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Job Creation, Job Destruction and Plant Turnover in Norvegian Manufacturing

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ABSTRACT. – We examine the magnitude and patterns of job creation and job destruction among Norwegian manufacturing plants. We find that 8.4 percent of the manufacturing jobs are eliminated annually, while new jobs constitute 7.1 percent of manufacturing employment in an average year. Even in a serious recession year, a considerable number of new jobs are created. About two thirds of the job reallocation take place within disaggregated industries. We show that entry and exit of plants are substantially more important for job reallocation in the long run than in the year-to-year changes. Small plants and small firms are net creators of jobs in the period we consider when manufacturing employment was declining. Our results provide support to selection models a la Jovanovic (1982), while vintage-capital models seem to be largely irrelevant as models of plant heterogeneity.

Création de postes, suppression de postes et mouvement d'entreprises dans l'industrie Norvégienne

RÉSUMÉ – Nous examinons l'ampleur et la structure des créations et des suppressions de postes dans les établissements de l'industrie manufacturière Norvégienne. Il apparaît que 8,4 % des postes sont supprimés chaque année, tandis qu'en moyenne 7,1 % sont créés. Même dans une année de forte récession, un nombre considérable de nouveaux postes est créé. Près de deux tiers de la réallocation a lieu au sein des industries. Nous remarquons que le nombre des entrées et sorties d'établissements est considérablement plus important dans la réallocation de postes à long terme que dans les changements à court terme. Les petits établissements et les petites entreprises sont des créateurs nets d'emploi dans la période qui nous intéresse c'est-à-dire où l'emploi manufacturier est en déclin. Nos résultats sont cohérents avec les modèles de sélection à la Jovanovic (1982), tandis que les modèles à génération de capital semblent inadéquats, de même que les modèles d'hétérogénéité de l'établissement.

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1 Introduction

The labour market in Norway, as in other Scandinavian countries, is often, claimed to be heavily regulated and therefore incapable of adjustment to changes in job opportunities, at least in the domestic policy debate. Our analysis is related to this issue as we measure the amount of adjustment taking place in the Norwegian manufacturing sector in terms of the reallocation of jobs between plants. Empirical research for other OECD countries have revealed large rates of simultaneous job creations and job destructions within narrowly defined manufacturing sectors, and throughout the business cycles. We document similar patterns of job creations and job destructions for Norwegian manufacturing. The results confirm the view that there is a lot of job mobility at the micro level, reflecting a substantial amount of heterogeneity of employment changes at the plant level. Our findings, compared to similar studies for other countries, suggest that the manufacturing sector in Norway is not very different from the manufacturing sector in other OECD countries.

The Norwegian evidence is interesting in an international perspective, as Norway has a distinct macroeconomic record for the period we consider. Norway experienced a large increase in oil revenue from 1976 to 1986. Compared to most other European countries, the unemployment rate in Norway has been very low, below 4 percent throughout the period we consider (1976-1986); see figure 1. The business cycle pattern is characterized by the slumps in 1978 and, more severely, in 1981-1982, and the boom from 1984 to 1986. Clearly, the period we consider covers a number of interesting events that affect job creation and job destruction. With this macroeconomic background, it is somewhat surprising to find that the patterns of job creation and job destruction in Norway are not very different from other OECD economies.

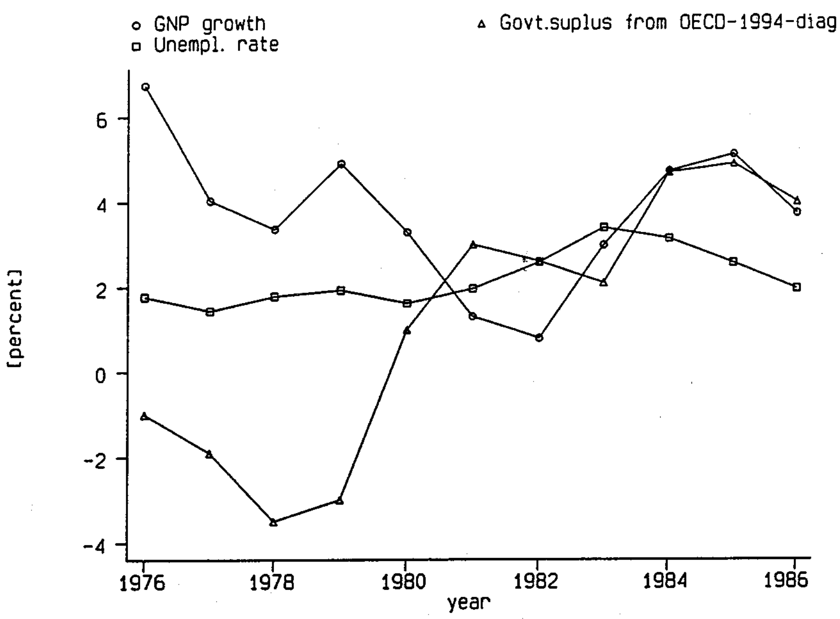
Despite the differences between Norway and most other European countries in terms of macroeconomic indicators in general and the increase in oil-revenue in particular, the manufacturing employment has declined with a similar rate in Norway compared to e.g. the European Union (EU). Over the period we consider, Norwegian manufacturing employment fell with 5.6 percentage points (from 22.7 percent in 1976 to 17.1 percent in 1986) as a share of total employment, while the corresponding figure for the EU from 1974 to 1986 is 5.5 percentage points [1].

Our paper is inspired by studies of US manufacturing by DUNNE *et al.* [1989], DAVIS and HALTIWANGER [1992] and DAVIS *et al.* [1993], and we relate our findings to their results. DUNNE *et al.* studied plant turnover and job creation in the longer run (5 year periods), and followed the cohorts over a long time period. Davis and Haltiwanger considered job creation from year to year. DAVIS *et al.* examined the importance of small plants

1. See OECD (1991, table 2.11).

FIGURE 1

Macroeconomic indicators for the Norwegian economy 1976-86. Percentages. *Symbols: □ – The unemployment rate; ○ – GNP growth; △ – Government surplus relative to GNP.*



and firms for job creation and job destruction. The OECD [1987] [2] study of job creation and job destruction in France, Sweden, and (West-) Germany is also closely related to our study, and will provide some perspective on our findings. Job creation and destruction in Canadian manufacturing have been extensively studied by BALDWIN and GORECKI [1990] and BALDWIN *et al.* [1994]. We have followed the studies cited above in several ways in order to facilitate cross-country comparisons, and we will present some of their findings below.

Section 2 provides operational definitions of job creation, job destruction, and related concepts. This section also discusses our data sources, which have some advantages compared to data used in similar studies for other countries. Section 3 lays out our primary findings on the extent of job creation and destruction in Norwegian manufacturing. This section pays particular attention to the importance of plant turnover and the role of small and medium sized plants and firms. Section 4 examines the relationship between our findings and various theories on labour demand, firm growth and job creation. We summarize and discuss our main findings in section 5.

2. See also OECD (1994) for more recent figures.

2 Definitions and Data

2.1. Defining Job Creation and Job Destruction

It is by now well established in the literature to relate the amount of job creation and job destruction to the difference in employment in plants between two periods. *Job creation* is the difference in employment in all plants that increase employment between the two time periods, while *job destruction* is the corresponding number for all plants that reduce their employment. Appendix A presents a formal definition of job creation and related concepts. *Net job creation* is the difference between job creation and destruction. *Gross job reallocation* –also termed *total job-turnover* in the literature [3] – is the sum of job creation and job destruction. Gross job reallocation includes both movements of jobs between plants and net changes in the number of jobs. All the concepts defined here (job creation, job destruction, net job creation, and gross job reallocation) can be defined at the sectorial level and at the aggregate level.

