

## GROSS JOB FLOWS

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### Contents

Abstract	2712
JEL codes	2712
1 Introduction	2712
2 Concepts and measurement	2716
2.1 Job flow concepts	2716
2.2 Measurement issues and comparisons across studies	2718
2.3 Notation and formulas	2719
3 Key facts about gross job flows	2720
3.1 Large magnitude	2720
3.2 Predominance of idiosyncratic factors	2723
3.3 Persistence of underlying employment movements	2727
3.4 Concentration and lumpiness of underlying employment movements	2727
3.5 Systematic differences across sectors: magnitude	2731
3.6 Distinct cyclical dynamics of creation and destruction	2733
3.7 Systematic differences across sectors: cyclical dynamics	2738
4 Employer characteristics and the magnitude of job flows	2742
4.1 Sectoral differences	2742
4.2 Plant-level regressions	2744
4.3 Employer size and job reallocation	2747
5 Theories of heterogeneity	2749
5.1 Explaining the magnitude of gross job flows	2749
5.2 Explaining cross-sectional variation in the magnitude of job flows	2752
5.3 National differences in the magnitude of gross job flows	2753
6 Job flows and worker flows	2754
6.1 Relative magnitudes	2754
6.2 Other evidence on the connection between job and worker flows	2757

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6.3	Job destruction and worker displacement	2759
7	Job flows and creative destruction	2761
7.1	Theoretical models	2761
7.2	Empirical studies of reallocation and productivity growth	2762
7.3	Evidence for the US manufacturing sector	2764
8	Job and worker flows in transition economies	2768
8.1	Background and theoretical issues	2769
8.2	Broad patterns of reallocation in transition economies	2772
8.3	Gross flows in Poland and Estonia	2775
9	Cyclicalities in job flows	2780
9.1	Theoretical perspectives	2781
9.2	Normative issues	2784
9.3	Empirical evidence on the role of allocative shocks	2785
10	Job flows, productivity and welfare: selected theoretical issues	2787
10.1	A simple model of investment and job flows	2787
10.2	Choking off the creative destruction process	2790
10.3	Unleashing the creative destruction process	2794
10.4	Job flows and longterm growth	2795
11	Concluding remarks	2796
	References	2797

## Abstract

Market economies experience high rates of job creation and job destruction in almost every time period and sector. Each year, many businesses expand and many others contract. New businesses constantly enter, while others abruptly exit or gradually disappear. Amidst the turbulence of business growth and decline, jobs, workers and capital are continually reallocated among competing activities, organizations and locations. We synthesize the growing body of research on this process, especially as it pertains to the creation and destruction of jobs. We summarize and analyze empirical regularities related to cross-sectional, cross-country and cyclical variation in job flows. We also relate theories of heterogeneity, growth and fluctuations to the large magnitude of job flows and to systematic patterns of cross-sectional and time variation. Other major themes include the connection between job flows and worker flows, creative destruction and the productivity-improving role of factor reallocation, reallocation behavior and consequences in transition economies, and the productivity and welfare effects of policies that impede or encourage job flows. © 1999 Elsevier Science B.V. All rights reserved.

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## 1. Introduction

Market economies experience high rates of job creation and job destruction in almost every time period and sector. Each year, many businesses expand and many others contract. New businesses constantly enter, while others abruptly exit or gradually disap-

pear. Amidst the turbulence of business growth and decline, jobs, workers and capital are continually reallocated among competing activities, organizations and locations. We synthesize the growing body of research on this process, especially as it pertains to the creation and destruction of jobs.

Changes in the number and mix of jobs at individual firms and production sites reflect many forces: the diffusion of new products and technologies, the success or failure of research and marketing efforts, negotiations with employees and labor organizations, learning by doing on the part of managers and workers, the costs of hiring, training and firing workers, the costs of adjusting co-operating factors of production, changes in the availability of inputs, competition from rivals, access to financial backing, ownership changes and corporate restructurings, regulatory and tax law changes, and the growth and decline of particular markets. As this list suggests, job creation and destruction are part of a larger process of adjustment, reallocation and growth.

Much of the reallocation process, and much of our interest in it, centers on the labor market. The creation and destruction of jobs require workers to switch employers and to shuffle between employment and joblessness. Along the way, some workers suffer long unemployment spells or sharp declines in earnings; some retire early or temporarily leave the labor force to work at home or upgrade skills; some switch occupation or industry; some change residence to secure a new job, migrating short or long distances, often with considerable disruption to the lives and jobs of family members.

The workers who participate in this process differ greatly in the bundle of skills, capabilities and career goals that they bring to the labor market; likewise, jobs differ greatly in the skill requirements, effort and diligence that they demand from workers. The diversity of workers and jobs, and their large flows, underscore the truly breathtaking scale and complexity of the search, assignment and reallocation processes carried out by the labor market and supporting institutions. Research in this general area has mushroomed in the past twenty years and is now the subject of several excellent surveys and book-length treatments.<sup>1</sup> The matching process and the prospect of match termination also influence the nature of ongoing employment relationships and the patterns of investment by both workers and firms, as emphasized in another strand of the literature.<sup>2</sup>

On the macroeconomic level, the extent to which the reallocation and matching process operates smoothly determines, in large measure, the difference between successful and unsuccessful economic performance. The persistently high unemployment rates in France, Spain and several other Western European countries over the past two decades point to the enormous costs of a partial breakdown in the reallocation and matching process.<sup>3</sup> The recent and ongoing transition to market-oriented economies in Eastern Europe and the

<sup>1</sup> See Mortensen (1986), Pissarides (1990), Devine and Kiefer (1991) and Mortensen and Pissarides (1999) on the search approach to labor market analysis. Sattinger (1993) surveys assignment models of the labor market.

<sup>2</sup> Parsons (1986, Section 4) and Section 4 in Malcomson (this volume) review work in this area.

<sup>3</sup> Recent work on this topic includes Caballero and Hammour (1998b), Cabrales and Hopenhayn (1997), Ljungqvist and Sargent (1996), Millard and Mortensen (1997), and chapters by Machin and Manning, and Nickell and Layard in this volume.

former Soviet Union brought tremendous shifts in the industrial structure of employment and in the ownership and operation of business enterprises. Large differences in output movements, unemployment rates, private-sector expansion and other performance indicators in formerly statist economies suggest that the efficiency of the restructuring and reallocation process varies greatly. A different line of empirical research focused on the US economy suggests that job reallocation from less to more productive plants plays a major role in longer term productivity gains. On another related front, much of the initial and continuing impetus behind research on gross job flows reflects a desire to better understand cyclical fluctuations in employment, output and productivity.

These introductory remarks suggest that job flows are closely connected to worker flows, unemployment behavior, individual wage dynamics, the evolution of firms and industries, economic restructuring, and aggregate productivity growth. Naturally enough, then, much research on job flows stands at the intersection of labor economics, macroeconomics and industrial organization. New data on job flows and related theoretical developments have helped build new bridges and solidify old links between labor economics, on the one hand, and macroeconomics and industrial organization on the other. Some specific examples give content to this claim.

- *Employer lifecycle dynamics*: Cross-sectional evidence on gross job flows sheds light on the lifecycle dynamics of establishments and firms. Dunne et al. (1989b) and Davis and Haltiwanger (1992) report a strong, pervasive pattern of larger gross job flow rates at younger US manufacturing plants, with detailed controls for size and industry in the latter study.<sup>4</sup> The same pattern shows up repeatedly in empirical studies of firm-level and plant-level growth behavior (Evans, 1987a,b; Dunne et al., 1989a; Troske, 1996). This ubiquitous pattern highlights the connection between employer lifecycle dynamics and the gross flows of workers and jobs, and it points to the importance of selection effects in the evolution of plants and industries (Jovanovic, 1982).
- *Reallocation and productivity growth*: Recent studies by Baily et al. (1992, 1996), Olley and Pakes (1996) and others find that the reallocation of jobs and factor inputs from less efficient to more efficient plants accounts for a large fraction of industry-level productivity gains. In related work, Basu and Fernald (1995) quantify the implications of cyclical variation in factor reallocation activity for Solow-type measures of aggregate technology shocks.
- *Reallocation and business cycles*: Time-series data on gross flows shed new light on the nature of business cycles and the connection between recessions and the reallocation of workers and jobs. Empirical regularities in job flow behavior have helped stimulate a renewed interest in labor market dynamics and a new generation of equilibrium business cycle models that emphasize frictions in the reallocation of workers and jobs (e.g., Mortensen, 1994; Ramey and Watson, 1997).

<sup>4</sup> Similar findings hold in data on the Maryland private sector (Lane et al., 1996), the French private sector (Nocke, 1994) and the Norwegian manufacturing sector (Klette and Mathiassen, 1996).

- *Lumpiness, heterogeneity and aggregation:* The pervasiveness and magnitude of large-scale gross job flows underscore the dangers of reasoning about aggregate and industry-level dynamics from representative-employer models. Large-scale heterogeneity among employers implies considerable scope for aggregation to smooth away even pronounced non-linearities and asymmetries in firm-level and establishment-level employment dynamics (e.g., Caballero, 1992). Gross job flow data also point to considerable lumpiness in establishment-level employment changes. Taken together, lumpiness and heterogeneity imply that aggregate employment dynamics are closely intertwined with the evolution of the cross-sectional distribution of establishment-level employment changes.

Research on job flows also addresses important topics that lie squarely within the domain of labor economics:

- *Reasons for worker mobility:* Many prominent and insightful theories of worker mobility dynamics stress match quality and supply-side concerns such as job-shopping, human capital acquisition, career progression and events that affect preferences regarding work (e.g., children). Without downplaying the importance of these considerations, recent research on job flows highlights the major role of demand-side disturbances that induce shifts in the distribution of job opportunities across locations. It is now apparent, as perhaps it was not a decade ago, that a satisfactory account of worker mobility dynamics in market economies requires a major role for demand-side disturbances as well as for supply-side and match-quality effects.
- *Worker sorting and job assignment:* Many economic theories deal with assignment problems that arise when workers are imperfect substitutes in production, or when they differ in their ability or desire to work with cooperating factors. Assignment models underlie the analysis of several important topics in labor economics including dual labor markets, equalizing differences in wage payments, labor market sorting based on comparative and absolute advantage, and the organization of workers into teams and hierarchies (Sattinger, 1993). Worker and job flows across locations are among the most important mechanisms by which the economy continually adjusts the assignment of workers to each other and to cooperating factors of production.

The chapter proceeds as follows. Section 2 introduces basic definitions and important measurement issues. Section 3 synthesizes several of the main empirical regularities to emerge from research on job creation and destruction behavior. Section 4 provides an in-depth characterization of how job flows vary with employer characteristics such as size, age, wages and capital intensity. Section 5 reviews theories and empirical studies that help to explain the large magnitude of gross job flows and their systematic variation with employer and industry characteristics. Section 6 takes up the relationship between job flows and worker flows. Section 7 considers the connection between job flows and creative destruction, drawing on two largely distinct lines of research: theoretical studies of reallocation and growth and empirical studies that quantify the role of between-plant factor

reallocation in productivity growth. Section 8 considers the reallocation process in transition economies. Section 9 focuses on the cyclical dynamics of job creation and destruction. Section 10 develops a theoretical model of costly factor reallocation and uses it to investigate the productivity and welfare effects of job flows. Section 11 concludes.

## 2. Concepts and measurement

### 2.1. Job flow concepts

The concept of a job is a familiar one, but meaningful measurement and interpretation of job creation and destruction statistics require careful definitions and assumptions. A job, in our terminology, means an employment position filled by a worker. With this in mind, we define gross job creation and destruction as follows:

**Definition 1.** (Gross) job creation at time  $t$  equals employment gains summed over all business units that expand or start up between  $t - 1$  and  $t$ .

**Definition 2.** (Gross) job destruction at time  $t$  equals employment losses summed over all business units that contract or shut down between  $t - 1$  and  $t$ .

Under these definitions, the net employment change is simply the difference between gross job creation and destruction.

Some studies measure job creation and destruction using establishment-level employment changes, where an establishment (or plant) is a specific physical location at which production of goods or services takes place. Other studies use firm-level employment changes, where a firm (or company) is an economic and legal entity that encompasses one or more establishments. For our purposes, establishment-level data are preferred on both conceptual and measurement grounds. Firm-level data mask the job flows between establishments of the same firm. In addition, accurate longitudinal linkages are more difficult to achieve with firm-level data because of sometimes complicated changes in ownership and organization (mergers, acquisitions and divestitures).

Most studies fail to capture job flows within establishments. Suppose, for example, that an establishment replaces several secretaries with an equal number of computer programmers. Employment at the establishment is unchanged, so that calculations based on establishment-level data record no job creation or destruction associated with the replacement of secretaries by programmers. A few studies summarized in Section 3.1 seek to measure job flows within establishments or firms. Section 4.3 suggests an indirect approach to estimating job flows within establishments using only establishment-level data.

We interpret measured increases and decreases in employment at a business unit as changes in desired employment levels rather than as changes in the stock of unfilled positions. When a vacancy arises as the result of a quit, for example, the position can

likely be refilled within three or twelve months, if desired. Since the highest sampling frequency we examine is quarterly, we are reasonably confident in this interpretation. The interpretation is buttressed by the fact, reported below, that measured job creation and destruction occur primarily at business units that undergo substantial contraction or expansion during the sampling interval.<sup>5</sup>

A useful way to summarize the heterogeneity of employment changes across business units is to count the number of jobs that either disappear from shrinking units or newly appear at expanding units. We refer to this job destruction and creation activity as job reallocation, because it entails the reshuffling of job opportunities across locations.

**Definition 3.** (Gross) job reallocation at time  $t$  is the sum of all business unit employment gains and losses that occur between  $t - 1$  and  $t$ .

Job reallocation equals the sum of job creation and job destruction.

Another measure derived from establishment- or firm-level employment changes will prove useful for understanding the sources of job reallocation and, in particular, the role played by shifts in the sectoral composition of employment demand.

**Definition 4.** Excess job reallocation equals (gross) job reallocation minus the absolute value of the net employment change.

Excess job reallocation represents that part of job reallocation over and above the amount required to accommodate net employment changes. It is an index of simultaneous job creation and destruction.<sup>6</sup> As we show below, excess job reallocation admits an exact decomposition into two components: one that captures between-sector employment shifts, and one that captures excess job reallocation within sectors.

As employment opportunities shift across locations, workers undertake conformable shifts. Job-losing workers find employment at different establishments, become unemployed and search for a new job, or leave the labor force. Newly available jobs become filled by jobless or already employed workers. Of course, workers often switch employers or change employment status for reasons largely unrelated to the reallocation of jobs. Thus, job reallocation should be distinguished from worker reallocation, which we define as follows:

**Definition 5.** (Gross) worker reallocation at time  $t$  equals the number of persons who change place of employment or employment status between  $t - 1$  and  $t$ .

<sup>5</sup> Blanchard and Diamond (1990) measure job creation as the sum of employment gains at new and expanding establishments plus an estimate of the change in outstanding vacancies. The resulting job creation time series for the US manufacturing sector differs little from the one defined in the text and plotted in Fig. 4.

<sup>6</sup> Gross job reallocation rises with simultaneous job creation and destruction, but – unlike excess job reallocation – it also rises with the absolute value of net employment change. For this reason, excess job reallocation is a more appropriate index of simultaneous creation and destruction than gross job reallocation.

We elaborate on the connection between job and worker reallocation and consider other measures of labor market flows in Section 6.

## 2.2. *Measurement issues and comparisons across studies*

Several measurement problems and conceptual differences hamper easy comparisons of gross job flows across studies and countries.<sup>7</sup> First, as noted above, the definition of business units differs among datasets. As a related point, the procedures for defining the boundaries of firms and establishments, even if applied carefully and consistently over time, differ among data sources and especially countries. Second, the integrity of longitudinal linkages for establishments and firms varies greatly across datasets and, in some cases, over time for the same dataset. Failures to adequately track changes in organizational structure, ownership and administrative identifiers in longitudinal business data can yield spuriously large gross job flows, especially in the form of spurious entry and exit. Third, the concept of a job differs across studies. Most studies calculate gross job flows from point-in-time changes for all workers, but some studies use changes in time-averaged employment measures or restrict attention to full-time or permanent workers. Fourth, the sampling interval differs across studies, which influences the share of transitory employment movements captured in measured job flows. Fifth, sectoral coverage and sampling frames vary markedly across datasets. Some datasets are drawn from the universe of all business units in a sector, while others are restricted to units above a certain size (e.g., 20 employees). Many datasets are restricted to particular industries or regions or omit the public sector.

Another measurement difference across studies involves the growth rate concept. Some studies use a traditional growth rate measure, namely the employment change from period  $t - 1$  to  $t$  divided by employment in period  $t - 1$ . This measure has two unattractive features: it is asymmetric about zero, and it cannot accommodate births and deaths in an integrated manner. An obvious alternative is the log difference, which has the advantage of symmetry about zero. However, the log difference is unbounded above and below and hence does not easily afford an integrated treatment of births, deaths and continuing employers. For these reasons, we prefer a non-traditional growth rate measure that has become the standard approach to measurement in recent studies of gross job flow behavior. Our preferred growth rate measure equals the change in employment between period  $t - 1$  and  $t$ , divided by the simple average of employment in  $t - 1$  and  $t$ . This growth rate measure is symmetric about zero, lies in the closed interval  $[-2, 2]$ , facilitates an integrated treatment of births and deaths, and is identical to the log difference up to a second-order Taylor series expansion.

Differences in datasets and measurement procedures call for the exercise of sound judgment and some caution in comparing gross job flows across studies and countries. When making cross-country comparisons, in particular, we emphasize within-country

<sup>7</sup> Our discussion here of measurement-related issues is brief. Davis and Haltiwanger (1998) discuss measurement in several US datasets at length, and Davis et al. (1990, 1996) extensively treat issues that arise in measuring gross job flows in the Longitudinal Research Datafile for the US manufacturing sector.



patterns that are less susceptible to distortions caused by differences in data quality and measurement procedures.

### 2.3. Notation and formulas

Some notation helps to clarify the concepts introduced above and to spell out the relationships among them. Let  $EMP_{est}$  denote the number of workers at employer  $e$  in sector  $s$  at time  $t$ .  $S_t$  denotes the set of employers with positive employment in  $t$  or  $t - 1$ .  $S_t^+$  denotes the subset of employers that expand or enter between  $t - 1$  and  $t$ , and  $S_t^-$  denotes the subset that contract or exit.

Gross job creation (Definition 1) in sector  $s$  at time  $t$  is

$$C_{st} = \sum_{e \in S^+} \Delta EMP_{est}, \quad (1)$$

where  $\Delta Y_t = Y_t - Y_{t-1}$ , and gross job destruction (Definition 2) is

$$D_{st} = \sum_{e \in S^-} |\Delta EMP_{est}|. \quad (2)$$

The net sectoral employment change is  $NET_{st} = C_{st} - D_{st}$ . Gross job reallocation (Definition 3) can be expressed as

$$R_{st} = \sum_{e \in S} |\Delta EMP_{est}| = C_{st} + D_{st}. \quad (3)$$

Excess job reallocation (Definition 4) in sector  $s$  equals  $R_{st} - |NET_{st}|$ . Given a particular classification of sectors indexed by  $s$ , the aggregate excess reallocation of jobs satisfies the decomposition,

$$R_t - |NET_t| = \left( \sum_s |NET_{st}| - |NET_t| \right) + \sum_s (R_{st} - |NET_{st}|). \quad (4)$$

The first term on the right-hand side captures between-sector employment shifts, and the second summation captures excess job reallocation within sectors. Note that the first term equals zero if all sectors change in the same direction.

To express the job flow measures as rates, we divide by a measure of size. We measure the time- $t$  size of a business unit as the simple average of its employment in  $t - 1$  and  $t$ :  $Z_{est} = 0.5(EMP_{est} + EMP_{e,s,t-1})$ . Summing  $Z_{est}$  over units within sector  $s$  yields  $Z_{st}$ , the size of the sector at  $t$ . In terms of this notation, the time- $t$  growth rates can be written  $g_{est} = \Delta EMP_{est}/Z_{est}$  for unit  $e$ , and  $g_{st} = \Delta EMP_{st}/Z_{st}$  for sector  $s$ . As mentioned above, these growth rate measures lie in the closed interval  $[-2,2]$ , with endpoints corresponding to exit and entry.

Using lower-case letters for rates, the sectoral creation, destruction and reallocation rates can be written

$$c_{st} = \frac{C_{st}}{Z_{st}} = \sum_{e \in S^+} \left( \frac{Z_{est}}{Z_{st}} \right) g_{est}, \quad (5)$$

$$d_{st} = \frac{D_{st}}{Z_{st}} = \sum_{e \in S^-} \left( \frac{Z_{est}}{Z_{st}} \right) |g_{est}|, \quad (6)$$

$$r_{st} = \frac{R_{st}}{Z_{st}} = \sum_{e \in S} \left( \frac{Z_{est}}{Z_{st}} \right) |g_{est}| = c_{st} + d_{st}. \quad (7)$$

Eqs. (5)–(7) express the job flow rates in terms of the size-weighted frequency distribution of employment growth rate outcomes. Eq. (7), in particular, states that the job reallocation rate is equivalent to the size-weighted mean of absolute growth rates among business units. The decomposition for the excess job reallocation rate can be written

$$x_t = r_t - |g_t| = \left[ \sum_s \left( \frac{Z_{st}}{Z_t} \right) |g_{st}| - |g_t| \right] + \left[ \sum_s \left( \frac{Z_{st}}{Z_t} \right) (r_{st} - |g_{st}|) \right]. \quad (8)$$

### 3. Key facts about gross job flows

#### 3.1. Large magnitude

We begin our characterization of the facts by reviewing findings about the magnitude of job flows. Table 1 presents average job flow rates from various studies on US data. The studies differ in time period, sampling interval, sectoral coverage and definition of business unit, but some clear patterns emerge. First, and most important, the pace of job creation and destruction is rapid. Using annual figures, roughly 1 in 10 jobs are created and another 1 in 10 are destroyed each year. Second, rates of job creation and destruction are somewhat lower for manufacturing than private-sector non-manufacturing. Third, there is a large transitory component in the higher frequency job flows, especially the quarterly flows, as the quarterly (annual) rates do not simply cumulate to the annual (5-year) rates. Fourth, rates for between-firm job reallocation are typically lower than corresponding rates for between-establishment reallocation. This pattern reflects employment shifts between establishments of the same firm.

Table 2 presents average annual job flow rates for 18 countries. Rather strikingly, high rates of job creation and destruction are pervasive. The constant churning of job opportunities that characterizes the US labor market represents the normal state of affairs for both developed and developing economies. Differences in sectoral coverage, data quality, and business unit definitions hamper fine cross-country comparisons, but Table 2 also indicates that, within countries, gross job flow rates for non-manufacturing tend to be higher than those for manufacturing.

The measures reported in Tables 1 and 2 do not capture employment shifts within business units. A few studies, summarized in Table 3, provide some analysis of within-

Table 1  
Average gross job flow rates: US studies

Geographical coverage	Period	Industry coverage	Sampling unit	Job creation	Job destruction	Net growth	Job reallocation	Source
<i>5-Year changes</i>								
United States	1967–1982	Manufacturing	Establishments	29.6	30.9	-1.3	60.5	Dunne et al. (1989b, Table 1)
<i>Annual changes</i>								
United States	1973–1993	Manufacturing	Establishments	8.8	10.2	-1.3	19.0	Baldwin (1996, Table 1)
Selected states <sup>a</sup>	1979–1983	Private sector	Reporting units <sup>b</sup>	11.4	9.9	1.4	21.3	Anderson and Meyer (1994, Table 1)
Selected states <sup>a</sup>	1979–1983	Manufacturing	Reporting units	10.2	11.5	-1.3	21.6	Anderson and Meyer (1994, Table 1)
Wisconsin <sup>a</sup>	1978–1982	Manufacturing	Reporting units	12.1	9.1	3.0	21.2	Leonard (1987, Table 6.6)
Wisconsin <sup>a</sup>	1978–1982	Non-manufacturing	Reporting units	14.8	12.3	2.5	27.1	Leonard (1987, Table 6.6)
Michigan <sup>a</sup>	1978–1988	Manufacturing	Firms	6.2	8.5	-2.3	14.7	Foote (1997, Table 1)
Michigan <sup>a</sup>	1978–1988	Private sector	Firms	10.0	9.6	0.4	19.6	Foote (1997, Table 1)
Pennsylvania <sup>a</sup>	1976–1985	Private sector	Reporting units	13.3	12.5	0.8	25.8	OECD (1987, Table 4.1)
<i>Quarterly changes</i>								
United States	1947–1993	Manufacturing	Establishments	5.8	6.0	-0.2	11.8	Davis and Haltiwanger (1998)
United States	1930–1940	Manufacturing	Establishments	11.5	10.3	1.2	21.8	Davis and Haltiwanger (1998)
Maryland <sup>a</sup>	1985–1993	Manufacturing	Reporting units	7.5	8.8	-1.3	16.3	Lane et al. (1996, Table 1)
Maryland <sup>a</sup>	1985–1993	Private sector <sup>c</sup>	Reporting units	8.7	8.9	-0.2	17.6	Lane et al. (1996, Table 1)
West Virginia <sup>a</sup>	1990–1994	Manufacturing	Establishments	4.9	5.8	-0.9	10.7	Spletzer (1997)
West Virginia <sup>a</sup>	1990–1994	Total	Establishments	8.4	8.0	-0.4	16.4	Spletzer (1997)

<sup>a</sup> Based on data for employers covered by the Unemployment Insurance (UI) system. The UI system covers all private sector employment except self-employed persons, domestic workers, some railroad workers, and certain non-profit organizations.

<sup>b</sup> Reporting units are a mixture of establishments, firms and tax-paying units.

<sup>c</sup> The agriculture, mining and contract construction, and the government sector are not included. The reported numbers are unweighted averages across sectors.

Table 2  
International comparison of annual gross job flow rates (annual averages as percentages of employment)

Country	Period	Coverage	Employer unit	Job creation	Job destruction	Net growth	Job reallocation	Source
Australia	1984-1985	Manufacturing	Establishments	16.1	13.2	3.9	29.3	Borland and Home (1994)
Canada	1974-1992	Manufacturing	Establishments	10.9	11.1	-0.2	21.9	Baldwin et al. (1998, Table 2)
Canada	1983-1991	All employees	Firms	14.5	11.9	2.6	26.3	OECD (1996, Table 2)
Chile	1976-1986	Manufacturing	Establishments	13.0	13.9	-1.0	26.8	Roberts (1996, Table 2.1)
Colombia	1977-1991	Manufacturing	Establishments	12.5	12.2	0.3	24.6	Roberts (1996, Table 2.1)
Denmark	1983-1989	Private sector	Establishments	16.0	13.8	2.2	29.8	OECD (1996, Table 2)
Denmark	1981-1991	Manufacturing	Establishments	12.0	11.5	0.5	23.5	Albaek and Sorensen (1996, Table 2)
Estonia	1992-1994	All employees	Firms	9.7	12.9	-2.2	22.6	Haltiwanger and Vodopivec (1997)
Finland	1986-1991	All employees	Establishments	10.4	12.0	-1.6	22.4	OECD (1996, Table 2)
France	1984-1992	Private sector	Establishments	13.9	13.2	0.6	27.1	OECD (1996, Table 2)
France	1985-1991	Manufacturing	Firms	10.2	11.0	-0.8	21.2	Nocke (1994, Table 3)
France <sup>a</sup>	1985-1991	Non-manufacturing	Firms	14.3	11.8	2.4	26.1	Nocke (1994, Table 3)
Germany	1983-1990	All employees	Establishments	9.0	7.5	1.5	16.5	OECD (1996, Table 2)
Germany (Lower Saxony)	1979-1993	Manufacturing	Establishments	4.5	5.2	-0.7	9.7	Wagner (1995, Table A2.1)
Italy <sup>b</sup>	1984-1993	Private sector	Firms	11.9	11.1	0.8	23.0	Contini et al. (1995, Table 3.1)
Israel	1971-1972	Manufacturing	Establishments	9.7	8.2	1.5	17.9	Gronau and Regev (1997)
Morocco	1984-1989	Manufacturing	Firms	18.6	12.1	6.5	30.7	Roberts (1996, Table 2.1)
Netherlands	1979-1993	Manufacturing	Firms	7.3	8.3	-1.0	15.6	Gautier (1997, Table 3.3)
New Zealand	1987-1992	Private sector	Establishments	15.7	19.8	-4.1	35.5	OECD (1996, Table 2)
Norway	1976-1986	Manufacturing	Establishments	7.1	8.4	-1.2	15.5	Klette and Mathiassen (1996, Table 1)
Sweden	1985-1992	All employees	Establishments	14.5	14.6	-0.1	29.1	OECD (1996, Table 2)
USA	1973-1993	Manufacturing	Establishments	8.8	10.2	-1.3	19.0	Baldwin et al. (1998, Table 1)
USA <sup>c</sup>	1979-1983	Private sector	Establishments	11.4	9.9	1.4	21.3	Anderson and Meyer (1994, Table 11)
USA <sup>c</sup>	1979-1983	Manufacturing	Establishments	10.2	11.5	-1.3	21.6	Anderson and Meyer (1994, Table 11)
United Kingdom	1985-1991	All employees	Firms	8.7	6.6	2.1	15.3	OECD (1996, Table 2)

<sup>a</sup> Non-manufacturing includes commerce, transport and communications, services, insurance, banking and financial institutions.

