Washington Consensus formula in the region. Labour market reforms began to be implemented in the late 1970s with a view to making that market more flexible.[3]

Where the business cycle is concerned, Chile suffered a large fall in gross domestic product (GDP) in the early 1980s (ΔGDP –13% in 1982 and –3.5% in 1983), which took the unemployment rate to 20%. The subsequent recovery yielded strong growth (ΔGDP averaging 7.7% in 1986-1997) characterized by a steady decline in unemployment. Finally, there was an adjustment phase (ΔGDP –1.1% in 1999) associated with the Asian crisis, which raised unemployment to around 10% (figure 1). It is within this context of structural

[2] Again, industrial sectors with high total factor productivity growth usually display higher net employment growth and higher job turnover. See Foster, Haltinwanger and Krizan (1998) and Loecker and Konings (2003) for a more detailed analysis of the link between productivity and employment flows.

[3] See Hachette (2000) for a more detailed review of the labour market reforms.

reform and stages in the macroeconomic cycle that industrial employment is analysed.

1. General patterns

The industrial employment situation has passed through three stages, in line with the business cycle: a large decline between 1979 and 1984, steady growth between 1986 and 1995 and, lastly, a sharp decline beginning in 1996 (figure 1). A positive correlation can also be seen between aggregate changes in employment and the recruitment of unskilled (blue-collar) workers, who form the base of industrial employment. Recruitment of more highly skilled (white-collar) workers shows less dispersion and more stable behaviour over the different stages of the cycle.

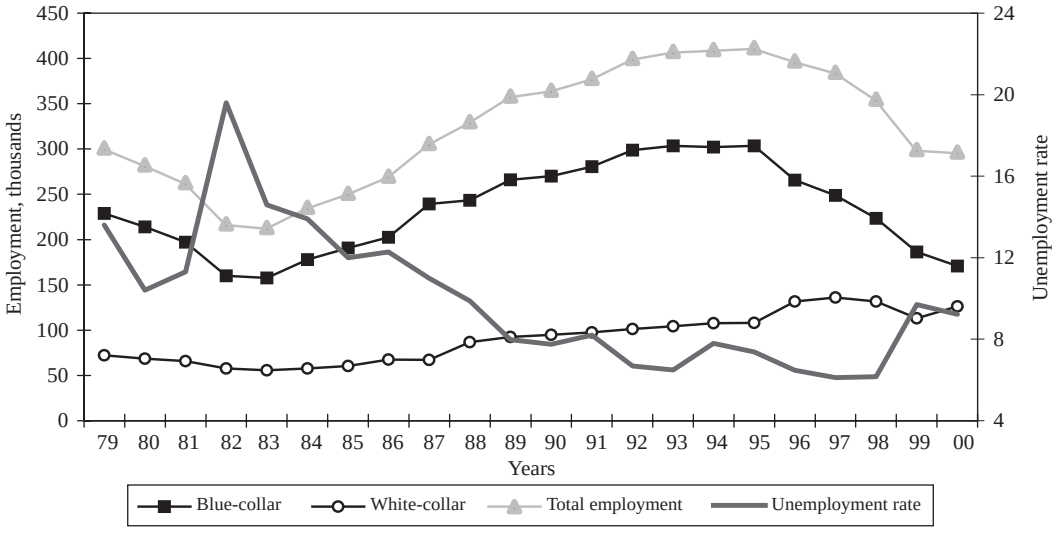
Job flows are a significant part of the employment dynamic, so that net employment growth "masks" processes of creation and destruction that are not only substantial, but continuous. Thus, job creation and destruction are continuous phenomena over the whole business cycle, even when the net change in employment is very small or non-existent (figure 2). In fact, job creation averaged 13% a year between 1980 and 2000, while destruction averaged 13.2% (table 1). Between them, these processes yielded average job turnover of 26.2% over the period.

Net job creation, meanwhile, went through two periods of negative rates (1980-1983 and 1996-2000) and one of positive net growth (1984-1995). This supports the intuitive perception that net job creation is directly associated with macroeconomic developments, and is thus procyclical. In fact, the index of correlation between the trend of ΔGDP and Δemployment is 0.4 (figure 3). The behaviour of net employment growth is a consequence of the procyclical evolution of job creation, on the one hand, and the countercyclical evolution of job destruction, on the other (appendix B). In fact, the indices of correlation between job creation and destruction and the trend of ΔGDP are 0.19 and –0.41, respectively. It is noteworthy that creation is less sensitive (as an absolute value) than destruction: whereas the elasticity of job creation to changes in ΔGDP is 0.02%, the elasticity of destruction is –0.25%. Thus, while job destruction increases strongly at times of recession, creation does not fall by as much.

One aspect that emerges from the non-symmetrical relationship between creation/destruction and the cycle is that job turnover tends to be countercyclical: the correlation between the turnover rate and ΔGDP is 0.27, whereas the correlation between turnover and Δnet employment is –0.37. In other words, job turnover tends to increase in periods of

FIGURE 1

Chile: Industrial employment by worker type and unemployment rate[a]
(Thousands and percentages)



Source: Prepared by the author using data from the Yearly National Industrial Survey (ENIA) and the National Institute of Statistics (INE).

[a] White-collar: skilled personnel carrying out administrative duties. Blue-collar: low-skilled workers engaged in production work. The unemployment rate is the aggregate rate for the economy.

TABLE 1

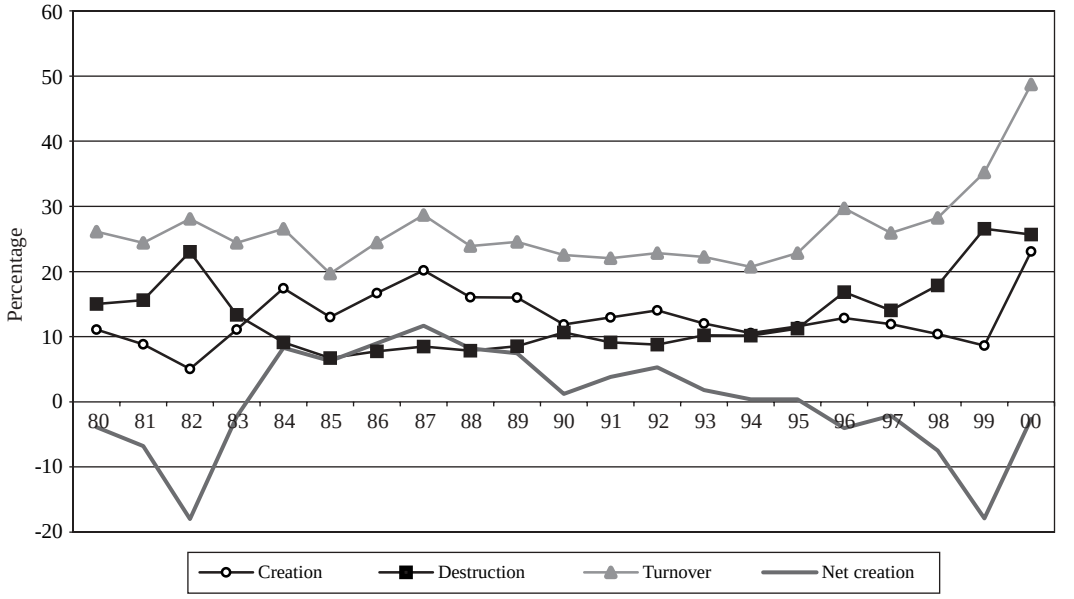
Chile: Rates of creation, destruction, turnover and net creation of industrial employment, 1980-2000
(Percentages)