Our measures of job creation and job destruction do not include the reallocation of jobs within plants, since our measures are constructed by adding up the *net* plant-level employment changes. Neither will our job creation measure capture new jobs that are left unfilled, *i.e.* new jobs that create vacancies. On the other hand, a vacancy that is filled will *cet.par.* be counted as a contribution to our measure of job creation also if the job/vacancy have existed for some time.

2.2. The Data Sources

Our primary data source is the annual census of the Norwegian manufacturing sector covering the period from 1976 to 1986 [4]. This census covers, in principle, all manufacturing plants except units where the owner is the only person employed. A considerable effort has been carried out to obtain a high quality level for the manufacturing census data, not least because this data source has been considered an important ingredient in the macroeconomic planning models which have been extensively used by the Ministry of Finance in Norway. Despite this effort, one should not ignore possible problems with incomplete coverage and the data quality at least for the very smallest plants. We will add further comments on this issue below.

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3. Notice the distinction between *worker* turnover rates and *job* turnover rates; see e.g. DAVIS and HALTIWANGER [1992] for a discussion of their relationship. Unfortunately, it is not possible to compare the job turnover rates presented in this paper with worker turnover rates, as worker turnover rates are not available for Norway.
4. See Statistics Norway (several years), *Manufacturing Statistics*, Official Statistics of Norway NOS C 36, Statistics Norway, (Oslo), and HALVORSEN *et al.* (1989) for details on the construction of these data sets.

The unit of observation is the plant. *Employment* is defined as the *annual average* number of people employed, including part-time workers and owners. We will also report a few results based only on full-time workers [5]. Each plant is identified by a number that remains unchanged until production ceases to take place at the cite. Ownership changes do not affect the identification number; only the company code associated with the plant will be altered when there is a change in ownership. This system is useful when we turn our attention to the importance of plant turnover on job creation and destruction. Other studies have been plagued by excessive counts of entries and exits, and thereby the importance of plant turnover for gross job reallocation, as they have not been able to separate ownership changes from real plant turnover. The fact that we can identify entries and exits from year to year is clearly an advantage of these data as compared to e.g. DUNNE *et al.* [1989].

The census data have been supplemented by a special data source which distinguish between various kinds of entries and exits [6]. This data source identifies plants that disappeared from the census because the plant size fell below the size threshold (where the owner is the only person employed in the firm). Our data also provide information about plants that entered or disappeared from the manufacturing census because their activity was altered or redefined to manufacturing from non-manufacturing activity, and *vice versa*. We have experimented with different definitions of entry and exit and how that affect the rates of job creation and job destruction, and we will report the outcomes of some of these experiments below. In the main results reported below, we have treated plants that have been reclassified to manufacturing plants (from mining or service industries) as expansion rather than entry, and plants have been counted as contracting if they are reclassified out of the manufacturing statistics. How we defin entry and exit turned out to be of little importance for most of our results.

2.3. **Comparability with Other Studies**

In the following sections, we will repeatedly compare our results with studies from other countries. Clearly, such comparisons are a very interesting aspect of this research field, as they might throw some light on the large differences between OECD countries, in macroeconomic performance in general and their unemployment records in particular. Such comparisons are, however, problematic, as the data sources and definitions from different countries are often inconsistent. Let us therefore point out some problems that should be kept in mind when we discuss our results in view of the findings from other studies. A systematic examination of the direction and magnitude of the various biases in the different studies is beyond the scope of this paper. We will just mention some of the problems that should be kept

5. It would have been interesting also to consider employment counts based on full-time equivalents, but this was not feasible as we only have information about working hours at the plant level for a few of the years in our data set.
6. HAUGLAND [1982a, 1982b] provides documentation of this so-called Entry-Exit file.

in mind: *Sample selection:* A number of studies are based on samples that are not representative for the whole population of plants. The main problem is often that plants below a certain threshold are excluded. This problem is particularly severe when the analysis focus on entry and exit, as a number of continuing plants might be counted as entrants and exiting plants as they move across the sample threshold. *Sampling interval:* Some of the studies of entry and exit have been based on censuses taken at intervals of several years. A longer sampling interval will not capture the plants/firms that turn out to be unsuccessful and close down a few years after their entry. This is a large fraction of the entrants [7]. *Unit of observation:* It varies between job flow studies whether the plant or the firm is the unit of observation. It is not clear whether the job turnover rates are lower or higher at the firm versus the plant level. Since job reallocation between plants within a firm will not be captured by turnover rates at the firm level, this will create lower rates at the firm level. On the other hand, entry and exit of firms will not necessarily create entry and exit of plants, as pointed out in section 2.2. Hence, job turnover can be higher at the firm level. *Definition of jobs:* The number of jobs in a plant has been defined as the annual average number of jobs or the number of jobs at a given date of the year. Whether owners and part time workers are included also differ between studies.

3 Basic Findings on Job Creation and Destruction

3.1. **Overall Job Creation and Destruction Rates**

3.1.1. ***Annual Movements***

The number of manufacturing plants in Norway have on average declined by 0.3 percent per year, while employment has declined by 1.8 percent annually, over the period 1976-1986. The gross numbers of entries and exits of jobs and plants by far exceed these net numbers; see table 1, part A. In an average year, 8.4 percent of the jobs were destructed. Every year there is also significant job creation, the average number is 7.1 percent. Even in a serious recession year, such as 1982, there was a substantial creation of new jobs (5.0 percent).

The last column in table 1, part A, reveals the large magnitude of gross job reallocation taking place every-year. If we consider a random manufacturing job, there is 15.5 percent probability that this job has been created during the

7. See Klette and Mathiassen ([1996], ch. 4).

TABLE 1

Components of job creation and destruction in the manufacturing sector. Percentage of total manufacturing employment.

Years	Plant birth (1)	Plant expansion (2)	Plant contraction (3)	Plant closing (4)	Total job creation (1 + 2)	Total job destruction (3 + 4)	Net job creation (1 + 2 – 3 – 4)	Total job reallocation (1 + 2 + 3 + 4)
A. Annual movements								
1977	0.9	6.3	5.7	1.1	7.1	6.8	0.3	14.0
1978	1.5	6.2	7.2	1.7	7.7	8.8	– 1.2	16.5
1979	1.3	6.0	6.8	1.5	7.2	8.3	– 1.1	15.6
1980	0.7	6.2	5.7	1.3	6.9	7.0	– 0.1	13.9
1981	1.1	5.6	6.8	1.5	6.7	8.3	– 1.6	14.9
1982	0.7	4.3	6.8	1.2	5.0	8.0	– 3.0	12.9
1983	1.1	4.7	10.0	2.2	5.8	12.2	– 6.4	18.0
1984	1.3	6.3	6.4	2.1	7.5	8.5	– 1.0	16.0
1985	1.4	7.8	6.1	1.3	8.7	7.4	1.3	16.0
1986	1.4	7.8	6.2	2.4	9.2	8.5	0.7	17.7
Average	1.1	6.0	6.8	1.6	7.1	8.4	– 1.2	15.5
Std. dev.	0.29	1.12	1.24	0.45	1.24	1.50	2.21	1.65
B. Longer run movements								
1976-81	5.8	12.0	13.6	8.5	17.8	22.1	– 4.2	39.8
1981-86	5.8	13.4	16.5	11.0	19.2	27.5	– 8.4	46.6
1976-86	11.1	17.9	21.2	20.8	29.0	42.0	– 13.0	71.0

previous year or (and) will be destructed in the coming year. This number is fairly stable across years, without a strong cyclical pattern [8].

