Job Flows And Plant Size Dynamics: Traditional Measures and Alternative Econometric Techniques

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Abstract

This paper measures the relation between job flows and establishment size applying econometric techniques best suited for analyzing the long-run dynamics of large cross-section. Using a balanced panel from the Mexican Manufacturing sector, it shows that in line with existing evidence, initially small firms create proportionally more jobs than large firms. Since these results suffer from regression toward the mean, the paper applies an alternative technique and it does not find any long-run tendency of small establishment converging toward the mean. Furthermore, it shows how cross-sectional dynamics varies across industries, and how it is linked to gross and net flows in each sector. We observe convergence to the mean in relatively stable industries, and asymmetric dynamic behaviour between expanding and declining industries.

Keywords: Job Flows, Firm Size Dynamics, Regression to the Mean.
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1 Introduction

In the last decade, much of the discussion on labour market issues focused on the process of job creation and destruction, and great emphasis has been given to the relation between job flows and firm size, both in the policy debate (OECD 1994) and among academic scholars (Davis et al. 1996a).

If we define firm size as employment in a base year, two statistical regularities hold. First, job creation and destruction are substantially greater among small firms; second, net employment changes are a decreasing function of establishment size. These findings helped to stimulate the policy debate on the crucial role of small firms in the process of job formation. Unfortunately, from these regularities it is not possible to infer whether, in the long run, small firms create proportionally more jobs than large firms. Among others, Davis et al. (1996a; 1996b) point out the regression fallacy associated with the relationship between net employment changes and firm size, and they suggest an alternative approach based on the notion of long-run optimal size. When firm size is measured as the average employment across all years in the sample, Davis et al. show that in the U.S. manufacturing sector there is no clear relationship between net job creation and firm size.

This paper assesses the traditional measures, and argues that any definition of firm size that arbitrary forces each unit in the sample into a pre-defined size category will ignore the flows of jobs *between size categories*. Furthermore, when firm size is defined as the average employment across all years in the sample, as it is done by Davis et al. (1996), a positive relationship between firm size and net job creation may simply indicate that initially smaller firms created jobs throughout the period, and ended up relatively larger.

Clearly, to properly estimate long-run convergence of the firm size distribution, and to follow accurately employers between size categories without incurring in the regression fallacy, it is necessary to apply an alternative econometric technique. Fortunately, methodology for this purpose has recently been introduced by Quah (1993a; 1993b) in the context of economic growth, and applied by Lamo and Koopmans (1995) to the study of plant distribution in the Chemical sector, and by Konings (1995) in a paper that studies the evolution of plant size in the British manufacturing sector. Using a balanced panel for the Mexican manufacturing sector, the paper shows how conventional results may change when firm size dynamics is estimated non parametrically. Overall, there is no evidence of small firms systematically creating more jobs than large firms and, thus, no evidence of convergence to the mean for the sample as a whole.

Parallel to the debate on the role of small firms in the job creation process, a vast literature on empirical industrial economics has used firm level data to look at the turnover and mobility of firms (Caves, 1998; Sutton, 1997). Thus, it seems natural to apply the methodology we propose at the industry level, and to ask whether the dynamics of the firm distribution varies across industries, and whether it is linked to gross and net flows within sectors. This exercise shows that convergence to the mean is observed in relatively stable sectors, with an interesting asymmetric dynamic behaviour between expanding and declining industries.

The paper proceeds as follows. Section (2) briefly describes the data and measures job flows for the Mexican manufacturing industry. Section (3) assesses the traditional methodology for studying the relationship between job flows and establishment size. Section (4) describes an alternative technique based on a direct estimate of the dynamics of the entire firm-size distribution. Section (5) applies the methodology at the aggregate level, while section (6 applies it at level of the industry. Section (7) briefly summarizes and concludes the paper.

2 Measurement Criteria

2.1 The Data

The dataset is a panel of 2021 continuing establishment over the period of 1984 to 1990 (7 years). The source of data are administrative records of the "Annual Industrial Survey" of the Mexican manufacturing industry. On average, it covers between 70 and 80 percent of the industry in terms of production and employment. The average establishment size in the sample is 220 employees and entry and exit of establishments are not observed. Each establishment is assigned to an industry at the level of the Mexican Census classification. These industries have been aggregated to the "Raga" level, which corresponds to the classification used in the Input Output table of 1985. The number of industries is 47, which can be aggregated to 10, as it is done in section 5. Within the sample, large establishments correspond to the manufacturing population while small firms are randomly sampled. Even though the under-representation of small firms may apparently be a problem, it is not clear why the results of this paper should be affected by the fact that smaller establishments are randomly sampled.

2.2 Notation and Definitions

Let x_{it} be the size of establishment i at time t, which, as we outline in the next section, can be measured as employment at time t, as employment between t and $t+1$ or as average employment in all years in the sample. The growth rate of establishment i at time t, g_{it}, is then defined as

$$g_{it} = \frac{n_{it} - n_{it-1}}{x_{it}}, \tag{1}$$

where n_{it} and n_{it-1} are employment for establishment i at time t and $t-1$ respectively. If x_{it} is measured as the average employment between t and $t-1$, (1) is similar to the growth rate used by Davis- Haltiwanger (1990) and (1992), with deaths (births) corresponding to the left (right) endpoint. In the present paper the interval will be somewhat smaller since we do not observe deaths and births. The gross job creation and destruction rate are related to the size weighted frequency distribution of firm growth rates in the following way. Let job creation in sector j at time t be defined as

$$JC_{jt} = \sum_{J \in I} g_{it} \frac{x_{it}}{X_{jt}} \quad \forall\ i: \ \ g_{it} > 0, \tag{2}$$

where X_{jt} represents the size of sector J, and I is the set of all establishment in sector j at time t. Job destruction rate, JD_{jt}, is defined analogously for declining establishments. Gross job reallocation in sector j at time t, JR_{jt}, is simply the sum of gross job creation and destruction, while the difference between the two, NET_{jt} is the traditional measure of net employment changes. Since we do not observe jobs, vacancies and entry and exit, the measurement criteria adopted underestimate the true measures of job creation and destruction. For the first two problems there is little one can do about it. The problem with entry and exit is potentially more serious. However, Hamermesh (1993) and OECD (1994) estimate the relative importance of the various flows of jobs and conclude that the contribution to net and gross employment changes of continuing firms accounts for roughly 70 percent of the gross flow of jobs. With this coefficient in mind, we proceed to the calculation of the flows.