Year	Job creation (1)	Creation in new firms	Creation in continuing firms	Creation in new firms/ Total creation	Job destruction (2)	Destruction in exiting firms	Destruction in continuing firms	Destruction in exiting firms/ Total destruction	Turnover rate (3) = (1) + (2)	Net creation (4) = (1) - (2)
1980	11.4	2.3	9.1	20.2	15.0	6.3	8.7	42.0	26.4	–3.6
1981	9.1	1.8	7.3	19.8	15.6	6.0	9.6	38.5	24.7	–6.5
1982	5.6	1.4	4.2	25.0	23.1	4.7	18.4	20.3	28.7	–17.5
1983	11.1	2.9	8.2	26.1	13.3	5.0	8.3	37.6	24.4	–2.2
1984	16.6	4.9	11.7	29.5	9.1	3.3	5.8	36.3	25.7	7.5
1985	12.6	2.0	10.6	15.9	6.8	1.8	5.0	26.5	19.4	5.8
Average 1980-85	11.1	2.6	8.5	23.0	13.8	4.5	9.3	32.7	24.9	–2.8
1986	16.1	3.2	12.9	19.9	7.8	3.2	4.6	41.0	23.9	8.3
1987	19.0	5.9	13.1	31.1	8.5	2.7	5.8	31.8	27.5	10.5
1988	15.5	3.3	12.2	21.3	7.9	2.3	5.6	29.1	23.4	7.6
1989	15.3	3.7	11.6	24.2	8.5	2.7	5.8	31.8	23.8	6.8
1990	11.8	3.4	8.4	28.8	10.6	3.2	7.4	30.2	22.4	1.2
1991	12.8	4.0	8.8	31.3	9.1	1.8	7.3	19.8	21.9	3.7
1992	13.6	5.1	8.5	37.5	8.8	3.0	5.8	34.1	22.4	4.8
1993	11.9	4.0	7.9	33.6	10.2	3.1	7.1	30.4	22.1	1.7
1994	10.5	3.0	7.5	28.6	10.2	3.1	7.1	30.4	20.7	0.3
1995	11.6	4.9	6.7	42.2	11.2	3.3	7.9	29.5	22.8	0.4
1996	13.1	7.3	5.8	55.7	16.9	4.4	12.5	26.0	30.0	–3.8
1997	12.1	4.8	7.3	39.7	14.1	6.6	7.5	46.8	26.2	–2.0
Average 1986-97	13.6	4.4	9.2	32.2	10.3	3.3	7.0	31.8	23.9	3.3
1998	10.8	3.6	7.2	33.3	17.8	9.3	8.5	52.2	28.6	–7.0
1999	9.5	3.7	5.8	38.9	26.6	16.0	10.6	60.2	36.1	–17.1
2000	23.1	15.5	7.6	67.1	25.7	15.0	10.7	58.4	48.8	–2.6
Average 1980-2000	13.0	4.3	8.7	33.2	13.2	5.1	8.1	38.6	26.2	–0.2

Source: Prepared by the author on the basis of the Yearly National Industrial Survey conducted by the National Institute of Statistics (INE, various years).

FIGURE 2

Chile: The dynamic of industrial employment
(Percentages)



Source: Prepared by the author on the basis of the Yearly National Industrial Survey conducted by the National Institute of Statistics (INE, various years).

recession, when adjustment costs are less because of low demand.[4] Despite this relative efficiency of employment turnover in Chile, the creation and destruction series present a negative correlation (of –0.26), suggesting a resource reallocation process that is not highly synchronized.

At the theoretical level, Caballero and Hammour (1996) propose a job turnover model with fixed entry costs, technological growth and cyclical demand fluctuations, and conclude that it is during recessions that an efficient economy should make its greatest efforts to reallocate productive resources, as opportunity costs are lower then. They also maintain that a poorly functioning labour market could erode the efficiency of job turnover and result in a stiffening of the production structure, characterized by a diminished capacity for renewal. In an empirical study dealing with the United States, Caballero and Hammour (1994) likewise find that destruction is more sensitive to the business cycle and that there is a negative correlation between the creation and destruction series, and argue that recessions have a cleansing effect that manifests itself, among other things, in the replacement or disappearance of obsolete technologies, products or processes.

The data also show that the entry and exit of enterprises is of great importance in accounting for the dynamic of employment. Job creation due to the emergence of new companies contributed an average of 33.2% to total job creation in 1980-2000 (table 1). Companies exiting the market, meanwhile, were responsible for 38.6% of job destruction.