To put this rate of gross job reallocation into perspective, notice that it is of similar magnitude as the gross job reallocation rates found for the manufacturing sector in Germany, France, Sweden, US (Pennsylvania) and Canada by OECD [1987], covering a similar period as we do. BALDWIN *et al.* [1994] have found somewhat higher rates of job creation and destruction in the US and Canada, using more carefully constructed data sources than did OECD. The gross job reallocation rates reported in these studies vary from 12.7 percent in (West-) Germany [9] to 20.5 percent in Canada [10].

3.1.2. *Longer Run Movements*

To what extent is the picture of high gross job reallocation a short run phenomenon? Table 1, part B, shows that between 40 and 50 percent

8. See SALVANES [1995] for a detailed analysis of the business cycle pattern of job reallocation in Norwegian manufacturing.
9. OECD (1987), table 4.7, Manufacturing industries.
10. BALDWIN *et al.* ([1994], table 1).

of the jobs were reallocated within each of the periods 1976-1981 and 1981-1986. When we consider the whole period 1976-1986, the gross job reallocation rate is 71 percent. More precisely, 42 percent of the jobs present in 1976 were eliminated by 1986, whereas 29 percent of the manufacturing jobs in existence in 1986 had been created within the period from 1976.

3.2. The Importance of Entry and Exit of Plants

3.2.1. *Short Run*

Table 1, part A, shows that one fifth of the job destruction in an average year was due to plant exit. One sixth of the new jobs were created through entries. Hence, entries and exits do not constitute large parts of the job creation and destruction processes, at least in the short run.

We can not rule out that these figures underestimate the true importance of entry and exit. It is not unlikely that some of the small, least successful and short-lived plants have not been captured by the manufacturing census. Unfortunately, we do not have information about how serious this problem is in our data set.

As mentioned in section 2.2, we have treated plants that have been reclassified from mining or services to manufacturing as expanding plants. If we counted these plants as births, the job creation rates changed to 1.6 percent for plants births and 5.5 percent for plant expansions; if reclassifications out of manufacturing are counted as plant closing, the job destruction rate is increased to 2.0 percent for plant closings and reduced to 6.4 percent for plant contractions.

Our definition of jobs include part-time jobs. If we exclude part-time jobs and consider only full-time jobs, we find that the average net job creation rate declines to –1.6 percent, while the average, total job reallocation rate increases to 16.8 percent [11]. We find it somewhat surprising that the job reallocation rate is higher when we exclude the part-time jobs.

Table 1, part A, presents only the immediate job creation of new plants in the year they enter, but it is also interesting to consider the longer run impact of new entrants. This will be done next.

First, notice that DAVIS and HALTIWANGER [1990], studying US manufacturing, find the importance of entry and exit for job creation to be slightly larger than what we have found for Norway. They report that one quarter of annual job destruction was accounted for by plant exit, and that one fifth of new jobs, in an average year, were created through new entrants.

11. The individual components behind these estimates, based only on full-time jobs, are as follows: Average job creation rates for plant birth and plant expansions are 1.1 and 6.5 percent, while the job destruction rates for plant contraction and plant closings are 7.6 and 1.6 percent.

3.2.2. ***Long Run***

The numbers reported in table 1, part A, suggest that entry and exit of plants constitute a quite moderate part of annual job creation and destruction. Let us now consider the impact of plant births and closures in the longer run. Table 2 shows the employment shares of new plants in the years following their entry. The table reveals that the employment share for a new cohort is fairly stable, as the cohort ages. Two opposing forces create this stability; the surviving plants expand while a number of plants exit. Both the growth rate for the survivors and the hazard rate decline when the cohort gets older [12].

TABLE 2

Employment shares over time for new cohorts. Percentage of total manufacturing employment.

	Year									
Cohort	77	78	79	80	81	82	83	84	85	86
77	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9
78		1.5	1.5	1.8	1.6	1.6	1.6	1.7	1.6	1.7
79			1.3	1.5	1.4	1.4	1.5	1.5	1.5	1.4
80				0.7	0.8	0.9	0.9	0.9	0.9	1.1
81					1.1	1.0	0.9	0.8	0.9	0.8
82						0.7	0.7	0.7	0.7	0.7
83							1.1	1.3	1.3	1.2
84								1.3	1.3	1.4
85									1.4	1.5
86										1.4

The employment share for declining plants is also highly stable; see table 3.1. Once more there are two opposing forces creating this stability. The relative size declines substantially in the years before exit (table 3.2). What offset (but also contribute to) this decline in size is the number of new, unsuccessful entrants which provide jobs for only a few years before they exit.

Table 1, part B, reveals the cumulative effect of plant entry and exit on job creation and destruction in the longer run. Almost a third (5.8 percent out of 17.8 percent) of the jobs created from 1976 to 1981 were created by new entrants in the period. The number for the subsequent period, 1981 to 1986, was slightly lower. Plant closures are even more important for job destruction for these periods. And if we consider the period 1976 to 1986 as a whole, almost half of the job destruction was due to plant closures.

Entry and exit of plants obviously account for a larger part of job creation and job destruction in the longer run. One reason is that many jobs created

12. See KLETTE and MATHIASSEN ([1996], ch. 4).

Table 3.1

Employment shares for plants with different years of closure. Percentage of total manufacturing employment.

	Year									
Closure date	77	78	79	80	81	82	83	84	85	86
77	1.1									
78	1.9	1.6								
79	1.8	1.8	1.5							
80	2.0	2.0	1.9	1.3						
81	1.9	2.0	1.8	1.7	1.5					
82	1.3	1.4	1.4	1.3	1.4	1.2				
83	2.9	3.0	2.8	2.6	2.4	2.4	2.1			
84	3.2	3.2	2.9	3.0	2.8	3.0	3.0	2.1		
85	1.2	1.3	1.4	1.4	1.5	1.4	1.4	1.3	1.3	
86	2.6	2.4	2.5	2.4	2.4	2.5	2.5	2.5	2.4	2.4

Table 3.2

Relative size for plants with different years of closure.

	Year									
Closure date	77	78	79	80	81	82	83	84	85	86
77	0.25									
78	0.43	0.37								
79	0.49	0.44	0.36							
80	0.58	0.52	0.46	0.32						
81	0.67	0.62	0.53	0.46	0.38					
82	0.48	0.44	0.41	0.35	0.32	0.27				
83	0.92	0.87	0.75	0.64	0.54	0.48	0.41			
84	1.26	1.15	0.96	0.92	0.81	0.77	0.68	0.47		
85	0.50	0.48	0.48	0.46	0.45	0.39	0.35	0.39	0.29	
86	1.09	0.96	0.93	0.84	0.83	0.78	0.65	0.57	0.49	0.49

and lost in plants in permanent operation, are temporary in nature, at least in a 5 to 10 year perspective. We will further consider the persistency of job creation and destruction in section 3.4.

Dunne *et al.* [1989] found plant turnover to affect a significantly larger share of jobs in US manufacturing, than we have found for Norway. For about the same period as we consider here, they found that plant turnover accounted for the dominant share of gross job reallocation.