<sup>b</sup> Contini and Paceli (1995, p. 33) report that efforts to purge the data of spurious births and deaths reduce the Italian gross job flow rates by about one-fifth.

<sup>c</sup> Selected states. Based on data for employers covered by the Unemployment Insurance (UI) system. The UI system covers all private sector employment except self-employed persons, domestic workers, some railroad workers, and certain non-profit organizations.

unit job reallocation. The Hamermesh et al. (1996) study for the Netherlands relies on survey responses to questions about whether hires were to new or existing positions. Based upon the survey responses, about 11% ( $0.8/(6.2 + 0.8)$ ) of total measured job reallocation arises from within-firm reallocation. Dunne et al. (1997) rely on a classification into production and non-production workers to measure within-establishment reallocation. They find that about 12% of total measured job reallocation reflects within-plant reallocation. Lagarde et al. (1994) exploit detailed information on job classifications to study within-establishment flows. Measurement difficulties presented by worker movements between job classifications cloud the interpretation of their results, but taken at face value, Lagarde et al. find that within-establishment job shifts between skill categories account for almost half of total job reallocation.

### 3.2. *Predominance of idiosyncratic factors*

A second basic fact is the dominant role of plant-specific and firm-specific factors in accounting for the large observed magnitudes of gross job flows.

Table 4 illustrates the pervasiveness of high job reallocation rates across manufacturing industries. Virtually every 2-digit industry in each country exhibits an annual rate of job reallocation that exceeds 10%. Interestingly, Table 4 also suggests that the industry pattern of job reallocation intensity is quite similar across countries. A simple regression of industry-level reallocation rates on country and industry fixed effects for the United States, Canada and the Netherlands yields the following. The  $R$ -squared on country effects alone is 0.08, the  $R$ -squared on industry effects alone is 0.48, and the  $R$ -squared on country and industry effects together is 0.56. Further, the  $F$ -tests for the specification with both effects yield  $P$ -values of 0.06 for country effects and 0.03 for industry effects. In short, even this small sample of three countries provides clear evidence of systematic industry-level patterns in the pace of job reallocation.<sup>8</sup>

The high pace of job reallocation in every industry suggests that a large fraction of gross job flows reflects within-sector reallocation activity rather than between-sector employment shifts. We evaluate this hypothesis in Table 5 by reporting the decomposition (8) for several countries and sectoral classification schemes.

A remarkable aspect of Table 5 is the inability of between-sector shifts to account for excess job reallocation. For example, employment shifts among the approximately 450 four-digit industries in the US manufacturing sector account for a mere 13% of excess job reallocation.<sup>9</sup> Simultaneously cutting the US manufacturing data by state and two-digit

<sup>8</sup> Rank correlations of the industry reallocation rates make the same point. The pairwise rank correlation of industry reallocation rates is 0.56 between the United States and Canada, 0.28 between the United States and the Netherlands and 0.60 between the United States and Norway. Similarly, Roberts (1996) reports positive rank correlations of industry-level reallocation rates among Chile, Colombia and Morocco. The correlations reported in his Table 2.6 are higher for excess reallocation rates than for gross job reallocation rates.

<sup>9</sup> The average four-digit manufacturing industry has about 39,000 employees and accounts for about 0.04% of aggregate US employment.

Table 3  
Job reallocation rates between and within employers<sup>a</sup>

Study	Coverage	Employer unit	Between reallocation rate	Within reallocation rate	Notes
Hamermesh et al. (1996, Table 2)	Netherlands, all sectors, 1988–1990	Firms	6.2	0.8	Changes in number of jobs within the firm are identified by respondents of the survey. Respondents report whether a hire occurred to a new or to an existing job
Lagarde et al. (1994, Table 1)	France, all sectors, 1984–1991	Establishments	7.9	6.7	Changes in number of jobs within the plant are identified by observing changes in six skill categories of workers
Dunne et al. (1997, Table 5)	USA, manufacturing 1972–1988	Establishments	19.2	2.7	Changes in number of jobs within the plant are identified by observing changes in two categories of workers: production and non-production

<sup>a</sup> Within reallocation equals jobs created plus jobs destroyed within the establishment (firm) minus the absolute value of the establishment's (firm's) net employment change. Summing this quantity over all establishments (firms) and dividing by aggregate employment yields the within reallocation rate. The between reallocation rate is the job reallocation rate in Definition 3.

Table 4  
Average annual job reallocation rates by country and industry<sup>a</sup>

	USA 1974–1992	Canada 1974–1992	Netherlands 1979–1993	Norway 1976–1986
Food	17.9	19.5	18.4	15.3
Tobacco	12.7	12.3		
Textiles	16.9	21.3	19.1	18.3
Apparel	25.2	27.8	23.4	
Lumber	25.8	26.2	20.8	15.7
Furniture	20.7	27.7		
Paper	12.5	11.1	14.6	12.6
Printing	17.1	22.0	16.3	
Chemicals	14.0	18.7	12.1	12.7
Petroleum	14.2	15.6	10.1	13.2
Rubber	20.3	21.5	12.1	
Leather	22.4	24.2	17.5	
Stone, clay, glass	20.4	23.0	15.6	
Primary metals	16.0	13.3	5.2	6.3
Fabricated metals	20.0	27.7	18.8	18.7
Non-electric machinery	20.5	27.8	16.4	
Electric machinery	19.5	24.6	11.3	
Transportation	18.4	20.6	14.6	
Instruments	10.5	28.1	19.7	
Miscellaneous	14.4		28.5	18.3
Total manufacturing	19.0	21.9	15.6	15.5

<sup>a</sup> Sources: USA, Baldwin et al. (1998, Table 2) except the data for instruments and miscellaneous, which are from 1973–1988 data in Davis et al. (1996); Canada, Baldwin et al. (1998, Table 2); Norway, Klette and Mathiassen (1996, Table 6); Netherlands, Gautier (1997, Table 3.7).

industry yields a contribution of only 14% for between-sector shifts. Davis and Haltiwanger (1992) report that even when sectors are defined by simultaneously crossing 2-digit industry, region, size class, plant age class and ownership type (14,400 sectors), between-sector shifts account for only 39% of excess job reallocation.<sup>10</sup> The same finding holds up in studies for other countries. For example, using detailed industry classifications (600 industries), Nocke (1994) finds that only 17% of excess job reallocation in France is accounted for by between-sector employment shifts.

These results provide little support for the view that high rates of job reallocation arise primarily because of sectoral disturbances or economy-wide disturbances with differential sectoral effects – at least when sectors are defined in terms of industry, region, size and age. Instead, the results in Table 5 imply that job flows are largely driven by plant-level and firm-level heterogeneity in labor demand changes.

<sup>10</sup> To appreciate the level of detail captured by this sectoral classification scheme, we remark that the average nonempty “sector” contains only about five sampled plants.

Table 5  
Fraction of excess job reallocation accounted for by employment shifts between sectors

Country	Period	Classification scheme	Unit of analysis	Number of sectors	Average number of workers per sector (in 000's)	Fraction resulting from shifts between sectors	Source
USA	1972-1988	4-Digit SIC manufacturing	Plant	448/456	39.1 <sup>a</sup>	0.13	Davis and Haltiwanger (1992, Table 3.8)
USA	1972-1988	2-Digit SIC manufacturing by state	Plant	980	17.9	0.14	Davis and Haltiwanger (1992, Table 3.8)
Denmark	1983-1989	1-Digit ISIC private sector	Plant	8	196.1	0.00	OECD (1994a, Table 3.5)
Finland	1986-1991	2-Digit ISIC	Plant	27	48.9	0.06	OECD (1994a, Table 3.5)
Germany	1983-1990	2-Digit ISIC	Plant	24	1171.2	0.03	OECD (1994a, Table 3.5)
Italy	1986-1991	2-Digit ISIC private sector	Firm	28	321.5	0.02	OECD (1994a, Table 3.5)
Netherlands	1979-1993	2-Digit SIC	Firm	18	10.0	0.20	Gautier (1997, Table 3.12 (and calculations))
Sweden	1985-1991	2-Digit ISIC	Plant	28	112.4	0.03	OECD (1994a, Table 3.5)
Norway	1976-1986	5-Digit ISIC manufacturing	Plant	142	2.4	0.06	Klette and Mathiassen (1996, Table 8 (and calculations))
France	1984-1988	NAP private sector	Plant	15	883.3	0.06	OECD (1994a, Table 3.5)
France	1985-1991	Detailed industry	Firm	600	36.6	0.17	Nocke (1994, Table 6)
France	1984-1991	NAP	Plant	100		0.12	Lagarde et al. (1994, Table 2)
New Zealand	1987-1992	2-Digit ISIC	Plant	28	27.5	0.01	OECD (1994a, Table 3.5)
Chile	1979-1986	4-Digit manufacturing	Plant	69	3.7	0.12	Roberts (1996)
Colombia	1977-1991	4-Digit manufacturing	Plant	73	6.31	0.13	Roberts (1996)
Morocco	1984-1989	4-Digit manufacturing	Plant	61	4.0	0.17	Roberts (1996)

<sup>a</sup> The US numbers are based on a sample of establishments with the reported number of workers per sector equal to the sample weighted totals. The unweighted averages for the US are 29.3 and 13.5 thousand for the 4-digit and 2-digit, state exercises, respectively.



### 3.3. Persistence of underlying employment movements

How persistent are the employment changes that underlie the job creation and destruction figures? An answer to this question helps to understand business-level employment dynamics and the character of the worker reallocation associated with job reallocation. To the extent that measured job creation and destruction represent short-lived employment changes, the changes can be implemented largely through temporary layoffs and recalls. To the extent that plant-level employment changes are persistent, they must be associated with longterm joblessness or worker reallocation across plants.

In thinking about how to measure persistence, we stress that our focus is on the persistence of the typical newly created or newly destroyed job. This focus is distinct from a focus on the persistence of the typical existing job or the persistence of establishment size. In line with our focus, we measure persistence according to the following definitions:

**Definition 6.** The  $N$ -period persistence of job creation is the percentage of newly created jobs at time  $t$  that remain filled at each subsequent sampling date through time  $t + N$ .

**Definition 7.** The  $N$ -period persistence of job destruction is the percentage of newly destroyed jobs at time  $t$  that do not reappear at any subsequent sampling date through time  $t + N$ .

These persistence measures lie between 0 and 100% and are non-increasing in  $N$  for any given set of jobs destroyed or created at  $t$ .

Table 6 summarizes the persistence properties of job creation and destruction over 1 and 2 year horizons for several countries. Roughly 7 in 10 newly created jobs survive for at least 1 year, and roughly 8 in 10 newly destroyed jobs fail to reappear 1 year later. At 2 years, the persistence of annual job creation and destruction is somewhat lower. The most important aspect of these results is the implication that annual job creation and destruction figures largely reflect persistent plant-level employment changes.<sup>11</sup>

### 3.4. Concentration and lumpiness of underlying employment movements

Many studies find that births and deaths account for large fractions of job creation and destruction. But, more so than most other gross job flow statistics, the measured roles of births and deaths are influenced by sample design, the sampling interval, the unit of observation (firm or establishment), and the quality of longitudinal links. Since available

<sup>11</sup> It may be helpful to reconcile the high persistence of annual job creation and destruction with some well-known facts about the importance of temporary layoffs in the US manufacturing sector. For example, Lilien (1980, Table III) estimates that 60–78% of all manufacturing layoffs ended in recall during the years 1965–1976, which might seem difficult to square with the results in Table 6. But Lilien also reports that 92% of manufacturing unemployment spells ending in recall last three months or less. Hence, most of the short-duration temporary layoffs are not captured by the annual job creation and destruction numbers, which are based upon point-in-time to point-in-time changes from one year to the next.

Table 6  
Average persistence rates for annual job flows

	USA 1973-1988		Denmark 1980-1991		Netherlands 1979-1993		Norway 1977-1986		France 1985-1990	
	1 year	2 years	1 year	2 years	1 year	2 years	1 year	2 years	1 year	2 years
Job creation	70.2	54.4	71.0	58.0	77.9	58.8	72.7	65.1	73.4	51.5
Job destruction	82.3	73.6	71.0	58.0	92.5	87.3	84.2	79.8	82.1	68.2
Sources	Davis et al. (1996, Table 2.3)		Albaek and Sorensen (1996, Table 3)		Gautier (1997, Tables 3.16 and 3.19)		Klette and Mathiassen (1996, Table 5 and 4)		Nocke (1994, Table 4)	

datasets often differ greatly along these dimensions, it is difficult to directly compare the prominence of births and deaths across countries and studies.

On a conceptual level, births and deaths are simply the extremes of an underlying growth-rate distribution. It is more informative to characterize how creation and destruction are distributed over the entire distribution rather than just reporting the mass at the endpoints.

These considerations prompt us to characterize the distribution of job creation and destruction over the underlying growth-rate distributions for studies that meet the following criteria: annual sampling frequency, comprehensive or nearly comprehensive sample frame for a major sector, clearly defined observational unit, high quality longitudinal links, and availability of the data (to us). Two studies fully meet these criteria: Davis et al. (1996), who study the US manufacturing sector, and Albaek and Sorensen, 1996, who study the Danish manufacturing sector. For these two countries, Fig. 1 displays the distributions of job creation (to the right of zero) and job destruction (to the left of zero) over intervals of the symmetric growth rate measure defined in Section 2.3. The intervals have width 0.10 and are centered on the reported midpoints. Two additional mass points at +2 and -2 correspond to births and deaths.

Fig. 1 shows that gross job flows in manufacturing are concentrated in a relatively small number of plants that experience high rates of expansion or contraction. Table 7 makes the same point, adding Canada and Israel to the data displayed in Fig. 1. All four countries show high concentration of job creation and destruction at relatively few plants, and equivalently, considerable lumpiness in plant-level employment adjustments.

This concentration, or lumpiness, carries some important implications that merit a few remarks here. First, the lumpiness of plant-level employment movements points to a major role for fixed costs in the adjustment of labor or cooperating factors of production. Put differently, such lumpiness is difficult to reconcile with traditional models of convex adjustment costs that long dominated work on dynamic labor demand issues (see Nickell, 1986; Hamermesh and Pfann, 1996). Some recent empirical work on employment dynamics accommodates a much richer specification of adjustment costs (e.g., Caballero and Engel, 1993; Caballero et al., 1997). In addition to characterizing microeconomic adjustment patterns, this work shows how the cross-sectional distribution of outcomes for individual employers influences the behavior of aggregate employment. Parallel work on consumer durables and business investment, surveyed in Attanasio (1998) and Caballero (1998), also highlights the interaction between the cross-sectional distribution of microeconomic outcomes and the behavior of aggregates.

Second, Fig. 1 and Table 7 contain an important message about the connection between job flows and worker flows. As we discuss in Section 6, many firms experience worker attrition rates of 10–20% per year. This high attrition rate suggests that most job destruction is easily and painlessly accommodated by workers who are nearly indifferent about separation in any event. But Table 7 tells us that over two-thirds of job destruction in the manufacturing sector takes place at establishments that shrink by more than 20% over the span of a year. In other words, the bulk of the job destruction measured in annual data

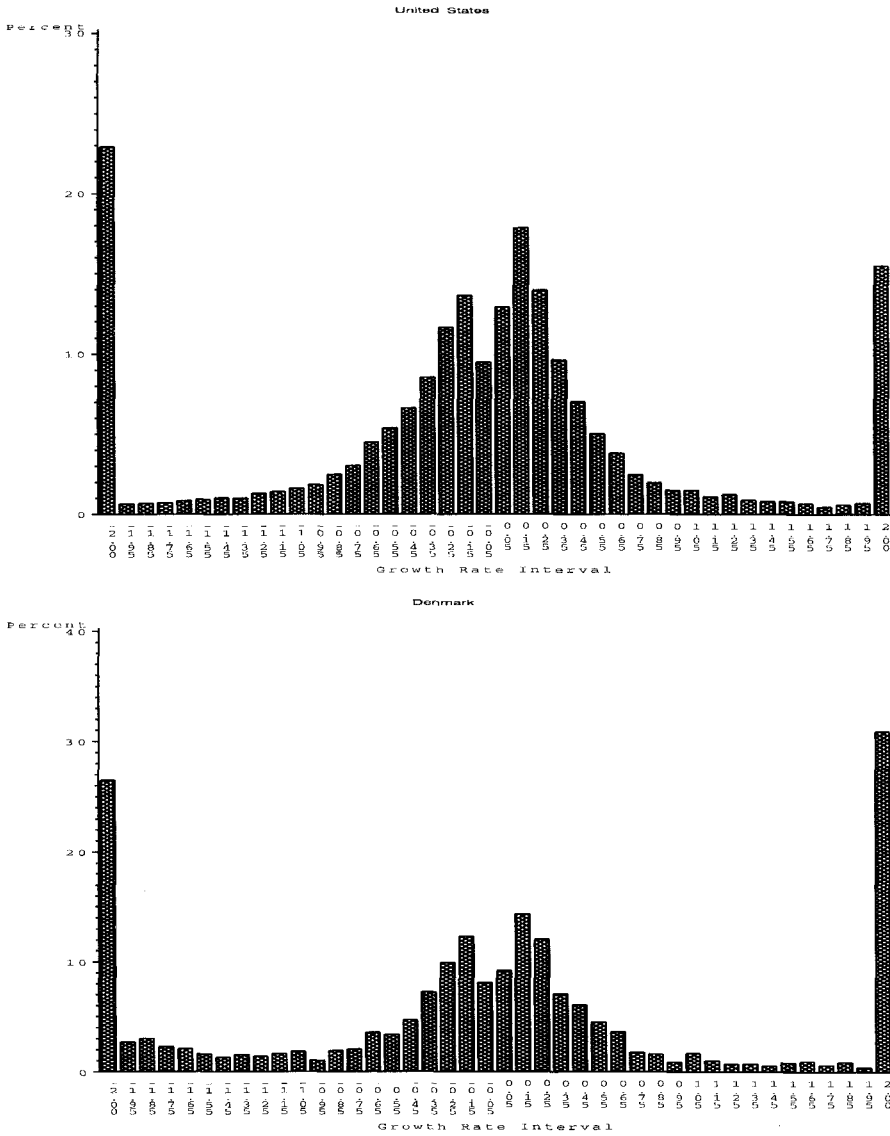


Fig. 1. Distribution of plant-level job creation and destruction. Creation (destruction) percentages are depicted for positive (negative) growth rate intervals. Source: US, Davis et al. (1996); Denmark, Albaek and Sorensen (1996).

represents job loss from the point of view of workers.<sup>12</sup> The “job loss” component of measured job destruction is even higher during recessions, when job destruction rates rise and quit rates fall.

Table 7  
The concentration of job creation and job destruction<sup>a</sup>

Country	Sector	Percent of job creation or destruction accounted for by plants with growth rates in the indicated interval					
		[-2,-1)	[-1,-0.2)	[-0.2,0)	(0,0.2]	(0.2,1]	(1,2]
United States	Manufacturing	32.9	44.0	23.1	30.7	45.1	24.2
Canada	Manufacturing		77.7	22.3	24.8	75.2	
Denmark	Manufacturing	45.9	33.7	20.4	23.4	37.4	39.1
Israel	Manufacturing		84.7	15.3	21.8	78.2	

<sup>a</sup> Sources: United States, Davis et al. (1996); Canada, Baldwin et al. (1998); Denmark, Alback and Sorensen (1996); Israel, Gronau and Regev (1997).

Third, the high concentration of job creation and destruction may accentuate effects on workers and local economies. A sharp employment reduction at a single large plant can flood the local labor market, which increases the hardship that falls on each job loser. Conversely, a sharp employment increase at a single plant can induce an in-migration of workers and their families that strains the capacity of the local community to provide schooling, housing, roads and sewers. The local economy effects of job creation and destruction events are probably most important for manufacturing and a few other industries dominated by large establishments.<sup>13</sup> We are not aware of much research at this intersection point between labor and spatial economics, but the growing availability of matched longitudinal employer–worker datasets suggests that it may become an important topic in future work.

### 3.5. Systematic differences across sectors: magnitude

Table 4 points to systematic differences in the pace of job reallocation across industries. It turns out that there are many strong cross-sectional patterns in the intensity of job reallocation. We defer a detailed examination of these cross-sectional patterns to Section 4, but Fig. 2 displays two of the most consistent and powerful relationships. These figures show how the excess job reallocation rate varies with employer size and age in the US manufacturing sector. They also show the relationship of size and age to the net job growth rate, a topic of independent interest. These figures are based on size-weighted plant-level regressions of the employment growth rate and the absolute growth rate on a quartic in employer size interacted with dummy variables for the indicated employer age categories.

<sup>12</sup> This inference is less secure for non-manufacturing sectors for two reasons. First, worker attrition rates tend to be higher outside the manufacturing sector. Second, we know of no studies that examine whether non-manufacturing job flows are more or less concentrated than shown in Fig. 1 and Table 7.

<sup>13</sup> Davis and Haltiwanger (1991, Fig. 4.B) report that in 1986, for example, the average manufacturing employee worked at a facility with nearly 1600 workers.

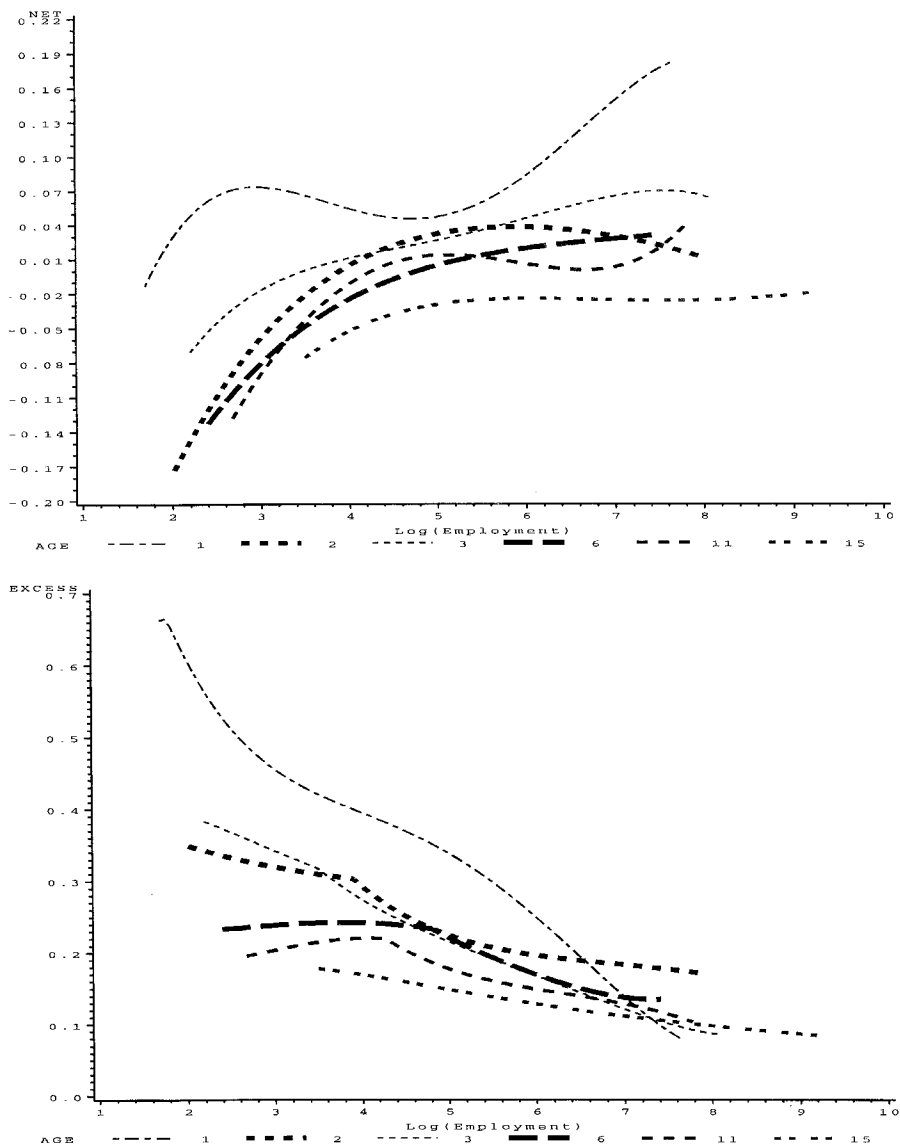


Fig. 2. (a) Net growth rate for age classes, by employer size; (b) excess job reallocation for age classes, by employer size. Source: authors' calculations for the US manufacturing sector.

Age refers to the number of years since the establishment first had positive employment. We use pooled data for the US manufacturing sector in 1978, 1983 and 1988, three years

that allow us to construct detailed age measures. The regression specifications include year effects.

Using the estimated regression functions, we calculated the fitted relationships of the net growth rate and the excess reallocation rate to employer size and age.<sup>14</sup> Fig. 2 displays the fitted relationships from the 5th to the 95th percentile of the employment-weighted distribution of plant size.

Some clear and very strong patterns emerge. Holding size constant, net growth declines sharply with age; excess job reallocation also declines with age, except for the largest plants. Holding age constant, net growth increases with size, and excess reallocation declines sharply with size.

Nocke's (1994) study allows for a crude investigation of size and age relationships in data on French job flows. His Table 10 presents employment-weighted net and gross job reallocation rates cross-tabulated by detailed employer size and age classes. Using the information in his table, we generated Fig. 3. The Nocke tabulations are equivalent to a cell-based regression of net growth and job reallocation on detailed employer size and age classes and are roughly comparable to the ones presented in Fig. 2. Although the patterns are somewhat less dramatic, they are basically the same as in the US manufacturing sector.

These results highlight the important role of employer characteristics in accounting for the magnitude of job flows, and they provide clues about the reasons for large job flows. They also suggest that systematic differences in the size and age structure of employment partly account for the industry differences in job reallocation rates in Table 4 and the country differences in Table 2. The strong relationship of employer age to both net growth and excess reallocation points to a major role for employer lifecycle effects. We return to these and related themes in Section 4.

### *3.6. Distinct cyclical dynamics of creation and destruction*

This section addresses two straightforward questions about time variation in gross job flows. First, does the magnitude of gross job flows vary much over time? Second, is there an asymmetry in the respective roles of job creation and destruction in accounting for the dynamic adjustment of employment?

Fig. 4 presents quarterly job creation, job destruction and net growth rates for the US Manufacturing sector from 1947:1 to 1993:4.<sup>15</sup> It is apparent that gross job flow rates vary considerably over time. The job destruction rate ranges from 2.9% to 10.8% of employment per quarter, while the job creation rate ranges from 3.8 to 10.2%. Job creation and destruction covary negatively, but the correlation of  $-0.17$  is small. A noteworthy feature of the data is the relatively volatile nature of job destruction. As measured by the time-series variance, destruction varies 50% more than creation in the quarterly data.