2.3 A Brief Look at the Aggregate Flows

Figure (1) plots aggregate manufacturing employment over time. The second half of the eighties is a period of sustained net job creation with overall employment growth equal to 7 percent between 1984 and 1990. Table (1) reports the time series introduced in the previous section, and Figure (2) plots the gross flows against time. Values for net employment changes indicate that between 1984 and 1990 employment fluctuates substantially, with

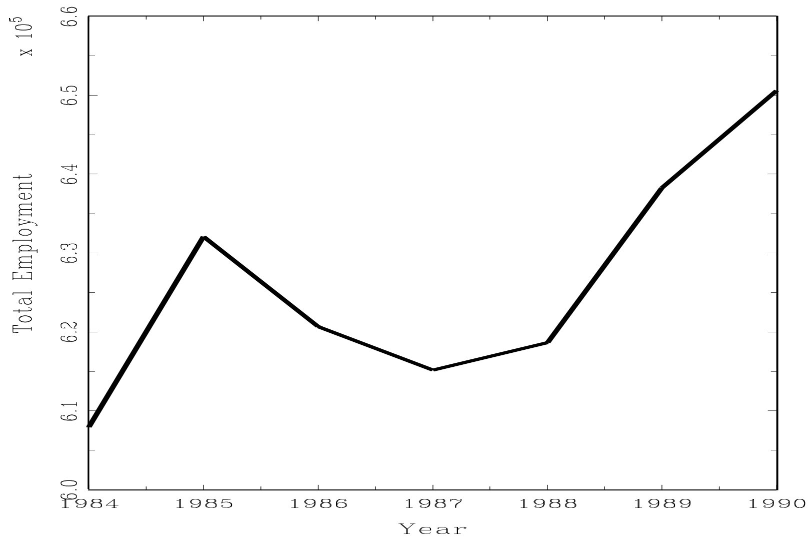

Figure 1: Manufacturing Employment 1984-1990

more than 3 percent employment growth in 1984 and 1988, and almost 2 percent fall in 1985. Correlation values in Table (1) show that employment changes are strongly correlated with both job creation and destruction. Job reallocation, with the exception of 1986 and 1987 is approximately constant, and does not show any increase during the recession, as in U.S. data compiled by Davis and Haltiwanger (1990). Finally, Table (1) reports also excess job reallocation, which is simply defined as the difference between job reallocation and the absolute value of net employment change. According to the estimate presented in table (1), an average of 8 percent of jobs where "reshuffled" across establishments in the Mexican manufacturing sector.

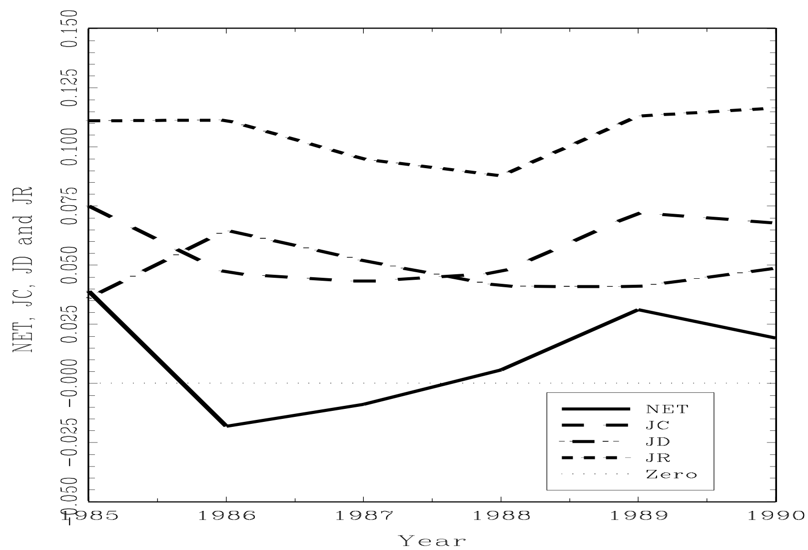

Figure 2: Aggregate Job Flows: 1984-1990

Table 1: Job Flows in the Mexican Manufacturing Sector

Year	Job Creation JC	Job Destruction JD	Net Employment Change NET	Job Reallocation JR	Excess Job Realocation EXC
1984-85	7.49	3.6	3.89	11.09	7.20
1985-86	4.65	6.47	-1.82	11.19	9.30
1986-87	4.29	5.18	-0.89	9.48	8.59
1987-88	4.66	4.1	0.56	8.77	8.21
1988-89	7.2	4.08	3.11	11.29	8.17
1989-90	6.77	4.86	1.91	11.64	9.72
Pearson Correlat.	$\rho(JC, NET)$ 0.932 (0.006)	$\rho(JD, NET)$ -0.859 (0.028)		$\rho(JR, NET)$ 0.4 (0.421)	$\rho(EXC, NET)$ -0.55 (0.24)

Marginal significance in parenthesis

Sources: Authors' calculations.

3 Job Flows and Firm Size. The Traditional Approach: Assessment and Measures.

The definition of gross job flows in equation (2) depends clearly on the way establishment size is defined. With respect to the relationship between firm size and job flows, different definitions of establishment size yield different results. This section shows how the results are affected by each definition, and discusses the methodological problems associated with each measure.