To summarize, plant turnover accounts for a minor part of job creation and job destruction at high frequencies, where contraction and expansion of existing plants clearly dominates. But in the longer run, plant entries and plant exits in particular, are important for the job creation and job destruction processes in Norwegian manufacturing.

3.2.3. *On Wedervang's Study*

Some of the patterns pointed out in our paper and in related studies, were identified in a study of Norwegian firms by Wedervang 30 years ago (WEDERVANG, 1965). Wedervang focused on the empirical patterns of firm heterogeneity, turnover and growth, but paid little attention to job turnover. He considered three periods: 1930-1933, 1933-1937 and 1937-1948. The importance of firm entry and exit for job turnover can be calculated from his results (see in particular his ch. 10).

There are however a number of reasons why his results are not directly comparable to those presented in the present study: First, Wedervang's study has the firm as the unit of observation, rather than the plant as in the present study [13]. Second, Wedervang considers only firms with at least 5 employees, while we also include smaller firms in our study. Finally, the lengths of the periods he covers differ from ours. Clearly, all these differences between the present study and Wedervang's analysis could be adjusted and accounted for, but this is outside the scope of this paper.

If we consider Wedervang's results [14], keeping in mind the differences listed above, we notice that his job creation rates and job destruction rates associated with entry and exit are somewhat lower than those we have reported in table 1. That is to say, for the periods he covers, his average job creation rate associated with entry is 2.8 percent per year, while the job destruction rate corresponding to exit is 1.9 percent per year [15]. These rates, in particular the rate for entry, are larger than the (annual) rates reported in table 1.

3.3. Job Creation Among Small and Large Plants

3.3.1. *Plant Size*

The importance of small firms in creating jobs has received a good deal of attention in the policy debate in Norway, as in most other countries [16]. Table 4, part A, shows some evidence on job creation and destruction by plant size in Norwegian manufacturing. Considering job creation, there is a clear tendency for higher job creation *rates* for the smaller plants. But the employment share is much higher for the larger plants, so the number of jobs created are much higher for the group of the largest plants as compared to the smallest plants; see columns 4-6 in table 4. For instance, the number

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13. See SALVANES [1995] for rates of job creation at the *firm* level in the 1970s and 1980s. He provides a more detailed examination of the relationship between his results and the findings in Wedervang's book.
14. See in particular his tables X-5a - X-5c.
15. We have neglected the period which includes the Second World War. See SALVANES [1995] for details of these calculations.
16. See e.g. LLEWELLYN [1992]. DAVIS *et al.* [1993] give a thought-provoking review of the debate and evidence for the US. They discuss the many pitfalls that can arise when interpreting the evidence on job creation in small versus large firms.

TABLE 4

Rates of job creation and destruction by size, 1977-86. Percentage of employment in the size group.

Size class [1]	Total job creation	Total job destruction	Net job creation	Total job reallocation	Employ-ment share [2]	Share of job creation in manufacturing	Share of job destruction in manufacturing
A. Plant size							
< 5	18.9	18.1	0.8	37.0	3.9	10.3	8.5
5-20	10.9	11.1	– 0.2	22.0	12.9	19.8	17.3
20-50	8.0	8.8	– 0.8	16.8	14.9	16.9	15.8
50-100	6.6	8.1	– 1.5	14.7	14.3	13.4	14.0
> 100	5.2	6.8	– 1.6	12.0	54.1	39.6	44.5
B. Firm size							
< 20	13.3	12.5	0.8	25.8	15.3	28.2	22.7
20-50	8.0	8.5	– 0.5	16.5	12.5	13.9	12.6
50-150	6.2	7.6	– 1.4	13.8	18.9	16.3	17.1
150-500	5.6	7.9	– 2.3	14.5	19.0	14.8	18.0
500-1000	6.0	7.2	– 1.2	13.2	13.1	10.9	11.2
> 1000	5.4	7.3	– 1.9	12.7	21.3	16.0	18.5

1) Size is measured as average employment in year t and $t-1$.

2) Percentage of total manufacturing employment.

of jobs created by plants with more than 100 employees are four times larger than by plants with less than 5 employees.

If we turn to job destruction, smaller plants also have a higher job destruction rate than larger plants. Considering both the creation and destruction rates it is evident that the amount of gross reallocation of jobs is sharply decreasing with plant size. There is net job destruction in all size categories except for the plants with less than 5 employees, and the net job creation rates are more negative for larger plants. When we also consider that the employment shares are larger for larger plants, it is clear that employment is declining most rapidly among the largest plants. In fact, almost 3 times as many jobs were lost among plants with more than 100 employees, compared to plants with 100 employees or less, even though these groups have roughly the same shares of total employment. Notice that we have measured size by the *average* level of employment for the years t and $t-1$ [17]. Hence, we avoid the tendency to exaggerate job losses in large plants, and job creation for small plants, inherent in studies that condition on *initial* size (*i.e.* $t-1$) [18].

We will return to the issue of job creation and destruction in large versus small plants in the next section where we examine survival rates for newly

17. We have also considered estimates by size defined in terms of the average employment level over the whole period covered by our data set; see the working paper version of this paper. They are very similar to the results reported here.
18. See DAVIS *et al.* [1993] for a discussion.

created jobs. Our study has only focused on manufacturing industries, and it is widely believed that small establishments are more important for job creation in the service sectors [19].

Our finding that small plants tend to have a higher job creation rate could partly reflect the problems with incomplete coverage that we have mentioned above. That is, the probability that unsuccessful and short-lived plants have not been captured in the manufacturing statistics is likely to be higher for the smaller plants. This will create a larger upward bias in the job creation figures for the smaller plants [20].

3.3.2. *Firm Size*

Table 4, part B, presents job creation rates similar to table 4, part A, but reported by firm size rather than plant size. Table 4, part B, shows that the job creation rate for firms with less than 20 employees is more than twice as large as for firms with more than 50 employees, whereas the job creation rate is independent of size for firms larger than 50 employees. The job destruction rate shows a similar pattern, and consequently, so does the gross job reallocation rate. Table 4, part B, shows that the smallest firms have a positive job creation rate, while larger firms do not. Employment is moving from larger to smaller firms over this period. We emphasize that size is here defined as average size for the years t and $t-1$, so this result is not an artifact due to the combination of noisy data and poor conditioning. But problems with incomplete coverage of small, unsuccessful firms could potentially contribute to this result.

DAVIS *et al.* [1993] found that both job creation and job destruction rates decline significantly with plant and firm size in US manufacturing, as we have done for Norway. But they showed that there is no pattern in the relationship between plant or firm size and *net* job creation in the US, contrary to the negative relationship we have found for Norway for firms with less than 500 employees. For Norway, there is some truth in the claim that small firms are the source of new jobs in manufacturing.

3.4. Persistence of Jobs Created or Lost

On average, 72 percent of newly created jobs survive at least one year, while 84 percent of lost jobs remain eliminated one year after they were destructed. These rates are very stable across the period we consider; the standard deviations are 4.2 and 2.0 percentage points, respectively. The two-year survival rates are only slightly smaller than the one-year survival rates [21].

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19. See OECD (1987, 1994) and Blanchflower and Burgess (1994) for studies of job creation in non-manufacturing sectors.
20. This issue has been extensively discussed in the literature on “Gibrat’s law” and the relationship between firm growth and firm size; see e.g. EVANS [1987] and HALL [1987].
21. The two-year persistence rate for newly created jobs is 65.1 percent, while the “persistence rate” for eliminated jobs are 79.8 percent.