<sup>14</sup> We fit the excess reallocation rate as the difference between the fitted absolute growth rate and the absolute value of the fitted net growth rate for each value of size and age.

<sup>15</sup> We constructed these time series by splicing BLS data on worker separations and accessions to LRD data on job flows using the method described in Davis and Haltiwanger (1996, Appendix A).

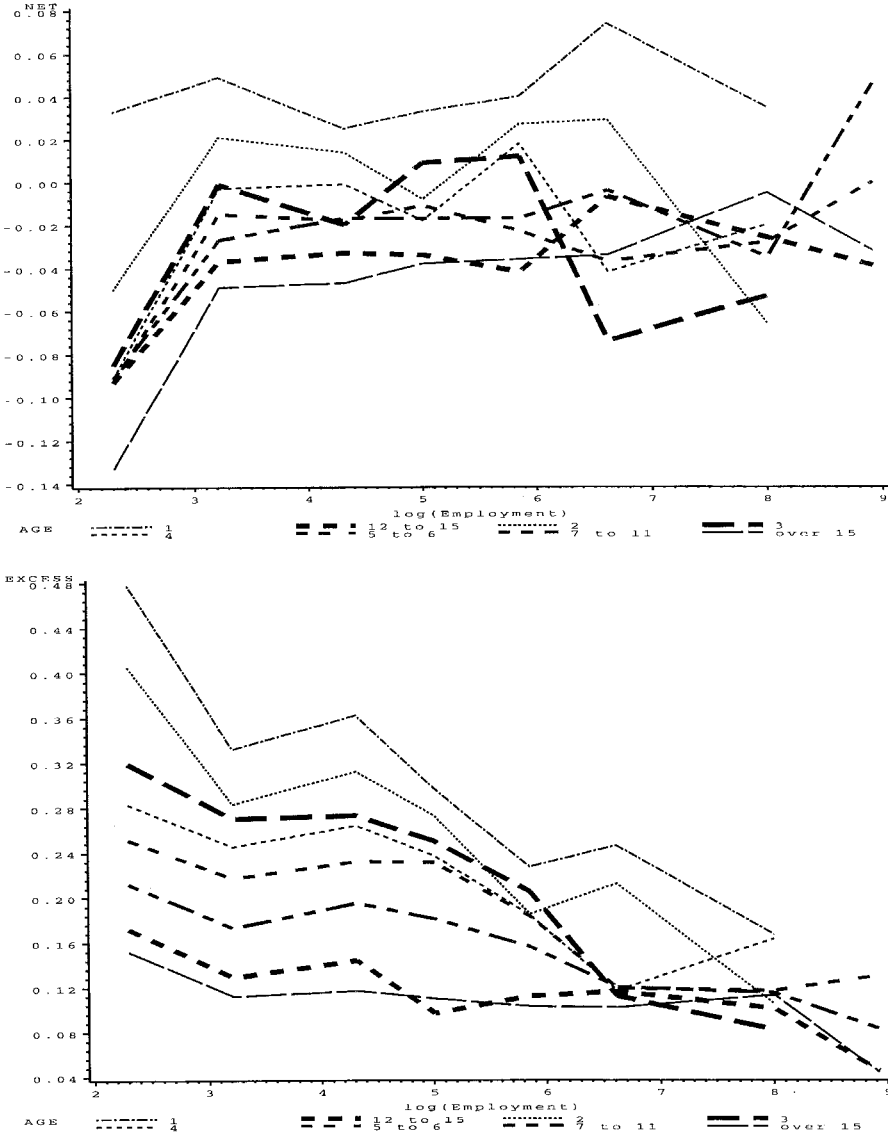


Fig. 3. (a) Net growth rate for age classes, by employer size; (b) excess reallocation for age classes, by employer size. Source: authors' calculations based upon French data reported by Nocke (1994, Table 10).

Fig. 4 points to distinctly different cyclical dynamics in job creation and destruction. As expected, creation tends to fall and destruction tends to rise during recessions, but the



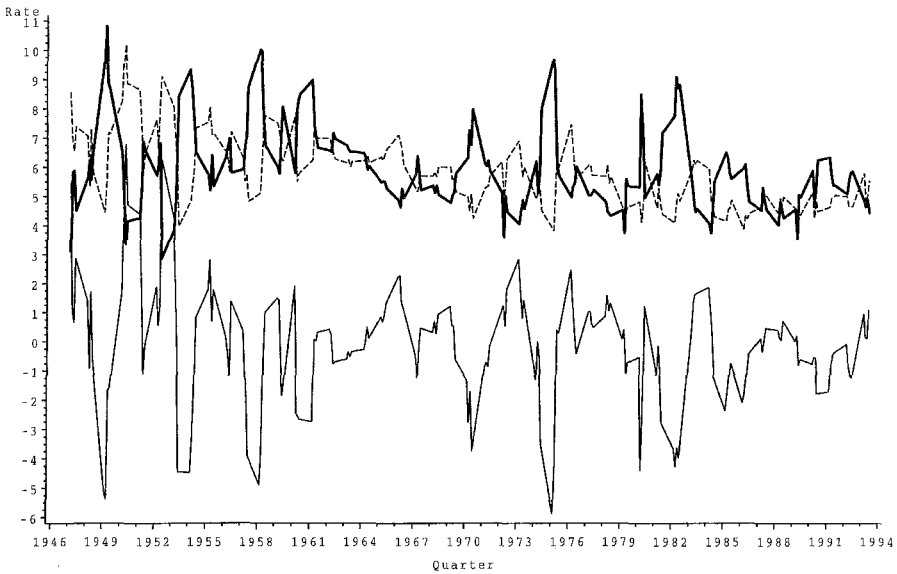


Fig. 4. Job creation and job destruction in US manufacturing. Dashed line, job creation; heavy solid line, job destruction; light solid line, net growth.

cyclical behavior of the two series is not symmetrical. Job destruction rises dramatically during recessions, whereas job creation initially declines by a relatively modest amount. There is some tendency for an upturn in job creation one or two quarters after a spike in destruction.

Fig. 5 presents annual job creation and destruction rates in the manufacturing sector for eight countries. Unfortunately, the available sample period for most countries other than the United States is quite short, and there are some important differences in the nature of the samples across countries. The US and Canadian series are the most comparable, as Baldwin et al. (1998) harmonized the measurement of the gross job flow series from establishment-level data in these two countries. The series for Denmark, Norway and Colombia are establishment-based and have been tabulated using procedures similar to the US data. The German series are also establishment-based but less comparable, because they reflect somewhat different measurement procedures. The series for the Netherlands and the United Kingdom are firm-based, and the UK sample is restricted to continuing firms with more than 20 employees.

It is apparent that job flow rates exhibit considerable volatility in all countries. Except in Denmark and Colombia, job destruction is more volatile than job creation. The variance of destruction divided by the variance of creation is 2.04 for the United States, 1.49 for Canada, 1.48 for Norway, 1.0 for Denmark, 2.68 for the Netherlands, 1.69 for Germany, 0.68 in Colombia, and 18.19 for the UK. The especially high relative volatility of job

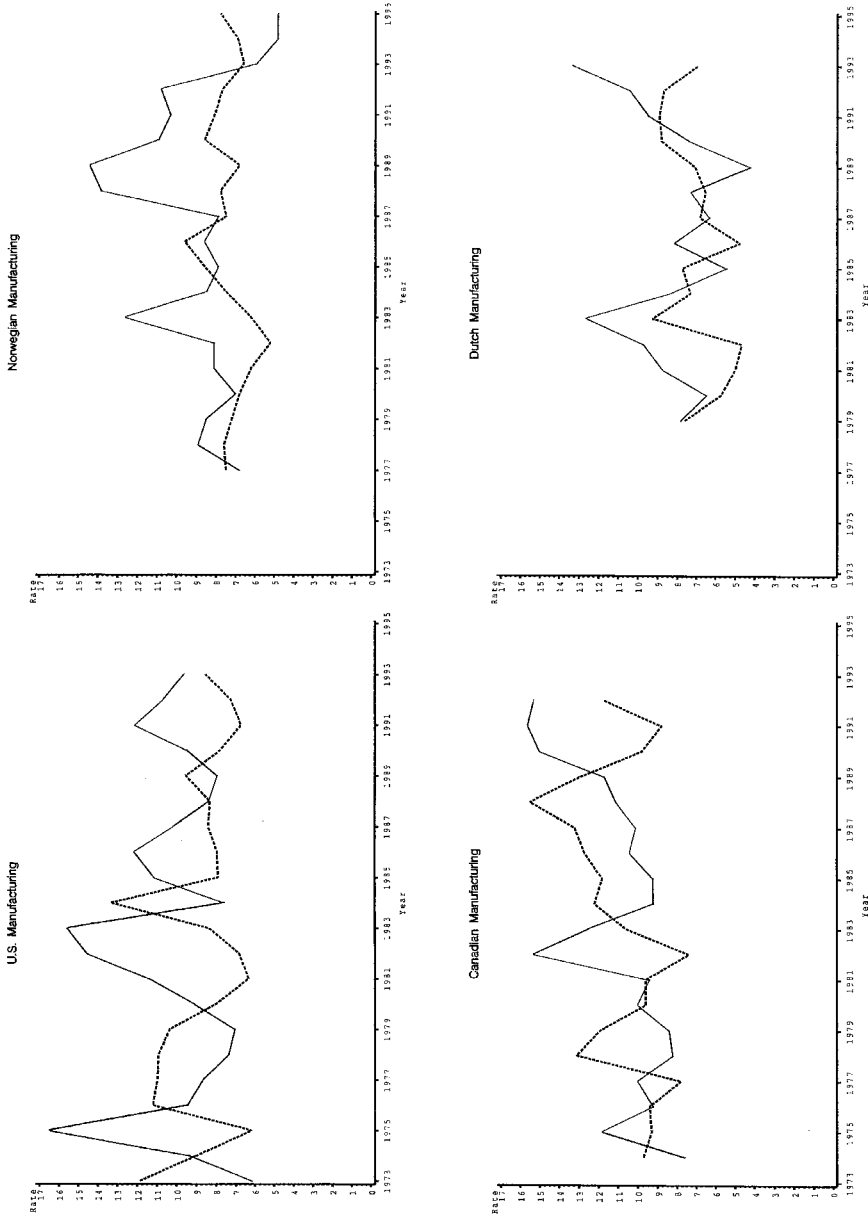


Fig. 5. Job creation and job destruction across countries. Dashed line, job destruction. Source: US, Canada, Baldwin et al. (1996); Norway, Salvanes (1997); Netherlands, Gautier (1997); Germany, Wagner (1995); Denmark, Albaek and Sorensen (1996); UK, Konings (1995); Colombia, Roberts (1996).

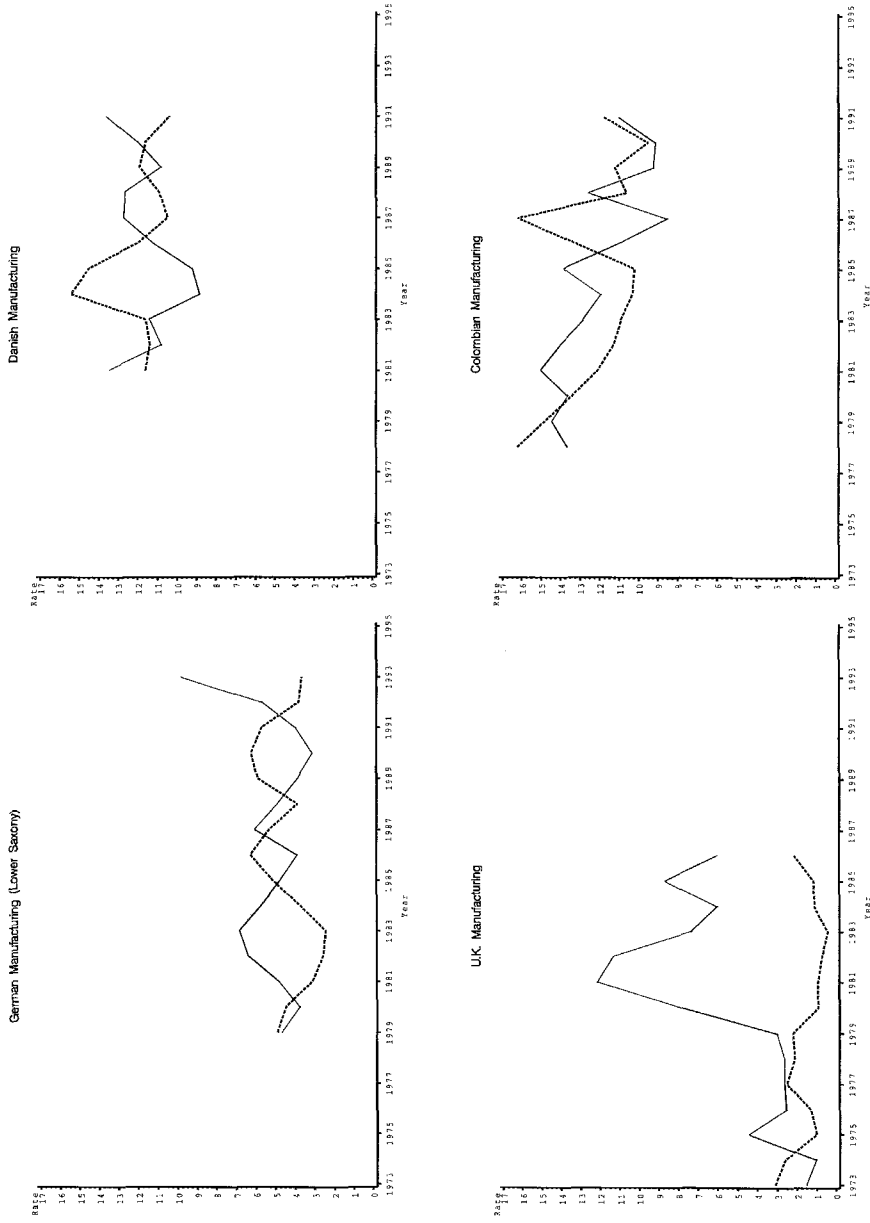


Fig. 5. (continued)

destruction in the UK probably reflects the restricted sample underlying the study. We show below, using US data, that the relative volatility of job destruction is systematically lower for younger and smaller businesses.

### 3.7. Systematic differences across sectors: cyclical dynamics

The asymmetric cyclical behavior of job creation and destruction in the manufacturing sector has attracted much attention in recent work. A natural question is whether this cyclical asymmetry extends to non-manufacturing industries. Information about non-manufacturing industries is limited to fewer studies, shorter sample periods and, on the whole, lower quality data, but the available evidence points to important between-industry differences in cyclical dynamics.

Foote (1997, 1998) shows that the relative variance of job destruction declines sharply with an industry's trend employment growth rate. He finds this relationship in annual data on a broad set of Michigan industries from 1978 to 1988 and in annual data on 4-digit US manufacturing industries from 1972 to 1988. Most industries in his Michigan sample exhibit positive trend growth and show at least as much volatility in creation as in destruction. Foote also proposes an explanation for this relationship based on a mechanical ( $S,s$ ) model with a fixed set of employers. The basic idea is that a negative (positive) employment trend leads the cross-sectional density of deviations from desired employment to bunch near the destruction (creation) boundary, so that job destruction (creation) is more responsive to common shocks. Foote's simple ( $S,s$ ) model also yields quantitative predictions, and on this score the model deviates from the empirical evidence in two respects. First, the relative standard deviation of job creation rises more rapidly with trend growth than predicted by the model. Second, conditional on trend growth, the standard deviation of destruction exceeds that of creation, in contrast to the model's prediction of equal variability.

Boeri (1996) presents evidence on the cyclical behavior of gross job flows using annual data for 8 countries (US, Canada, Denmark, France, Germany, Italy, Norway and Sweden). The data for most countries are based on administrative records that cover most or all of the private sector. Boeri finds that the variance of job creation tends to be larger than the variance of job destruction in most of these countries.<sup>16</sup> However, the time series for most countries are quite short and, in many cases, limited to rather quiescent periods that lack sharp variation in employment growth rates. For example, Boeri's Chart 1 shows relatively little cyclical variation in Italy, approximately zero or positive employ-

<sup>16</sup> Boeri argues that the US manufacturing pattern is an outlier, but the evidence presented in Fig. 5 indicates otherwise. Boeri also argues that the measured volatility of creation and destruction in the US manufacturing sector is distorted by the exclusion of (most) establishments with fewer than 5 employees. However, the very small plants omitted from the LRD sampling frame comprise only 4% of manufacturing employment, too little to account for the greater measured volatility of job destruction. Foote notes that the cyclical behavior of manufacturing job flows in the Michigan data is unaffected by the exclusion of establishments with fewer than 5 employees.

ment growth in all years in Denmark, a slow secular decline in employment growth that eventually became negative but no apparent cycle in Sweden, and modest contraction (less than 5%) in the early 1980s but no sharp cycles in France. In contrast, US manufacturing employment contracted by almost 10% per year in the middle 1970s and again in the early 1980s but grew modestly in other years. These observations suggest the limited cyclical variation in Boeri's sample may account for his failure to find sharp differences in the relative volatility of creation and destruction.<sup>17</sup>

Despite short sample periods and other data problems, the evidence amassed in Boeri (1996), Foote (1997, 1998) and Fig. 5 clearly suggests that manufacturing and non-manufacturing sectors exhibit systematically different job flow dynamics. Another way to shed light on this issue is to focus on the relationship between employer characteristics and cyclical dynamics within manufacturing. In particular, the US manufacturing data are rich enough to examine a variety of employer characteristics like size, age, capital intensity, product market concentration and trend growth. The effects of these industry characteristics are interesting in their own right, but their study also enables us to explore what might be special about manufacturing.

To pursue this approach, we conducted the following exercise. Using 4-digit quarterly job creation and destruction rates for US manufacturing industries from 1972:2 to 1993:4, we constructed the ratio of the time-series standard deviation of destruction to the standard deviation of creation for each industry. Fig. 6 presents scatter plots of the log standard deviation ratios against the trend employment growth rate, a measure of the employment-weighted firm size distribution, a measure of the employment-weighted establishment age distribution, and the inventory-sales ratio in the industry. Table 8 shows related bivariate and multivariate regression results.

The scatter plots show that the relative volatility of destruction falls with trend growth and rises with firm size, plant age and the inventory-sales ratio. Table 8 shows that the relative volatility of destruction also rises with capital intensity in a bivariate regression. The size and age patterns confirm results in Davis and Haltiwanger (1992) and Davis et al. (1996), while the trend growth rate pattern reproduces results in Foote (1997, 1998). The capital intensity relationship is in line with the theoretical model of Caballero and Hammour (1994), and the inventory relationship is in line with the theoretical model of Hall (1997b).

<sup>17</sup> The administrative data underlying the job flow measures in Boeri's study are another concern. He provides little information about data quality and longitudinal linkage procedures. While administrative (tax) data hold great promise for longitudinal analyses, there are pitfalls in their use given the inherent difficulties in maintaining longitudinal identifiers. In the United States, for example, multi-establishment firms may have one or several taxpayer identification numbers (EINs). EINs for establishments and firms may change for a variety of reasons related to administrative convenience, organizational change and ownership change. These problems with taxpayer identification numbers present serious difficulties in measuring job flows accurately. Ongoing analysis at the US Bureau of the Census suggests that the identification number and associated longitudinal linkage problems are more severe for small establishments, especially in retail trade and the service sectors. See Davis and Haltiwanger (1998) for further discussion of longitudinal linkage problems in US datasets.

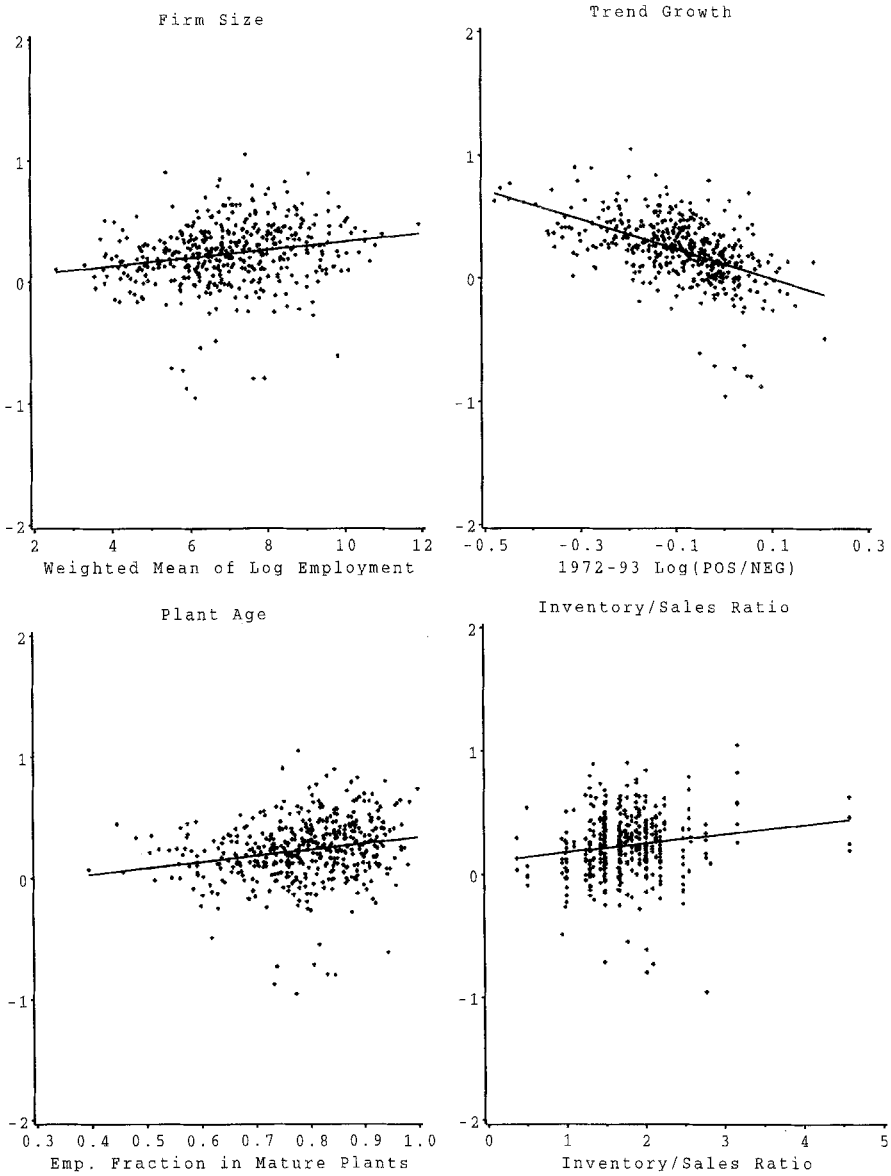


Fig. 6. The relative volatility of destruction and industry characteristics. The scale on the vertical axes shows the log of the job destruction standard deviation divided by the log of the job creation standard deviation.

Table 8  
Job flow standard deviation ratio regressions, four-digit US manufacturing industries, 1972:2 to 1993:4 (dependent variable,  $\log[(\text{job destruction rate standard deviation})/(\text{job creation rate standard deviation})]$ )<sup>a</sup>

Variable	Mean (SD)	Coefficient (standard error)							
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log standard deviation ratio	0.23 (0.26)								
Trend growth <sup>b</sup>	-0.094 (0.11)	-1.19 (0.09)						-1.14 (0.10)	-1.51 (0.17)
Trend squared	0.021 (0.033)								-1.48 (0.56)
Firm size <sup>c</sup>	8.78 (1.59)				0.035 (0.008)			0.035 (0.009)	0.036 (0.008)
Plant age <sup>d</sup>	0.79 (0.11)					0.51 (0.11)			
4-Firm concentration <sup>e</sup>	0.38 (0.21)						0.06 (0.12)	-0.22 (0.07)	-0.22 (0.07)
Capital intensity <sup>f</sup>	4.14 (0.89)	0.032 (0.014)							
Inventories/sales <sup>g</sup>	1.76 (0.55)	0.074 (0.022)							
R <sup>2</sup>		0.264	0.012	0.027	0.047	0.044	0.002	0.289	0.300

<sup>a</sup> After dropping two industries with missing data on TFP growth, there are 445 observations for each variable except for the inventory/sales ratio for which there are 425 observations. Each industry receives equal weight in the calculation of descriptive statistics and regression coefficients. All regressions include an intercept. The following variables are statistically insignificant when added to the multivariate specification (8): (i) plant age, (ii) capital intensity, (iii) 1972-1993 TFP growth rate, (iv) mean hourly wage for production workers, and (v) the inventory-sales ratio (smaller sample). Including these variables has little effect on the coefficient estimates and standard errors reported in (8).

<sup>b</sup> Trend growth equals the log of the 1972-1993 mean creation rate minus the log of the 1972-1993 destruction rate.

<sup>c</sup> Firm size equals the weighted mean of log firm employment in 1972, 1977, 1982 and 1987. Results with an analogous establishment-based size measure are very similar.

<sup>d</sup> Plant age equals the fraction of industry employment at mature plants in the years from 1973 to 1986, where "mature" means at least 9-13 years old. See Section 7.3.2 in the Appendix to Davis et al. (1996) for details.

<sup>e</sup> 4-Firm concentration equals the fraction of 1987 shipments accounted for by the four leading firms in the industry. These data were kindly supplied by Michael Kiley.

<sup>f</sup> Capital intensity equals the log of capital per production worker (thousands of 1982 dollars).

<sup>g</sup> The inventory-sales ratio equals the average ratio of monthly nominal inventories to sales from the M3 data for the 1972-1993 period.

The multivariate regression results in Table 8 indicate that several independent effects underlie cross-sectional differences in the cyclical dynamics of creation and destruction. In this regard, recall Foote's (1997, 1998) proposed explanation for the relative volatility of creation and destruction. As Foote notes, trend growth does not help explain differences in the relative volatility of creation and destruction among two-digit manufacturing industries. Even in the 4-digit industry data, much of the systematic variation in the standard deviation ratios is unexplained by trend growth differences. This point can be seen in Fig. 6 by observing that the predicted standard deviation ratio at a zero trend growth rate is substantially greater than zero. Foote's theory predicts that the ratio should be greater or less than zero as the trend growth rate is negative or positive. Most importantly, the relative volatility of destruction rises with firm size and declines with industry concentration after controlling for trend growth effects.

These results provide clear evidence that the cyclical dynamics of job creation and destruction vary sharply and systematically with observable industry-level characteristics. The pattern of results helps explain the somewhat different nature of job flow dynamics in the manufacturing and non-manufacturing sectors of the economy. Except for product market concentration, every statistically significant variable in the bivariate and multivariate regressions of Table 8 reinforces a tendency towards greater relative volatility of destruction in manufacturing industries. Manufacturing industries exhibit slower employment growth, greater capital intensity, higher inventories, older establishments, and larger firms and establishments in comparison to most other industries. Each of these characteristics is associated with a positive effect on the relative volatility of destruction.

## **4. Employer characteristics and the magnitude of job flows**

### *4.1. Sectoral differences*

Section 3.5 highlights important differences in net and gross job flow rates by industrial sector and employer characteristics. This section expands upon Section 3.5 by summarizing the main empirical regularities found in previous work on sectoral differences in job flows.

The most heavily studied characteristics in this regard are employer size and age. According to Figs. 2 and 3, excess job reallocation rates decline sharply in employer size and age, a pattern that stands out clearly in other studies. Fig. 7 depicts the relationship between job reallocation and employer size for 8 studies spanning 7 different countries. Some of the studies rely on firm-level data, others use establishment-level data. The message is clear: job reallocation rates decline with employer size. A similar figure (not shown) reveals that job reallocation also consistently declines with employer age. These robust patterns with respect to employer size and age are quite striking in light of the major differences among studies in measurement, country and sectoral coverage, and data.