When we measure establishment size by employment in the base year, two statistical regularities hold. First,Job reallocation declines sharply as a function of size. Table (2) reports the distribution of gross job flows and employment by establishment size for eight OECD countries. R&P (1995) argues that the "empirical evidence in favor of the inverse relationship between job turnover and firm size appears to be the only *sure* result that we have... It shows up in all countries, independently of the data sources and methodology, as well as of the prevailing institutions". Second, there is a negative relationship between net job creation and firm size. In Table (2), for 7 out of 8 countries in the sample net job creation is positive in small firms, while the opposite seems true for large firms. In this section we consider in some details these findings, and we argue that the second relationship is based on a common regression fallacy, and thus uninformative on long-run role played by small firms in the job creation process.

Table (3) reports gross flows by establishment size for the Mexican manufacturing sector and confirms the empirical regularities found in the OECD economies of Table (2). Job reallocation is more than 23 percent for the smallest size category and declines sharply as a function of size. Furthermore, with an average employment growth of 1 percent, large firms underperform the aggregate economy while, at the same time, small firms grow at an exceptional average rate of 11 percent. The 11 percent growth is entirely driven by the average creation rate of over 17 percent.

Recently, a number of scholars, and notably Davis et al. (1996b), have pointed out the statistical problems linked to the results in Table (3). First, higher rates of job creation by small establishments should be treated with particular attention. Given our measure of job flows, it turns out that a firm of size 10 that creates and destroys one job records a reallocation rate of 20%, while if the same two jobs had been created by an establishment of 100 employees, the same figure would be 2%. Second, higher net employment changes by small firms do not imply by themselves that small establishments create proportionally

Table 2: Net Employment Change by Establishment Size Class across the OECD

Country	period	Size	Job Reallocation	Net Changes
Canada	1983-91	<20	39.01	7.36
		20-99	26.89	2.21
		100-499	26.15	0.92
		>500	15.99	-0.41
Finland	1986-91	<20	29.83	2.46
		20-99	19.85	-2.32
		100-499	18.37	-4.27
		>500	16.59	-6.86
Germnay	1986-91	<20	32.31	0.57
		20-49	18.20	-2.20
		50-99	13.75	-3.49
		100-249	12.25	-3.89
		250-499	13.98	-4.96
		500-999	11.31	-4.83
		1000-2499	16.77	-14.19
		2500-4999	8.8	-7.32
		>5000	8.47	-8.47
Italy	1984-93	<5	43.49	6.36
		6-9	30.78	0.08
		10-19	25.41	-0.84
		20-49	20.77	-1.32
		50-99	17.38	-1.30
		100-199	15.15	-1.52
		200-499	13.47	-1.42
		500-999	12.34	-1.43
		>1000	8.76	-2.28
New Zeland	1987-92	<20	37.67	0.96
		20-99	32.77	-6.13
		100-499	21.57	-3.55
		>500	45.07	-20.56
Sweden	1985-92	<20	39.84	5.64
		20-99	25.31	-1.86
		100-499	21.57	-3.55
		>500	21.82	-5.48
U.K.	1987-89	<5	77.50	34.1
		5-9	48.6	11.2
		10-19	34.40	5.20
		20-49	26.90	4.10
		50-99	24.00	5.80
		100-499	23.4	4.2
		500-999	26.40	8.60
		1000-4999	16.10	1.10
		5000-9999	20.8	1.60
		>10000	7.3	2.1
U.S.	1973-88	¡19	41.1	10.3
		20-49	26.7	0.6
		50-99	23.4	-0.7
		100-249	20.6	-1.7
		250-499	17.3	-2.5
		500-999	15.3	-2.7
		1000-2499	14.1	-2.6
		2500-4999	13.3	-2.5
		5000-9999	11.8	-2.4

Sources: R&P (1995) and reference therein;
U.S. figure from Davis et al. (1995)

Table 3: Job Flows by Establishment Size Category

	Establishment Size as Employment in Base Year				
	Employees < 20	Employees $20 - 50$	Employees $51 - 99$	Employees $100 - 500$	Employees > 500
Average Job Creation	17.33	9.07	8.42	6.66	5.1
Average Job Destruction	5.99	4.9	5.2	4.7	4.71
Average Job Reallocation	23.33	14.01	13.68	11.3	9.8
Average Net Change	11.3	4.08	3.1	1.9	0.39

Average weighted by the number of jobs in each year

Sources: Authors' calculations.

more jobs. Such conclusions should also consider the share of job creation with respect to the employment share by each category. Table (4) takes explicitly into consideration the shares and the proportion of jobs created by each category. The fraction of jobs created by each size category over the employment share in the same category is a measure independent of the relative size of each category, so that it becomes possible to compare performance across categories. On average, the ratio between the share of jobs created by small firms over their employment share is more than 3, against 0.86 for the establishments with more than 500 employees. Among the two extremes, the relationship falls monotonically. It is necessary to stress the difference between net and gross flows before reaching any conclusion from this partial result. Table (4) calculates the same ratio for job destruction, and find that small firms also play a more active role in the process of job destruction. Again, the relationship between our proportional measure of job destruction and firm size falls monotonically. Even though small firms more than proportionally create and destroy jobs, the last rows of Table (4) shows that the difference between rows 2 and 3 in Table (4) is positive for small firms and negative only for the very large firms. Overall, Table (4) confirms a more active role of small establishments in the process of net job formation.