DAVIS and HALTIWANGER [1992] report very similar results for US manufacturing; the average, one-year persistence rate for job creation in their study was 67 percent, while the one-year persistence rate for job destruction was 81 percent. We conclude that annual job creation and destruction in Norwegian manufacturing, as in US manufacturing, largely reflect persistent changes in employment rather than temporary layoff and recall policies.

In the previous section we presented some evidence that suggest that larger plants are eliminating more jobs than smaller plants. But we also pointed out that gross job reallocation is more extensive among the smaller plants. This last point is confirmed in table 5, which shows that the one-year survival rate for a job is lowest for the smallets plants. However, if we focus on newly created jobs or eliminated jobs, the picture is no more turbulent for the smaller plants than for the larger. That is to say, small plants do not provide the same job security as larger plants, but small *expanding* plants offer the same job security as for jobs in larger plants. There seems to be no essential difference in the layoff policy for small and large plants.

TABLE 5

Survival and persistence rates for all jobs, new jobs, and lost jobs by size, 1977-86.

Size class [1)]	One year survival rate		One year persistence rate
	All jobs	New jobs	Lost jobs
A. Plant size			
< 5	81.9	73.5	83.0
5-20	88.9	74.3	84.5
20-50	91.2	75.6	84.3
50-100	91.9	75.2	84.5
> 100	93.2	69.6	84.0
B. Firm size			
< 20	87.5	72.1	84.2
20-50	91.5	74.0	82.2
50-150	92.4	74.8	82.8
150-500	92.1	71.0	86.0
500-1000	92.8	70.7	83.5
> 1000	92.7	71.4	83.5

1) Size is measured as average employment in the years t and $t-1$.

DAVIS *et al.* [1993] provide, for US manufacturing, more clear-cut evidence that jobs provided by larger employees have a higher survival rate independent of whether all or only newly created jobs are considered. They report, as we also find for Norwegian manufacturing, that the persistence rate for destructed jobs is no larger for smaller than larger plants in the US.

4 Confrontation with Theories on Job Creation and Destruction

4.1. The (Un)Importance of Industry-Specific Shocks

Above, we have reported very high rates of gross job reallocation. Most economic models consider labour demand and the labour market as directly linked to the overall activity level in the economy and, less frequently, in terms of reallocation of jobs between industries. This section presents evidence on the importance of reallocation of jobs between plants within the same narrowly defined industries, as a share of gross job reallocation in the manufacturing sector as a whole. We will explore the usefulness of other models and theories on labour demand and job reallocation below.

4.1.1. *The Sectorial Pattern of Job Creation*

Table 6 shows net and gross job flows by (2-digit ISIC) industry. All industries have reduced their employment over the period 1976-1986; the net, annual growth rates vary between –0.1 percent in Food manufacturing (ISIC 31) to –5.2 percent in Textiles (ISIC 32). Despite this steady decline, there is substantial job creation in all industries, varying from 3.6 percent in Metals (ISIC 37) to 8.9 percent in Metal products (ISIC 38). Column 8 shows that there is a large amount of gross job reallocation in all industries. The ranking of the industries in terms of gross job reallocation rates is largely consistent with the pattern for US and Canada, reported by BALDWIN *et al.* [1994].

It is interesting to note the high, positive correlation betwene total job creation (the sum of job creation in expanding and new plants: column 5) and total job destruction (the sum of job destruction in contracting and closing plants: column 6) across industries; the correlation coefficient is 0.64 (std.err. = 0.064). At a much more disaggregated industry level, based on 5-digit ISIC codes, the correlation coefficient between total job creation and total job destruction is 0.29 (std.err. = 0.0004). At the 5-digit ISIC level, there are 142 manufacturing industries in our data set. The correlation pattern suggests that the movement of jobs from declining to expanding industries is a small part of job creation and destruction.

Next, consider the correlation between net job creation and gross job reallocation. This correlation is negligible (and negative): The correlation coefficient is –0.009 (s.e. = 0.82) at the 2-digit ISIC level and –0.12 (s.e. = 0.15) at the 5-digit ISIC level. Hence, net job creation is a poor indicator for the amount of adjustment in terms of gross job reallocation taking place within an industry.

What percentage of gross job reallocation is due to movements of jobs from declining industries to expanding industries? The answer will of course depend on how finely we divide the industry groups. To make the answer as favorable as possible to the orthodox view, that job creation and destruction

TABLE 6

Components of job creation and destruction by industry. Percentage of employment in the industry.

Industry (ISIC)	Plant birth (1)	Plant expansion (2)	Plant contraction (3)	Plant closing (4)	Total job creation (1 + 2)	Total job destruction (3 + 4)	Net job creation (1 + 2 – 3 – 4)	Total job reallocation (1 + 2 + 3 + 4)
Food (31)	0.9	6.7	5.9	1.7	7.6	7.6	-0.1	15.3
Textiles (32)	0.9	5.7	8.8	2.9	6.6	11.7	-5.2	18.3
Wood products (33)	0.9	6.1	6.9	1.8	7.0	8.7	-1.7	15.7
Paper products (34)	0.9	4.8	5.6	1.2	5.7	6.8	-0.9	12.6
Chemicals (35)	1.1	4.8	6.0	0.9	5.9	6.9	-1.1	12.7
Mineral products (36)	1.0	5.2	5.9	1.1	6.2	7.0	-0.9	13.2
Basic metals (37)	0.5	3.1	5.5	0.6	3.6	6.1	-2.6	6.3
Metal products (38)	1.5	7.4	7.9	1.9	8.9	9.8	-0.9	18.7
Miscellaneous (39)	1.9	6.4	8.0	2.0	8.3	10.0	-1.8	18.3
Total manufacturing	1.1	6.0	6.8	1.6	7.1	8.4	-1.2	15.5

primarily reflect industry shifts in employment, we have used the finest industry disaggregation possible with our data; the industries are identified by the 5-digit ISIC-codes. The formal expression for our decomposition procedure is presented in appendix A.

On average across years, we find that the average job creation rate is 10.0 percent in expanding industries; see table 7. An expanding (declining) industry is identified as an industry with net increases (decreases) in employment. The average job creation rate in declining industries is 5.0 percent. The corresponding job destruction rates are 5.8 and 10.3 percent for expanding and declining industries, respectively. That is to say, for every job created in an expanding industry, 0.6 jobs are lost. And for every job disappearing from a declining industry, 0.5 new jobs are created.

TABLE 7

Components of job creation and destruction in expanding and contracting industries. Percentage of employment in industry group.