The results in Fig. 2 on the relationship between net job growth and employer age are



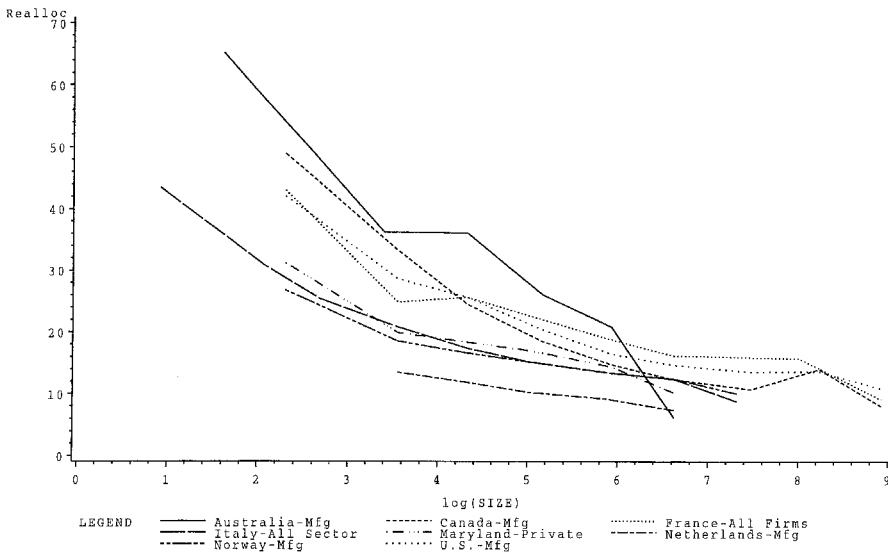


Fig. 7. Annual job reallocation rates by employer size. Source: Norway, Klette and Mathiassen (1996, Table 4); US, Davis et al. (1996, Table 4.1); Canada, Baldwin and Picot (1994, Table 7); Netherlands, Gautier (1997, Table 3.8); Australia, Borland and Home (1994, Table 3); France, Nocke (1994, Table 9); Maryland, Lane et al. (1996, Table 4); Italy, Contini et al. (1995, Table 3.7).

also typical of many studies. For example, Hall (1987), Evans (1987a,b), and Dunne et al. (1989a,b) all find that net growth declines with employer age, even after controlling for employer size.

In contrast, previous work presents sharply different characterizations of the relationship between employer size and net job growth. A common finding that seemingly contradicts Fig. 2 is that net growth tends to decline with employer size, even after controlling for employer age. This finding appears in Evans (1987a,b) and Hall (1987), among others. Controlling for age, Dunne et al. (1989a,b) find that net growth declines with size for single-unit establishments and is U-shaped in size for multi-unit establishments.

Several factors potentially contribute to the sensitivity of the size-net growth relationship, but the most important consideration is probably regression-to-the mean effects.<sup>18</sup> Evans et al. investigate the relationship between the growth rate of employment from period  $t - 1$  to  $t$  and employer size in period  $t - 1$ . In contrast, Fig. 2 depicts the relationship between the employment growth rate and the average of employer size in periods  $t -$

<sup>18</sup> Other considerations include the use of firm-level data in Hall and Evans, the use of different growth rate concepts, and the weighting of employer-level observations. Hall and Evans measure growth as the log first difference and use standard econometric selection techniques to adjust for omitted births and deaths. Dunne et al. use the traditional growth rate measure, which allows them to include deaths but not births in their cell-based regressions. Finally, these studies are carried out on an unweighted basis, whereas our analysis is employment weighted.

1 and  $t$ . As explained in Leonard (1987) and Davis et al. (1996, Chapter 3), regression-to-the-mean effects overstate the relative growth performance of smaller employers when there is an important transitory component in (measured) employment. Davis et al. demonstrate that the employer size measure used in Fig. 2 (based upon the average of employment in period  $t - 1$  and  $t$ ) substantially mitigates these effects.<sup>19</sup>

Beyond size and age effects, previous work documents several other sectoral patterns in the magnitude of job flows. Davis et al. (1996) find that excess job reallocation rates decline in average plant-wages, decline in capital intensity, increase in plant-level product specialization, decrease in energy intensity, and increase with industry-level total factor productivity growth. Chow et al. (1996), Konings et al. (1996) and Leonard and Zax (1995) report strikingly smaller job flow rates in the public sector as compared to the private sector.

#### 4.2. Plant-level regressions

Previous work on sectoral differences in job flow magnitudes is limited to one-way and two-way tabulations by employer characteristics. To shed light on how job flow magnitudes vary with employer characteristics in a multivariate setting, we extend the analysis in Fig. 2 to encompass a wide range of employer characteristics. We pool plant-level data from the LRD for 1978, 1983 and 1988,<sup>20</sup> and we then fit employment-weighted regressions of net employment growth and the absolute value of net growth to a variety of controls and plant-level regressors. We report results for the predicted variation in the net employment growth rate and for the difference between the predicted absolute growth rate and the absolute value of the predicted net growth rate. This difference yields the predicted excess reallocation rate as a function of employer characteristics.

Control variables in the regression specification include year effects, 4-digit industry effects, ownership-type effects and state effects. The other regressors are a quartic in log employment interacted with detailed age (as in Fig. 2), a quartic in plant-level energy intensity, a quartic in wages per worker, percentiles of the capital-per-worker distribution, and a measure of plant-level product specialization.<sup>21</sup> To characterize the marginal influence of each employer characteristic on the net growth and excess reallocation rates, we evaluate the predicted variation associated with that characteristic while holding other characteristics fixed at their medians. Figs. 8 and 9 display the results.

According to Fig. 8, the age and size related patterns exhibited in Fig. 2 continue to hold after controlling for many additional characteristics. Holding age and other employer

<sup>19</sup> Other work on this point includes Borland and Home (1994), Baldwin and Picot (1995), Huigen et al. (1991) and Wagner (1995).

<sup>20</sup> As noted above, these sample years allow us to construct the most detailed plant age measures.

<sup>21</sup> Wages per worker are measured as the ratio of total salary and wages to total employment; energy intensity is measured as the ratio of energy expenditures to the total value of shipments; product market specialization is measured as the share of the plant's shipments value accounted for by its chief five-digit product class – the seven categories include complete specialization and then six remaining classes; and capital intensity is measured as the adjusted book value of capital per worker. The adjusted book value makes use of a capital goods price deflator as described in Haltiwanger (1997).

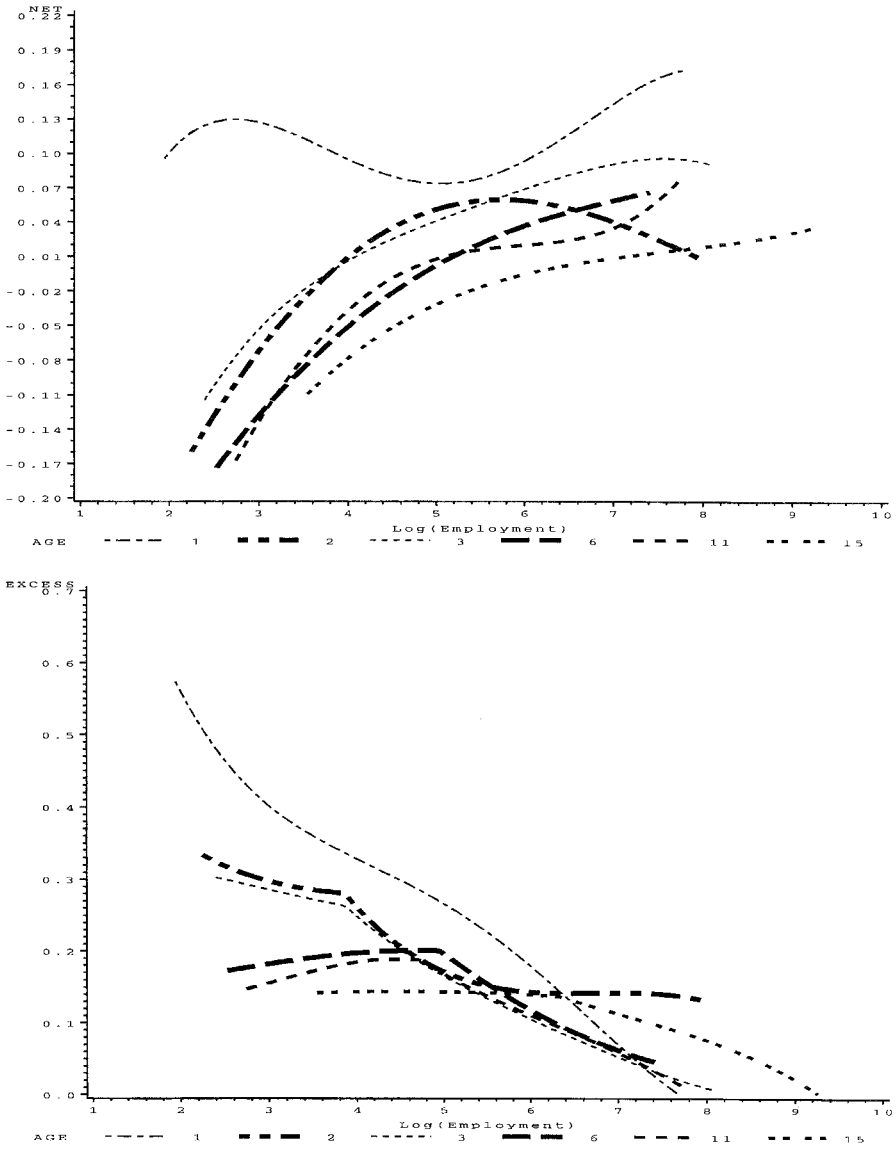


Fig. 8. (a) Net growth rate for age classes, by employer size; (b) excess job reallocation for age classes, by employer size. In contrast to Fig. 2, the relationships plotted in this figure control for a large collection of employer characteristics as described in the text.

characteristics constant, the net employment growth rate rises sharply and the excess reallocation rate falls sharply with employer size. Holding size and other characteristics

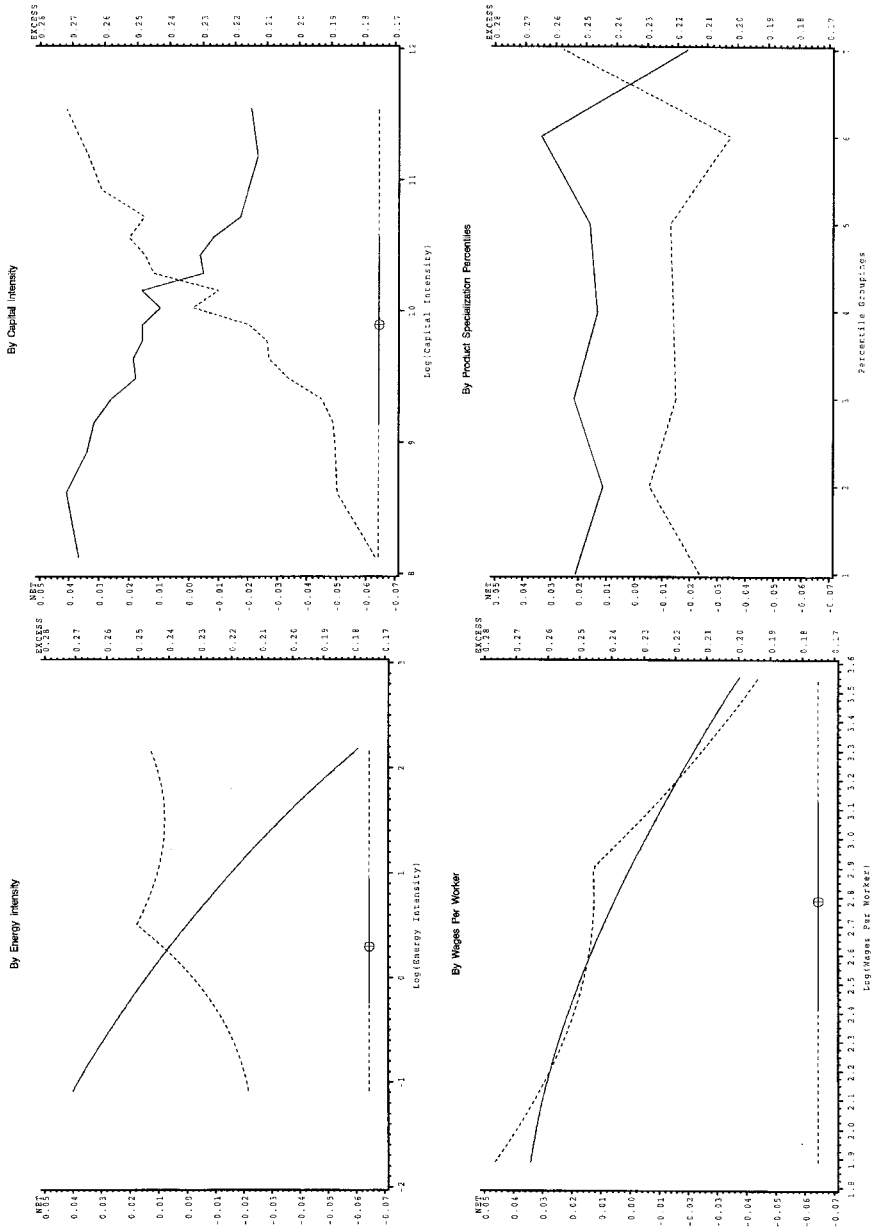


Fig. 9. Growth rate and excess reallocation by employer characteristics. The solid line is net; the dashed line is excess. The horizontal lines above the horizontal axes for energy intensity, wages and capital intensity depict the 5th, 25th, 50th (circle), 75th and 95th percentiles.

constant, the net growth and excess reallocation rates tend to fall with employer age. The age effects on excess reallocation are more pronounced among smaller plants.

Net job growth and excess reallocation also show strong and systematic relationships to several other employer characteristics. Net employment growth decreases in energy intensity, wages per worker and capital intensity. Excess job reallocation rises with energy and capital intensity and falls with wages per worker. These fitted relationships are very strong, and they highlight large predictable variation in the level and volatility of plant-level employment growth rates. For example, conditional on other regressors, the 90–10 differential in the predicted net growth rate is about 10 percentage points for energy intensity, 6 percentage points for capital intensity, and 7 percentage points for the wage variable. The predicted variation in excess job reallocation rates are similarly large.

### 4.3. Employer size and job reallocation

The evidence presented in Sections 3.5, 4.1 and 4.2 shows that excess job reallocation rates decline sharply with employer size. This strong empirical regularity holds in every industry, country and time period studied, and it survives the introduction of an extensive set of controls for age, capital intensity, worker skill and other observable employer characteristics. The same empirical regularity turns up in the industrial organization literature as a negative relationship between firm size and the variance of growth rates in employment, sales or other measures of economic activity (Caves, 1998).

A natural question is whether, and to what extent, this empirical regularity can be accounted for by a simple statistical model that interprets each large unit as a collection of independent smaller units. An affirmative answer suggests that the observed relationship between size and job reallocation is merely an artifact of how we draw the boundaries of the firm or establishment. Thus, a simple statistical model can provide a useful benchmark for gauging whether there is an economic phenomenon to be explained and, if so, the strength of the size–reallocation relationship.

We address this question as follows. For establishments of size  $z$ , we fit LRD data to a grid of 203 annual growth rate outcomes on  $[-2, 2]$ , with outcome probabilities denoted by the vector  $p$ . The outcomes are birth, death, no change and 200 subintervals of length 0.02 on  $(-2, 0)$  and  $(0, 2)$ . We set the grid point for each subinterval to its mean observed growth rate outcome in the data.

Now consider a large establishment that consists of  $n$  independent subunits of size  $z$ , each of which has outcome probabilities  $p$ . Independence implies that the joint distribution of growth rate outcomes for the subunits is multinomial with parameters  $n$  and  $p$ . Specifically, let  $x$  be a vector with elements corresponding to the 203 outcomes on  $[-2, 2]$ , and let each  $x_i$  be a nonnegative integer that denotes the number of subunits that experience the  $i$ th growth rate outcome, for  $i = 1, 2, \dots, k = 203$ . The probability of each possible outcome vector for the aggregate of the  $n$  subunits is given by

$$f(x|n, p) = \binom{n!}{x_1! \cdots x_k!} p_1^{x_1} \cdots p_k^{x_k}. \quad (9)$$

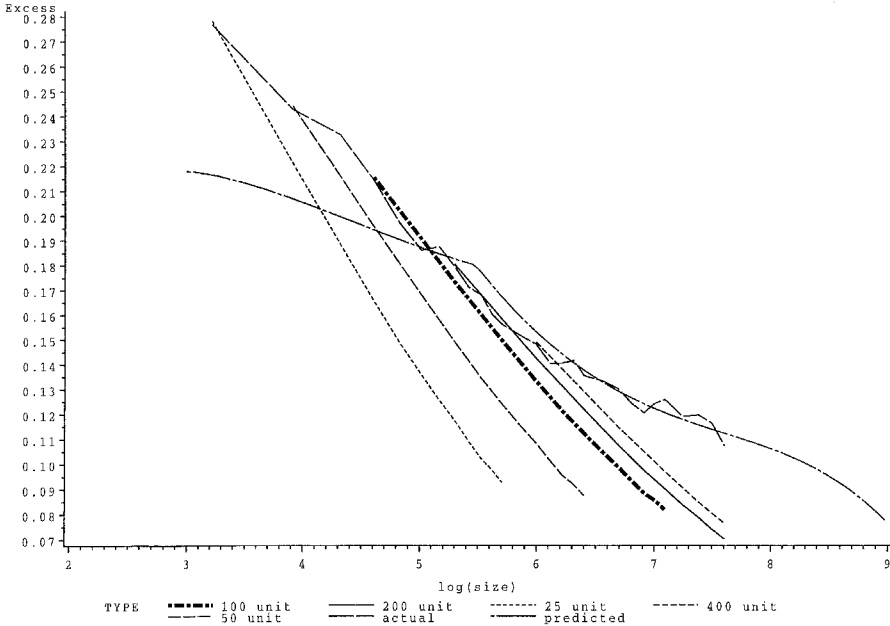


Fig. 10. Actual, predicted and theoretical excess reallocation rates as a function of log plant size.

Using this fact, we can calculate the rates of job creation, job destruction and excess reallocation implied by the statistical model for establishments of size  $zn$  for various values of  $z$ , thereby tracing out the predicted relationship between size and gross job flows. We carry out these calculations for five alternative definitions of a subunit or “small” establishment:  $z_1 = 25$ ,  $z_2 = 50$ ,  $z_3 = 100$ ,  $z_4 = 200$ , and  $z_5 = 400$ . For each value of  $z$ , we use all observations in the symmetric (in logs) interval  $[0.9z, 1.11z]$  to fit  $p$  and select grid points. We select grid points separately for each value of  $z$ .<sup>22</sup>

Fig. 10 plots the predicted relationship between (log) size and excess reallocation for each value of  $z$  under the assumption of independent, equal-size subunits.<sup>23</sup> The actual relationship is overlaid against the relationships predicted by the model of independent subunits. The results show clearly that the predicted relationships are approximately linear in logs and more steeply sloped than the actual relationship. Evidently, large establishments are not random collections of smaller establishments.

In fact, the visual test provided by Fig. 10 understates the failure of the independent subunits model, because it ignores powerful correlates of size that also affect job realloca-

<sup>22</sup> The LRD contains over one million annual plant-level growth rate observations in the 1973–1993 period, so that the data afford ample leverage for estimating  $p$  on narrow intervals about each  $z$ .

<sup>23</sup> We generated the predicted relationships by Monte Carlo simulation.

tion intensity. The two most important correlates in this respect are plant age and the level of plant wages. In particular, plant age and mean worker wages rise sharply with plant size, but job reallocation intensity declines with wages and plant age. To account for these correlates of plant size, Fig. 10 also plots the fitted relationship between excess reallocation and size based on a regression model that controls for plant-level age and average wage. The regression-based relationship shows essentially the same degree of departure from the independent subunits model for larger plants but a much stronger departure for smaller plants.

While the model of independent equal-size subunits fails to account for the observed relationship between size and excess reallocation, it remains an open question as to whether a slightly richer model fits the data. In particular, consider a slight generalization of Eq. (9) that replaces the parameter  $n$  by a smooth function of size, say  $n(\text{size})$ , with  $0 < n'(\cdot) < 1$ . According to this model, a large plant is a random collection of subunits that have the same growth rate distribution as small plants, but subunit size grows with plant size. We plan to explore the performance of this simple model and its implications in future work.

Our analysis of the relationship between size and job reallocation is also relevant to the earlier discussion of within-plant and within-firm job reallocation in Section 3.1. In particular, statistical models of the sort set forth above could be used to estimate the “missing” intra-plant (intra-firm) job flows in studies based on plant-level (firm-level) data. While the specific model (9) is overly simple for this purpose, it is easily modified to specify  $n$  and  $p$  as smooth functions of size and possibly other employer characteristics. Such models, if successfully fit to data on job flows between employers, generate implied measures of job flows within employers.

## 5. Theories of heterogeneity

This section draws together theories and evidence related to the reasons for cross-sectional heterogeneity in plant-level and firm-level employment adjustments. We focus on how the theories and evidence relate to the magnitude of gross job flows and cross-sectional patterns in the magnitudes.

### 5.1. Explaining the magnitude of gross job flows

Sectoral shocks with differential effects among industries, regions, plant birth cohorts and employer size categories are natural suspects as driving forces behind job creation and destruction. As it turns out, however, the empirical evidence accumulated over the past several years (summarized in Table 5) shows quite clearly that such sectoral shocks account for a very small fraction of gross job flows. To the best of our knowledge, the only favorable evidence for this type of sectoral shock interpretation of gross job flows appears in Konings et al. (1996), who find that sharp employment contractions at state-owned manufacturing enterprises account for a large fraction of gross job flows in the

manufacturing sector during Poland's transition to a market-oriented economy. More generally, the Konings et al. study favors the view that in the early years of transition from statist to market-oriented economies the huge employment shifts between industries and from state-controlled to private enterprises account for a large fraction of overall job flows. Other than such dramatic episodes of wrenching change, the magnitude of gross job flows is not explained by sectoral shocks at the level of industries, regions and other easily measured sectoral groupings.

The magnitude of within-sector heterogeneity implies that idiosyncratic factors dominate the determination of which plants create and destroy jobs, which plants achieve rapid productivity growth or suffer productivity declines. One likely reason for such heterogeneity in plant-level outcomes is the considerable uncertainty that surrounds the development, adoption, distribution, marketing and regulation of new products and production techniques. Uncertainty about the demand for new products or the cost-effectiveness of alternative technologies encourages firms to experiment with different technologies, goods and production facilities (Roberts and Weitzman, 1981). Experimentation, in turn, generates differences in outcomes (Jovanovic, 1982; Ericson and Pakes, 1995). Even when motives for experimentation are absent, uncertainty about future cost or demand conditions encourages firms to differentiate their choice of current products and technology so as to optimally position themselves for possible future circumstances (Lambson, 1991).

Another likely reason for heterogeneity is that differences in entrepreneurial and managerial ability lead to differences in job and productivity growth rates among firms and plants. These differences include the abilities to identify and develop new products, to organize production activity, to motivate workers and to adapt to changing circumstances. There seems little doubt that these and other ability differences among managers generate much of the observed heterogeneity in plant-level outcomes. Business magazines, newspapers and case studies (e.g., Dial and Murphy, 1995) routinely portray the decisions and actions of particular management teams or individuals as crucial determinants of success or failure. High levels of compensation, often heavily skewed toward various forms of incentive pay (see Murphy's chapter in this volume), also suggest that senior managers play key roles in business performance, including productivity and job growth outcomes.<sup>24</sup>

Another important source of heterogeneity involves the selection process whereby new businesses learn over time about initial conditions relevant to success and business survival (Jovanovic, 1982). As learning about initial conditions diminishes with age, its contribution to job flows among plants in the same birth cohort eventually diminishes. This type of theory provides an appealing interpretation of the strong and pervasive negative relationship between employer age and the magnitude of gross job flows shown in Figs. 2 and 8. However, it provides a seriously incomplete explanation for the overall magnitude of job flows, because it fails to explain the large gross flows among mature plants. Based on

<sup>24</sup> Many economic analyses attribute a key role to managerial ability in the organization of firms and production units. Lucas (1978) provides an early and influential formal treatment.



some simple identifying assumptions, Davis and Haltiwanger (1992) conclude that learning about initial conditions in the sense of Jovanovic (1982) accounts for only about 10% of gross job flows in the US manufacturing sector. The underlying reasons for this result are straightforward: the fraction of employment in young establishments is small, and the pace of job reallocation among mature plants is rapid.

Other factors that drive heterogeneity in plant-level productivity and job growth outcomes involve plant- and firm-specific circumstances and disturbances. For example, energy costs and labor costs vary across locations, and so do the timing of changes in factor costs.<sup>25</sup> Cost differences induce different employment and investment decisions among otherwise similar plants and firms. These decisions, in turn, influence the size and type of labor force and capital stock that a business carries into the future. Thus, current differences in cost and demand conditions induce contemporaneous heterogeneity in plant-level job and productivity growth, and they also cause businesses to differentiate themselves in ways that lead to heterogeneous responses to common shocks in the future. The role of plant-specific shocks to technology, factor costs and product demand in accounting for the pace of job reallocation has been explored in Hopenhayn (1992), Hopenhayn and Rogerson (1993), Bergin and Bernhardt (1996), Campbell and Fisher (1996), Campbell (1997) and Gouge and King (1997).

Slow diffusion of information about technology, distribution channels, marketing strategies, and consumer tastes is another important source of plant-level heterogeneity in productivity and job growth. Griliches (1957) finds a gradual diffusion of hybrid corn technology among US farmers. Nasbeth and Ray (1974) and Rogers (1983) document multi-year lags in the diffusion of knowledge about new technologies among firms producing related products. Mansfield et al. (1981) and Pakes and Schankerman (1984) provide evidence of long imitation and product development lags. Rhee et al. (1984) report that foreign buyers and sellers were important transmitters of technical information in the Korean industrialization process. The remarkable proliferation of differentiated computerware suggests an important role for information diffusion in the production and use of computer products.<sup>26</sup>

Between-plant heterogeneity in employment outcomes also arises from capital vintage effects.<sup>27</sup> As an extreme example, suppose that new technology can only be adopted by constructing new plants. In this case, technologically sophisticated plants enter to displace older, out-moded plants, and gross job flows reflect a productivity-enhancing process of creative destruction. While holding some appeal, this interpretation of gross job flows runs

<sup>25</sup> On large spatial variation in energy prices and in the timing of major energy price changes, see King and Cuc (1996) and Woo et al. (1997).

<sup>26</sup> Knowledge diffusion plays a key role in many theories of firm-level dynamics, industrial evolution, economic growth and international trade. See, for example, Grossman and Helpman (1991), Jovanovic and Rob (1989), and Jovanovic and MacDonald (1994).

<sup>27</sup> See Aghion and Howitt (1992, 1994), Caballero and Hammour (1994, 1996a), Campbell (1996), Stein (1997), Cooley et al. (1996), and Chari and Hopenhayn (1991).

counter to the prevalent findings that failure rates decrease sharply with plant and firm age (e.g., Dunne et al., 1989a,b), and that productivity rises with plant age (e.g., Baily et al., 1992; Bahk and Gort, 1993). As discussed above, empirical regularities related to plant age and capital vintage are likely to reflect important selection effects. Depending on precisely how one slices the data and the quality of measures for capital vintage, vintage effects may be obscured by selection effects. Vintage and selection effects may also interact in important ways. For example, although new plants may more readily adopt technological advances embodied in new capital goods, the probability of successful adoption may vary with managerial ability. Regardless of these barriers to clean identification of capital vintage effects in empirical work, the basic point remains that the vintage of installed capital (properly measured) is probably an important source of heterogeneity in plant-level behavior. Similarly, the vintage of the manager or the organizational structure may also induce plant-level heterogeneity (Nelson and Winter, 1982) and interact with other factors that contribute to differences in behavior among seemingly similar plants.