From the results of Table (4), we would expect the growth rate of each firm to be negatively correlated to its initial size. Establishment growth rate regressions and studies on the evolution of the size distribution have been at the core of a large literature in Industrial Organization (Evans 1987a; 1987b). Caves (1998) reviews in some details this literature and argues that *it is well known that mean growth rates of surviving firms are not independent of their sizes, but tend to decline with size and also with the unit's age (when size is controlled*

Table 4: Proportional Measure of Job Flows by Establishment Size Category

	Employees < 20	Employees $20 - 50$	Employees $51 - 99$	Employees $100 - 500$	Employees > 500
Average Employment Share	0.2	1.6	4.5	36.4	58.1
$\frac{\text{Share of Job Creation}}{\text{Employment Share}}$ (a)	3.15	1.56	1.45	1.13	0.86
$\frac{\text{Share Job Destruction}}{\text{Employment Share}}$ (b)	1.27	1.06	1.11	1.00	0.98
Net Proportional Share	1.87	0.50	0.34	0.13	-0.12

(a) Job created by each category over employment share in the same category

(b) Job destroyed by each category over employment share in the same category

for)[1]. These patterns have often been considered incosistent with the well known Gibrat's Law, according to which growth rates are independent of initial size.

Despite the evidence provided in Tables (3) and (4), and the results in the literature surveyed by Caves (1998), it is still not possible to conclude that small firms play a distinct *long run* role in the process of net job creation. The major problem to overcome before assessing the role played by small firms in job creation is the statistical fallacy known as "Galton fallacy", or *regression to the mean.* The regression bias arises in any longitudinal data set and has received particular attention in the empirics of economic growth (Quah (1993a) and Friedman (1992). Technically, because of the Galton fallacy, when we regress net employment changes by firms on initial employment, a negative coefficient on initial size may be uninformative about the long run relationship between initial size and firm growth[2]. Intuitively, results in Tables (3), (4) can be affected by the regression fallacy for the following reason. If a firm suffers from transitory deviation of employment around its long-term optimum size, temporarily smaller firms will gain jobs during their path to equilibrium, and vice-versa for temporarily larger firms. If establishment size is measured as employment

[1] A similar statistical regularity is suggested by Sutton (1997)

[2] Quah (1993b) shows why a negative coefficient of a regression of growth rate on initial size may be inconsistent with a stationary standard deviation in the underlying distribution.

in base year, the existence of temporary deviation would bias upward job creation by small firms and job destruction by large firms. Consequently, when we regress firm growth over initial employment, a negative coefficient on initial size may simply capture the existence of temporary shocks, without telling anything about the underlying relationship between firm size and firm growth.

Thus, if we are mainly interested in the long-run relationship between firm size and job creation an alternative method is probably called for. Aware of this problem, Davis et al. (1996b) propose a measure of establishment size that tries to capture an establishment optimal long-run size. To avoid the regression fallacy, they attribute job flows to a smaller or larger size category calculating the average size across all observations in the sample. Applying this latter measure to plant level in the U.S. manufacturing sector, they do not find any systematic relationship between establishment size and long-run firm size measure.

Table (5) computes job flows by firm size measuring establishment size as the average employment over all years in the sample. Table (5) is constructed using the same size category as Table (4), but assigning an establishment to each category according to its average employment between 1984 and 1990. The fourth row of Table (5) reverses the results of Table (3), and shows a positive monotonic relationship between establishment size and net employment changes. Similar conclusions hold for the bottom row of Table (5), which replicates the calculation of Table (4) with the new long-run size. A casual interpretation of the result of Table (5) indicates that small firms more than proportionally destroy jobs.

Even though Table (5) may partially avoid the regression fallacy, it does not give us a clear answer on the relationship between firm size and job flows. Results in Table (5) may simply indicate that firms initially small (large) created (destroyed) jobs throughout the period and ended up relatively large (small). Furthermore, to the extent that the latter interpretation is correct, it seems that substantial dynamics between category is taking place. In all the Tables presented so far, we focused exclusively on within category job creation. This practice, by construction, hides any intradistribution dynamics. This discussion should highlight the fact that the definition of small and large establishments is a relative concept, and that any such definition is somehow arbitrary. The next section considers an alternative econometric technique that allows one to measure job flows and firm size avoiding the Galton fallacy, and explicitly considering job flows between size categories.

Table 5: Proportional Measure of Job Flows by Establishment Size Category

	Firm Size as Average Employment between 1984 and 1990				
	Employees < 20	Employees $20-50$	Employees $51-99$	Employees $100-500$	Employees > 500
Average Employment Share	0.2	1.6	4.5	31.4	63.0
Average Job Creation	7.62	6.41	6.72	6.37	5.43
Average Job Destruction	8.52	6.79	6.3	5.2	4.18
Average Job Reallocation	16.1	13.2	13.07	11.6	9.6
Average Net Change	-0.009	-0.003	0.003	1.11	1.25
$\frac{\text{Share of Job Creation}}{\text{Employment Share}}$ (a)	1.26	1.10	1.14	1.09	0.91
$\frac{\text{Share Job Destruction}}{\text{Employment Share}}$ (b)	1.73	1.44	1.34	1.10	0.87
Net Proportional Share	-0.47	-0.34	-0.19	-0.01	0.037