Years	Plant birth (1)	Plant expansion (2)	Plant contraction (3)	Plant closing (4)	Total job creation (1 + 2)	Total job destruction (3 + 4)	Net job creation (1 + 2 – 3 – 4)	Total job reallocation (1 + 2 + 3 + 4)
A. Expanding industries (5-digit ISIC)								
1977	1.1	7.7	4.4	0.9	8.8	5.3	3.4	14.1
1978	2.3	8.8	4.9	1.2	11.1	6.1	5.0	17.2
1979	2.2	7.7	4.3	0.9	9.9	5.2	4.8	15.0
1980	1.1	7.7	4.5	0.9	8.8	5.4	3.3	14.1
1981	2.1	8.8	4.9	1.3	10.9	6.2	4.7	17.1
1982	1.0	7.1	5.4	0.7	8.1	6.1	2.0	14.2
1983	3.2	8.2	6.1	1.7	10.5	7.8	3.7	19.1
1984	2.0	8.5	4.9	1.8	10.7	6.7	3.8	17.2
1985	1.3	8.1	4.2	1.0	10.3	5.2	4.1	14.6
1986	1.9	9.6	4.5	1.5	11.5	5.9	5.5	17.4
Means	1.7	8.3	4.6	1.2	10.0	5.8	4.2	15.8
Std. dev.	0.70	0.73	0.58	0.38	1.13	0.81	1.02	1.80
B. Contracting industries (5-digit ISIC)								
1977	0.6	4.1	7.6	1.5	4.7	9.1	– 4.4	13.8
1978	0.7	4.2	0.9	2.0	4.9	11.0	– 6.1	15.9
1979	0.5	4.4	9.1	2.0	4.9	11.1	– 6.3	16.0
1980	0.4	4.5	7.0	1.7	4.9	8.7	– 3.8	13.6
1981	0.6	4.3	7.6	1.5	4.9	9.1	– 4.3	14.0
1982	0.6	3.4	7.2	1.4	4.0	8.6	– 4.6	12.5
1983	0.8	4.3	10.5	2.3	5.1	12.8	– 7.7	17.8
1984	0.6	4.3	7.7	2.3	4.9	10.0	– 5.1	14.9
1985	1.5	6.0	9.2	1.6	7.5	10.8	– 3.3	18.4
1986	0.5	4.7	9.1	3.9	5.3	13.0	– 7.8	18.1
Means	0.7	4.3	8.4	1.9	5.0	10.3	– 5.4	15.3
Std. dev.	0.31	0.65	2.60	0.74	0.90	1.61	1.57	2.08

4.1.2. *The Importance of Intra-Industry Job Flows*

To illuminate this issue further, we have disaggregated annual gross job reallocation into three components (the operational definition of this decomposition is given in appendix A):

I. Job reallocation due to *net changes* in total manufacturing employment.

II. Job reallocation required to accomodate changes in employment *between industries*.

III. Reallocation of jobs between *plants within the same industry*.

We have considered each of these components as a share of gross job reallocation (as reported in table 1). On average, 10 percent of gross job reallocation were accounted for by changes in total manufacturing employment (cf. component I.); see table 8. However, this share varies considerably between years, with a pronounced counter cyclical pattern.

TABLE 8

Decomposition of annual job reallocations. Percentage of total manufacturing job reallocation.

Year	Net change in manufacturing employment	Between industries	Within industries
A. Annual movements			
1977	2.2	25.2	72.6
1978	7.1	26.9	66.0
1979	7.1	28.8	64.2
1980	0.2	25.0	74.4
1981	10.8	18.7	70.5
1982	23.2	7.6	69.2
1983	35.5	4.9	59.6
1984	5.9	22.3	71.8
1985	8.1	15.4	76.5
1986	4.0	31.7	64.3
Average	10.3	20.7	68.9
Std. dev.	10.8	8.9	5.3
B. Long run movements			
1976-81	17.6	20.7	61.7
1981-86	24.6	12.7	62.7
1976-86	27.2	15.2	57.6

Another 21 percent of gross job reallocation in manufacturing was accounted for by changes in employment between (5-digit ISIC) industries in an average year (cf. II.). After we have considered these two components (I. and II.), we are left with 69 percent of gross job reallocation in manufacturing. That is to say, more than two thirds of job creations and destructions reflect job reallocation between plants within the same industry. This share would be even higher if we had applied more aggregated industry classifications.

4.1.3. *Intra-Industry Job Flows in the Longer Run*

One might think that intra-industry job reallocation is less important in the longer run, and that industry differences in production costs, demand and technological change play a more dominating role as the time-horizon is increased. Our findings suggest to the contrary that job flows between industries are *less* important in the longer run, relative to job reallocation within industries. If we consider the period 1976-1986 as a whole, only 15 percent of gross job reallocation in manufacturing was accounted for by reallocation of jobs between industries (table 8). Not surprisingly, the net job destruction in the manufacturing sector as a whole is more important in the longer run. 58 percent of gross job reallocation consisted of reallocation of jobs across plants belonging to the same industry.

4.2. **Theories on Plant Heterogeneity**

4.2.1. ***Three Different Theories***

The recent empirical research on job reallocation has spurred interest in theories that capture plant heterogeneity within industries. Three basic theoretical models have been in focus. One of these models is formulated by JOVANOVIC [1982] [22]. This model considers new entrants as equipped with different efficiency parameters, which are unknown to the entrepreneurs at the date of entry. From the plant's performance over time, the entrepreneur updates his/her knowledge about the plant's relative efficiency. Entrepreneurs that accumulate favorable information about their relative efficiency expand, while plants with a poor performance eventually decide to exit. The learning process takes time, as it is contaminated by random, idiosyncratic cost disturbances. Jovanovic's model has some empirical implications that are interesting in our context [23]. In particular, his model predicts that both the job creation and job destruction rates (and consequently, also the job reallocation rate) should be higher for younger cohorts.

Another basic model of plant heterogeneity has some contradicting implications; JOHANSEN [1972] has examined a vintage-capital model where differences in efficiency and survival across plants are explained (mainly) by differences in the date of entry and the vintage of their capital stocks [24]. That is, technical efficiency is determined by the vintage of the plant's capital – *embodied technological change*, and plants must commit to a fixed set of factor intensities at the date of entry – *"putty-clay" technology*.

The Johansen model identifies entry and exit within a technologically advancing industry, by the replacement of old, inefficient plants with new, technologically more advanced plants. Younger plants should also perform better, according to the Johansen model, as their choice of technology and factor proportions are better adapted to the prevailing factor prices [25]. In sum, these properties of the model imply that job creation should be most pronounced among young plants, while job destruction should take place among old plants. Furthermore, most of the reallocation of jobs within an industry should take place between different cohorts, while job reallocation within cohorts should be a minor component, according to this model of plant heterogeneity. Or to translate to the concepts of this paper, Johansen's model predict that (*i*) job creation should be concentrated among

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22. See also LIPPMAN and RUMELT [1982] and PAKES and ERICSON [1989].
23. See EVANS [1987] for a more elaborate discussion of the empirical content of Jovanovic's model for firm growth.
24. See also JOHANSEN [1959] and SALTER [1966]. FØRSUND and HJALMARSSON [1987] present more recent empirical research in the tradition of Johansen's putty-clay/vintage model. LAMBSON [1991] has examined a theoretical model of entry and exit with a focus on putty-clay technology. JOVANOVIC and LACH [1989], and JOVANOVIC and MACDONALD [1994] have given a theoretical analysis of industry evolution with a focus on embodied technical change.
25. This implication from the Johansen/putty-clay model requires some systematic drift in the ratio of factor prices. Some systematic drift is clearly taking place in Norwegian manufacturing as far as the ratio between wages and other factor prices is concerned.

new plants, (*ii*) job destruction should be more evident for older plants, and (*iii*) the job reallocation rate within cohorts should be small relative to the job reallocation rate across all plants within the industry.