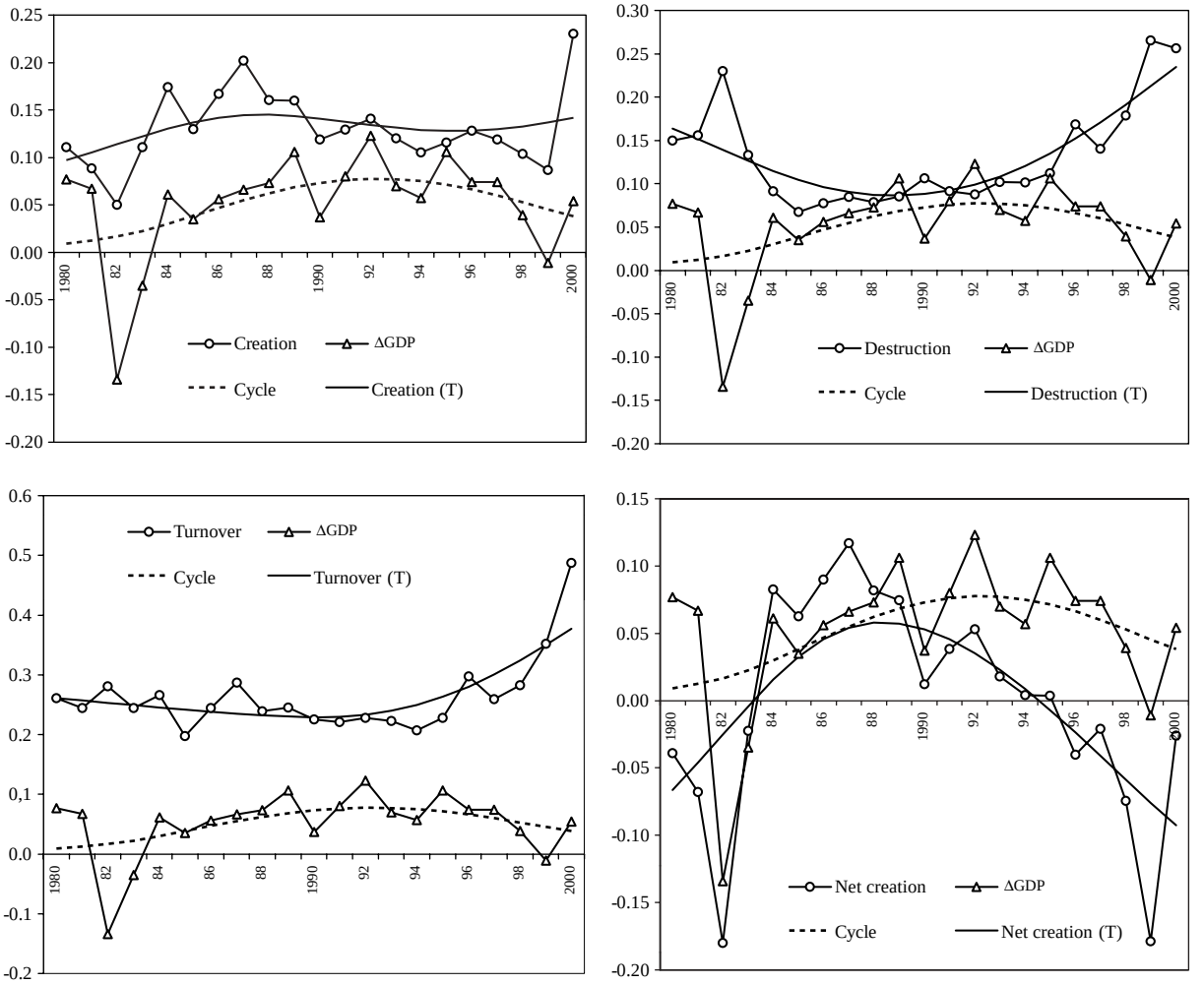
2. Sectoral characteristics

At a more disaggregated level, it transpires that most industrial sectors display significant rates of job creation and destruction, conjoined with great heterogeneity in turnover levels. This suggests that specific sectoral factors have a strong influence on labour mobility: for example, capital intensity, optimum plant size, sunk costs and technology patterns. When average data for 1980-2000 are used, the sectors that display the greatest employment turnover are: pottery, china and earthenware, wood, furniture, petroleum derivatives and apparel (table 2). These are

[4] This result contradicts the one presented by Roberts (1996), who finds no cyclical patterns in industrial employment turnover in Chile between 1979 and 1986.

FIGURE 3

Chile: Cyclical patterns of employment flows



Source: Prepared by the author using 1979-2000 data from the National Industrial Employment Survey conducted by the National Institute of Statistics (INE, various years) and Central Bank of Chile data.

generally labour-intensive sectors. Conversely, oil refineries, iron and steel, other chemicals and tobacco, which are capital-intensive, have low job turnover.

Owing to its marked heterogeneity, sector 311-Foods is analysed at the 4-digit level of the International Standard Industrial Classification of All Economic Activities (ISIC/Rev. 2), and it also displays major differences. Processing of fish and crustaces, for example, has a remarkably high job turnover rate of some 39%, whereas sugar production has a rate of 17%. These data evince two stylized facts: first, job turnover declines as capital intensity increases and, second, there is a strong correlation between job creation and destruction (figure 4).

Sectoral patterns, meanwhile, confirm the countercyclical nature of job turnover: of 37 industrial sectors, 30 display countercyclical employment flows. There is also a negative correlation between the job creation and destruction series in 25 sectors. These results show that the economy has a certain degree of flexibility[5] and increases resource reallocation in the "down" part of the cycle. There is no synchrony, however, between job creation and destruction.

[5] Caballero, Engel and Micco (2004) analyse microeconomic flexibility in a number of Latin American countries and conclude that Chile, while less flexible than the United States, is more flexible than Mexico or Venezuela.

TABLE 2

The dynamic of industrial employment by sector of the International Standard Industrial Classification of All Economic Activities (ISIC/Rev. 2), 1980-2000 averages
(Percentages)

Sector	Job creation (1)	Job destruction (2)	Job turnover (3) = (1) + (2)	Correlation (1) and (2)
361 - Pottery, china and earthenware	14.0	19.2	33.2	0.06
331 - Wood	16.1	17.0	33.1	-0.14
332 - Furniture	13.9	14.1	28.0	-0.19
354 - Petroleum products	14.4	13.5	27.9	0.12
322 - Wearing apparel	12.2	14.7	26.9	-0.24
351 - Chemicals	14.5	11.5	25.9	-0.27
384 - Transport equipment	13.0	12.8	25.8	-0.36
390 - Other industries	12.7	13.1	25.8	0.02
381 - Metal products	12.7	12.3	25.0	-0.61
312 - Other foodstuffs	13.3	11.5	24.9	-0.29
369 - Other non-metallic mineral products	12.6	12.2	24.9	0.06
323 - Leather	9.2	15.2	24.5	-0.04
372 - Non-ferrous metals	12.9	10.3	23.1	-0.13
382 - Non-electrical machinery	10.4	12.5	22.9	-0.33
313 - Beverages	11.0	11.5	22.5	-0.07
356 - Plastics	12.6	9.5	22.2	-0.65
324 - Footwear	10.1	11.5	21.7	0.11
355 - Rubber products	10.2	11.5	21.7	-0.45
383 - Electrical machinery and appliances	10.3	11.2	21.5	-0.48
362 - Glass	8.9	12.3	21.2	-0.11
385 - Professional and scientific equipment	10.5	10.6	21.1	0.21
341 - Paper and paper products	10.7	10.0	20.7	0.08
321 - Textiles	82	11.5	19.8	-0.59
342 - Printing and publishing	8.9	9.1	18.0	-0.31
314 - Tobacco	7.4	10.5	17.9	0.41
352 - Other chemicals	9.3	8.5	17.8	-0.11
371 - Iron and steel	4.4	5.7	10.1	-0.35
353 - Oil refineries	1.9	3.6	5.5	0.33
3114 - Processing of fish, crustaces and others	22.4	16.8	39.2	-0.59
3113 - Canning and preserving fruits/veg.	17.8	16.6	34.4	-0.29
3115 - Manufacture veg./animal oils and fats	12.9	16.2	29.1	-0.07
3112 - Dairy products	12.4	10.2	22.6	-0.33
3117 - Bakery products	11.1	11.4	22.5	0.42
3111 - Slaughter, preparing, preserving meat	12.5	9.7	22.2	-0.15
3116 - Grain mill products	9.9	11.9	21.8	0.03
3119 - Cocoa, chocolate, sugar confectionery	10.3	9.7	20.0	0.33
3118 - Sugar factories and refineries	7.0	10.2	17.2	-0.18

Source: Prepared by the author using 1979-2000 data from the Yearly National Industrial Survey conducted by the National Institute of Statistics (INE, various years).