### *5.2. Explaining cross-sectional variation in the magnitude of job flows*

As shown in Sections 3.5 and 4, there is substantial variation in the pace of job reallocation across sectors defined by industry and other employer characteristics. Important employer characteristics include employer size, employer age, factor intensities and wages. Many of the explanations for the overall magnitude of reallocation also have the potential to account for cross-sectional patterns in job flow magnitudes. An obvious case in point is learning about initial conditions as an explanation for sharply higher job reallocation rates at younger plants. Empirical evidence is highly favorable to this view. Relevant empirical studies include Dunne et al. (1989a,b), Davis and Haltiwanger (1992), Lane et al. (1996), Nocke (1994), Klette and Mathiassen (1996), Evans (1987a,b) and Troske (1996) as well as the evidence presented in Figs. 2 and 8.

Learning about initial conditions and differences in the plant-age structure of employment also help explain industry and sectoral differences in the pace of reallocation. Davis and Haltiwanger (1992) find that differences in the plant-age structure of employment account for about one-third to one-half of the variation in job reallocation rates across industries, regions and employer size classes in the US manufacturing sector. A major role for employer age in this regard, even conditional on employer size, is unsurprising in light of Figs. 2 and 8.

Evidence for the US manufacturing sector indicates that the magnitude of gross job flows declines sharply with plant-level wages. For example, Davis et al. (1996, Table 3.4.) report that the excess job reallocation rate in the bottom quintile of the plant-wage distribution is nearly double the corresponding rate in the top quintile. The plant-level regression results in Fig. 9 confirm this empirical regularity after conditioning on a large set of other employer characteristics.

Human capital theory offers a simple interpretation for this wage-related pattern in gross

job flows.<sup>28</sup> Under a human capital interpretation of wage differentials, high-wage plants operate with workers who have high average levels of human capital. Differences in average wages across plants partly reflect differences in plant- and firm-specific components of human capital. Because specific human capital strengthens the durability of the employment relationship in the face of changes and disturbances that alter the match continuation value, the magnitude of gross job flows declines with average plant wages.<sup>29</sup>

Simple statistical models like the one developed in Section 4.3 also have the potential to account for much of the between-sector and between-size class variation in job reallocation. The basic idea is that large employers have lower rates of job reallocation, because they smooth out the idiosyncratic disturbances that hit smaller units.

A related idea is that differences in the degree of product specialization lead to differences in job reallocation intensity. According to this hypothesis, diversified plants are able to provide a more stable employment environment by diversifying the idiosyncratic component of product-specific shocks. Davis et al. (1996, Table 3.6) provide some supportive evidence in that the pace of job reallocation is substantially higher among completely specialized plants than more diversified plants. This phenomenon may contribute to between-industry differences in job flow magnitudes, given Gollop and Monahan's (1991) evidence that plant-level product specialization varies among industries. Another related hypothesis is that the degree of product differentiation influences between-industry variation in job reallocation rates. Boeri (1994, Table IV) contains a bit of supportive evidence for this hypothesis.

Yet another hypothesis emphasizes that the intensity of the shocks that drive reallocation varies across industries. A potentially important driving force is the pace of technological change and any associated process of creative destruction. In this regard, Davis et al. (1996, Table 3.7) report that industries with more rapid productivity growth exhibit greater rates of within-industry reallocation. This finding supports the view that industry differences in the pace of technological advance contribute to differences in job reallocation rates. However, we find no marginal effect of total factor productivity growth on excess job reallocation when we introduce industry-level productivity growth measures into plant-level regression specifications similar to the one considered in Section 4.2.

### 5.3. National differences in the magnitude of gross job flows

In our presentation of Table 2, we intentionally refrained from detailed cross-country comparisons of job flow magnitudes. There are major pitfalls in simple comparisons of this sort. Differences in sample coverage and in the definitions of business units cloud direct comparisons of magnitudes. In addition, many gross job flow measures suffer from serious longitudinal linkage problems in the underlying dataset. The ability to accurately

<sup>28</sup> Oi (1962), Becker (1975, Chapter 2), Jovanovic and Mincer (1981), and Parsons (1986) are especially pertinent to the discussion at hand.

<sup>29</sup> Of course, this conclusion could be overturned if the variance of shocks to the demand for labor rises sharply enough with specific human capital intensity.

identify ownership and organizational changes varies across datasets, and the frequency of such unidentified changes probably varies greatly across datasets for different countries.

In spite of measurement difficulties, some studies seek to interpret cross-country differences in broad measures of job reallocation intensity. Of particular interest is the connection between the role of institutions that impede employment adjustment and the pace of job reallocation. Cross-country analyses (e.g., Garibaldi et al., 1997) find no apparent relationship between the pace of job reallocation and mandated job security provisions, but Bertola and Rogerson (1997) contend that the failure to find a relationship reflects more than measurement problems. They argue that it is important to look at the full range of labor market institutions and, in particular, the role of wage-setting institutions. They show that policies that contribute to wage compression yield a greater pace of reallocation, holding job security provisions constant. Accordingly, they suggest that the surprisingly high rates of job reallocation in many Western European countries may reflect the impact of wage compression policies that offset the impact of job security provisions.

We do not believe that strong inferences about the effects of economic policies and institutions can be drawn from cross-country comparisons of aggregate job flow rates. Aside from measurement problems and the limited number of data points, this chapter compiles ample evidence that the magnitude of job flows vary quite sharply with industry, employer size and employer age. Hence, the large country differences in the industry, size and age structure of employment lead to major differences in aggregate job flow rates, apart from any effects of labor market policies and institutions. Careful, disaggregated studies are essential to convincingly identify the effects of policies and institutions on labor market flows in a cross-country context.

A disaggregated approach has other advantages as well. It can greatly expand the usable variation in the data, and it facilitates the study of how labor market policies regarding job and worker flows influence the structure of employment. For example, Davis and Henrekson (1997, Table 9.12) report mild evidence that, relative to a US benchmark, the distribution of Swedish employment is systematically shifted away from industries with high job reallocation rates. This finding suggests that Swedish policies that penalize job and worker flows systematically alter the structure of Swedish employment.

## **6. Job flows and worker flows**

The preceding sections focus on the flow of jobs across production sites rather than the flow of workers. This section treats worker flows and their connection to job flows. We consider the relative magnitude of various labor market flows and other evidence on how job flows relate to worker flows.

### *6.1. Relative magnitudes*

Davis and Haltiwanger (1998) review US-based research on the magnitude of worker and job flows. Early work in this area (e.g., Blanchard and Diamond, 1990) relies on household

surveys to measure worker flows and separate data on employers to measure job flows. Drawing on several studies, our review concludes that total worker turnover (accessions plus separations) in the United States amounts to about one third of employment per month, and worker reallocation (Definition 5) amounts to about 25% of employment per quarter and 37% of employment per year.<sup>30</sup> Job reallocation accounts for about 35–46% of worker turnover in quarterly data.

The relative size of job and worker flows varies over time and among industries. In manufacturing, job reallocation accounts for a relatively high fraction of worker turnover, even though job flows in manufacturing are smaller than in non-manufacturing. Cyclical variation in the relative size of job and worker flows is large. Quits fall sharply in recessions (Hall, 1972) and job reallocation rises, which imparts strong countercyclic movements to the ratio of job reallocation to worker turnover (Akerlof et al., 1988; Albaek and Sorensen, 1996).

Recent work exploits matched employer–worker data to examine how worker separations and accessions covary with employer-level creation and destruction. Table 9 reports average accession, separation, creation and destruction rates from several such studies. Each study finds an important role for job creation and destruction in worker accessions and separations, but there are large differences in the creation-accession and destruction-separation ratios across studies.

Reported differences in the role of job flows reflect important differences in measurement procedures. To develop this point, we compare the Anderson and Meyer (1994) and Lane et al. (1996) studies, both of which rely on administrative records for the US unemployment insurance system. These studies rely on quarterly wage records for individual workers, but they process the records differently, and Anderson and Meyer also draw on unemployment benefit records.<sup>31</sup>

Both studies use quarter-to-quarter changes in employment levels and employment affiliations to measure job flows and worker flows. In addition, Anderson and Meyer include temporary layoffs spells that end in recall within the quarter in their measures of separations and accessions. They identify these within-quarter layoff-recall events from records on unemployment benefits paid, rather than from changes in the employment affiliation or status of workers. They do not count within-quarter layoff-recall events in their measures of job creation and destruction. Hence, Anderson and Meyer count short-

<sup>30</sup> Worker turnover measures the gross number of labor market transitions, whereas worker reallocation measures the number of persons who participate in transitions. Worker turnover exceeds worker reallocation for two reasons. First, job-to-job movements induce two transitions per transiting worker. Consider, for example, two workers who exchange jobs and employers. Two workers move, but there are four transitions – two separations and two accessions. Other worker mobility events induce equal-sized increments to worker turnover and worker reallocation. Second, worker turnover measures often encompass all separations and accessions that occur during an interval of time, whereas worker reallocation measures typically reflect changes in employer or employment status between discrete points in time. See Davis and Haltiwanger (1998) for an extended discussion of the relationships among the various worker flow and job flow measures that appear in the literature.

<sup>31</sup> The two studies also differ in that Anderson and Meyer limit attention to employers that have 50 or more employees at least once in the sample period.

Table 9  
Worker and job flow rates in matched worker-employer datasets (percentage of sectoral employment)

Country/ state	Period	Coverage	Sampling frequency	Accession rate	Job creation rate	Separation rate	Job destruction rate	Creation/ accession (%)	Destruction/ separation (%)	Source
USA (selected states)	1979-1983	Private sector	Quarterly	22.3	7.1	21.4	6.4	31.8	29.9	Anderson and Meyer (1994, Table 13)
USA (selected states)	1979-1983	Manufacturing	Quarterly	24.7	5.8	24.6	6.2	23.5	25.2	Anderson and Meyer (1994, Table 13)
USA - Maryland	1985:3-1993:3	Private sector <sup>a</sup>	Quarterly	18.4	9.0	18.7	9.3	49.1	49.7	Lane et al. (1996, Table 1)
USA - Maryland	1985:3-1993:3	Manufacturing	Quarterly	12.9	7.5	14.2	8.8	58.1	62	Lane et al. (1996, Table 1)
Denmark	1980-1991	Manufacturing	Annual	28.5	12.0	28.0	11.5	42.1	41.1	Albaek and Sorenson (1996, Tables 3 and 4)
Netherlands	1979-1993	Manufacturing <sup>b</sup>	Annual	16.3	7.3	15.7	8.3	44.8	52.9	Gautier (1997, Tables 2.2 and 3.3)
Norway	1987-1994	Manufacturing	Annual	21.0	11.0	23.0	13.0	52.4	56.5	Salvanes (1997, Table 1)
Norway	1987-1994	Banking and insurance	Annual	21.0	12.5	22.0	14.5	59.5	65.9	Salvanes (1997, Table 1)

<sup>a</sup> Employment-weighted means of one-digit industry rates. 1992 employment figures from the Economic Report of the President were used as weights.

<sup>b</sup> Job creation and job destruction are for manufacturing for the period of 1979-1993. Accession and separation rates appear to be for the entire economy for the period of 1971-1991.

term worker flows in separations and accessions, but they do not count the corresponding shortterm job flows in creation and destruction. In this respect, the Anderson and Meyer results provide a lower bound on the true creation-accession and destruction-separation ratios.

Lane et al. (1996) examine job and worker flows that involve “full-quarter” employees and employment spells. A full-quarter employee in quarter  $t$  is one who receives compensation from the employer in quarters  $t - 1$ ,  $t$  and  $t + 1$ . After restricting attention to full-quarter employees and employment positions, Lane et al. (1996) proceed to measure job and worker flows using quarter-to-quarter changes in employment levels and employment affiliations. Clearly, this procedure excludes the within-quarter layoff-recall events that Anderson and Meyer capture in their accession and separation measures. The “full-quarter” requirement also excludes other shortterm worker and job flows. Given the probationary nature of many new employment relationships and, consequently, the very high separation hazards in the first month or two of new matches (Hall, 1982; Anderson and Meyer, 1994), the “full-quarter” requirement probably screens out a larger portion of worker flows than job flows. In this respect, Lane et al. (1996) provide an upper bound on the true creation-accession and destruction-separation ratios.

These remarks explain why Lane et al. (1996) consistently find a much larger role for job flows than Anderson and Meyer (1994). The creation-accession ratio is 32% for the private sector and 23% in manufacturing according to Anderson and Meyer (1994), but 50% in the private sector and 58% in manufacturing according to Lane et al. (1996). Similarly, the destruction-separation ratio is 31% for the private sector and 25% in manufacturing according to Anderson and Meyer (1994), but 51% in the private sector and 62% in manufacturing according to Lane et al. (1996). The especially large differences between the two studies for the manufacturing sector reflect the high incidence of short layoff-recall events in the US manufacturing sector.

Two messages emerge from this discussion. First, matched employer–worker data do not automatically yield precise, unambiguous characterizations of the relationship between worker flows and job flows. Measurement procedures matter greatly, as highlighted by the comparison between the Anderson–Meyer and Lane et al. studies. Sampling frequency and sample coverage (industry, employer size, etc.) are also likely to have a major bearing on findings about the relative size of worker flows and job flows. Second, despite these difficulties (and related difficulties in the earlier literature), a wide range of studies find that job flows underlie a big fraction of worker flows. The broadly similar results for the United States, Denmark, the Netherlands and Norway indicate that this feature of labor markets is prevalent across countries. In this respect, the findings summarized by Table 9 confirm findings in the earlier literature that compared worker flows and job flows based on tabulations of separate worker and employer datasets.

## 6.2. Other evidence on the connection between job and worker flows

Some additional remarks help to flesh out the role of job flows in worker reallocation

activity. First, the evidence on relative magnitudes neglects secondary waves of worker reallocation engendered by job creation and destruction. For example, a person who quits an old job in favor of a newly created job potentially creates a chain of further quits as other workers reshuffle across the new set of job openings. It follows that the direct plus indirect contribution of job flows to worker reallocation exceeds the figures reported in Table 9. Hall (1995) advances a related argument to explain the cyclical dynamics of unemployment flows. He shows that persistence in unemployment inflows can be largely accounted for by the burst of permanent job destruction that occurs at the onset of recessions. His story emphasizes that separations beget further separations because of high failure rates in new employment matches.

Second, the facts about concentration and persistence in Section 3 shed light on the connection between job flows and worker reallocation. Since more than two-thirds of job destruction reflects establishments that shrink by more than 25% over the span of a year, the bulk of annual job destruction cannot be accommodated by normal rates of worker attrition. In other words, annual job destruction largely represents job loss to workers. Since annual job creation and destruction primarily reflect persistent establishment-level employment changes, the bulk of annual job creation and destruction cannot be implemented by temporary layoff and recall policies. Hence, most of annual job destruction reflects permanent job loss that leads to a change in employer, a longterm unemployment spell, exit from the labor force, or some combination of these events.

The role of plant-level job destruction in worker displacement and unemployment depends partly on the extent to which establishments shrink by simply reducing accession rates. Perhaps employers can implement even large job destruction rates by a cutting back on new hires. Abowd et al. (1996) investigate how establishment-level accession and separation rates vary with the employment growth rate in French data. They find that employers mainly vary the hiring rate and not the separation rate to achieve net employment changes, provided that the establishment does not contract too rapidly – i.e., by more than about 15% per year. Abowd et al. conclude that “establishments shrinking in a given year reduce employment by reducing entry, not by increasing separations.” Hamermesh et al. (1996) report similar results in Dutch data.

We view these results as fully consistent with the claim that most job destruction is not accommodated by normal worker attrition. Only a small percentage of employers contract by more than 15% within a year, but these employers account for most of the job destruction. Thus, while it may be that most employers achieve employment changes by altering the hiring rate, most job destruction reflects employers with high separation rates.

Putting these results together supports the view that job loss and job destruction are costly events. Firms show a strong preference for natural attrition over costly layoffs as a tool for reducing employment. Only when required employment reductions exceed normal attrition do firms initiate separations at a higher rate. The spatial concentration of job destruction at relatively few establishments adds to the costs of job loss, because it limits the role of normal worker attrition. The temporal concentration of job destruction in recessions adds to the costs of job loss for the same reason. The costs of job destruction



in recessions are further compounded, because worker attrition rates (quits) are unusually low, and because spatial concentration rises.

### 6.3. Job destruction and worker displacement

One way to assess the impact of job destruction on job loss is to consider the connection between job destruction and unemployment flows. Davis et al. (1996, Chapter 6) and Hall (1995) present evidence of a close connection between increases in job destruction and increases in the unemployment inflow rate, especially for workers who consider themselves permanently laid off. Hall (1995) also emphasizes that the initial unemployment inflow associated with job destruction and permanent layoffs at the onset of a recession is only the beginning of the story, because the fragility of new worker-firm matches leads to higher unemployment re-entry rates in subsequent periods.

Another way to evaluate the connection between job destruction and unwelcome job loss is to consider the evidence on self-reported job displacement in the Displaced Worker Survey (DWS) supplement to the CPS. According to the DWS, a worker is displaced if he lost a job within a specified period of time because of a plant closing, an employer going out of business, a layoff without recall, or some similar reason.

To investigate this connection, we compare job loss rates tabulated by Farber (1997) using the DWS with measures of job destruction. The job loss rates from the DWS that Farber considers pertain to various 3-year horizons from the early 1980s to the mid 1990s. Job loss is defined as an involuntary separation based on the operating decisions of the employer for one of the reasons given above. Farber converts the number of displaced workers to a job loss rate by dividing through by the total number of workers at risk at the survey date. Multiple job losers are not double-counted. Using this methodology, the average job loss rate over a 3-year horizon is approximately 12%. This figure means that 12% of the workforce experiences at least one separation that is classified as a displacement over a 3-year horizon.

In contrast, the annual rate of job destruction in the US economy is approximately 10% in manufacturing industries and somewhat higher in most non-manufacturing industries (Table 1). To compare these annual rates to the 3-year job loss rates, it is not quite appropriate to simply cumulate the annual job destruction rate to generate a 3-year destruction rate, because some fraction of the annual job destruction is reversed and the affected workers recalled. From Table 6, roughly 74% of annual job destruction in US manufacturing persists for more than 2 years. The job destruction rate for US manufacturing over a 5-year horizon calculated by Baldwin et al. (1998) is approximately 26%. Putting these figures together, and taking into account that job destruction rates are higher for non-manufacturing, suggests that the 3-year job destruction rate exceeds 20% – a rate that is much greater than the corresponding 3-year job loss rate in the DWS.

Fig. 11 compares the time-series movements in the Farber job loss rates and the 3-year job destruction rates.<sup>32</sup> The job loss rates depicted are the overall rate and a rate for

<sup>32</sup> The destruction series terminates in 1993.

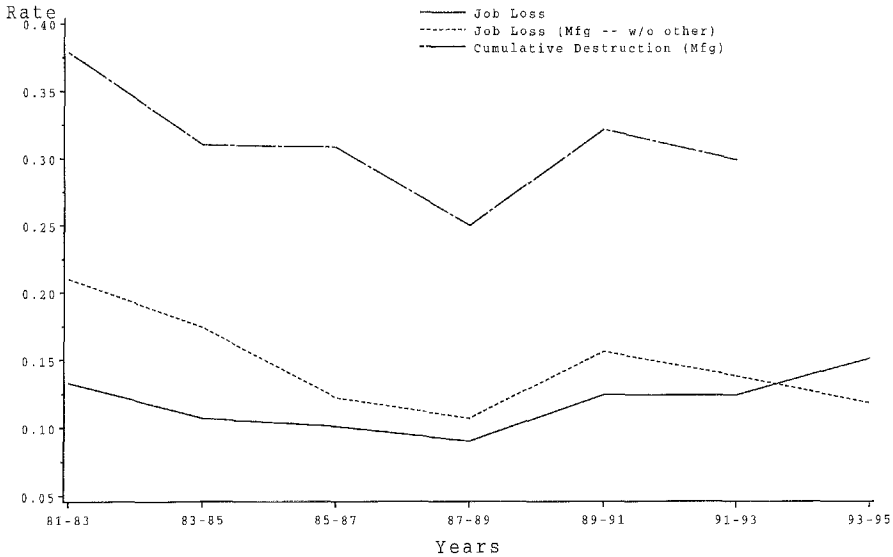


Fig. 11. Comparison of job loss rates and cumulative 3-year job destruction rate. Source: destruction tabulations from the LRD and job loss rates from the DWS supplement to the CPS.

manufacturing. Even though the industry-level job loss rates excludes the “other reason” category of job loss, the job loss rate for manufacturing typically exceeds the rate for the whole economy. The cumulative job destruction rates are much higher than the job loss rates, but the time series fluctuations in the manufacturing job destruction and job loss rates are quite similar.

Several factors probably underlie the large gap between the DWS job loss or displacement rate and the job destruction rate. First, the job loss rate counts workers only once over a 3-year horizon, even if they suffer multiple displacements. In contrast, a worker who moves from one declining establishment to another could show up several times in the cumulative job destruction figure, even if each job destruction event is permanent. Second, a major difficulty in interpreting the displacement measure is whether all workers who experience an employer-initiated separation consider themselves displaced. Third, as discussed above, establishments accomplish job destruction through a variety of means – attrition, hiring freezes and layoffs – that vary in importance over time and space.

The basic point is that many factors influence the relationship between job destruction and DWS measures of job loss. The large difference in magnitudes suggest that these factors matter greatly, but the job destruction and job loss rates nonetheless show similar patterns of time variation. Further study is required to understand the precise sources of the differences between the job destruction and job loss rates.

The effect of job destruction on workers is a central issue in welfare analyses of the reallocation process. On the one hand, the continuous reallocation of resources to their

highest valued uses is a necessary component of economic growth. (In the next section, we will see that much of aggregate productivity growth is accounted for by ongoing reallocation.) On the other hand, this reallocation process produces displaced workers who often experience large and persistent earnings losses.<sup>33</sup> Beyond important unresolved conceptual issues, a major barrier to greater progress in understanding these issues is the availability of suitable data. Ideally, we need data that simultaneously tracks the movement of jobs and workers and their relationship to earnings, unemployment, productivity and output. The importance of the underlying issues argues for assigning a high priority to the further development of integrated employer–worker datasets.

## 7. Job flows and creative destruction

### 7.1. Theoretical models

A long-standing view holds that economic growth in a market economy invariably involves reallocation. Schumpeter (1942) coined the term, “creative destruction”, which he described as follows (p. 83):

The fundamental impulse that keeps the capitalist engine in motion comes from the new consumers’ goods, the new methods of production or transportation, the new markets....[The process] incessantly revolutionizes from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism.

Creative destruction models of economic growth stress that the process of adopting new products and new processes requires the destruction of old products and processes.

An important paper that formalizes this Schumpeterian idea is Aghion and Howitt (1992). They develop a theoretical model in which endogenous innovations drive creative destruction and growth. The creator of a new innovation receives monopoly rents until the next innovation comes along, at which point the knowledge underlying the rents becomes obsolete. The incentives for investment in R&D and thus growth depend on this process of creative destruction. Appropriability and intertemporal spillover effects lead equilibrium growth to be slower than optimal. The appropriability effect arises because skilled labor receives a portion of the rents generated by innovation. The intertemporal spillover effect arises because current innovators are uncompensated for the knowledge benefits that they provide to future innovators. Set against these two effects, research firms do not internalize the destruction of rents generated by their own innovative activity. By itself, this business stealing effect leads to an excessively high growth rate. Aghion and Howitt (1992) show that the business stealing effect also tends to make innovations too small. On net, growth may be more or less rapid than optimal.

<sup>33</sup> See, e.g., Anderson and Meyer (1994), Dardia and Schoeni (1996), Farber (1993), Hall (1995), Jacobson et al. (1993), Ruhm (1991) and Topel (1990) for studies of the impact of displacement on earnings.

Some vintage capital models provide an alternative conceptualization of Schumpeterian views about creative destruction. One class of vintage models (e.g., Caballero and Hammour, 1994; Campbell, 1997) emphasizes the role of entry and exit. If new technology can only be adopted by new establishments, growth occurs only via entry and exit, which requires input reallocation. Another class of vintage models (e.g., Cooper et al., 1997) emphasizes that existing plants can adopt new technology by retooling. The retooling process may generate within-plant and between-plant job reallocation. For example, retooling to adopt a skill-biased technological improvement can bring changes to both the level and skill mix of the plant's work force.<sup>34</sup>

In all of these models, the reallocation of outputs and inputs across producers plays a critical role in economic growth. Stifling reallocation stifles growth. For several reasons, the rate of growth and the pace of reallocation may deviate from optimal outcomes. In this regard, Aghion and Howitt emphasize that agents (firms, innovators, workers) fail to internalize the effect of their innovative activities on others. Caballero and Hammour (1996a,b) emphasize that the sunkness of investment in new capital (human or physical) leads to ex post holdup problems with many harmful side effects.

Even when reallocation is vital for growth, there are losers in the process. Losers include the owners of the outmoded businesses that fail and the job-losing displaced workers. Set against these losses to particular businesses and individuals, reallocation leads to greater efficiency in resource allocation, increases in output and, according to the Schumpeterian view, sustained economic growth. The next two subsections review empirical studies that quantify the productivity benefits of factor reallocation and present evidence on these benefits in US manufacturing. Section 10 considers some welfare and productivity aspects of reallocation in a simple theoretical model of costly worker and capital mobility.

## *7.2. Empirical studies of reallocation and productivity growth*

The theories of heterogeneity treated in Section 5 and much theoretical work on creative destruction characterize technical change as a noisy, complex process that involves considerable experimentation (entry and retooling) and failure (contraction and exit). The large-scale, within-sector job reallocation documented in Sections 3 and 4 favors this view, but evidence on job flows alone says little about the strength of any relationship between reallocation and productivity growth.

Several recent empirical studies of plant-level and firm-level productivity behavior provide direct evidence on the role of factor reallocation in productivity growth.<sup>35</sup>

<sup>34</sup> See, e.g., Dunne et al. (1997) and Abel and Eberly (1997) for analysis of how changing technology affects the mix and scale of factors of production.

<sup>35</sup> See Baily et al. (1992), Olley and Pakes (1996), Bartelsman and Dhrymes (1994), and Foster et al. (1998), all of whom use the LRD, Aw et al. (1997) who use firm-level data from Taiwan and Liu and Tybout (1996), who use establishment-level data for Chile, Colombia and Morocco. Tybout (1996) contains a brief survey of the literature.

These studies find that the reallocation of output and inputs from less-productive to more-productive plants plays a major role in industry-level multifactor productivity growth. A closely related literature investigates the connection between employment reallocation and labor productivity growth.<sup>36</sup> The labor productivity studies yield a more mixed set of results and a typically smaller role for reallocation.

To see the basic approach in these empirical studies, start with the expression

$$P_{it} = \sum_{e \in I} s_{et} p_{et}, \quad (10)$$

where  $P_{it}$  denotes an index of labor or multifactor productivity for industry  $i$ ,  $p_{et}$  denotes a corresponding productivity measure for plant or firm  $e$ , and  $s_{et}$  is the  $e$ th unit's share of industry activity (e.g., output share). For convenience, we henceforth refer to the individual units as plants. Now consider the following decomposition of the industry-level productivity index:

$$\begin{aligned} \Delta P_{it} = & \sum_{e \in C} s_{et-1} \Delta p_{et} + \sum_{e \in C} (p_{et-1} - P_{it-1}) \Delta s_{et} + \sum_{e \in C} \Delta p_{et} \Delta s_{et} + \sum_{e \in N} s_{et} (p_{et} - P_{it-1}) \\ & - \sum_{e \in X} s_{et-1} (p_{et-1} - P_{it-1}), \end{aligned} \quad (11)$$

where  $C$  denotes continuing plants,  $N$  denotes entering plants, and  $X$  denotes exiting plants. The first term in this decomposition reflects within-plant productivity gains weighted by initial shares. The second term is a between-plant effect that reflects changing shares of industry activity, weighted by the initial-period deviation of the plant's productivity from industry productivity. The third term is a covariance-type cross product that reflects whether activity shares shift towards plants with relatively rapid productivity growth. The last two terms capture the contribution of entering and exiting plants, respectively.

In this decomposition, the between-plant term and the entry and exit terms involve deviations of plant-level productivity from the initial industry index. For a continuing plant, an increase in its share contributes positively to the between-plant component when the plant has higher productivity than average initial productivity for the industry. Similarly, an exiting (entering) plant contributes positively when its productivity is lower (higher) than the initial average.