(a) Job created by each category over employment share in the same category

(b) Job destroyed by each category over employment share in the same category

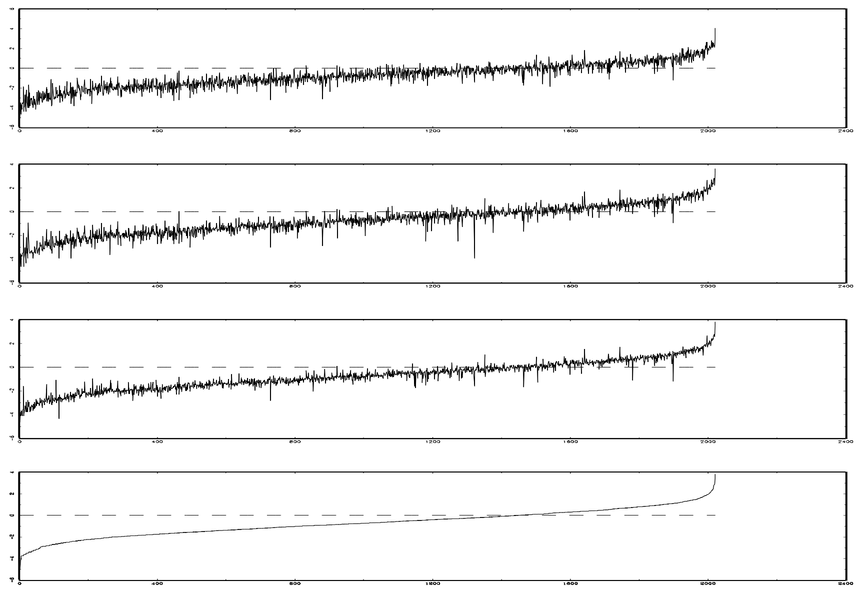

Figure 3: Ranking of Establishments Over Time

4 Job Flows Between Size Category and Analysis of Convergence

The analysis of the previous section suggested that substantial intradistribution dynamics may take place and that a considerable number of firms are overtaking each other. A first way of looking at the problem in a different way is as follows. Let n_{it} denote employment in establishment i at time t, and let us analyze the natural log of relative size $(n_{it}/\overline{n}_t)$, where $\overline{n}_t$ is the average employment in the sample at time t. Figure (3) plots the size distributions in the following way. Arrayed along the horizontal axis are more than 2000 establishments in the sample, sorted in order of increasing 1984 relative size $n_{it}/\overline{n}_t$. The horizontal line at height 0 indicates the average establishment at time t.

In Figure (3), monotonic by construction, any establishment below (above) the dotted line in the first panel has employment lower (higher) than the average in 1984. Proceeding further vertically upwards in Figure (3), we plot additional cross-profile lines at two year intervals (1986,1988 and 1990). In these graphs, firms overtake each other when succeeding cross-profiles become non-monotone. As suggested by Quah (1994), to understand better these graphs, let us consider two simple experiments. Suppose the cross-section of establishments were only adjusting towards the same steady state without overtaking each other, i.e. converging towards the mean. Then the profile in Figure (3) should maintain its monotonic property and its slope flatten out. This is not what unambiguously happens in Figure (3). Suppose, conversely, that establishments of different size were steadily diverging from each other. This time the cross-profile should still maintain its monotonic property, but with an increasing slope over time. As before, this is not what we see in the graph. The only obvious conclusion from Figure (3) is that firms continuously overtake each other and the monotonicity property of the first chart is lost over time. In this context, what we really need are econometric methods that allow us to measure job creation between size categories. Methodology for this purpose has been recently introduced by Quah (1993a; 1994) in the empirics of economic growth.

In what follows, let F_t denote the size distribution across establishments at year t; Quah suggests that the simplest probability model that can describe the dynamic behaviour of F_t is

$$F_t = T^*(F_{t-1}, u_t), \tag{3}$$

where T^* is an operator that maps a probability measure and a disturbance into another probability measure. Note that carrying out aggregate statistics of F, as we did in the previous section, would not suffice since we would hide any intra distribution dynamics. Furthermore, if we are interested in the long-run behaviour of the size distribution we can proceed as follows. If we ignore the disturbance term u_t and we iterate expression (3), the size distribution at time $s > t$ can be described as

$$F_{t+s} = (T^*)^s F_t. \tag{4}$$

Finally, if we let s go to infinity, the long-run (ergodic) distribution of establishment size can be characterized. In this context convergence (towards the mean) might manifest in F_{t+s} tending towards a mass point; alternatively the size distribution partitioning in small and large firms might be described by F_{t+s} being characterized by two points or a bimodal distribution.

Note that the stochastic difference equation (4) is untractable. The problem with (4) is that as long as F is a continuous variable, there are an infinite number of states. In this paper we focus on the simplest treatment we can have of (4) and we simplify the problem by approximating T^* in the following way. We first assume a countable state space for firm size $S = s1, \ldots, sr$ and we transform T^* into a simple transition probability matrix Q, which makes the difference equation (4) tractable. The problem becomes simply

$$F_{t+1} = QF_t, \tag{5}$$

where Q encodes all the relevant information about mobility within the cross section distribution and allows us to study the long-run ergodic size distribution of firms. The framework set forth let us infer both intradistribution dynamics encoded in the matrix Q and its long-run ergodic behaviour through successive iteration.

5 Results

To avoid the problems of arbitrariness in the size definition, we consider employment size with respect to the average establishment in each year.[3] Category thresholds are determined to make the initial distribution of firms is uniform. We typically work with a grid of size 5, and with an initial proportion of firm in each grid equal to 0.2. However, as a way to test the robustness of our results, Table 8 estimate a grid of size 7, with an initial proportion of firms equal to 0.142.

Our baseline exercise is reported in Table (6), where we estimate a one year transition matrix for the total manufacturing sector. In Table (6) the upper end of the state 0.175 indicates that in the first category we find all establishments whose employment is less of 17.5 percent than the average establishment in 1984. The mean establishment falls in the fourth category. Given these categories, we estimate the transition probability for each year of observation. We obtain six estimates and, averaging out across time, we obtain the Markov chain of Table (6). Obviously most of the probability lies in the main diagonal. This is a simple indication of the fact that employment is highly persistent. Furthermore, entries in the main diagonal are higher in the first and last rows. This follows from the fact that firms in those categories can only move in one direction. One of the most important observations from Table (6) concerns elements in the third row. The establishments in the third category have a higher probability of becoming smaller than larger, the contrary to what we would expect in a world where establishments converge towards the mean. Similarly, the probability mass of an establishment moving from the first to the second row is smaller than the probability of falling from the second to the first row. Finally, plants in the fourth

[3] While this measure of employment size has clear advantages, it "filters" out common trend.