3. Company size

Although small companies are the most numerous in the industrial sector, large enterprises are the most important for employment. According to the classification of size by sales used by the Production Development Corporation (Corporación de Fomento de la Producción-CORFO), small enterprises represent 46% of all establishments, medium-sized ones 17% and large companies 37%. In employment terms, on the other hand, large companies account for 73% and small ones for 16%. Following the methodology proposed by Davis, Haltinwanger and Schuh (1996), we analysed job creation and destruction by size and the share of each category in the total number of jobs created and destroyed.

What is striking at first sight is the close relationship between job creation/destruction and size. Job creation proves to be much the highest in microenterprises, with an average of 27% for the whole period (table 3). Small and medium-sized enterprises, meanwhile, had a creation rate of about 15%, which

TABLE 3

Chile: Rate of industrial job creation and destruction by company size, 1980-2000[a]
(Percentages)

Year	Job creation				Job destrucción			
	Micro	Small	Medium	Large	Micro	Small	Medium	Large
1980	5.0	11.2	14.4	10.7	50.1	21.7	14.3	12.7
1981	15.7	10.8	11.8	7.9	36.2	20.2	19.2	13.8
1982	13.4	6.9	8.2	3.9	62.5	28.7	28.2	20.0
1983	17.6	12.7	15.5	9.7	42.5	18.3	18.1	10.4
1984	11.8	22.5	24.9	14.8	39.1	13.2	10.0	7.4
1985	12.2	13.8	16.1	12.3	27.9	11.0	9.3	5.0
1980-1985 average	12.6	13.0	15.2	9.9	43.1	18.8	16.5	11.5
1986	14.6	17.3	19.2	16.2	57.2	13.2	10.4	5.8
1987	38.8	26.3	22.3	18.6	44.8	16.5	12.3	6.2
1988	12.4	14.1	18.2	16.1	48.0	15.9	8.8	6.2
1989	22.1	13.1	17.9	16.2	64.5	17.0	11.2	6.9
1990	28.1	13.1	15.4	11.3	55.0	20.8	14.2	8.7
1991	36.5	16.0	19.2	11.8	38.6	11.9	9.5	8.6
1992	17.4	14.5	15.3	13.9	35.7	15.7	9.5	7.7
1993	31.8	13.4	15.8	11.4	36.9	14.9	12.6	9.3
1994	18.0	12.6	13.4	10.0	48.6	14.3	12.2	9.4
1995	5.4	12.4	13.9	11.3	87.8	19.7	14.5	9.7
1996	56.8	22.1	21.2	10.8	64.9	22.4	16.4	16.1
1997	36.6	15.2	13.3	11.3	61.8	23.1	19.6	12.2
1986-1997 average	26.5	15.8	17.1	13.2	53.7	17.1	12.6	8.9
1998	27.0	11.4	12.7	10.0	24.8	25.9	20.4	16.5
1999	10.9	12.9	12.9	7.6	130.7	27.8	28.7	25.6
2000	134.2	21.6	22.2	22.5	30.4	34.9	31.2	23.8
1980-2000 average	27.0	14.9	16.4	12.3	51.8	19.4	15.7	11.5

Source: Prepared by the author using 1979-2000 data from the Yearly National Industrial Survey conducted by the National Institute of Statistics (INE, various years).

[a] Company classification by sales using the criteria of the Production Development Corporation (CORFO), based on development units (unidades de fomento-UF): microenterprises (0 to 2,400 UF), small (2,401 to 25,000 UF), medium-sized (25,000 to 100,000 UF) and large (100,000 UF and over).

TABLE 4

Chile: Share of total industrial jobs created and destroyed, by company size, 1980-2000[a]
(Percentages)

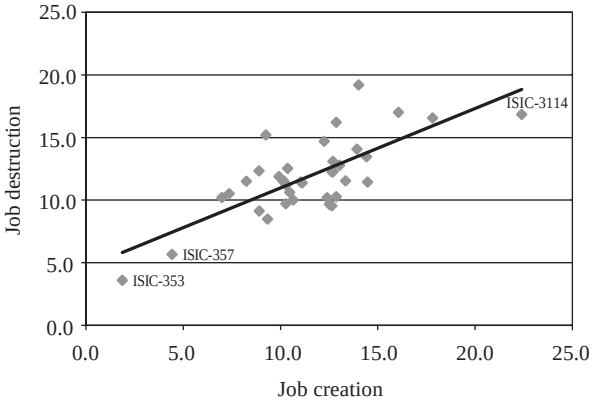
Year	Job creater (Share of total jobs created, by company size)				Jobs destroyed (Share of total jobs destroyed, by company size)			
	Micro	Small	Medium	Large	Micro	Small	Medium	Large
1980	0.5	19.3	12.7	67.5	3.5	27.6	9.4	59.5
1981	1.2	21.6	13.4	63.8	1.6	22.9	12.3	63.2
1982	2.6	27.6	17.5	52.4	2.6	25.2	13.1	59.1
1983	1.8	24.9	15.1	58.2	3.6	29.8	14.6	52.0
1984	0.6	26.6	15.1	57.7	3.8	29.6	11.5	55.1
1985	0.6	20.0	13.5	65.9	2.7	30.9	15.0	51.4
1980-1985 average	1.2	23.3	14.6	60.9	3.0	27.7	12.7	56.7
1986	0.4	17.2	12.2	70.3	3.2	28.4	14.2	54.2
1987	0.6	19.7	10.9	68.8	1.6	29.4	14.3	54.7
1988	0.2	12.1	10.5	77.3	1.5	27.7	10.4	60.4
1989	0.2	9.6	9.9	80.3	1.2	23.4	11.5	63.9
1990	0.3	12.5	11.2	75.9	0.8	22.2	11.5	65.5
1991	0.5	14.3	12.7	72.5	0.7	15.0	9.0	75.3
1992	0.2	11.1	9.4	79.4	0.6	19.3	9.4	70.7
1993	0.4	11.4	10.8	77.4	0.5	15.0	10.1	74.4
1994	0.3	12.2	10.4	77.2	0.7	14.4	9.8	75.1
1995	0.1	10.7	9.7	79.5	1.1	17.6	10.4	70.9
1996	0.6	17.5	13.6	68.3	0.5	13.5	8.0	77.9
1997	0.5	13.4	9.2	76.9	0.7	17.2	11.6	70.5
1986-1997 average	0.4	13.5	10.9	75.3	1.1	20.3	10.9	67.8
1998	0.9	11.5	9.5	78.1	0.5	15.1	8.9	75.5
1999	0.5	16.4	12.0	71.0	2.1	11.5	8.7	77.7
2000	3.5	10.6	7.7	78.2	0.7	15.4	9.7	74.1
1980-2000 average	0.8	16.2	11.8	71.3	3.5	27.6	9.4	59.5