We must confess that this is a narrow interpretation of the Johansen model; in his book he mainly uses the term production unit rather than plants. However, as Johansen [26] himself points out, his model might be of little empirical relevance if the production unit is turned into a too abstract concept which is difficult to link to observational units such as plants. GREGORY and JAMES [1973] give an extensive discussion of the empirical content of the vintage-model in connection with plant level observations. Our analysis targets the question of whether the vintage model is a useful point of departure when thinking about the sources of the large amount of plant heterogeneity and job reallocation within industries [27]. We recognize that the vintage model could be useful to explain the coexistence of different vintages of capital within an industry, without there being any close link between the age of the plants and the vintage of their capital stocks. In fact, DUNNE [1994] has recently documented that there is very low correlation between a plant's age and its use of modern technology in US manufacturing. Still, if vintage effects are important determinants of survival and growth, one would expect new plants to perform better than the average of older cohorts, which (on average) employ older capital.

The two models presented above are not necessarily antagonistic, but could be complementary. That is, exit and job destruction could be high for both very young and very old plants, due to selection in the early years, and outdated technology in the later years. As we shall see below, this is not the pattern we find in our data.

HOPENHAYN [1989], and DAVIS and HALTIWANGER [1990] have considered a third class of models, where plant growth and contraction are caused by idiosyncratic, random cost disturbances. DAVIS and HALTIWANGER [1992] points out that such disturbances could reflect regional cost changes, such as changes in local taxes, transport costs, local demand or (local) energy prices. With this background, we will below also consider the importance of regional differences in job creation and destruction, as did DAVIS and HALTIWANGER [1992].

Our analysis examines heterogeneity between plants within the manufacturing sector as a whole, rather than heterogeneity within individual industries, which is the focus of these theories. But as we showed in section 4.1, the differences in job creation and job destruction rates between industries are small relative to differences between plants within a given industry. We therefore believe that our conclusions based on the whole manufacturing sector are also valid for individual industries [28].

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26. See section 2.1 in JOHANSEN [1972].
27. GREGORY and JAMES [1973] presents a related analysis of the vintage capital model. They examine whether the vintage model is useful to explain plant heterogeneity in terms of productivity dispersion within industries.
28. A similar presumption is embedded e.g. in EVANS' [1987] tests of alternative theories of firm growth.

Jovanovic's model is formulated in terms of firm growth rather than plant growth. This is, however, a minor issue as the large majority of plants belong to single-unit firms [29].

4.2.2. *Age and Regional Differences in Job Creation*

Table 9 shows that there is a clear tendency for *both* the job destruction and the job creation rates to decrease with plant age. Consequently, the gross job reallocation rate is substantially lower for the older plants; the gross job reallocation rate for one year old plants is close to 50 percent, almost four times larger than for the oldest plants. This pattern fits very nicely with Jovanovic's selection model [30].

TABLE 9

Rates of job creation and destruction by age of plant. Percentage of employment in the age group.

Age	Job creation	Job destruction	Net job creation	Total job reallocation	Employment share 1)
0	–	–	–	–	1.2
1	28.2	18.8	9.4	47.0	1.1
2	18.0	14.4	3.6	32.4	1.1
3	10.7	15.0	– 4.3	25.6	1.0
4-5	11.7	11.0	0.7	22.7	2.3
6-10	9.7	11.0	– 1.3	20.7	4.9
11-14	9.1	11.1	– 2.0	20.1	2.5
15+	4.6	7.4	– 2.8	12.0	86.1
All	7.1	8.3	– 1.2	15.5	100.0

Johansen's vintage model, on the other hand, seems largely irrelevant as an explanation of plant heterogeneity, and job reallocation within industries [31]. The job destruction rate is substantially lower, not higher, for the older plants. Furthermore, there is a large amount of job reallocation taking place *within cohorts*, in particular for the younger plants.

Other studies have found a similar relationship between plant age and job creation and destruction rates; see DUNNE *et al.* [1989] and DAVIS and HALTIWANGER [1992] and the references cited there.

29. See KLETTE and MATHIASSEN ([1996], ch. 7), where we show that little of interest here is altered if we focus only on single-unit firms.
30. In KLETTE and MATHIASSEN ([1996], ch. 4) we have also confirmed the prediction of the Jovanovic's model that younger plants have a (substantially) higher exit rate. Similar findings have been reported by EVANS [1987] and DUNNE *et al.* [1989], among others. WEDERVANG ([1965], ch. 7C) pointed out the negative relationship between the exit rate of plants and their age 30 years ago, in his study of Norwegian manufacturing plants from 1930 to 1948.
31. GREGORY and JAMES [1973] obtained a similar conclusion; – that the vintage model is not very useful to explain productivity differences across plants within an industry.

There is one more number in table 9 that deserves attention; 86.1 percent of total manufacturing employment belongs to plants that are more than 14 years old. While most of the *changes* in employment take place among the younger plants, a great majority of manufacturing jobs are located in old plants.

Finally, we have examined the importance of regional reallocation of jobs. The plants have been allocated into five different regions: Northern Norway; Trøndelag; the West Coast; East and Central Norway [32]; and South [33]. On average, only 1.9 percent of gross job reallocation is due to movements of jobs between these five regions. If we break down the plants by region in interaction with (5 digit ISIC) industry, the larger part of gross job reallocation is still unaccounted for; see table 10. In short, reallocation of jobs between the (large) regions considered here constitutes a small fraction of gross job reallocation.

TABLE 10

Decomposition of job reallocations. Percentage of total manufacturing job reallocation.

Year	Net change in manufacturing employment	Between regions	Within regions	Between industries/ regions	Within industries/ regions
1977	2.2	1.9	96.0	36.2	61.6
1978	7.1	1.6	91.3	38.5	54.4
1979	7.1	2.3	90.7	37.0	56.0
1980	0.2	5.2	94.2	35.4	64.0
1981	10.8	0.5	88.7	29.7	59.5
1982	23.2	0.0	76.9	19.3	57.5
1983	35.5	0.0	64.5	13.0	51.5
1984	5.9	1.7	92.4	32.2	61.9
1985	8.1	5.1	87.9	26.1	65.8
1986	4.0	1.0	94.9	39.0	57.1
Average	10.3	1.9	87.8	30.6	58.9
Std. dev.	10.8	1.9	9.8	8.8	4.5

5 Summary and Final Comments

Many facts about job creation have been put forward above; let us summarize some of the main findings:

32. Østfold, Akershus, Oslo, Hedemark, Oppland, Buskerud, Vestfold and Telemark.
33. Agder and Rogaland.

• Job creation and destruction rates are substantial, reflecting a large amount of heterogeneity at the plant level even within narrow industry groups. These large amounts of heterogeneity have been shown to prevail both in the long and in the short run. We have documented that job creation and destruction to a large extent reflect persistent employment changes at the plant level, and not only temporary layoff and recall policies.

• Entry and exit are important for job creation and destruction in the long run, but constitute small parts of annual gross job reallocation.

• Job creation rates, but also job destruction rates, are substantially higher for small plants than for larger plants. Net job destruction is more prevalent among larger plants.

• Small firms, with less than 20 employees, have created additional jobs in the period we consider, while the larger firms have, on average, reduced their employment.

• Industry specific shocks account for a small share of gross job reallocation.

• Among the theories of plant heterogeneity considered, we find that Jovanovic [1982] selection hypothesis receives strong support, while the vintage hypothesis, as put forward by JOHANSEN [1972] a.o., seems to be largely irrelevant as an explanation for plant heterogeneity and job reallocation between plants (within industries).