Table 6: One Year Transition Matrix

Average 1984-1990. Total Manufacturing
Time Stationarity

Upper end of the state	0.175	0.355	0.665	1.37	∞
0.175	0.925	0.0714	0.00322	0.00	0.00
0.355	0.0847	0.823	0.0890	0.0037	0.00
0.665	0.0042	0.0883	0.824	0.0823	0.0085
1.37	0.00123	0.0045	0.0826	0.0849	0.0629
∞	0.00	0.0008	0.000161	0.0668	0.931
Ergodic	0.242	0.20	0.196	0.188	0.174

category have an higher probability of falling into the third category than moving up. The last row in Table (6) reports the ergodic distribution implied by entries in Table (6) and it does not show any evidence of establishment size converging to the mean.[4] If anything, there is some evidence of an increasing weight of the smaller category, but no evidence of convergence to the mean by initially small and large establishments, as results in Tables (3) and (4) would predict. Table (7) confirms the results of Table (6) for a one step transition matrix. What is happening to intradistribution dynamics is a large movement of initially larger establishments toward a smaller size category, with no evidence of a persistent growth by initially smaller firms towards the mean. To test the robustness of our findings, Table (8) performs the baseline exercise with a 7 by 7 transition matrix, where the mean falls in the sixth category. Once again, Table (8) shows that firms closer to the mean have a higher probability of falling than rising, and the implied ergodic distribution does not show evidence of convergence.

[4]In the calculation of the ergodic distribution we did not impose any restriction to ensure existence and uniqueness of the steady state distribution. Nevertheless the calculation requires time stationarity of the underlying stochastic process, a property that appears reasonable when establishment size is measured in terms of deviations from the mean.

Table 7: 5 Years Transition Matrix

Average 1984-1990. Total Manufacturing
Time Stationarity

Upper end of the state	0.175	0.355	0.665	1.37	∞
0.175	0.832	0.151	0.173	0.00	0.00
0.355	0.218	0.576	0.19	0.015	0.00
0.665	0.0198	0.183	0.587	0.20	0.0099
1.37	0.0495	0.00173	0.218	0.636	0.124
∞	0.00	0.0483	0.0217	0.145	0.829
Ergodic	0.287	0.198	0.203	0.175	0.13

Table 8: One Year Transition Matrix. 7 States

Average 1984-1990. Total Manufacturing
Time Stationarity

Upper end of the state	0.135	0.240	0.390	0.615	0.965	1.78	∞
0.135	0.904	0.0872	0.00566	0.00276	0.00	0.00	0.00
0.240	0.109	0.769	0.115	0.0055	0.002	0.000	0.00
0.390	0.00228	0.124	0.755	0.115	0.00343	0.0011	0.00
0.615	0.00228	0.0066	0.114	0.773	0.102	0.0024	0.00
0.965	0.00118	0.00236	0.00782	0.106	0.771	0.110	0.00177
1.78	0.00	0.001	0.0016	0.0060	0.0883	0.842	0.061
∞	0.00	0.00	0.0001	0.00	0.0028	0.076	0.92
Ergodic	0.182	0.153	0.146	0.141	0.123	0.143	0.112

6 Inside Manufacturing Industries

Firm size evolution depends primarily upon technological characteristics and market structure typical of the industry in which each establishment operates. In light of the vast literature on the mobility of firm within industries, it seems natural to apply our non-parametric technique at the industry level. More specifically, we ask whether regression to the mean is observed in any industrial sector, independently of its aggregate employment dynamics, or whether we observe different long-run tendencies in different sectors.

First for all, it is useful to document the extant of magnitude of job reallocation at the industry level. This is done in Table 9, which documents substantial rate of job reallocation in every manufacturing industry, indicating a remarkable degree of heterogeneity within narrowly defined sectors. This observation has lead scholars to ask whether this job reallocation process reflects sectoral shifts *across* industries or job reshuffling *within* industries. In what follows we following Konings (1995), and we construct the following index of intra-industry job reallocation in period t

$$index_t = 1 - \frac{\sum_j |NET_{jt}|}{\sum_j |JR_{jt}|}, \tag{6}$$

where NET_{jt} and JR_{jt} are respectively net employment change and job reallocation in industry j at time t. If equation 6 is equal to zero, then job flows reflect shifts occurring entirely across sectors, while a value of 1 reflects shifts occurring entirely within sectors. The yearly average value of this index is .32, in line with what Konings find for the U.K. manufacturing sector, but somewhat smaller than the value for a similar index calculated for the U.S. by Davis et al. (1996). Table 10 shows also that the index varies substantially over time, and presents an interesting positive correlation with net employment changes. This seems to support the finding of Konings (1995), who argues that in good times jobs are reallocated more within one sector, while in bad times jobs are reallocated more across sectors. This finding may be consistent with the analysis of Rotemberg and Saloner (1986), who solve a game theoretic model of price competition and firm restructuring, and argue that firm restructuring during booms is likely to happen in relatively good times, when the potential gain in terms of market share are larger. argues

Turning to the analysis of the dynamics of the firm size distribution, the appendix reports the upper limit of the categories for 10 sectors for which we obtained estimates of the transition probability. Even though there are some differences in the initial size distribution, each sector has the mean in its fourth category. The appendix shows also the transition probability matrix for each industry, as well as its ergodic distribution. The

Table 9: Job Flows in Mexican Manufacturing Industries

Sector	Average Net Change NET	Average Job Reallocation JR
Food	1.9	11.00
Beverages	2.4	9.81
Textile & Clothing	-1.19	9.22
Wood	0.2	8.91
Paper	-0.6	9.76
Chemical	1.26	9.36
Non-Metallic	0.09	10.60
Metallic	1.01	12.9
Machinery & Equipment	3.45	12.01
Car	-1.71	12.4
Source : Author Calculation		

Table 10: Index of Intra-Industry Job Turnover

Year	Index
1984-85	0.41
1985-86	0.17
1986-87	0.23
1987-88	0.21
1988-89	0.37
1989-90	0.57
Pearson Correlat.	$\rho(Index, NET)$ 0.72 (0.106)
Marginal significance in parenthesis *Sources:* Authors' calculations.	