Several related productivity decompositions appear in the literature, and they differ from Eq. (10) in sometimes subtle but important ways. The main distinguishing features of Eq. (10) are (i) an integrated treatment of entrants, exits and continuing plants, and (ii) a separation of between-plant and within-plant effects from covariance-type cross products. Because they do not separate out covariance-type terms, some decompositions in the literature are difficult to interpret for our purposes. For example, Griliches and Regev

<sup>36</sup> See Griliches and Regev (1995) who examine Israeli data, and Baily et al. (1996) and Foster et al. (1998), who use the LRD.

(1995) measure the within effect as the productivity change weighted by the average of shares in  $t$  and  $t - 1$ . This method yields a seemingly cleaner decomposition than Eq. (10), but the resulting within effect then partly reflects reallocation effects.

Another important issue involves the treatment of net entry. Many of the decompositions in the literature that consider net entry (e.g., Baily et al., 1992) measure its contribution as a simple difference in the weighted mean productivity for entering and exiting plants:

$$\sum_{e \in N} s_{et} P_{et} - \sum_{e \in X} s_{e,t-1} P_{e,t-1}.$$

Even if there are no productivity differences among plants, this method yields a positive (negative) contribution of net entry to industry-level productivity gains whenever the share accounted for by entrants ( $\sum_{e \in N} s_{et}$ ) exceeds the share accounted for by exiting plants ( $\sum_{e \in X} s_{e,t-1}$ ). There are corresponding (and offsetting) problems in the treatment of the contribution of continuing plants.

### 7.3. Evidence for the US manufacturing sector

We apply Eq. (11) to four-digit US manufacturing industries using plant-level data from the Census of Manufactures in 1977 and 1987.<sup>37</sup> We first decompose industry-level multifactor productivity changes using plant-level gross output to compute the shares ( $s_{et}$ ). This weighting methodology is common in recent work on multifactor productivity decompositions. Next, we decompose industry-level labor productivity changes using both plant-level gross output and labor input to compute the shares. Labor-based shares are more natural for labor productivity decompositions, but aggregation using gross output shares helps understand the relationship between multifactor and labor productivity decompositions and the role of reallocation in productivity growth.

Our index of plant-level multifactor productivity is

$$\ln MFP_{et} = \ln Q_{et} - \alpha_K \ln K_{et} - \alpha_L \ln L_{et} - \alpha_M \ln M_{et}, \quad (12)$$

where  $Q_{et}$  is real gross output,  $L_{et}$  is labor input (total hours),  $K_{et}$  is real capital and  $M_{et}$  is real materials. In practice, we separate capital inputs into structures and equipment. We measure outputs and inputs in constant (1987) dollars using industry-level price deflators, and we set factor elasticities to industry-level factor cost shares. Our index of plant-level labor productivity is the difference between log gross output and the log labor input. Applying these measurement and weighting procedures to the plant-level data yields industry-level productivity growth rates that correspond closely to the rates computed directly from industry-level data.

Table 10, Panel A reports weighted averages of the industry-level productivity decompositions. Following Baily et al. (1992), we aggregate over the nearly 450 industries using

<sup>37</sup> The measurement and analysis here follows closely Foster et al. (1998), and the results in Table 10 are drawn directly from that paper. See that paper and Haltiwanger (1997) for detailed discussion of measurement issues.



the average of nominal gross output in the initial and terminal years. In this way, we focus on within-industry productivity dynamics and exclude any effects of shifting industry composition.

Consider first the decomposition of the industry-level multifactor productivity changes. The within-plant component accounts for nearly half of the overall within-industry growth in multifactor productivity. In contrast, the between-plant component is small and negative. The cross-product term accounts for 34% of multifactor productivity growth from 1977 to 1987 in the average industry. This finding shows that a large fraction of multifactor productivity growth reflects rising output shares at plants that also experience productivity gains. Net entry plays an important role as well, accounting for 26% of the average industry change.

Taken together, the net entry and cross-product results show that 60% of the 10-year increase in multifactor productivity for the average manufacturing industry is accounted for by effects that involve the reallocation of output across production sites. Similar findings appear in other work on the decomposition of plant-level multifactor productivity changes. While the measurement methodology, decomposition technique and sectoral coverage vary among studies, a large contribution of output reallocation across production sites to multifactor productivity growth is a recurrent finding.

Panel B of Table 10 provides information about some underlying determinants of the multifactor productivity decomposition. The productivity indexes are reported relative to the weighted average for all plants in 1977. According to Panel B, entering plants have higher productivity than the average level among exiting and continuing plants in 1977 but slightly lower productivity than the continuing plants in 1987. Exiting plants have lower productivity than continuing plants. In short, entering plants tend to displace less-productive exiting plants, but they enter with about the same productivity as continuing plants.

A simple cohort analysis, also reported in Panel B, reveals that plants that entered in 1983–1987 have lower productivity than plants that entered in 1978–1982. In other words, the older cohort of entering plants is more productive than the younger cohort. This pattern suggests that selection and learning effects play an important role in plant-level productivity dynamics, an interpretation that finds further support in the more detailed analysis of Foster et al. (1998).<sup>38</sup>

Combining the results on multifactor productivity with evidence in Section 3 on the magnitude of job flows suggests that job reallocation plays an important productivity enhancing role. However, the precise connection between *job* reallocation and *output* reallocation is unclear. Put differently, output reallocation reflects many possibilities – changing labor shares, changing capital shares, changing material shares and changes in productivity itself. To shed further light on the connection between job and output reallocation, we turn now to labor productivity decompositions and compare the results using labor shares and gross output shares to aggregate over plants.

<sup>38</sup> Aw et al. (1997) present similar evidence of important and distinct roles for learning and selection effects in Taiwan. Also, see Bahk and Gort (1993).



The decompositions of labor productivity appear in Panel A of Table 10. Using labor or output shares yields similar rates of average labor productivity growth over this period. The contribution of net entry to labor productivity growth is also quite similar whether we use labor or output shares. Thus, in either case, reallocation plays an important role in labor productivity growth via net entry.<sup>39</sup>

For continuing plants, large differences arise between results based on output weights and results based on labor weights. The labor productivity decompositions based on output weights are very similar to the multifactor productivity decompositions. In sharp contrast, the labor productivity decomposition based on labor weights shows a much larger contribution for within-plant effects and a negative contribution for the cross-product term. The between-plant contribution to labor productivity gains is small and positive using labor weights. These results suggest that most of the 1977–1987 gains in labor productivity would have taken place even if labor shares had been held constant at initial levels.

To shed some light on the differences in results, Panel C of Table 10 presents simple correlations of plant-level growth rates in multifactor productivity and labor productivity with each other and with the growth in output, labor, capital inputs and capital intensity. Multifactor productivity growth is positively correlated with output growth but nearly uncorrelated with the input growth measures. Labor productivity growth is more strongly correlated with output and input growth. Labor productivity covaries negatively with labor inputs and positively with capital inputs. These different correlation patterns for plant-level growth in multifactor and labor productivity hold despite a strong positive correlation of 0.75 between the two productivity growth measures.

These results show that it is inappropriate to infer that all or even most job reallocation reflects the movement of employment from less productive to more productive sites. Instead, employment downsizing often accompanies or precedes large productivity gains. For example, as described in Davis et al. (1996, Chapter 5), the US steel industry underwent tremendous restructuring during the 1970s and 1980s. Much of this restructuring involved a shift from large, integrated mills to more specialized mini mills. Entry and exit played a major role, but the restructuring of the industry also involved the retooling of many continuing plants. The employment-weighted mean number of workers at a US steel mill fell from 7000 in 1980 to 4000 in 1985. Baily et al. (1996) find that continuing plants in the steel industry experienced substantial productivity gains while downsizing. Moreover, the downsizing episode in the early 1980s was followed by dramatic productivity gains in the steel industry in later years (Davis et al., 1996, Fig. 5.8).

This discussion highlights the point that job destruction should not be presumed to indicate poor performance for affected plants. As the steel industry example illustrates, in some cases the job destruction is part of a within-plant restructuring process that yields large productivity gains. It is also incorrect to draw the opposite inference – i.e., to equate down-

<sup>39</sup> In contrast to the findings here, Griliches and Regev (1995) do not find much of a role for net entry in their decomposition of labor productivity. The likely reason is the short horizon, three years, over which they measure productivity changes. Similarly, Liu and Tybout (1996) and Baily et al. (1996) find little contribution of net entry to annual productivity changes.

sizing with subsequent success. The weak correlation between multifactor productivity growth and labor input growth shows that neither upsizing nor downsizing of employment is an accurate indicator of strong productivity performance (Baily et al., 1996).

More generally, this discussion points out that the relationship of productivity growth to the reallocation of inputs and outputs is quite complex. Plants often change the mix of inputs as they change the scale of production. Some technological innovations lead to large employment declines at plants that adopt the new technology. Other technological innovations take the form of cost savings or quality improvements that enable adopting plants to increase market share and input usage. Another complicating and interesting factor is policy interventions that stifle or encourage reallocation. As shown in Olley and Pakes (1996), productivity movements in the manufacture of telecommunications equipment appear closely related to the regulatory process and its effect on factor reallocation. Important deregulatory events coincided with or shortly preceded large increases in the cross-sectional covariance between plant-level market share and productivity.

The young empirical literature on reallocation and productivity growth has already uncovered some provocative results. A better understanding of how input and output reallocation are connected to industry-level and aggregate productivity growth probably requires more structure than we (or the literature) have brought to bear. Given the importance of the topic, and the limits of our knowledge, this area of research merits a high priority in future work.

## 8. Job and worker flows in transition economies

The transition from centrally planned to market-oriented economies in Central and Eastern Europe and in the former Soviet Union would seem to call for the reallocation of jobs and workers on a truly grand scale. Great reallocations have indeed been underway in these economies, but the reallocation process has some distinctive and surprising features. As emphasized by Blanchard (1997), Boeri (1997) and others, large net flows of workers across firms and sectors have been associated with small gross flows and a stagnant unemployment pool. On a similar note, the available evidence points to surprisingly small gross job flows in post-communist transition economies. We review this and other evidence below. We also try to place the evidence in perspective as it relates to the broader transition experience and to the behavior of job and worker flows in more settled market economies.

This section proceeds as follows. We begin with an overview of the post-communist transition experience and the role of reallocation activity.<sup>40</sup> Next, we summarize the evidence on broad patterns of reallocation activity in these economies. Lastly, we examine gross job and worker flows in Poland and Estonia, two transition economies for which more detailed data are available.

<sup>40</sup> The reader may wish to consult Svenjar's (1999) piece in this volume for a more detailed treatment of labor markets in post-communist transition economies.

### 8.1. Background and theoretical issues

The post-communist transitions have been marked by dramatic output declines and (except for Russia and the Czech Republic) sharp, sustained increases in unemployment. To convey the magnitude of the output declines, we draw on de Melo et al. (1996), who summarize outcomes for 26 countries in Central and Eastern Europe and the former Soviet Union plus Mongolia. The timing and extent of economic liberalization differs among these countries, but most initiated or greatly accelerated the transition to a market-oriented economy in the years from 1990 to 1992.

With this rough generalization about the starting point of transition in mind, consider the following numbers. Among the 20 transition economies not afflicted by regional conflicts, measured gross domestic product in 1993/1994 stood at only 70% of its 1989 level.<sup>41</sup> Among the six countries with regional conflicts, the corresponding figure is 45%. The top-performing transition economies in this respect are Poland (88%) and Uzbekistan (89%). While measurement problems overstate the size of the contractions, the existence of large, persistent output declines is confirmed by other evidence and widely accepted by informed observers.<sup>42</sup>

The demise of central planning involved several major sectoral and structural shocks: large cuts in subsidies to state-owned enterprises, the freeing of relative prices, a collapse in established patterns of domestic and international trade, the restructuring and (in some countries) large-scale privatization of state-owned enterprises, and the removal of restrictions on private ownership and labor mobility.<sup>43</sup> Most transition economies also experienced extreme fiscal imbalances and brief or extended bouts of high inflation (Aslund et al., 1996). Prior to economic liberalization, and relative to market economies, the transition economies had high employment rates, overly large industrial sectors, small and repressed service sectors and compressed wage structures. In short, the economic liberalizations associated with the transition process introduced several major shocks into economies that already had a pent-up demand for reallocation.

Given the costly nature of much reallocation activity and the obsolescence of information, organization and physical capital developed under a regime of central planning, it is not surprising that transition involved initially sharp output declines and slow recoveries. Job loss brings unemployment and lost earnings even in well functioning market economies. This fact suggests that substantial unemployment and lost earnings are inevitable consequences of any ambitious program to restructure state-owned enterprises.

<sup>41</sup> By way of comparison, Blanchard (1997, p. 3) notes that "US GNP stood in 1933 at 70% of its 1929 level."

<sup>42</sup> Fischer et al. (1996, pp. 47–49) provide a short, useful discussion of problems in the measurement of output and its growth. Kaufman and Kaliberda (1996) use electricity consumption to proxy for true GDP growth in sixteen post-communist transition economies. Their Table A.2 suggests that the true decline in GDP from 1989 to 1994 averages about 70% of the officially reported decline.

<sup>43</sup> See Blanchard (1997), Svenjar (1999), Commander and Tolstopiatenko (1996) and the articles in Commander and Coricelli (1995) for description and analysis of these shocks with an emphasis on labor market implications. Rodrik (1994) treats the collapse of international trade among transition economies in Eastern Europe. Brada (1996) discusses differences among countries in privatization.

Capital reallocation is also costly. In an interesting case study of the closure of a California aerospace plant, Ramey and Shapiro (1996, Table 3) find that equipment resale prices average only 35% of net-of-depreciation purchase values. They also find low and declining capital utilization rates at the plant for several years prior to closure. Both findings point to a high degree of capital specificity at a large manufacturing facility – the same type of facility that predominated in the pre-transition economies. The Ramey–Shapiro results strongly suggest that large reductions in the flow of services from the pre-existing stock of physical capital are necessary consequences of the closure and restructuring of state-owned enterprises.

A sharp reduction in the flow of services from pre-existing information and organization capital is another likely consequence of restructuring and reallocation in transition economies. The development of information and organization capital suitable for the new market-oriented regime is likely to be slow. In this spirit, Atkeson and Kehoe (1997) show how the reallocation of productive factors to new activities and organizations involves a sacrifice of current for future (measured) output as the economy accumulates a new stock of organization capital. When calibrated to US data on job flows by plant age, their model implies that it takes 5–7 years before a transition economy begins to grow rapidly. The central message of their analysis is that, even in a well functioning transition economy, it takes several years before the favorable effects of economic liberalization show up in measured output.

The evidence and interpretations related to reallocation activity in transition economies are mixed. The rapid development of small private businesses in many transition economies, especially in the service sectors, fits the image of a creative destruction process unleashed by economic liberalization. But other aspects of the transition process are more aptly characterized as “disruptive destruction” or even “destructive creation”. In this regard, some potential pitfalls of economic liberalization are made clear in recent work.

Aghion and Blanchard (1994), for example, stress the negative fiscal effects of rapid reductions in subsidies to state-owned enterprises. If subsidy cuts lead to labor shedding in the state sector and large inflows into the unemployment pool, taxes on the private sector may rise to support increased government expenditures on social insurance programs; alternatively, budgetary pressures may induce the government to reduce investments in public infrastructure that facilitate private sector growth. Either way, private sector job creation and output growth are hampered. The main message is that excessively rapid restructuring and job destruction in the state sector can slow down private sector job creation.

Blanchard and Kremer (1997) stress the disruptive economic consequences of an end to central planning. In their model, transition undermines the system of bilateral relationships through which interfirm and international trade occurred under central planning. Given the demise of central planning, they show how an improvement in private opportunities for the sale of goods and services can disrupt the flow of intermediate inputs between state enterprises. The result is a collapse of output in the state sector. Asymmetric information about the value of private opportunities facing suppliers and thin markets in the supply of

intermediate inputs are central to their explanation for the transition-induced output decline. Blanchard (1997, pp. 43–45) presents suggestive evidence that disruptive effects of this sort were important in certain transition economies.

Murphy et al. (1992) stress how the freeing of some prices, but not others, leads to the diversion of inputs away from highest value uses. They analyze Russia's unhappy experience with partial price reform between 1988 and 1990. During that period, the input prices offered by state enterprises were often set below market-clearing levels, which allowed private firms to bid essential inputs away from the state sector by paying (slightly) higher prices. Because more severely underpriced inputs were likely to be in shorter supply in the state sector, the incentives for private sector entry were greatest in precisely those activities that diverted inputs with a high shadow value in the state sector. Under this regime, private sector entry and job creation destroyed potential output in the state sector. The Russian experience with partial price reform is but one example of the privately profitable but socially inefficient diversion of goods and services in post-communist transition economies. Credit subsidies, tax breaks, tariff exemptions and other special privileges have contributed enormously to rent seeking and resource misallocation in these economies.<sup>44</sup>

Furthermore, the demise of central planning and the introduction of economic reforms do not ensure secure property rights and enforceable contracts in the post-communist regime. Uncertain property rights and unenforceable contracts discourage investment and distort the allocation of productive inputs, which in turn lowers output and slows growth (Caballero and Hammour, 1996b). So, in addition to the other potential pitfalls of liberalization remarked upon above, the legal institutions required to sustain a healthy process of creative destruction were often lacking.

Despite these concerns about excessively rapid or radical reform, the weight of the evidence for post-communist transition economies suggests that faster and deeper liberalization have been associated with smaller output declines and speedier recovery.<sup>45</sup> Taken at face value, this cross-country evidence is hard to fully reconcile with most theories of costly reallocation addressed to outcomes in settled market economies. It is also hard to reconcile with theories of transition that emphasize the costs of rapid liberalization. As Aslund et al. argue, the evidence instead suggests an important role for complementarities between policy reforms (e.g., price liberalization and monopoly elimination) or positive externalities in the transition process (e.g., private-sector growth promotes the diffusion of useful information). The weight of the evidence also seems to support the view that delayed privatization worsens medium-term economic performance, because it leads to

<sup>44</sup> See Aslund et al. (1996). Their footnote 50 reports a striking example of rent extraction: "The Russian Sports Foundation, run by President Yeltsin's tennis trainer, was the main importer of alcohol into Russia in 1994 and 1995, as it was exempt from import tariffs and excise taxes. For 1995, the Russian Ministry of Finance valued the tax exemptions of the Sports Foundation at no less than \$6 billion, or 2% of Russia's GDP in that year."

<sup>45</sup> See de Melo et al. (1996), Fischer et al. (1996) and Aslund et al. (1996). Ickes (1996) sounds some cautionary notes regarding the interpretation of the evidence.

Table 11  
Sectoral shifts in output at current prices, 1989–1994, post-communist transition economies, by country reform group<sup>a</sup>

Country reform group	Cumulative liberalization index <sup>b</sup>	Change in percentage of GDP		
		Industry	Agriculture	Services
Advanced reformers	3.91	-11.2	-3.7	14.9
High-intermediate reformers	2.55	-11.0	0.7	10.4
Low-intermediate reformers	1.66	-1.9	-4.9	6.8
Slow reformers	0.90	2.9	-1.4	-1.5
Affected by regional tensions	2.11	-7.9	15.3	-7.4

<sup>a</sup> Source: de Melo et al. (1996, Table 5). The table summarizes outcomes for 26 post-communist countries in Eastern and Central Europe, the former Soviet Union and Mongolia. Countries are grouped and ordered by a cumulative index of economic liberalization as follows: Advanced reformers (Slovenia, Poland, Hungary, Czech Republic, Slovak Republic); High-intermediate reformers (Estonia, Bulgaria, Lithuania, Latvia, Albania, Romania, Mongolia); Low-intermediate reformers (Russian Federation, Kyrgyz Republic, Moldova, Kazakhstan); Slow reformers (Uzbekistan, Belarus, Ukraine, Turkmenistan); Affected by regional tensions (Croatia, Macedonia, Armenia, Georgia, Azerbaijan, Tajikistan).

<sup>b</sup> The cumulative liberalization index is a composite of quantitative rankings in three areas of economic liberalization: internal markets, external trade and payments, and the facilitation of private sector entry. Each country was assigned an index value between 0 and 1 in each year from 1989 to 1994. The index values were then summed over years to arrive at a cumulative liberalization index for each country. Hence, the cumulative index reflects both the depth and duration of economic liberalization. See de Melo et al. (1996) for details.

greater asset stripping in the state sector and greater appropriation of the income flows generated by state enterprises (Kaufman and Kaliberda, 1996).

On balance, it seems reasonable to maintain that the post-communist transition experience has been characterized by major unavoidable costs (e.g., loss of specific capital), much creative destruction, much socially harmful diversion of goods and services, some disruptive destruction, and the ongoing accumulation of new and socially useful forms of information and organization capital. The evidence below on reallocation activity in transition economies should be approached in this light.

### 8.2. Broad patterns of reallocation in transition economies

Table 11 reports enormous shifts in the sectoral composition of output for 26 post-communist transition economies. Each country is ranked by a cumulative index of economic liberalization and placed into one of five country reform groups. The two groups with the greatest reform show a tremendous reallocation of output from Industry to Services between 1989 and 1994. The low-intermediate reform group also shows a large increase in the share of GDP in Services, but little decline in the Industry share.<sup>46</sup> The “slow reform-

<sup>46</sup> As de Melo et al. (1996) point out, the shift to Services took place despite a precipitous decline in government services between 1990 and 1992 in the former Soviet Union.

Table 12

Industry reallocation intensity, selected transition and other economies (standard deviation of employment growth rates across one-digit industries, annual averages)

Country	Period	Standard deviation (%)	Source
Czech Republic		20.9	Boeri (1996, Table 1)
Slovakia		14.2	Boeri (1996, Table 1)
Hungary		9.0	Boeri (1996, Table 1)
Poland		20.3	Boeri (1996, Table 1)
Bulgaria		11.0	Boeri (1996, Table 1)
Estonia	1989–1991	2.7	Haltiwanger and Vodopivec (1997)
Estonia	1991–1994	8.5	Haltiwanger and Vodopivec (1997)
OECD	1990–1993	3.4	Blanchard (1997, p. 5)
United States	1939–1942	6.0	Authors' calculations
United States	1944–1947	6.4	Authors' calculations

mers” show comparatively modest changes in the sectoral composition of output. Finally, countries affected by regional tensions show a very different reallocation pattern that reflects a large-scale return to subsistence farming.

Measurement problems notwithstanding, there is little reason to doubt the basic impressions conveyed by Table 11. On the whole, the post-communist transition brought about major output shifts from Industry to Services. Greater output reallocations took place in countries with deeper and earlier reforms. The main countervailing pattern has been a return to Agriculture in countries afflicted by regional tensions.

Table 12 reports a measure of between-industry reallocation intensity for several transition economies and for several other countries. The measure, introduced by Lilien (1982) to explain cyclical fluctuations in the US unemployment rate, equals the standard deviation of the employment growth rate across one-digit industry groups. The message in Table 12 is clear: post-communist transition economies experienced enormous and rapid shifts in the industrial distribution of employment, even in comparison to the transformations associated with the US entry into World War II and the demobilization after the war's end.

Of course, the transition economies also underwent profound changes in the ownership and control structure of business enterprises. Table 13 addresses this matter, showing how the private sector share of GDP evolved in 17 post-communist transition economies. Once again, tremendous change is evident: the private sector share of GDP rose from an average of 14% prior to economic reform to 46% in 1995.

Impressive as they are, these numbers fail to convey the complexity and magnitude of transition-economy changes in the ownership and control of business enterprises. Without pretending to treat this issue in a serious way, we offer four remarks to supplement Table

Table 13  
Private sector percentage of GDP in post-communist transition economies<sup>a</sup>

Country	Year of most intense reform	Prior level	Change in year of most intense reform	Change over next 2 years	Level in 1994	Level in 1995
Armenia	1992	24.2	12.5			45
Belarus	1993	8.1				15
Bulgaria	1991	7.2		19.3	40.2	45
Croatia	1990	8.5		16.0	44.9	45
Czech Republic	1991	12.3	5.0	17.8	56.3	70
Estonia	1992	17.7	4.3	13.0	58.0	65
Georgia	1992	27.3	12.7	19.6	60.0	30
Hungary	1990	14.9				60
Kazakhstan	1992	12.2			20.2	25
Latvia	1992	12.0	19.8	16.0	53.0	60
Lithuania	1991	11.6	3.8			55
Poland	1990	28.6	2.8	16.8	56.0	60
Romania	1990	12.8	3.6	10.0	35.0	40
Russia	1992	10.1	3.9	11.0	25.0	55
Slovenia	1990	8.1	3.3	8.1		45
Ukraine	1994	7.5				35
Uzbekistan	1990	9.8	-3.2		54.2	30
Simple average		13.7				45.9

<sup>a</sup> Source: Aslund et al. (1996, Table 8). Estimates are for the "pure" private sector (that is, excluding cooperatives) and, as far as possible, for 100% privately owned companies. The numbers include agriculture. The original source varies with country and column. Measurement error probably accounts for reported declines in the private sector share of GDP for some countries and time periods.



13.<sup>47</sup> First, the role of new private firms, as opposed to newly privatized state firms, varies widely among countries. Second, many privatized firms are effectively controlled by insiders – managers and workers – whose objectives differ greatly from those of outside equity holders. Third, with the withering of central authority, even firms that remain in the state sector operate with a very different control structure than in the pre-transition era. Finally, the line between state and private sector activity is often blurry, especially in the former Soviet Union, and many “unofficial” private activities take place alongside official state sector activities.

Tremendous industrial reallocation and private sector growth would seem to set the stage for large gross flows of workers and jobs. The available evidence says otherwise. Table 14 summarizes the most widely available form of evidence on gross flows in the post-communist transition economies – unemployment inflows and outflows. Except for the Czech Republic, the table shows a stagnant unemployment pool with very small unemployment outflow rates – especially flows from unemployment to employment. The idea of a stagnant unemployment pool emerges as a chief theme in several multi-country studies of transition economies (OECD, 1994b; Commander and Coricelli, 1995; Blanchard, 1997). The available evidence also indicates that a high fraction of open positions are filled by workers who transit directly from another job, rather than from unemployment or nonparticipation. Blanchard (1997, pp. 90–91) reports the fraction of new hires that came directly from another job: 40% in Poland and 71% in Hungary in 1992, as compared to only 20% in the United States.

### 8.3. Gross flows in Poland and Estonia

The two transition economies that offer the richest data on labor market flows are Poland and Estonia. We draw on evidence for these two countries in an effort to sketch a more detailed picture of labor flows in the post-communist transition. In doing so, it is helpful to note how the broader transition experience of Poland and Estonia compares to that of other countries. Both Poland and Estonia undertook more radical liberalizations than most other transition economies and with decidedly better outcomes. Poland implemented major reforms in 1990; Estonia implemented major reforms in 1992. Both stayed the course of liberalization – initial reforms remained largely intact and further reforms followed. Initial conditions were also relatively favorable. Prior to 1990, the Polish and Estonian economies were more liberalized than most other communist countries, and both countries inherited a legacy of market-oriented economies in the pre-World War II era.

Estonian policies have been especially, indeed remarkably, conducive to job reallocation, worker mobility and high employment. According to Noorkoiv et al. (1997), Estonian unemployment benefits average less than 10% of wages, and the eligibility period

<sup>47</sup> The ownership and control structure of business enterprises in transition economies is a major research topic. For studies that treat this topic in connection with labor market implications, the interested reader might wish to begin with Blanchard (1997) and Commander and Tolstopiatenko (1996).