The results presented in this paper, and in similar studies for other countries, raise some questions about the point of departure in standard macroeconomic analysis [34]. In particular, the representative firm/plant seems to be largely a misleading point of departure for thinking about aggregate labour demand and unemployment issues. Non-representative agent models seem essential to understand *aggregate* employment dynamics [35], and econometric studies of firm behavior based on aggregate (industry-level) data seem inadequate for structural analysis. For instance, labour demand models estimated on aggregate data often incorporate long lags which are claimed to represent adjustment costs. Structural interpretations of the lag coefficients are often put forward, based on the notion of a representative firm. However, with the lack of correlation between net and gross job reallocation rates, as we and others have documented, such interpretations seem to be highly questionable.

Our results, in conjunction with related studies, suggest that labor market performance is the outcome of a larger set of opposing forces than the macro data indicate. There is much more job reallocation going on than required to accomodate the net changes in (manufacturing) employment. This finding suggests that e.g. frictions in the labour market and matching issues might be important explanations for the differences in the unemployment rates between countries and over time. With the large amount of job turnover found in Norway and other OECD countries, small differences in frictions will tend to create large differences in unemployment.

34. See also DAVIS and HALTIWANGER [1990] with comments for a discussion.
35. See CABALLERO *et al.* [1994] and references cited there.

However, the accounting analysis presented in this paper and similar studies is limited in scope since they are not closely connected to a theoretical framework. This raises some ambiguities when e.g. we want to compare job reallocation rates in Norway and other OECD countries. Is the difference between a 20.5 percent job reallocation rate in Canada and 15.5 percent rate in Norway a big difference? Or, more fundamentally, is a high job reallocation rate good news –indicating a flexible economy, or bad news–reflecting large adjustment costs? In order to make progress in answering these questions, we need an understanding of the *sources* and *implications* of the large amount of job reallocation that we and other studies have reported. That is to say, a theoretical framework is needed which links the patterns reported in this and other studies of job creation, to economic theory –both at the macro and micro levels. The good news is that this issue is a lively field of current research [36].

36. See CABALLERO and HAMMOUR [1994, 1995], HOPENHAYN and ROGERSON [1995], and ATKESON *et al.* [1995) and their references, in addition to the references given in section 4.2.

APPENDIX A

FORMAL DEFINITIONS

A.1 Job Creation Rates etc.:

Let

$$\Delta N_{it}^{+} \equiv \begin{cases} 0: & N_{it} \leq N_{i,t-1} \\ N_{it} - N_{i,t-1}: & \text{otherwise} \end{cases}$$

$N_{it} =$ Average employment in plant "i" in year "t". See section 2.B
and

$$N_t = \Bigg(\sum_{i \in \Omega_t} N_{it} + \sum_{j \in \Omega_{t-1}} N_{j,t-1} \Bigg) / 2$$

where Ω_t is the set of all manufacturing plants in year t. The **job creation rate**, θ_t^{JC}, is defined as:

$$\theta_t^{JC} \equiv \frac{\sum_{i \in \Omega_t} \Delta N_{it}^{+}}{N_t} \tag{1}$$

The job creation rate can be divided into two parts:

• **Plant births** – summing only over new entrants in the numerator in (1) (*i.e.* replace the set Ω_t by the set of entrants; Ω_t^{entr}, in the summation in the numerator).

• **Plant expansion** – summing over expanding plants in the numerator in (1) (*i.e.* replace the set Ω_t by the set of continuing and expanding plants; Ω_t^{exp}, in the summation in the numerator).

The **job destruction rate**, θ_t^{JD}, is defined correspondingly:

$$\theta_t^{JD} \equiv \frac{\sum_{i \in \Omega_t} \Delta N_{it}^{-}}{N_t} \tag{2}$$

where

$$\Delta N_{it}^{-} \equiv \begin{cases} N_{i,t-1} - N_{it}: & N_{it} \leq N_{i,t-1} \\ 0: & \text{otherwise} \end{cases}$$

The job destruction rate can also be divided into two parts:

• **Plant closing** – summing only over exiting plants in the numerator in (2) (*i.e.* replace the set Ω_t by the set of exiting plants; Ω_t^{exit}, in the summation in the numerator).

• **Plant contractions** – summing only over contracting plants, remaining in operation, in the numerator in (2) (*i.e.* replace the set Ω_t by the set of continuing and contracting plants; Ω_t^{cntr}, in the summation in the numerator).

The **gross job reallocation rate,** θ_t^{GJR}, is defined as:

$$\theta_t^{GJR} \equiv \theta_t^{JC} + \theta_t^{JD} \tag{3}$$

The **net job creation rate**, θ_t^{NJC}, is defined as:

$$\theta_t^{NJC} \equiv \theta_t^{JC} - \theta_t^{JD} \tag{4}$$

The four rates defined above (the job creation rate, the job destruction rate, the gross job reallocation rate, and the net job creation rate) can also be defined for a subset of manufacturing plants such as an industry, by restricting all summations above to the set of manufacturing plants belonging to, say, industry $I: \Omega_{It} \subset \Omega_t$, $I \in \Gamma$, where Γ is the set of all industries. The industry specific rates will be referred to with an additional subscript I, such as θ_{It}^{JC} etc.

A.2 Decomposing job creation:

In section 4.1 we have disaggregated annual gross job reallocations into three components. These three components are:

I. Job reallocation due to *net changes* in total manufacturing employment (λ_t^I).

II. Job reallocation required to accomodate changes in employment *between industries* (λ_t^{II}).

III. Reallocation of jobs between *plants within the same industry* (λ_t^{III}).

They are formally defined as:

$$\lambda_t^I \equiv \frac{\sum_i \Delta N_{it}^+ - \sum_j \Delta N_{jt}^-}{\sum_i \Delta N_{it}^+ + \sum_j \Delta N_{jt}^-} = \frac{\theta_t^{JC} - \theta_t^{JD}}{\theta_t^{JC} + \theta_t^{JD}}. \tag{5}$$

$$\lambda_t^{II} \equiv \frac{\sum_{K\in\Gamma} \Delta N_{Kt}^+ + \sum_{J\in\Gamma} \Delta N_{Jt}^-}{\sum_{i\in\Omega_t} \Delta N_{it}^+ + \sum_{j\in\Omega_t} \Delta N_{jt}^-} - \lambda_t^I = \frac{\sum_{K\in\Gamma} s_{Kt}\,|\,\theta_{Kt}^{JC} - \theta_{Kt}^{JD}\,|}{\theta_t^{JC} + \theta_t^{JD}} - \lambda_t^I, \tag{6}$$

where $s_{Kt} \equiv N_{Kt}/N_t$, *i.e.* the employment share of industry K. ΔN_{Kt}^+ is the *net job creation* if industry K is expanding, and zero if it is contracting.

Similarly, ΔN_{Jt}^{-} is the *net job destruction* if industry J is contracting, and zero if it is expanding.

Finally, we have

$$\lambda_t^{III} = 1 - \lambda_t^{I} - \lambda_t^{II} = 1 - \frac{\sum_{K\in\Gamma} \Delta N_{Kt}^{+} + \sum_{J\in\Gamma} \Delta N_{Jt}^{-}}{\sum_{i\in\Omega_t} \Delta N_{it}^{+} + \sum_{j\in\Omega_t} \Delta N_{jt}^{-}} = 1 - \frac{\sum_{K\in\Gamma} s_{Kt} \,|\, \theta_{Kt}^{JC} - \theta_{Kt}^{JD} \,|}{\theta_t^{JC} + \theta_t^{JD}}. \tag{7}$$

Similarly, total job reallocation can be decomposed into reallocations between and within other sectors such as regions, by replacing industries with regions in the formulas presented above.

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