Source: Prepared by the author using 1979-2000 data from the Yearly National Industrial Survey conducted by the National Institute of Statistics (INE, various years).

[a] Company classification by turnover (sales) using the criteria of the Production Development Corporation (CORFO), based on development units (unidades de fomento-UF): microenterprises (0 to 2,400 UF), small (2,401 to 25,000 UF), medium-sized (25,000 to 100,000 UF) and large (100,000 UF and over).

FIGURE 4

Chile: Job creation and destruction by sector, 1980-2000 average[a]
(Percentages)



Source: Prepared by the author using 1979-2000 data from the Yearly National Industrial Survey conducted by the National Institute of Statistics (INE, various years).

was higher than the 12.3% of large companies. Thus, the larger companies are, the lower their job creation rates. Job destruction also grows as company size diminishes: the rate is 11.5% in large companies, 15.7% in medium-sized ones and 19.4% in small ones, while in microenterprises the rate is 51.8%. These patterns suggest that job turnover is negatively associated with size.[6] Again, it also transpires that microenterprises display greater variance than larger enterprises in their employment flows and in respect of business cycle fluctuations. In other words, microenterprises are more volatile in their employment flows, while large companies behave more homogeneously over the period.

Turning to the share of different-sized companies in total job creation and destruction, it is found that the share of large companies (71% and 59%, respectively) is very large, while that of microenterprises (1% and 3%) is very minor (table 4). We can conclude, then, that smaller companies have higher job creation and destruction rates, but it is large companies that dominate gross creation and destruction flows.[7] This is because large companies account for a greater proportion of the industrial employment base.

IV

Employment flows and market opening

Market opening and trade liberalization feed through into the production structure through a variety of mechanisms. The formal routes are tariff cuts and trade agreements (bilateral and multilateral), while the informal routes include aspects such as more and better access to information, lower transport costs and, in a word, globalization. Taken together, these factors reduce the cost of trade and encourage businesses, industries and the economy as a whole to increase their participation in the world economy. In this context, increased participation in global trade and greater competition between economies raise the elasticity of employment vis-à-vis changes in relative prices, such as the exchange rate, increasing the importance of this as an allocation "price" and a determinant of factor location.[8] Currency appreciation, for example, may reduce domestic demand for labour because it makes imported products cheaper and increases competition. However, appreciation also increases imports of machinery and equipment, generating investment that

[6] Company size is strongly correlated with aspects such as company age and pay levels. While employment flows are not analysed in relation to these characteristics, newer companies with low pay levels can also be expected to have higher creation and destruction rates. Bergoeing, Hernando and Repetto (2003), for example, show that company age is negatively associated with turnover.

[7] Complementary calculations were carried out using the INE size classification. According to this classification, small companies are those with less than 50 employees, medium-sized companies those with 50 to 200 employees, and large companies those with 200 employees or more. Creation rates are 14% for small companies, 14% for medium-sized ones and 12% for large ones, while destruction rates are 18% for small companies, 14% for medium-sized ones and 9% for large ones. Their respective shares of gross creation (destruction), therefore, are 24.6% (33.6%) for small companies, 34.2% (35.3%) for medium-sized ones and 41.2% (31.1%) for large ones.

[8] From an economic point of view, market opening in itself tends to weaken the exchange rate; if appreciation occurs, this is probably for another reason (e.g., capital-account liberalization).

needs to be complemented by human resources, and that may increase the demand for labour in consequence.

Market opening yields benefits mainly through the reallocation of resources to more efficient uses, the incorporation of productivity-enhancing equipment and technology, and the development of exports. This process, in turn, is linked to comparative advantages and depends on resource endowment and capabilities. Market opening also creates costs, as increased external competition affects employment and wages and heightens the uncertainty of agents. Traditional trade models predict that trade liberalization will be followed by a rise in employment in sectors with comparative advantages and a decrease in sectors without such advantages. It is also clear that the effects of liberalization are heterogeneous, so that it is possible to identify gainers and losers both between sectors and between companies in a given sector.

Accordingly, theoretical models have recently been produced for international trade and market opening with non-homogeneous companies, to capture these different types of responses to liberalization. Bernard, Redding and Schott (2004), for example, combine traditional trade and comparative advantage theories with this new literature on heterogeneous firms (Melitz, 2003; Bernard, Jensen and Schott, 2003) and propose a model for the industrial dynamic in a context of liberalization and falling trade costs. Conceptually, market opening may have a variety of effects on firms: a greater likelihood of corporate death in the case of companies with low productivity, a greater likelihood that high-productivity enterprises will become exporters, and higher growth expectations for those that already export. In this situation, sectoral characteristics are important and have a direct effect on job turnover, relative wages and productivity in the industry concerned. The model shows that market opening raises the productivity of sectors as production is reallocated from unproductive firms to more productive ones, something that is most evident in industries with comparative advantages. This is because companies in those industries are more likely to be exporters, and this increases the entry rate of new enterprises while forcing low-productivity firms out of the market. One implication of the model described is that job turnover tends to be greater in industries with comparative advantages, owing to the greater number of businesses entering and exiting the market.

Trade reform in Chile began in 1974, and from then on tariffs were quickly cut and almost all non-tariff barriers removed. By 1979 the average tariff was just 10%. The process was reversed, however, because of the severe economic crisis of 1982-1983 and the average tariff rose to 20% in 1983 and 35% in 1984 (figure 5). At the same time, the exchange rate weakened sharply in 1983-1984 and a period of export promotion began (Moguillansky, 1999). After the crisis, trade liberalization acquired a new impetus and there were successive rounds of tariff cuts, bringing the tariff down to 11% in 1991. In 1999 tariffs began to be reduced by a further 1% a year, so that by 2003 they stood at 6%. These changes fostered a process of internationalization based on comparative advantages and Chile experienced strong export development in natural resource-related sectors. In this climate of increasing openness to trade (a number of international trade agreements were also signed), the index of industrial openness (exports plus imports over sales) rose from 38% in 1985 to over 58% in 2000 (figure 5).