Table 14  
Summary measures of unemployment rate dynamics: selected countries<sup>a</sup>

	Unemployment rate	Monthly inflow rate to unemployment	Monthly hazard rate from unemployment	Monthly hazard rate to employment	Percent longterm unemployment
<i>Advanced economies (averages for 1989–1991)</i>					
Canada	8.63	2.10	27.8		6.6
France	9.23	0.35	6.10		39.8
Germany	4.93	0.25	7.80		47.7
Italy	11.40	0.20	3.20		70.8
Japan	2.17	0.35	22.80		18.6
UK	6.80	0.60	13.55		38.5
US	5.8	2.05	42.8		5.9
<i>Transition economies (averages for 1992)</i>					
Czech Republic	3.1	0.6	25.8	18.0	28.4
Hungary	11.7	0.5	7.0	3.0	37.3
Poland	14.9	0.7	4.0	2.3	43.4
Slovakia	11.4	1.0	9.8	4.8	25.5
Romania	8.3	–	0.9	0.9	–
Bulgaria	6.0	1.8	5.5	1.1	–
Estonia	5.7	4.5	50.1	39.2	–
Russia	1.3	0.3	18.0	7.5	–

<sup>a</sup> Source: Tabulations for advanced economies are from OECD Employment Outlook (OECD, 1993). Tabulations for transition economies (except for Estonia) are from Blanchard et al. (1995, Table 7-8). Estonia tabulations are from Haltiwanger and Vodopivec (1997). Inflow rate to unemployment is percentage of labor force entering unemployment each month. Hazard rate from unemployment is percentage of unemployed leaving unemployment each month. Longterm unemployment is the percentage of unemployed with durations longer than 12 months.

lasts no more than nine months. Unemployment benefits are reduced or cut off for failure to report regularly to the employment office, failure to accept a suitable job when offered, and failure to accept temporary employment in public works. Subsidized job training and assisted self-employment programs dominate unemployment benefits for many workers. Furthermore, Estonia has no mandatory firing costs, very low minimum wages, no effective trade union movement, no restrictions on foreign investment, and no policy of propping up bankrupt firms to avoid layoffs. The taxes required to sustain unemployment and employment programs are less than 0.2% of GDP. Taxes to support pension benefits are also small. In short, taxes (explicit and implicit) on employment, worker flows and job flows are extremely low.

Table 15 summarizes some major changes in the distribution of Estonian employment from 1989 to 1995. Private enterprises accounted for less than 2% of employment in 1989 but 35% by January 1995. Over the same period, the share of employment in establishments with 100 or more workers fell from 75% to 46%. Employees accounted for 99% of the work force in 1989 as compared to 93% in 1995. These changes began before 1992, when Estonia implemented deep economic reforms, and accelerated thereafter. More

Table 15  
Employment shares by employer characteristics for Estonia, 1989–1995<sup>a</sup>

Year	By enterprise type			
	Collective	Private	State	
1989	20.9	1.5	77.6	
1992	18.9	9.4	71.7	
1995	11.1	34.8	54.0	
	By enterprise size			
	1–19	20–99	100–499	500+
1989	7.6	17.2	34.7	40.6
1992	12.4	20.3	31.4	35.9
1995	25.8	28.0	23.4	22.7
	By employment status			
	Employee	Employee/owner <sup>b</sup>	Self-employed	
1989	99.0	0.5	0.5	
1992	96.9	1.2	1.9	
1995	93.2	3.2	3.7	

<sup>a</sup> Shares are based upon employment on January 1 of each year. The tabulations are from Haltiwanger and Vodopivec (1997) and are based upon a labor force survey of households.

<sup>b</sup> Employee/owner refers to business owners with employees.

detailed annual data in Haltiwanger and Vodopivec (1997) show slow, steady change from 1989 to 1992 and rapid change in each year from 1992 to 1995.

Worker and job flow rates for Estonia and Poland appear in Table 16. The Estonian figures cover the entire economy and are broken down by type of enterprise. The Polish figures derive from two different sources: one covers only continuing state enterprises in the manufacturing sector; the other is broken down into state and private enterprises, but the extent of coverage is unclear.

Gross job flows were extremely small in both economies prior to economic liberalization. (An exception is the Estonian private sector, which enjoyed very high creation rates before and after 1992 but on a very small base.) To the extent that this pattern of minimal job flows prevails in other centrally planned economies, it helps understand their tendency to fall ever farther behind the productivity levels of market-oriented economies with comparable factor endowments. In particular, the evidence suggests that centrally planned economies choke off the productivity-enhancing role of job reallocation (Section 7).

Worker flows were also small prior to liberalization. In Poland, state-sector hiring and separation rates were less than 20% per year. In Estonia, they were even smaller in 1989 and 1990, except for hiring rates in the small private sector. Annual quit rates (separation minus destruction) in Estonia were only 9% in 1989, 11% and in 1990 and 12% in 1991. These low worker mobility rates suggest that centrally planned economies also choke off the productivity-enhancing role of worker sorting among employers and occupations.<sup>48</sup>

Liberalization brought a sharp jump in the state-sector job destruction rate in both countries. While the jump is large, the post-reform destruction rates are no higher than in a typical US recession.<sup>49</sup> This finding is remarkable on two counts. First, even in the post-reform period, gross job flows in transition economies are relatively small. Despite tremendous shifts in the industry and ownership structure of employment, job destruction in post-reform Poland and Estonia occurs at the same rate as in the much more modest sectoral transformations that typify US recessions. Second, this finding provides an interesting perspective on the performance of more settled market economies. The United States, for example, accommodates periodic episodes of annual job destruction rates on the order of 15–17% with a 1–2% decline in aggregate employment and consumption that persists for no more than 2 years. A similar job destruction intensity in the post-reform transition economies involves much, much larger employment and consumption declines that persist for several years. One can read this comparison as a sign of dismal labor market

<sup>48</sup> Theoretical models that incorporate a social return to worker mobility include Jovanovic (1979), Miller (1984), Kremer (1993), Jovanovic and Nyarko (1997) and Davis (1997). Topel and Ward (1992) provide a detailed empirical study of the connection between job matching and wage growth among young men. Jovanovic and Moffitt (1990) estimate that the worker-job match quality improvements associated with worker mobility increase GNP by 6–9% in the United States.

<sup>49</sup> The annual job destruction rate in the US manufacturing sector was 16.5% in 1975, 14.5% in 1982 and 15.6% in 1983 (Davis et al., 1996, Table 2.1).

Table 16  
Annual worker and job flow rates by enterprise types, Poland and Estonia<sup>a</sup>

	1988	1989	1990	1991	1992	1993	1994
<i>Worker hiring rates</i>							
Estonia, collective		9.9	12.2	11.6	12.5	14.6	16.7
Estonia, private firms		70.2	104.5	125.6	104.8	76.6	59.8
Estonia, state enterprises		8.6	11.1	11.4	12.7	14.1	13.5
Estonia, all employees		9.7	13.5	16.4	21.1	25.3	26.5
Poland, continuing state enterprises, manufacturing	17.1	17.9	12.9	9.7			
Poland, state sector	17.3	16.2	12.2		11.9		
Poland, private sector					38.8		
<i>Job creation rates</i>							
Estonia, collective		0.4	0.4	0.0	0.0	0.0	0.0
Estonia, private firms		64.9	93.5	113.3	89.4	60.0	39.0
Estonia, state enterprises		0.0	0.5	0.0	0.0	0.4	0.5
Estonia, all employees		0.5	2.7	4.5	6.9	11.1	10.9
Poland, continuing state enterprises, manufacturing	0.7	2.0	0.6	1.0			
<i>Worker separation rates</i>							
Estonia, collective		10.9	15.8	20.7	34.3	36.4	29.8
Estonia, private firms		6.4	18.4	20.4	27.3	28.7	32.4
Estonia, state enterprises		10.7	13.9	18.0	28.0	26.8	21.9
Estonia, all employees		10.7	14.3	18.4	28.7	28.2	25.5
Poland, continuing state enterprises, manufacturing	20.0	22.9	27.6	26.0			
Poland, state sector	18.0	19.8	23.0		22.4		
Poland, private sector					36.3		
<i>Job destruction rates</i>							
Estonia, collective		1.4	3.9	9.1	21.9	21.8	13.1
Estonia, private firms		1.1	7.8	8.1	11.9	12.3	11.5
Estonia, state enterprises		2.1	3.2	6.6	15.4	13.1	8.9
Estonia, all employees		1.5	3.5	6.5	14.5	14.1	10.0
Poland, continuing state enterprises, manufacturing	3.6	6.1	15.3	17.6			

<sup>a</sup> Sources: (1) The figures for Estonia are from Haltiwanger and Vodopivec (1997) and are based upon a labor force survey of households. They measure point in time to point in time flows – i.e., flows for 1989 are changes for the period from January 1, 1989 to January 1, 1990. Job creation and destruction represent lower bounds on job flows. (2) The figures for Poland (continuing state enterprises, manufacturing) are from Konings et al. (1996, Table 2). They are based on firm-level measures of full-time employment. State firms include unincorporated state-owned enterprises, joint stock companies with 100% state ownership, and majority state-owned firms. (3) The other figures for Poland are from Coricelli et al. (1995, Table 2-13). The precise coverage of these data and their relationship to the data used by Konings et al. (1996) are unclear.

performances in the transition economies or as a sign of remarkable resilience in the United States and many other market economies.

Liberalization also brought a sharp jump in worker mobility. In Estonia, the sum of annual hiring and separation rates rose from 20–33% in 1989–1991 to 50–53% in 1992–1994. Over the same period, annual quit rates rose from 9–12% to 14–15%. The evolving employment distribution plays a surprisingly minor role in this aspect of the Estonian experience. Indeed, the rise in quit rates and the sharp jump in worker turnover rates holds separately for each type of Estonian enterprise listed in Table 16.

The fragmentary Polish evidence also points to greater worker mobility as a consequence of economic reform. In the Polish case, composition effects appear to be the main story. Within the state sector, the sum of hiring and separation rates changes little during the period covered by Table 16. The quit rate at continuing state manufacturing enterprises actually falls with the onset of major reforms in 1990. But sharp differences in worker mobility rates between the Polish private and state sectors imply large increases over time in economy-wide worker mobility rates. The sum of hiring and separation rates in 1992 is 34% in the Polish state sector and 75% in the Polish private sector. Projecting these figures onto the rising share of employment in the Polish private sector (Table 13) implies an increase in the economy-wide sum of hiring and separation rates from 46% in 1989 to 59% in 1995.

In summary, the evidence indicates that Polish and Estonian labor markets are evolving from a central planning regime with sharply curtailed worker mobility and job reallocation to a regime more like that of the United States or Western Europe. The Estonian economy has already progressed a great distance toward US-style labor market flows (Tables 14 and 16). The evidence for Poland points to a less rapid evolution of the labor market and perhaps an eventual destination more like that of labor markets in many Western European countries.

## **9. Cyclicality in job flows**

Prevailing academic theories of the business cycle stress the role of aggregate shocks that induce broadly similar outcomes among households and among workers. See, for example, the fine collection of essays in Cooley (1995). These theories abstract from mobility costs and other frictions associated with the reallocation of jobs, workers and capital. For the most part, they also abstract from heterogeneity on the household and firm sides of the economy. Because they abstract from reallocation frictions and heterogeneity, these theories of the business cycle are silent about the behavior of job and worker flows. For the same reason, they deliver rather stunted interpretations of unemployment fluctuations and related phenomena.

Recent research on labor market flows has greatly stimulated attention on the role of reallocation frictions and heterogeneity in aggregate economic fluctuations. Several facts about labor market flows contribute to this stimulus. We mention a few. First, cyclical

increases in unemployment predominantly reflect an increase in the number of workers who experience permanent job separations (e.g., Davis and Haltiwanger, 1998, Table 5). Second, postwar US recessions are characterized by an increase in the number of workers who flow through the unemployment pool (e.g., Davis et al., 1996, Chapter 6). Third, recessions often coincide with sharp spikes in job destruction activity for major sectors of the economy (Section 3.7). This burst of job destruction largely reflects permanent employment declines at the affected establishments (Section 3.3). Fourth, job loss often leads to repeated spells of unemployment before the displaced worker settles into a new stable employment relationship. As a consequence, cyclical increases in job destruction lead to persistent increases in the aggregate unemployment rate (Hall, 1995). These facts, and many others, point to an intimate relationship between aggregate fluctuations and the intensity of reallocation activity, as reflected in labor market flows.

Once we build models that incorporate reallocation frictions and heterogeneity among production units, two central implications become evident: (i) aggregate shocks influence the intensity of reallocation activity, and (ii) shocks to the structure of factor demand can drive fluctuations in the economic aggregates that occupy the attention of business cycle researchers. The precise nature and strength of these influences depend on the details of the economic environment.

Models with reallocation frictions also help to address some well-recognized shortcomings in prevailing theories of the business cycle. Standard equilibrium business cycle models generate little amplification of shocks for standard specifications of technology and preferences (Campbell, 1994, Table 3). Standard models also fail to explain the persistence properties of aggregate fluctuations (Cogley and Nason, 1995; Rotemberg and Woodford, 1996). As emphasized by Hall (1997a), the introduction of labor market frictions improves the performance of standard models along both of these dimensions.

We now review recent research that investigates the relationship between labor market flows and aggregate fluctuations. We focus on broad themes and omit many important details of theoretical and empirical work in this area. As complements to our discussion here, we encourage the reader to consult Mortensen (1994), Davis et al. (1996) and Hall (1997a).

### 9.1. Theoretical perspectives

Most theories that incorporate job and worker flows adopt the premise that the economy is subject to a continuous stream of *allocative shocks* – shocks that cause idiosyncratic variation in profitability among job sites and worker-job matches.<sup>50</sup> The continuous stream of allocative shocks generates the large-scale job and worker reallocation activity

<sup>50</sup> See Aghion and Blanchard (1994), Andolfatto (1996), Blanchard and Diamond (1989, 1990), Burda and Wyplosz (1994), Caballero (1992), Caballero and Hammour (1994, 1996a), Campbell (1997), Campbell and Fisher (1997), Davis and Haltiwanger (1990), Foote (1998), Gautier and Broersma (1993), Greenwood et al. (1994), Hall (1991), Hosios (1994), Mortensen (1994), Mortensen and Pissarides (1993, 1994), Ramey and Watson (1997), Yashiv (1995), Den Haan et al. (1997), Bergin and Bernhard (1996) and Saint-Paul (1996).

observed in the data. To explicitly model the job and worker reallocation process, these theories incorporate heterogeneity among workers and firms along one or more dimensions. Various theories also emphasize search costs, moving costs, sunk investments and other frictions that impede or otherwise distort the reallocation of factor inputs. The combination of frictions and heterogeneity gives rise to potentially important roles for allocative shocks and the reallocation process in aggregate economic fluctuations.

Theories of cyclical fluctuations in job and worker flows can be classified into two broad types. One type treats fluctuations over time in the intensity of allocative shocks as an important driving force behind aggregate fluctuations and the pace of reallocation activity. A second type maintains that, while allocative shocks and reallocation frictions are important, aggregate shocks drive business cycles and fluctuations in the pace of worker and job reallocation. Although different in emphasis, the two types of theories offer complementary views of labor-market dynamics and business cycles, and both point toward a rich set of interactions between aggregate fluctuations and the reallocation process.

#### *9.1.1. Allocative shocks as driving forces behind aggregate fluctuations*

One can think of allocative shocks as events that alter the closeness of the match between the desired and actual characteristics of labor and capital inputs (Black, 1987, Chapter 13). Adverse aggregate consequences can result from such events because of the time and other costs of reallocation activity. For example, the OPEC oil price shock of 1973 increased the demand for small, fuel-efficient cars and simultaneously reduced the demand for larger cars. American automobile companies were poorly situated to respond to this shock, because their capital stock and work force were primarily directed toward the production of large cars. Consequently, capacity utilization and output fell in the wake of the oil price shock, even though a handful of plants equipped to produce small cars operated at peak capacity (Bresnahan and Ramey, 1993).

In considering this view, it is important to emphasize that allocative shocks affect tangible inputs to the production process (labor and physical capital) and intangible inputs. These intangible inputs include the information capital embodied in an efficient sorting and matching of heterogeneous workers and jobs, knowledge about how to work productively with coworkers, knowledge about suitable locations for particular business activities and about idiosyncratic attributes of those locations, the information capital embodied in longterm customer-supplier and debtor-creditor relationships, and the organization capital embodied in sales, product distribution and job-finding networks. When allocative shocks upset established patterns of production, they devalue information and organization capital specific to that pattern of production (Caplin and Leahy, 1993; Blanchard and Kremer, 1997). Recreating information and organization capital suited to the new pattern of production requires experimentation, time and expense (Atkeson and Kehoe, 1997). Meanwhile, the productive potential of the economy is reduced by the obsolescence of old information and organization capital. In addition, measured output may decline relative to true output because of a shift toward unmeasured investment activities (Section 10.3).



These remarks make clear why the economic adjustments to these shocks are often costly and time consuming. It follows that sharp time variation in the intensity of allocative shocks can cause large fluctuations in gross job flows and in conventional measures of aggregate economic activity such as the output growth rate and the unemployment rate.

### *9.1.2. Reallocation timing effects*

For many reasons, adverse aggregate shocks can lead to a concentration of certain reallocation activities during recessions. First, an adverse aggregate shock can push many declining and dying plants over an adjustment threshold. During boom times, a firm may choose to continue operating a plant that fails to recover its long-run average cost, because short-run revenues exceed short-run costs, or because of a sufficiently large option value to retaining the plant and its work force. Adverse aggregate shocks also lead to a burst in job destruction and job search in the equilibrium search models of Mortensen and Pissarides (1993, 1994).

Second, the reallocation of specialized labor and capital inputs involves foregone production due to lost work time (e.g., unemployment or additional schooling), worker retraining, the retooling of plant and equipment, the adoption of new technology, and the organization of new patterns of production and distribution. On average across firms and workers, the value of foregone production tends to fluctuate procyclically, rising during expansions and falling during recessions. This cyclical pattern generates incentives for both workers and firms to concentrate costly reallocation activity during recessions, when the opportunity cost of the resulting foregone production is relatively low. This mechanism is highlighted in the models of Davis and Haltiwanger (1990), Hall (1991), Caballero and Hammour (1994) and Bergin and Bernhardt (1996).

Third, the curtailment of credit availability that often accompanies a recession causes investment cutbacks, employment declines and business failures among firms with imperfect access to credit markets, especially if those firms simultaneously experience declines in cash flow. To some extent, the cutbacks and failures induced by a credit crunch are likely to be concentrated among firms with weaker prospects for future profitability, but they are also concentrated among firms that – for whatever reason – face greater difficulties in overcoming informational problems that impede the flow of credit. Thus, a credit crunch induces a reallocation of capital and employment away from credit-sensitive sectors and firms toward sectors and firms that are less dependent upon outside sources of credit to fund current operations and investments. Blanchard and Diamond (1990) discuss this idea in the context of cyclical dynamics in job flows.

Fourth, adverse aggregate shocks may trigger the revelation of accumulated pieces of information that bear upon the desired allocation of jobs, workers and capital inputs. In other words, an adverse aggregate shock can lead to an increase in the intensity of allocative shocks. Schivardi (1997) develops this theme in an explicit theoretical model that builds on earlier work on information spillovers by Caplin and Leahy (1993, 1994). Davis et al. (1996, Chapter 5) and Horvath et al. (1997) provide related discussions.

### 9.1.3. *Non-convex adjustment costs*

As we pointed out in Section 3.4, the lumpiness of establishment-level employment adjustments points to a major role for fixed costs in the adjustment of labor or cooperating factors of production. Fixed costs of adjustment can strongly influence the cyclical behavior of job flows. A key point is that the cross-sectional distribution of production units, in terms of where they stand relative to their adjustment thresholds, influences the response to aggregate shocks.

Fixed cost of adjustment induce a subtle relationship between microeconomic and aggregate adjustment dynamics. Caballero (1992) considers an environment in which individual employers face asymmetric fixed costs of adding and shedding workers. In his setup, the adjustment cost asymmetry leads to greater lumpiness in destruction than creation at the plant level but equally volatile fluctuations in destruction and creation at the aggregate level. The heterogeneity among employers completely smoothes away the pronounced asymmetry in plant-level employment adjustments.

Nevertheless, non-convex adjustment costs can interact with other features of the economic environment to generate asymmetric cyclical dynamics in job creation and destruction. In Caballero's (1992) environment, destruction is more volatile than creation at the aggregate level, if aggregate shocks are positively serially correlated and negative ones tend to be less frequent and stronger than positive ones. Campbell and Fisher (1996) develop a related framework with asymmetric costs of employment changes and  $(S,s)$  adjustment behavior. They show that fixed costs of job creation can cause the optimal  $(S,s)$  bands to respond to aggregate disturbances in a manner that yields asymmetries in the cyclical dynamics of creation and destruction. Foote's (1997, 1998) explanation for the relative volatility of job creation and destruction, which we discussed in Section 3.7, plays off of the interaction between lumpy microeconomic adjustment behavior and trend growth in desired employment.

## 9.2. *Normative issues*

Caballero and Hammour (1996a, 1998a) highlight the potential for labor markets to malfunction because of appropriability or hold-up problems. These problems arise whenever investment in a new production unit or the formation of a new employment relationship involves some degree of specificity for workers or employers, and there are difficulties in writing or enforcing complete contracts. In their (1996a) model, Caballero and Hammour show that efficient restructuring involves synchronized job creation and destruction and relatively little unemployment. In contrast, the inefficient equilibrium restructuring process that emerges under incomplete contracts involves the decoupling of creation and destruction dynamics and relatively large unemployment responses to negative shocks. As discussed in Mortensen and Pissarides (1994), appropriability problems arise naturally in many search and matching models. Malcomson (1999) provides a broad discussion of hold-up problems in the labor market.

Ramey and Watson (1997) highlight the potential for inefficient separation outcomes in

a dynamic environment with incentive problems in the employment relationship. They develop an equilibrium search model with the following key features: (i) employment relationships that require cooperative behavior (high effort) to achieve efficient output levels, (ii) difficulty in maintaining cooperative behavior in bad states of the world, and (iii) sunk investments made by firms prior to match formation that influence the incentives for firm and worker to sustain cooperative outcomes in the face of bad shocks. In the Ramey–Watson environment, fragile employment relationships can develop in which bad shocks bring about a collapse in the incentives to put forth effort and sustain cooperation. In this way, bad states of the world trigger inefficient separations. Larger sunk investments lead to higher match surplus and hence stronger incentives to maintain cooperative behavior in order to preserve the relationship.

Incomplete risk-sharing raises important normative questions with respect to labor market flows. The welfare consequences of job creation and destruction activity obviously depend on the availability of risk-sharing mechanisms to job-losing and job-seeking workers. Risk-sharing opportunities are also likely to influence the efficiency of job search activity, separation behavior and match-specific investment decisions. Despite the importance of incomplete risk sharing in the context of job and worker reallocation activity, the analysis of dynamic labor market models with incomplete risk sharing is in its infancy. Gomes et al. (1996) is a first attempt to grapple with this issue. They analyze a dynamic equilibrium matching model with incomplete risk sharing and aggregate shocks that influence the distribution of match productivities and consumption levels. As modeling and computation techniques continue to improve, dynamic labor market models with incomplete risk sharing are likely to receive much greater attention.

### 9.3. Empirical evidence on the role of allocative shocks

Many empirical studies shed light on some of the theoretical issues discussed above. One issue that has received considerable attention is whether time variation in the intensity of allocative shocks is an important driving force behind aggregate fluctuations. A provocative paper by Lilien (1982) documented a strong, positive time-series relationship between aggregate unemployment and the cross-industry dispersion of employment growth rates in postwar US data. He interpreted this relationship as supporting the view that half or more of cyclical unemployment fluctuations were driven by sectoral shifts in labor demand or, in our terminology, the intensity of allocative shocks. Abraham and Katz (1986) questioned this interpretation. They set forth empirically plausible conditions under which Lilien's empirical evidence is consistent with the view that aggregate shocks are the main driving force behind aggregate fluctuations. They also documented a pattern of strong negative comovements between unemployment and vacancies over the business cycle, which they interpreted as confirming an aggregate shock view of unemployment fluctuations.<sup>51</sup>

<sup>51</sup> Blanchard and Diamond's (1989, 1990) conclusion that allocative shocks play little role in driving aggregate fluctuations also rests heavily on this interpretation of unemployment-vacancy comovements. On the suitability of this identifying assumption, see Hosios (1994) and Davis (1987).

The subsequent literature has tried various methods to identify the underlying contribution of allocative shocks to business cycle fluctuations. Many studies have adopted Lilien's basic approach but explored alternative and arguably better proxies for sectoral shocks. For example, Loungani et al. (1990) and Brainard and Cutler (1993) argue that the dispersion in stock returns is a better proxy for the intensity of allocative shocks. Both papers find that aggregate unemployment rises when stock return dispersion rises. Davis et al. (1997) find similar results in regional unemployment fluctuations. Shin (1997) relates unemployment fluctuations to intersectoral and intrasectoral dispersion in accounting measures of economic performance. However, like Lilien's measure, stock return and accounting measures of dispersion are outcomes and not direct measures of the intensity of allocative shocks.

An alternative approach imposes identification assumptions in structural VAR models. Blanchard and Diamond (1989, 1990), Davis and Haltiwanger (1990, 1996) and Campbell and Kuttner (1996) pursue the idea that aggregate shocks and allocative shocks generate different covariance properties for key variables like unemployment and vacancies or job creation and destruction. In terms of job flows, the basic insight is that aggregate shocks cause job creation and destruction to move in opposite directions, whereas allocative shocks cause them to move in the same direction. This insight is helpful but provides only qualitative identifying restrictions rather than exact identification. Davis and Haltiwanger (1996) and Campbell and Kuttner (1996) both conclude that these qualitative restrictions are insufficient to pin down with much precision the importance of allocative shocks as driving forces behind aggregate fluctuations.<sup>52</sup> However, the qualitative restrictions imply a systematic tradeoff between the contribution of aggregate shocks and the contemporaneous response of job destruction to an aggregate shock innovation. Specifically, aggregate shocks are the dominant driving force only if they are allowed to have disproportionately large contemporaneous effects on job destruction. In a related finding, Davis and Haltiwanger (1999) report that energy price and interest rate spread innovations lead to much larger short-run responses in job destruction than in job creation.

In another approach, Caballero et al. (1997) achieve identification by imposing a structure that permits the measurement of desired and actual employment at individual plants. Their structure allows for nonlinear employment dynamics of the sort that arise in models with fixed costs of factor adjustment, and it separately identifies common and idiosyncratic forces that underlie changes in desired employment.<sup>53</sup> Under their approach to identification, they find that aggregate shocks are the dominant driving force behind aggregate employment fluctuations. They also find a highly nonlinear plant-level employment

<sup>52</sup> These two papers also restrict contemporaneous and long run responses to aggregate shocks and allocative shocks in order to achieve exact or over identification.

<sup>53</sup> Unlike the structural VAR approach, the CEH approach does not require assumptions about the correlation between aggregate shocks and the intensity of allocative shocks. Empirically, CEH find a negative time series correlation between aggregate shocks and the second moment of the cross-sectional distribution of idiosyncratic shocks.

response to movements in desired employment – plants with large differences between actual and desired employment adjust relatively more.

The findings of Caballero et al. (1997) are also relevant to asymmetric cyclical dynamics in job creation and destruction. In particular, they find that the job flows generated by aggregate shocks in their framework exhibit the asymmetric cyclical patterns described in Section 3.7 for the manufacturing sector. This result implies that it is possible to account for the cyclical asymmetry in creation and destruction by allowing for sufficient non-linearity in microeconomic adjustment behavior. Finally, several studies relate direct measures of sectoral or allocative shocks to cyclical fluctuations in unemployment, employment and job flows. In light of the major oil price shocks that struck the economy in 1973–1984, 1979–1980 and 1986, most studies of this sort focus on energy price shocks. Bresnahan and Ramey (1993), Davis and Haltiwanger (1999), Davis et al. (1997), Loun-gani (1986) and Mork (1989) develop evidence that energy price shocks drive aggregate fluctuations by upsetting established patterns of production and triggering a costly reallocation process. Atkeson and Kehoe (1994) and Hamilton (1988) develop related theoretical interpretations.

## 10. Job flows, productivity and welfare: selected theoretical issues

This section provides a theoretical treatment of selected issues that arise in connection with job flows. We set forth a simple model of job flows with costly worker mobility and specific physical capital.<sup>54</sup> We use the model to address several topics: (i) the effects of policies that impede job flows, (ii) the productivity-enhancing role of factor reallocation, (iii) reallocation dynamics in transition economies, and (iv) the role of job flows in long-term growth.