Table 11: Mobility and Convergence Across Sectors

Average 1984-1990. Total Manufacturing

Time Stationarity

Industry	Ergodic Distribution 5 Size categories(*)	NET (a)	Average Mean (b)	Mean Change (c)	Mobility Index (d)
Group 1:					
Wood	0.17 0.14 0.22 0.24 0.21	0.2	181.6	0.01	0.158
Chemical	0.18 0.15 0.20 0.24 0.21	1.26	263	0.07	0.151
Group 2:					
Textile	0.17 0.12 0.12 0.22 0.34	-1.19	295.1	-0.06	0.175
Car	0.06 0.12 0.20 0.31 0.30	-1.71	266.5	-0.1	0.155
Paper	0.09 0.11 0.09 0.18 0.51	-0.6	161.9	-0.037	0.184
Group 3:					
Beverages	0.17 0.21 0.17 0.20 0.22	2.4	765.1	0.15	0.187
Machinery	0.38 0.12 0.21 0.18 0.09	3.45	667.6	0.209	0.176
Metal	0.18 0.19 0.23 0.19 0.19	1.01	284	0.06	0.227
Food	0.28 0.23 0.18 0.16 0.12	1.9	238	0.12	0.162
Group 4:					
Non Metalic	0.16 0.25 0.19 0.23 0.15	0.09	323	0.003	0.162

(*) For upper limit of the initial distribution see Appendix

(a) Net employment change between 1984 and 1990

(b) Average Establishment Size

(c) Proportional Change in the Mean

(d) Shorrock Mobility Index

Sources: Authors' calculations.

transition probability matrix shows that, as expected, the highest probability lies in the main diagonal, but entries in the other cells are non-zero. As expected, firm employment is highly persistent, but intradistribution dynamics is sizable.

Table (11) looks in more details at the ergodic distribution in each sector and a series of other statistics related to job flows. The first result in Table (11) is the difference in the ergodic behaviour across industries. Wood and Chemical industry shows some evidence of convergence, with the highest probability clearly in the fourth category. The same ergodic behaviour is not observed in other industries. Non-Metallic sector registers a different form of convergence, with a bimodal concentration of firms in the second and the fourth category. Textile and Clothing, the Car industry and Paper are characterized by a totally different ergodic behaviour, with the mode concentrated in the highest category. Finally food, metal, machinery and equipment and beverages, show no clear pattern of mobility. Table (11) also reports, for each sector, average net employment change, average establishment size, the proportional change in the mean over time and a measure of Shorrocks (in Geweke et al. (1986)) mobility index of persistence, defined as

$$M(P) = \frac{n - tr(P)}{n - 1}, \tag{7}$$

where M is the mobility index, P is the Markov chain, n is the number of categories and $tr(P)$ is the trace of P. A value of $M(P)$ of 0 indicates an absolute persistence in the process, whereas a value of $n/n - 1$ indicates the highest possible mobility.

Table (11) shows that for the converging sectors average net employment change is approximately constant and the proportional change in the mean is slightly positive. If we take a simple average between groups of sectors, job reallocation for Wood and Chemical sectors (Table 9) and the Shorrocks index are the smallest between all groups. Conversely, the second group (textile, car and paper) has a downward shifting of the mean and a negative average net employment change. Both job reallocation and the mobility indices are, on average, higher than the corresponding values for the converging sectors. Group 3 is characterized by a substantial increase in the mean, roughly 15 percent. Note that the mobility index for group 3, on average .19, is the highest among the three groups of sectors identified. Similarly for job reallocation, with an average value of .096.

Table (11) suggests that firm size distribution dynamics in each sector is linked to the dynamic behaviour of the sector as a whole. Relatively stable sectors, with small changes in both the mean and total employment (group 1) converge to the mean with relatively little intradistribution dynamics. On the other hand, declining sectors, such as those in group 2, experience a mass concentration into the highest size categories. Finally, expanding sectors (group 3) do not show any particular tendency in the size distribution, but, as a group, they are characterized by the highest mobility level, both in term of job reallocation and the Shorrocks index. These results suggest a remarkable asymmetric behaviour in the size distribution between expanding and declining sectors, and some evidence of convergence for relatively stable sectors.

At the theoretical level, as Sutton (1997) points out in his recent survey, there does not seem to be any general argument that suggests either a convergence or a divergence is the size of the largest firms. A large set of forces are at work, and it seems that reasonable models can be constructed with opposite implications of long run convergence of firms of different sizes. However, the results of Table 11, whereby declining industries experience an increase in concentration in the upper quantile of the firm size distribution appear to be in line with the prediction of the model proposed by Ghemwat and Nalebuff (1990). These authors analyze a simple game in which firms reduce capacity as demand decline. They show that the largest firms shed capacity first until they become equal in size of the next largest; then both shrink together until they hit the size of the next largest, and so on.

7 Conclusions

In the last decade, much emphasis in the policy debate has been given to the role of small firms in the process of job creation. Empirically, when we measure firm size as employment in a base year, small firms more than proportionally create jobs. This paper discussed the methodological problem linked to the definition of establishment size, and measured the relation between job flows and establishment size with different plant size definitions. It argued that the traditional measures suffer from Galton fallacy, and they are uninformative on the long-run relationship between job flows and establishment size. Applying non parametric techniques best suited for analyzing the dynamics of a large cross-section, the paper did not find any long-run movement of initially small establishments toward the mean, and no evidence of convergence. Furthermore, applying the analysis at the industry level, the paper highlights an interesting asymmetric behaviour in the dynamics of the expanding and declining sector.

Konings (1995) in a paper that studies the evolution of plant size in the British manufacturing industry finds similar results. The next step would be to apply the same methodology to other dataset and control to what extent the results of this paper represent a more general result. If these empirical results should be further confirmed, important implications for industry dynamics would naturally follow.