We shall now analyse the impact of the exchange rate, tariffs and comparative advantages on employment flows at the sectoral level. The hypotheses to be investigated are as follows: i) whether comparative advantages have positive effects on job turnover, as suggested by Bernard, Jensen and Schott's (2003) model; ii) whether the impact of the exchange rate is significant and, if so, whether it is heterogeneous between sectors, and iii) whether tariff cuts actually do increase job destruction.

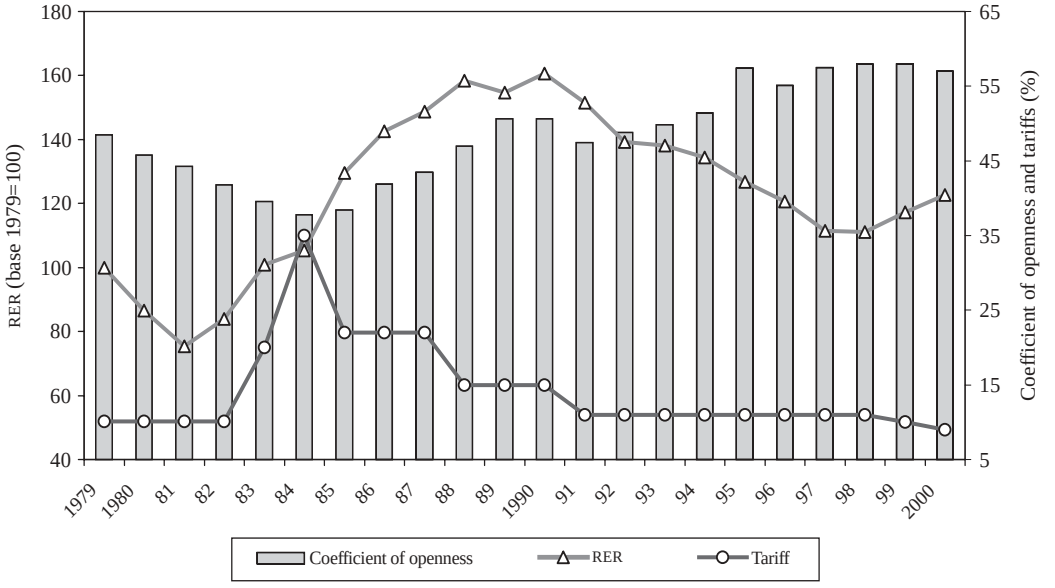
1. The econometric model and methodology

To analyse the link between employment and the exchange rate, tariffs and comparative advantages, three employment flow models —creation, destruction and turnover— were applied to a set of variables. The models were specified at the sectoral level, to three digits of ISIC/Rev. 2 (four digits in the case of 311-Foods), with annual periodicity for 1980-2000. Among the explanatory variables included were output growth, changes in the exchange rate and the import tariff, and a variable representing comparative advantages, defined as net exports. A multiplication variable was also established for the exchange rate and comparative advantages to test degrees of employment response by sector. A lagged dependent variable was included to verify the existence of a time dynamic in employment flows. Thus, the equations to be calculated were:

$$JC_{it} = \beta_0 \cdot JC_{it-1} + \beta_1 \cdot \Delta PIB_t + \beta_2 \cdot \Delta TCR_t + \beta_3 \cdot \Delta T_{t-1} + \beta_4 \cdot A_{it} + \beta_5 \cdot A_{it} \cdot \Delta TCR_t + \eta_i + \mu_t + \varepsilon_{it} \quad (1)$$

FIGURE 5

Chile: Real exchange rate, average tariff and index of industrial openness,[a] 1980-2000
(Percentages and index)



Source: Prepared by the author using data from the Central Bank of Chile and the Industrial Performance Analysis Programme of the ECLAC Division of Production, Productivity and Management.

$$JD_{it} = \beta_0 \cdot JD_{it-1} + \beta_1 \cdot \Delta PIB_t + \beta_2 \cdot \Delta TCR_t + \beta_3 \cdot \Delta T_{t-1} + \beta_4 \cdot A_{it} + \beta_5 \cdot A_{it} \cdot \Delta TCR_t + \eta_i + \mu_t + \varepsilon_{it} \quad (2)$$

$$JR_{it} = \beta_0 \cdot JR_{it-1} + \beta_1 \cdot \Delta PIB_t + \beta_2 \cdot \Delta TCR_t + \beta_3 \cdot \Delta T_{t-1} + \beta_4 \cdot A_{it} + \beta_5 \cdot A_{it} \cdot \Delta TCR_t + \eta_i + \mu_t + \varepsilon_{it} \quad (3)$$

where subindex i corresponds to the industrial sector (i=1,…,37) and t to the time period (t:1,…,21), while JC_{it} is job creation, JD_{it} destruction and JT_{it} turnover; ΔGDP_t is the annual variation in gross domestic product; ΔRER_t is the annual variation in the real exchange rate; ΔT_{t-1} is the change in the import tariff (lagged one period) and A_{it} is an index of comparative advantages defined as exports minus imports ($A_{it}=X_{it}-I_{it}$). Meanwhile, H_i is the fixed effect that is constant over time but different between sectors; Δ_t are random shocks that are homogeneous between sectors but different in time and Δ_{it} is the traditional random error. The employment data are from the Yearly National Industrial Survey (Encuesta Nacional Industrial Anual-ENIA), the data on GDP, tariffs and the exchange rate were obtained from the Central Bank of Chile, and the sectoral information on comparative advantages (A_{it}) was prepared using BADECEL data.[9]

Separate calculation of each of these three autoregressive models, where one of the explanatory variables is the lagged dependent variable, yields a correlation between the error term and the lagged dependent variable (JC_{it-1}, JD_{it-1} and JT_{it-1}). For this reason, the calculation of each ordinary least squares (OLS) equation is inconsistent. A traditional approach to estimating panel models of this kind is to use the fixed effect (FE) methodology and express the original variables as deviations from means. While this transformation eliminates the η_i component, there may still be problems because a correlation remains between the lagged dependent variable and the transformed error term. Still, when the sample size is fairly large, the bias will be less. Benavente and Melo (2003) show that while OLS estimation produces an upward bias in the β_0 coefficient of each model, FE estimation

[9] Foreign Trade Data Bank for Latin America and the Caribbean, maintained by the Statistics and Economic Projections Division of ECLAC.

produces a downward bias, although in this case it would not be very large owing to the time dimension of the panel (T=21).