### 10.1. A simple model of investment and job flows

We introduce general and specific forms of physical capital into a model of Davis and Haltiwanger (1990). The model incorporates two frictions associated with job creation and destruction: the abandonment of physical capital and a time cost of moving for workers.

Consider an economy with a unit mass of consumer-workers distributed over two types of production sites. A fraction  $H_t$  of the workers begin period  $t$  matched to high-productivity sites, and the remaining workers are matched to low-productivity sites. Each period, a fraction  $\sigma_t$  of the high-productivity sites suffer adverse shocks that cause them to revert to low-productivity status. As existing high-productivity sites suffer adverse shocks, an equal (or larger) number of potential high-productivity sites becomes available. These shocks to the spatial distribution of production opportunities inject a continuous stream of allocative disturbances into the economy.

When matched to a worker, low-productivity sites produce  $(Q_t L_t)^{1-\alpha} K_L^\alpha$  units of output.

<sup>54</sup> Other dynamic equilibrium models that incorporate both costly worker reallocation and specific physical capital include Bergin and Bernhard (1996), Caballero and Hammour (1996a), and Den Haan et al. (1997).

Here,  $Q_t$  denotes the exogenously determined technology level,  $L_L$  governs labor efficiency at low-productivity plants, and  $K_L$  denotes the amount of general (i.e., mobile) physical capital allocated to low-productivity sites. *Operational* high-productivity sites produce  $(Q_t L_H)^{1-\alpha} K_H^\alpha$  when matched to a worker, using analogous notation.

To make the potential new sites operational requires two forms of specific investment: site-specific physical capital, and worker mobility from a low-productivity site to the new site. These two investments capture the costly nature of job creation and match formation in a simple manner. Let  $\gamma$  denote the (expected) fraction of a period required for a worker to move between sites, and let  $\theta_t$  denote the fraction of workers at low-productivity sites that moves in period  $t$ . The nature of the investment in site-specific physical capital is spelled out below.

We now formulate the aggregate production possibilities and laws of motion for the economy. Aggregate labor efficiency units are given by

$$Q_t l_t = Q_t \{ [H_t(1 - \sigma_t) + (1 - H_t + \sigma_t H_t)\theta_t(1 - \gamma)]L_H + (1 - H_t + \sigma_t H_t)(1 - \theta_t)L_L \}, \tag{13}$$

which reflects the assumption that mobility occurs after the realization of shocks. The terms multiplying  $L_H$  and  $L_L$  equal employment at high-productivity and low-productivity plants, respectively.

An efficient spatial allocation of mobile capital requires equal amounts of capital per labor efficiency unit at each site. Using this spatial allocation condition and the efficiency units expression (13), we can write gross aggregate output as

$$Y_t = (Q_t l_t)^{1-\alpha} K_t^\alpha = Q_t l_t k_t^\alpha, \tag{14}$$

where  $k_t$  denotes capital per efficiency unit of labor in period  $t$ .

Aggregate consumption satisfies

$$C_t = Y_t - I_t - s[\theta_t(1 - H_t + \sigma_t H_t)]^\phi, \quad s > 0, \phi > 1, \tag{15}$$

where  $I_t$  denotes investment in general capital, and the third term captures the output devoted to investment in specific physical capital. The quantity inside the square brackets equals the number of new sites made operational during period  $t$  through specific investment and mobility. According to Eq. (15), specific physical capital is created subject to increasing marginal costs. This assumption captures the appealing notion that rapid creation of specific assets is costly, and it facilitates the existence of a steady-state equilibrium with interior solutions for  $\theta$  and  $H$ .

The two endogenous aggregate state variables in the economy satisfy

$$H_{t+1} = H_t(1 - \sigma_t) + \theta_t(1 - H_t + \sigma_t H_t) \tag{16}$$

and

$$K_{t+1} = I_t + (1 - \delta)K_t, \tag{17}$$

where  $\delta$  is the depreciation rate for general physical capital.

Consumer-workers order alternative stochastic consumption streams according to the expected value of

$$\sum_{t=0}^{\infty} \beta^t A_t U(C_t)$$

where the time discount factor  $\beta \in (0,1)$ ,  $A_t$  is an exogenous random variable that shifts the desired timing of consumption, and  $U(\cdot)$  is a period utility function obeying the usual concavity and Inada conditions.

In this economy, we think of  $A_t$  and  $Q_t$  as aggregate taste and technology disturbances, and we think of  $\sigma_t$  as indexing the intensity of shocks to the preferred spatial allocation of factor inputs. These allocative shocks reflect location-specific disturbances to technology and the performance of installed capital goods.<sup>55</sup> Shocks to the size of  $L_H$  relative to  $L_L$  could be incorporated into the model to capture a different notion of allocative disturbances. Exogenously determined government consumption could be introduced through a straightforward modification to the aggregate resource constraint (15). These five categories of shocks –  $A$ ,  $Q$ ,  $\sigma$ , the ratio ( $L_H/L_L$ ), and government purchases – are likely to induce different dynamics in gross job flow and investment activity.

Equilibrium outcomes in this economy hinge crucially on assumptions about market structure. One key issue involves the sharing of consumption risks implied by costly worker mobility across plants with different stochastic productivity streams. The second key issue is the bilateral monopoly problem that potentially arises in connection with the sunk investments made by workers and firms in new production sites.<sup>56</sup> We focus on the complete markets case with full sharing of consumption risks and competitive wage determination prior to sunk investments.

Under complete markets, and focusing on interior solutions, equilibrium dynamics satisfy the Euler equations for general investment ( $I$ ) and specific investment ( $\theta(1 - H + \sigma H)$ ):

$$AU'(C) = \beta E[(1 + \widetilde{MP}_K - \delta)\widetilde{A}U'(\widetilde{C})], \tag{18}$$

$$\begin{aligned} AU'(C)\{s\phi[\theta(1 - H + \sigma H)]^{\phi-1} + [L_L - (1 - \gamma)L_H]MP_L\} \\ = \beta E\{(1 - \widetilde{\sigma})[s\phi(\widetilde{\theta}(1 - \widetilde{H} + \widetilde{\sigma}\widetilde{H}))^{\phi-1} + [\gamma L_H \widetilde{MP}_L]\widetilde{A}U'(\widetilde{C})\}. \end{aligned} \tag{19}$$

Here, a tilde denotes a next-period value, and the expectations are taken conditional on current information, which includes knowledge of  $A$ ,  $Q$  and  $\sigma$ . The factor marginal products for general capital and labor efficiency units are given by  $MP_K = \alpha k^{\alpha-1}$  and  $MP_L = (1 - \alpha)Qk^\alpha$ .

As indicated by Eq. (19), the stochastic rate of return to specific investment is influenced

<sup>55</sup> In richer formulations of the model, they might also reflect shocks to the cost of locally supplied inputs and demand for the site's output.

<sup>56</sup> See, for example, Gomes et al. (1996) on the first issue and Caballero and Hammour (1997) on the second.

by several current and future factors. The first term inside the braces on the left side of Eq. (19) equals current output devoted to specific investment in the marginal new site. This term depends on the current marginal product of labor and the amount of worker mobility. The second term in braces represents the current output foregone by moving one more worker, a negative quantity when the time costs of moving are sufficiently small. These two output costs are valued at  $AU'(C)$ . On the right-hand side of Eq. (19), the  $(1 - \bar{\sigma})$  term represents a stochastic depreciation rate on investment in specific human and physical capital. Other terms on the right side indicate that the rate of return to specific investment also depends on the future level of specific investment and the future marginal product of labor.

For suitable parameter values, this model exhibits a steady-state equilibrium with interior solutions for all variables. Table 17 displays steady-state outcomes for selected parameter settings. The outcomes look sensible, which encourages us toward further analysis of the model.

10.2. Choking off the creative destruction process

Governments often implement labor market policies that impede job flows and, as a consequence, the reallocation of workers and cooperating factors of production. These policies can hamper the efficiency of factor allocations with adverse consequences for productivity and welfare. Well-known theoretical analyses of this topic include Bentolila and Bertola (1990) and Hopenhayn and Rogerson (1993).

To address this issue, we start from a steady-state equilibrium and trace out the dynamic response to a complete shutdown of job flows in a non-stochastic version of the model. That is, we set  $\theta_t = 0$  for  $t \geq 0$ , which we think of as an extreme version of policies that impede job reallocation. To evaluate the welfare effects of this policy intervention, we compute the equivalent consumption variation,  $x$ , as the solution to

$$\frac{\log[\bar{C}(1 - x)]}{1 - \beta} = \sum_{t=0}^{\infty} \beta^t \log(\tilde{C}_t),$$

where  $\bar{C}$  denotes consumption in the initial steady-state equilibrium, and  $\tilde{C}_t$  is the consumption path following the intervention.

Fixing the level of technology  $Q$ , setting  $U(C) = \log C$ , substituting from Eqs. (13)–(17) into Eq. (18), and imposing  $\theta = 0$  yields a second-order nonlinear difference equation in  $K_t$ :

$$\frac{(Ql_{t+1})^{1-\alpha} K_{t+1}^\alpha - K_{t+2} + (1 - \delta)K_{t+1}}{(Ql_t)^{1-\alpha} K_t^\alpha - K_{t+1} + (1 - \delta)K_t} = \beta[1 - \delta + \alpha(Ql_{t+1})^{1-\alpha} K_{t+1}^{\alpha-1}], \quad t \geq 0. \quad (20)$$

The difference equation is not autonomous, because the coefficients involving  $l_t$  and  $l_{t+1}$  evolve over time in line with Eqs. (13) and (16). The path for physical capital following the policy intervention solves Eq. (20) with boundary conditions  $K_0 = \bar{K}$  (initial steady state) and  $\lim_{t \rightarrow \infty} K_t = \tilde{K}$  (new steady state).



Table 17

Steady-state outcomes in theoretical model (baseline parameter settings:  $\alpha = 0.3, \beta = 0.99, \delta = 0.025, L_L = 1, Q = 1$ )

Row	Other parameter settings					Outcomes						
	$L_H$	$\sigma$	$\gamma$	$\phi$	$s$	$\theta$	$H^a$	General capital share <sup>b</sup>	Specific capital share <sup>c</sup>	$SUM \times 100^d$	Unemployment rate $\times 100^e$	Fraction of wealth in specific forms <sup>f</sup>
1	2.0	0.10	0.50	2.0	200	0.053	0.36	0.21	0.08	7.3	1.8	0.15
2	2.0	0.10	0.50	2.0	100	0.203	0.72	0.21	0.12	14.9	3.6	0.22
3	2.0	0.10	1.00	2.0	200	0.044	0.31	0.21	0.06	6.5	3.1	0.14
4	2.0	0.08	0.50	2.0	200	0.092	0.56	0.21	0.11	9.2	2.2	0.23
5	2.0	0.10	0.50	2.2	200	0.120	0.58	0.21	0.10	11.9	2.9	0.20
6	2.2	0.10	0.50	2.0	200	0.071	0.43	0.21	0.10	8.9	2.2	0.19

<sup>a</sup>  $H$ , the fraction of workers who begin the period matched to a high-productivity site, is given by

$$H = \left(\frac{1}{\sigma}\right) \left(\frac{MP_L[(1 - \gamma)L_H + \beta(1 - \sigma)\gamma L_H - L_L]}{[1 - \beta(1 - \sigma)]s\phi}\right)^{1/(\phi-1)},$$

where

$$MP_L = (1 - \alpha)k^\alpha \quad \text{and} \quad k = \left(\frac{1 + \beta\delta - \beta}{\beta\alpha}\right)^{1/(\alpha-1)}.$$

<sup>a</sup> General capital's output share equals  $HY$ .

<sup>b</sup> Specific capital's output share equals  $s[\theta(1 - H + \sigma H)]^\phi Y$ .

<sup>c</sup>  $SUM$  is the job reallocation rate (the sum of job creation and destruction divided by employment), computed as  $[2\theta(1 - H + \sigma H)]/(1 - \text{unemployment rate})$ .

<sup>d</sup> The unemployment rate equals  $\theta(1 - H + \sigma H)\gamma$ .

<sup>e</sup> The fraction of wealth in specific forms equals  $V_H H / (V_H H + V_K K)$ .

Fig. 12 displays the pre-intervention steady-state outcomes and the post-intervention response path for a particular parameter configuration.<sup>57</sup> The ratio of high-to-low productivity is 2.4 for total factor productivity and 3.5 for labor productivity, which are in line

<sup>57</sup> To simplify the numerical solution in a more complicated experiment below, we restrict attention to the full depreciation case  $\delta = 1$  for general physical capital. In this case, a simple change of variables reduces Eq. (20) to a first-order difference equation.

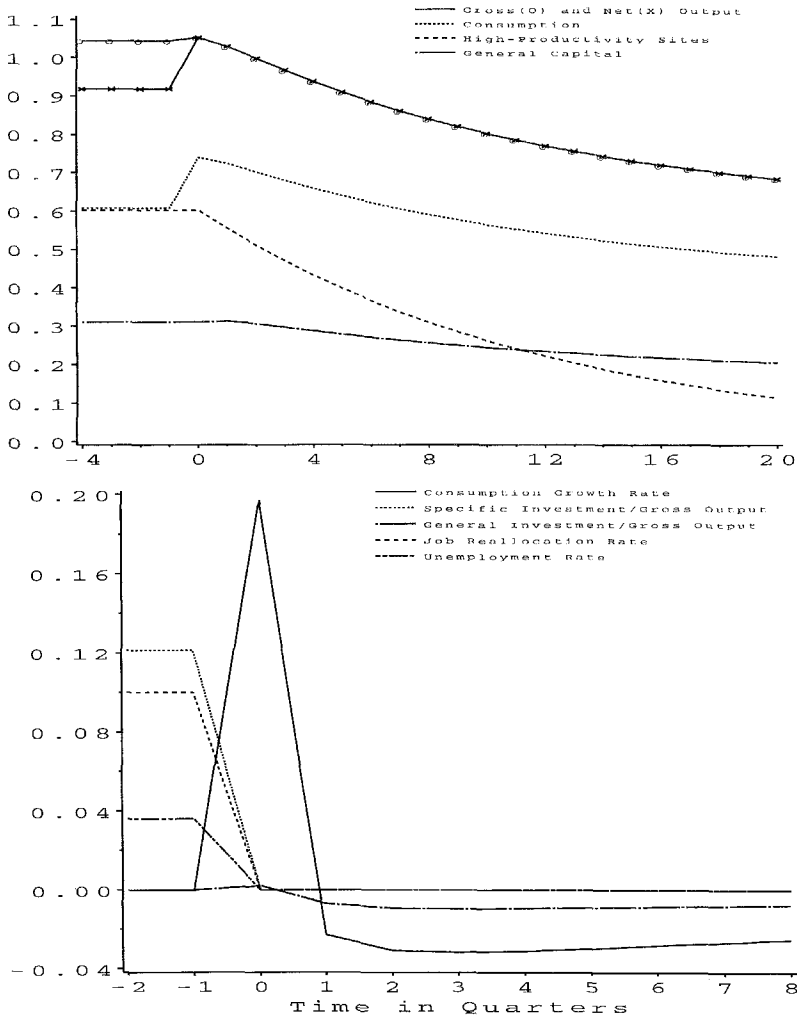


Fig. 12. Creative destruction shut down at time 0.  $\sigma = 0.08, s = 100, \gamma = 0.75, \phi = 2.2, \beta = 0.99, \delta = 1.0, \alpha = 0.3$ , low productivity = 1.0, high productivity = 2.4.

with empirical evidence on between-plant productivity differentials (see, e.g., Bartelsman and Doms, 1997). The value of  $\gamma = 0.75$  corresponds to an unemployment spell length of slightly less than 10 weeks.

The initial steady state exhibits a job reallocation rate of 10% per quarter and a frictional unemployment rate of 3.6%. Roughly 12% of gross output is devoted to investment in site-specific physical capital. In practice, investment in specific forms of physical capital may

involve foregone output rather than measured capital expenditures. For this reason, we report output gross and net of specific physical investment costs.

The shutdown of creative destruction triggers responses that look like a consumption-led business cycle boom. Consumption rises by 20% in the intervention period and remains above the pre-intervention level for 2 years. Unemployment and job reallocation decline (to zero). Investment in general physical capital rises very slightly and then declines slowly. Output rises initially, more so when calculated net of investment in specific physical capital.

The time-0 increase in gross output reflects the increase in aggregate labor efficiency units as workers shift from reallocation to production activities. The sharper, more sustained rise in net output reflects, in addition, a shift in the composition of output away from specific investment activities. In practice, certain specific investments (e.g., adjustment costs associated with changing the scale of operations) are unlikely to show up in measured output figures. In this regard, net output exceeds its pre-intervention level for one year following the shutdown of creative destruction.

These results suggest that policy barriers to job reallocation and creative destruction can have highly favorable shortterm effects on standard measures of aggregate economic performance. By enriching the model to include specific investment in information and organization capital along the lines of Prescott and Visscher (1980), Jovanovic (1982) or Atkeson and Kehoe (1997), it seems likely that the policy responses would look even more favorable (in the short term) and be more persistent. Greater substitution possibilities between specific and general forms of physical capital would presumably lead to a larger impact effect on general capital.

Despite the favorable shortterm effects, choking off the creative destruction process causes large welfare losses. For the numerical experiment in Fig. 12, the equivalent consumption variation equals 25.8% of initial steady-state consumption. In other words, the representative agent would be willing to forego one-quarter of consumption in the current and all future periods to preserve the creative destruction process. This welfare loss reflects the longer term decline in consumption and output caused by choking off productivity-enhancing factor reallocation (see Section 7).

This analysis suggests why societies might adopt policies that restrict job flows and the creative destruction process, even though such policies cause large declines in productive efficiency and welfare. In the short term, restrictions on job flows improve consumption and other standard measures of economic performance. Looking beyond the model, such policies may also function as second-best risk-sharing institutions or serve the interests of particular constituencies at the expense of the general welfare. Furthermore, when job flows and creative destruction have been suppressed for a period of time, a renewal of the process may be accompanied by highly unfavorable shortterm consequences, as we demonstrate below.

Our discussion of policies that impede job flows omits much important research on employment security laws, job destruction taxes, firing costs and related issues. Lindbeck and Snower (1988), Saint-Paul (1996), Bertola (1998), Booth (1997) and Mortensen and

Pissarides (1994) contain rich treatments of these issues and extensive references to the literature.

### 10.3. *Unleashing the creative destruction process*

We now reverse the previous experiment and trace out the dynamic response to unleashing the creative destruction process. Starting from a steady-state equilibrium with  $\theta = 0$ , we compute the transition path implied by Eqs. (13)–(19).<sup>58</sup> We think of this experiment as a crude counterpart to opening up the creative destruction process in the post-communist transition economies. While the experiment omits many important aspects of the transition experience, it captures the pent-up need for factor reallocation.

Fig. 13 displays results for the same parameters as in Fig. 12. The shortterm fallout from unleashing the creative destruction process is highly unfavorable by standard measures of economic performance. Consumption initially declines by 21% and requires six quarters to return to its initial level. Net output initially declines by 15% and requires three quarters to return to its initial level. Of course, unemployment and job destruction rise sharply. We conclude that even an optimally functioning transition economy can experience a sharp and sustained deterioration in economic performance, as conventionally measured. Recalling our discussion of Atkeson and Kehoe (1997) in Section 8.1, this conclusion is likely to be strengthened by the introduction of other mechanisms for the accumulation of specific capital.

To our surprise, the initial pace of reallocation activity undershoots rather than overshoots the new steady-state levels. The job destruction rate and the unemployment rate jump sharply at time 0 but to levels that fall well short of long-run values. (Compare the transition outcomes in Fig. 13 to the pre-intervention outcomes in Fig. 12.) Evidently, the consumption and investment smoothing incentives built into the model promote a gradual movement towards high job flow and unemployment rates. Another relevant feature of the model is the fixed relative productivity values,  $L_H$  and  $L_L$ . A richer specification in this regard might lead to a large initial burst of reallocation activity to quickly pursue the most attractive new opportunities.

Despite the shortterm pain, the longer term gains to unleashing the creative destruction process are enormous in the example of Fig. 13. Output, labor efficiency and general physical capital grow steadily following the onset of creative destruction, eventually rising more than 75% above initial values. Consumption eventually rises to 45% above its initial level, and the welfare gain (equivalent variation) amounts to nearly 35% of initial consumption.

<sup>58</sup> Substituting Eqs. (13)–(17) into (18) and (19) yields a system of two non-linear, non-autonomous, second-order difference equations in  $H_t$  and  $K_t$ . After using a change of variable to reduce Eq. (18) to a first-order equation, we numerically solve Eq. (18) and (19) one at a time, iterating back and forth between them until convergence. At each iteration, we use a shooting method to solve Eq. (19).

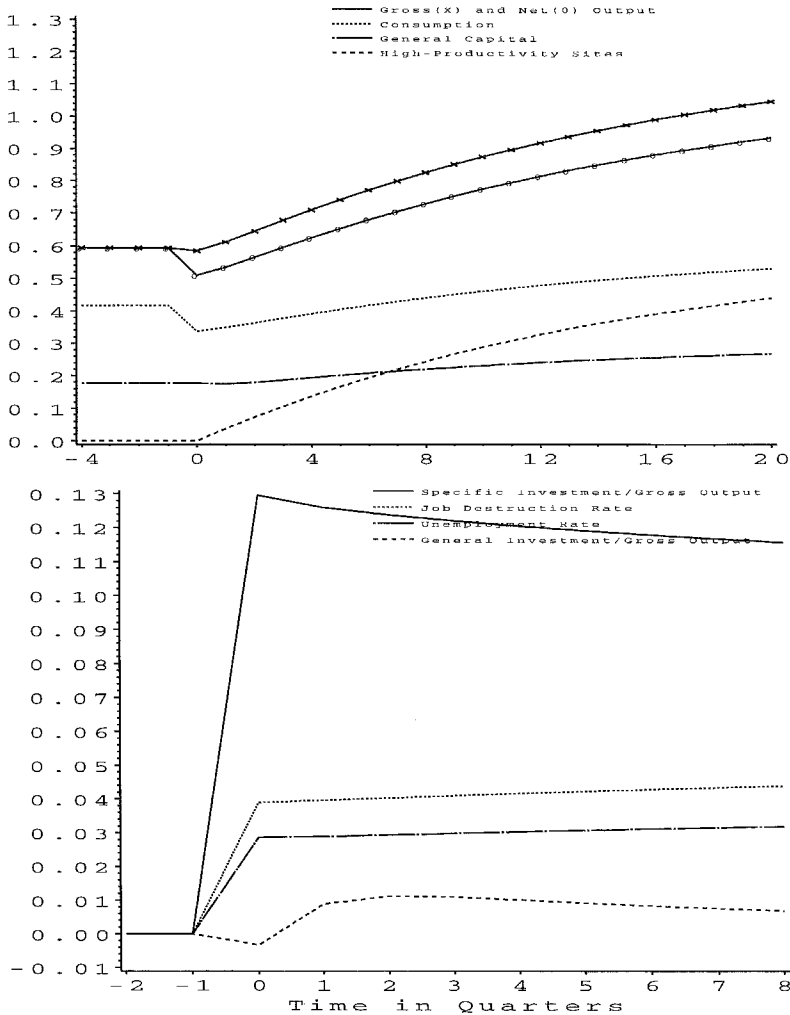


Fig. 13. Creative destruction unleashed at time 0.  $\sigma = 0.08, s = 100, \gamma = 0.75, \phi = 2.2, \beta = 0.99, \delta = 1.0, \alpha = 0.3$ , low productivity = 1.0, high productivity = 2.4.

10.4. Job flows and longterm growth

Suppose that  $Q$  and  $s$  grow at the steady rate  $Q$ , while  $A$  and  $\sigma$  remain constant over time. As before, let  $U(C) = \log(C)$ . Under these assumptions, the model exhibits a balanced growth path with steady growth in consumption, general capital and output at rate  $Q$  and along which the intensity of reallocation activity remains constant:

$$\text{capital per labor efficiency unit} = k = \left[ \frac{1 + q + \beta\delta - \beta}{\alpha\beta} \right]^{1/(\alpha-1)}, \quad (21)$$

$$\text{job flows} = \sigma H = \left( \frac{[(1 - \gamma)L_H + \beta(1 - \sigma)\gamma L_H - L_L](1 - \alpha)k^\alpha}{[1 - \beta(1 - \alpha)]s\phi} \right)^{1/(\phi-1)}, \quad (22)$$

$$\text{unemployment} = \gamma\sigma H. \quad (23)$$

It follows immediately from these equations that more rapid growth corresponds to a lower stock ( $H$ ) of relatively productive sites, smaller job creation and destruction rates, and a lower unemployment rate. In other words, the model delivers a negative relationship between longterm growth and the intensity of creative destruction activity.

This implication of the model runs counter to Schumpeter's "essential fact about capitalism." Moreover, choking off the creative destruction process in this model causes no permanent slowdown in economic growth. In sharp contrast, Aghion and Howitt's (1992) model incorporates Schumpeter's view by inextricably tying innovation and growth to the creative destruction process. Creative destruction is essential to growth in their model, and more rapid growth corresponds to more intense creative destruction. Similar remarks apply to the vintage models of Caballero and Hammour (1994, 1996a) that feature exogenous technological improvements embodied in new capital goods.

In comparing these models of the creative destruction process, we immediately see that theory makes no general prediction about the empirical relationship between longterm growth and the pace of factor reallocation. The comparison also highlights two very different views about the causal connection between longterm growth and factor reallocation. One view, illustrated by the numerical experiments in Figs. 12 and 13 ties creative destruction to the level of productivity and output. Another view ties creative destruction to their longterm growth rates.

The studies to date on job flows and factor reallocation provide little help in assessing the relative merits of these alternative views of the creative destruction process. The empirical work reviewed in Section 7.2 clearly points to a major role for factor reallocation in industry-level productivity gains, but it is not clear whether and how much factor reallocation contributes to the longer term growth rate of output.

## 11. Concluding remarks

This chapter synthesizes and adds to the growing body of research on gross job flows and related topics. Progress in this area has been rapid in recent years, but many key issues remain unresolved and some important questions have as yet received scant attention. We have pointed out some of the unresolved issues and open lines of inquiry along the way.

Our essay devotes little attention to some important topics that are closely related to the behavior of job flows or their consequences: the job search process, employer-worker

matching, earnings losses among job-losing workers, inefficient separations because of asymmetric information and incentive problems, limited risk sharing and unemployment insurance, wage-setting institutions and job creation, job security provisions, and other policies that influence labor market flows and factor allocations. Fortunately, several of these topics receive careful treatment in other *Handbook* chapters. See, especially, Abowd and Kramarz, Bertola, Farber, Nickell and Layard, Machin and Manning, and Mortensen and Pissarides.

An understudied line of empirical inquiry involves questions of how and why wages vary with employer-level job growth and worker turnover. The advent of rich datasets that link workers and employers and follow each over time seems likely to bring this type of question to the forefront of future work on labor market flows. This development may eventually bring about a much closer integration of work on labor market flows with work on wage determination and other traditional topics in labor economics.

Recent work indicates that this process has begun. Belzil (1997) investigates how individual wages vary with firm-level measures of job creation and worker turnover. He exploits a remarkable dataset that links a random sample of Danish firms to their workers and follows each over a twelve-year period. The dataset contains excellent controls for standard human capital variables and is rich enough to permit worker and firm fixed effects. Conditional on firm and worker controls, Belzil finds that male wages are higher at firms with (contemporaneously) higher job creation rates. Results vary with sample and estimation method, but the effect is very large: 2–4% higher wages for each additional percentage point of (annual) net job growth. He also finds some evidence that wages are higher at firms with higher rates of worker turnover (accessions plus separations). The wage response to firm-level job creation and worker turnover is larger for new hires and for workers who have low job tenure. These results clearly point to the role of entry-level wages as an instrument for influencing the firm's job creation rate. They do not favor the view that higher wages reduce turnover costs, but instead suggest that higher wages help attract workers and compensate them for high separation risk.

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