1 Appendix: Transition Matrices at the Industry Level

In this section I report the one year transition matrices for the 10 industries of the Mexican manufacturing sector.

Table 12: Food Industry. First Order Transition Matrix

Average 1984-1990. Food Industry
Time Stationarity

Upper end of the state	0.225	0.390	0.670	1.38	∞
0.225	0.939	0.052	0.008	0.00	0.00
0.390	0.068	0.842	0.047	0.005	0.00
0.670	0.005	0.115	0.809	0.07	0.00
1.38	0.00	0.0103	0.074	0.862	0.0538
∞	0.00	0.000	0.000	0.070	0.929
Ergodic	0.287	0.238	0.183	0.166	0.126

Table 13: Beverages Industry. First Order Transition Matrix

Average 1984-1990. Beverages Industry
Time Stationarity

Upper end of the state	0.310	0.645	0.950	1.32	∞
0.310	0.929	0.066	0.011	0.00	0.00
0.645	0.062	0.823	0.115	0.00	0.00
0.950	0.005	0.128	0.763	0.11	0.00
1.32	0.00	0.0202	0.075	0.82	0.084
∞	0.00	0.000	0.000	0.0768	0.923
Ergodic	0.174	0.217	0.178	0.205	0.226

Table 14: Textile and Clothing. First Order Transition Matrix

Average 1984-1990. Textile and Clothing
Time Stationarity

Upper end of the state	0.175	0.355	0.640	1.32	∞
0.175	0.931	0.066	0.002	0.00	0.00
0.355	0.082	0.832	0.081	0.003	0.00
0.640	0.00	0.072	0.826	0.098	0.002
1.32	0.0058	0.027	0.058	0.861	0.0793
∞	0.00	0.000	0.000	0.0528	0.947
Ergodic	0.172	0.127	0.128	0.226	0.347

Table 15: Wood Industry. First Order Transition Matrix

Average 1984-1990. Wood Industry
Time Stationarity

Upper end of the state	0.27	0.490	0.815	1.41	∞
0.27	0.923	0.0772	0.00	0.00	0.00
0.49	0.0917	0.795	0.108	0.00	0.00
0.815	0.00	0.0664	0.846	0.0873	0.00
1.41	0.00	0.00	0.075	0.87	0.054
∞	0.00	0.005	0.005	0.056	0.932
Ergodic	0.172	0.145	0.229	0.245	0.21

Table 16: Paper Industry. First Order Transition Matrix

Average 1984-1990. Paper Industry
Time Stationarity

Upper end of the state	0.285	0.490	0.705	1.26	∞
0.285	0.884	0.0996	0.00	0.0167	0.00
0.49	0.094	0.80	0.106	0.00	0.00
0.705	0.00	0.111	0.751	0.137	0.002
1.26	0.00	0.0139	0.0662	0.853	0.067
∞	0.00	0.00	0.00	0.0238	0.976
Ergodic	0.09	0.11	0.096	0.183	0.519

Table 17: Chemical Industry. First Order Transition Matrix

Average 1984-1990. Chemical Industry
Time Stationarity

Upper end of the state	0.21	0.4	0.745	1.5	∞
0.21	0.925	0.0068	0.005	0.00	0.00
0.4	0.079	0.817	0.096	0.0063	0.00
0.745	0.059	0.073	0.842	0.0785	0.00
1.50	0.0017	0.00	0.0678	0.874	0.056
∞	0.00	0.00	0.00	0.063	0.937
Ergodic	0.184	0.151	0.204	0.244	0.217

Table 18: Non-metallic Industry. First Order Transition Matrix

Average 1984-1990. Chemical Industry
Time Stationarity

Upper end of the state	0.11	0.28	0.620	1.59	∞
0.11	0.923	0.072	0.0045	0.00	0.00
0.28	0.0479	0.836	0.112	0.0037	0.00
0.62	0.00	0.148	0.773	0.0792	0.00
1.59	0.00	0.003	0.0676	0.885	0.0436
∞	0.00	0.00	0.00	0.0663	0.934
Ergodic	0.16	0.255	0.19	0.233	0.153

Table 19: Metallic Industry. First Order Transition Matrix

Average 1984-1990. Chemical Industry
Time Stationarity

Upper end of the state	0.19	0.395	0.750	1.51	∞
0.19	0.879	0.117	0.0038	0.00	0.00
0.395	0.107	0.753	0.137	0.0035	0.00
0.750	0.0075	0.104	0.768	0.12	0.00
1.51	0.00	0.0068	0.138	0.773	0.0819
∞	0.00	0.003	0.00	0.0776	0.919
Ergodic	0.18	0.19	0.232	0.193	0.196

Table 20: Machinery and Equipment Industry. First Order Transition Matrix

Average 1984-1990. Machinery and Equipment Industry
Time Stationarity

Upper end of the state	0.145	0.35	0.675	1.42	∞
0.145	0.973	0.0269	0.00	0.00	0.00
0.35	0.075	0.808	0.117	0.00	0.00
0.67	0.00	0.06	0.832	0.105	0.00
1.42	0.005	0.00	0.12	0.81	0.0652
∞	0.00	0.000	0.00	0.13	0.870
Ergodic	0.385	0.126	0.217	0.182	0.09

Table 21: Car Industry. First Order Transition Matrix

Average 1984-1990. Car Industry
Time Stationarity

Upper end of the state	0.14	0.255	0.565	1.24	∞
0.14	0.886	0.114	0.00	0.00	0.00
0.255	0.0616	0.836	0.102	0.00	0.00
0.565	0.00	0.062	0.846	0.092	0.00
1.24	0.00	0.00	0.59	0.877	0.0637
∞	0.00	0.000	0.00	0.066	0.934
Ergodic	0.065	0.122	0.201	0.312	0.301

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