In these circumstances, a more suitable econometric approach would be to use the generalized method of moments (GMM). GMM estimation consists in transforming the model into first differences and then using lags of the variables in levels as instruments of the endogenous variables. On the assumption that there is no autocorrelation, then, the error term in the transformed equation $\Delta\varepsilon_{it} = \varepsilon_{it} - \varepsilon_{i,t-1}$ is orthogonal to past values of the variables of the model in levels. Arellano and Bond (1991) propose to carry out the estimation by transforming the equation into first differences and then using the past levels of the dependent variable and predetermined variables,[10] and the differences of the endogenous variables, as instruments of the lagged explanatory variable. This methodology presupposes the existence of a correlation between the explanatory variables and the error and, at the same time, the absence of any second-order autocorrelation.

2. Results

This subsection presents the results of the estimates carried out using the OLS, FE and GMM methodologies (the last of which was proposed by Arellano and Bond, 1991). Because GMM estimation corrects the inconsistency resulting from the correlation between the error term and the lagged dependent variable of each of the equations to be estimated, the analysis of the results is centred on this methodology. The empirical evidence shows, furthermore, that the GMM estimates satisfy the suppositions for their application: the instruments are not correlated with the error and there is no second-order autocorrelation, as is shown by the Sargan overidentification test and the Lagrange multiplier, respectively (table 5).

First, there is the fact that the coefficients associated with the lagged dependent variables (JC_{it-1}, JD_{it-1} and JT_{it-1}) are significant and FE<GMM<OLS, owing to the downward bias of the FE estimator and the upward bias of the OLS estimator. The results of the coefficients associated with ΔGDP confirm that there has been procyclical job creation and countercyclical job destruction. Support for countercyclical job turnover, however, is provided only by the FE estimation. The variable that captures comparative advantages (A_{it}), meanwhile, shows a positive and significant impact on job turnover. This is explained by the effect of this variable on job creation, with a coefficient that is significant at 1%. Thus, there is evidence that comparative advantages, in a context of market opening, have a positive effect on labour reallocation, as Bernard, Redding and Schott's (2004) model shows.

Import tariffs, meanwhile, are also important in explaining employment flows. The fact is that while the impact on job creation is nil, a tariff cut has a positive and significant effect on destruction. It could be inferred, then, that a tariff cut increases external competition, so that the demand for labour falls and companies recruit less, with some even having to exit the market altogether. Indeed, Alvarez and Vergara (2004) show that in Chile it was plants in sectors competing with imports that were the most affected by trade liberalization. One consequence of the impact of liberalization on job destruction is a rise in job turnover, supporting the argument that liberalization hastens the reallocation of resources.

A depreciation in the real exchange rate (ΔRER_t), meanwhile, has a positive, if moderate, effect on job creation. Thus, a 10% depreciation in ΔRER yields a rise of 2.7% in job creation. The effect of the real exchange rate on job destruction, on the other hand, is not significant. Given that exchange-rate depreciations have a positive effect on job creation, it is not surprising if this results in greater job turnover. The coefficients associated with Z_{it}, as an interactive variable between comparative advantages and the exchange rate, offer a profounder insight into the phenomenon, for while the coefficient estimated in the destruction model is not significant, in the creation model it is positive and significant. This indicates that when the RER depreciates, the increase in job creation is greater in sectors with comparative advantages. Thus, in the event of depreciation, the growth in job creation will be greater in export-oriented sectors (such as 372-Non-ferrous metals or 341-Paper and cellulose) than in sectors that compete with imports (such as 385-Machinery). From these results it follows, then, that a real exchange-rate depreciation leads to an increase in labour reallocation as a result of greater job creation, and this is most marked in sectors with comparative advantages.

[10] X_{ix} is predetermined if $E[X_{ix},\varepsilon_{is}]\neq 0$ for $s<t$, but $E[X_{ix},\varepsilon_{it}]=0$ for all $s\leq t$. Intuitively, if the error term at t has any effect on subsequent realizations of x_{it}, then x_{it} is predetermined.

TABLE 5

Chile: Parametric evidence

(Estimated coefficients and t test in parentheses)

Methodology →	Generalized method of moments (GM) (Arellano and Bond, 1991)			Fixed effect (FE)			Ordinary least squares (OLS)		
Dependent variables →	Creation (JC_{it}) (1)	Destruction (JD_{it}) (2)	Turnover (JT_{it}) (3)	Creation (JC_{it}) (4)	Destruction (JD_{it}) (5)	Turnover (JT_{it}) (6)	Creation (JC_{it}) (7)	Destruction (JD_{it}) (8)	Turnover (JT_{it}) (9)
Job creation [JC_{it-1}]	–0.09 (–2.14)[a]			–0.10 (–2.53)[b]			0.17 (4.48)[a]		
Job destruction [JD_{it-1}]		0.08 (2.18)[b]			0.22 (5.88)[a]			0.31 (8.55)[a]	
Job turnover [JT_{it-1}]			0.12 (2.75)[b]			0.18 (4.07)[a]			0.43 (10.90)[a]
GDP growth [ΔGDP_t]	0.65 (8.44)[a]	–0.49 (–5.39)[a]	0.13 (1.09)	0.60 (10.39)[a]	–0.79 (–10.72)[a]	–0.32 (–3.40)[a]	0.49 (7.74)[a]	–0.75 (–1.06)[a]	–0.30 (–3.03)[b]
Variation in RER [ΔRER_t]	0.27 (6.81)[a]	–0.01 (–0.23)	0.25 (3.82)[a]	0.24 (6.15)[a]	–0.18 (–3.69)[b]	0.01 (0.17)	0.21 (4.84)	–0.18 (–3.53)[a]	0.003 (0.05)
Variation in tariffs [ΔT_{t-1}]	–0.04 (–0.08)	–0.37 (–6.37)	–0.45 (–6.10)[a]	0.08 (1.02)	–0.32 (–3.20)[b]	–0.26 (–1.97)[b]	0.06 (0.75)	–0.34 (–3.28)[b]	–0.31 (–2.20)[b]
Net exp [$A_{it} = (X_{it} - I_{it})$]	0.005 (6.26)[a]	0.01 (1.10)	0.005 (4.38)[a]	0.004 (5.89)[a]	–0.0005 (0.07)	0.004 (2.91)	0.001 (3.46)[b]	–0.000 (–0.07)	0.001 (1.94)[c]
Net exp.*ΔTCR [$Z_{it} = A_{it} * \Delta RER_t$]	0.0002 (4.14)[a]	0.000 (0.87)	0.0003 (3.23)[a]	0.0002 (3.83)	0.000 (0.07)	0.0003 (2.52)[b]	0.0001 (2.30)[b]	0.000 (0.18)	0.0001 (1.70)[c]
Observations	703	703	703	740	740	740	740	740	740
Sectors	37	37	37	37	37	37	37	37	37
Wald chi^2 (6) / F(6.697)	169.9	356.3	123.9	26.2	36.0	8.4	21.11	41.4	24.1
Sargan test (Prob>chi^2)	0.81	0.93	0.77						
LM Test Ar (1) (Prob>z)	0.00	0.00	0.00						
LM Test Ar (2) (Prob>z)	0.25	0.11	0.55						
R^2				0.18	0.23	0.06	0.14	0.25	0.16

Source: Prepared by the author.

[a] Coefficient significant at 1%. [b] Coefficient significant at 5%. [c] Coefficient significant at 10%.

V

Conclusions

The analysis of employment flows shows that, underlying net changes in employment, there are continuous creation and destruction phenomena that are significant at every point of the economic cycle, entailing a substantial turnover of resources. Between 1980 and 2000, job creation averaged 13% and destruction 13.2%, yielding job turnover in excess of 26%. Job creation is procyclical in nature, while destruction is strongly countercyclical. Both phenomena also behave asymmetrically in respect of macro performance: destruction is more volatile and presents greater elasticity vis-à-vis changes in GDP growth. This explains why job turnover also behaves countercyclically. Meanwhile, company demography (birth and death) is also an important factor in job creation and destruction: on average, the birth of companies accounts for 33% of job creation, while the death of companies accounts for 38% of job destruction.

In sectoral terms, what is striking is the great heterogeneity of employment flows, revealing how important sector-specific factors are. The more labour-intensive a sector is, in fact, the greater the job turnover. In turn, sectoral statistics confirm that job turnover patterns are countercyclical: the lower opportunity costs are, the higher labour reallocation is, reflecting the relative efficiency of the resource reallocation process in the economy. Nonetheless, the negative correlation between job creation and destruction suggests there is no time synchrony between the two. The evidence also suggests that creation and destruction rates (and turnover rates) are negatively associated with company size, and that it is large enterprises that dominate the job creation and destruction totals.

Three conclusions can be drawn from the econometric estimates. First, comparative advantages have a positive effect on job creation, and thence on job turnover. Bernard, Redding and Schott (2004) suggest that this could be due to companies in sectors with comparative advantages being more likely to export, which increases the number of company start-ups and forces low-productivity firms out of the market. Second, an exchange-rate depreciation has a positive effect on job creation, and thus on job turnover. The empirical evidence also shows that these phenomena are more pronounced in export-oriented sectors, precisely because the additional benefits deriving from higher export returns result in greater demand for labour. Third, trade liberalization increases employment turnover, and this is due to the rise in job destruction. Specifically, this is probably because of increased competition in import sectors, illustrating the adverse effects of market opening on employment.

APPENDIX

Definition of variables

Information is available at the industrial plant level with annual periodicity for the period 1979-2000. The data come from the Yearly National Industrial Survey (ENIA) conducted by the National Institute of Statistics (INE). This is a panel database that includes about 15,000 manufacturing establishments, catalogued to four digits in the International Standard Industrial Classification of All Economic Activities (ISIC/Rev.2). The employment information is broken down between white-collar workers (relatively highly skilled staff performing administrative duties) and blue-collar workers (staff engaged in production work). Following Davis and Haltinwanger (1992), if we consider that n is plant-level employment, then aggregate job creation (JC) and aggregate job destruction (JD) in an industry are defined as:

$$JC_t = \sum i \varepsilon S; \Delta N > 0 \left(n_{it} - n_{it-1}\right) + \sum i \varepsilon E\left(n_{it}\right)$$

$$JD_t = \sum i \varepsilon S; \Delta N < 0 \left| \left(n_{it} - n_{it-1}\right) \right| + \sum i \varepsilon X\left(n_{it-1}\right)$$

where subindex i refers to the industrial plant, S are companies with a continuous presence in the market between t-1 and t, E are companies entering the market in period t, and X are companies exiting it in period t. Creation and destruction rates are defined simply by dividing each variable by the average of the aggregate employment level (L) at t and t-1:

$$JC_t = \left\{ \sum i \varepsilon S; \Delta N > 0 \left(n_{it} - n_{it-1} \right) + \sum i \varepsilon E \left(n_{it} \right) \right\} / \left(\sum i \left(n_{it} \right) + \sum i \left(n_{it-1} \right) \right) * 1/2$$

$$JD_t = \sum i \varepsilon S; \Delta N < 0 \left| \left(n_{it} - n_{it-1} \right) \right| + \sum i \varepsilon X \left(n_{it-1} \right) / \left(\sum i \left(n_{it} \right) + \sum i \left(n_{it-1} \right) \right) * 1/2$$

Job creation and destruction at the sectoral level, meanwhile, are defined as:

$$JC_{It} = \sum i \varepsilon I, S; \Delta N > 0 \left(n_{it} - n_{it-1} \right) + \sum i \varepsilon I, E \left(n_{it} \right)$$

$$JD_{It} = \sum i \varepsilon I, S; \Delta N < 0 \left| \left(n_{it} - n_{it-1} \right) \right| + \sum i \varepsilon I, X \left(n_{it-1} \right)$$

where *I* refers to each manufacturing sector at the three-digit level of ISIC/Rev. 2 (four digits in the case of 311). Much as in the aggregate case, creation rates are obtained by dividing the above by average employment between *t* and *t-1* in each sector:

$$JC_{It} = \sum i \varepsilon I, S; \Delta N < 0 \left(n_{it} - n_{it-1} \right) + \sum i \varepsilon I, E \left(n_{it} \right) / \left(\sum i \varepsilon I \left(n_{it} \right) + \sum i \varepsilon I \left(n_{it-1} \right) \right) * 1/2$$

$$JD_{It} = \sum i \varepsilon I, S; \Delta N < 0 \left| \left(n_{it} - n_{it-1} \right) \right| + \sum i \varepsilon I, X \left(n_{it-1} \right) / \left(\sum i \varepsilon I \left(n_{it} \right) + \sum i \varepsilon I \left(n_{it-1} \right) \right) * 1/2$$

Lastly, net creation (*JCN*) and job turnover (*JT*), at both the aggregate and sectoral levels, are defined as:

$JCN_t = JC_t - JD_t$ (industry) ; $JCN_{It} = JC_{It} - JD_{It}$ (sector)

$JT_t = JC_t + JD_t$ (industry) ; $JT_{It} = JC_{It} + JD_{It}$ (sector)

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