

How occupational employment is affected by mass layoffs

An analysis of business establishment microdata—created by combining microdata from the Occupational Employment Statistics program and the Mass Layoff Statistics program—reveals that jobs lost between 2000 and 2007 in establishments where extended mass layoffs occurred tended to be those which required less training and fewer analytical skills; jobs in occupations that were core to the specific industry generally were retained

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In recent years, mass layoffs have affected large numbers of workers.¹ Even during times of stable employment levels or economic expansion, mass layoffs occur because of cost-cutting initiatives, relocation of operations, changes in technology or consumer demand, or other reasons. Not surprisingly, some occupations are more affected by these layoffs than are others. By using a sample of establishments that had at least one extended mass layoff during the 2000–2007 period, this article examines the types of jobs affected by layoffs. An examination of this period offers insight into the mass layoff effects on occupational employment before the start of the 2007–2009 recession.²

By combining data from two Bureau of Labor Statistics programs—Mass Layoff Statistics (MLS) and Occupational Employment Statistics (OES)—pre- and post-layoff employment snapshots were compared for each sampled establishment. The total employment of the 4,520 establishments in the sample was more than 2.5 million before layoffs and less than 2.2 million after layoffs—an overall decline in employment of approximately 350,000 jobs, or 14 percent. This study focuses on changes in occupational employment overall and by industry, geographic region, and reason for the layoff.

The pattern of changes shows that, in

general, occupations that were retained or whose employment expanded after layoffs were those that tended to require analytical skills and extensive technical training, such as computer, financial, and legal analysts. Establishments generally let go of workers in occupations that tended to require less training, such as clerical and personal care occupations, and in occupations that tended to require mainly nonanalytical skills, such as material moving and production occupations. This finding was evident in the most commonly reported reason for layoffs.

This overall pattern was driven, in part, by the industries that experienced relatively large numbers of layoff events and by the occupations' relative importance in their respective industries. Layoffs in the manufacturing and information technology industries during the study period contributed to the employment declines in production and computer occupations; however, these occupations' relative importance to their respective industries seemed to lessen the impact of the layoff.

A second finding was that establishments were more likely to retain employment in occupations that are core to their industry. For example, establishments in finance and insurance industries tended to increase employment in business and financial operations occupations, schools tended to increase

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employment of teachers, and hospitals tended to increase employment in healthcare occupations, despite layoffs in other occupations. Other industries saw declines in core occupations, but the declines were smaller than the declines in occupations with support functions.³ For example, manufacturing industries saw employment declines in most occupational groups, but production workers were laid off at lower rates than were production workers in other industries.

This finding was most noticeable in geographic regions where mass layoffs occurred in industries that were dominant in their economies. For example, the Midwest, which had higher employment concentrations in manufacturing and wholesale and retail trade industries than did other regions, lost relatively fewer workers in occupations core to those sectors: production, sales, and transportation occupations. The other regions had larger percentage declines in employment in these occupations. Likewise, the West region, which had relatively high concentrations of employment in motion picture and sound recording industries, lost relatively little employment in arts, design, entertainment, and media occupations.

Methodology and data description

The first step was to identify establishments that had an extended mass layoff and also had reported occupational employment data to the OES survey both before and after the layoff event. To obtain the largest number of sample observations, establishments that had a layoff during the 2000–2007 period were matched with OES data from 1999 to 2008.

MLS defines the universe of extended mass layoffs as private nonfarm establishments that had at least 50 initial claims for unemployment insurance benefits filed against them during a 5-week period, with at least 50 workers separated for more than 30 days.⁴ Companies were identified by their State-specific unemployment insurance (UI) number. From 2000 to 2007, there were 45,027 extended mass layoff events. Excluding Puerto Rico, the full MLS dataset contained 44,623 events. The OES data set comes from a nationwide establishment survey of occupational employment and wages. Some 400,000 business establishments are surveyed every year, and 2,611,373 distinct establishments reported data between January 1999 and May 2008.⁵

If multiple layoffs occurred within a company and county, only the first layoff event was used, in order to best capture the occupations most vulnerable to layoff. Of the 44,623 layoff events, many were within both the same

company and county. Counting only the first event, there were 24,537 unique company/county layoff events. MLS records were matched to OES establishments by State, county, and UI account. There were 10,969 events that had at least one corresponding OES observation. An MLS record may match more than one of the company’s establishments in the OES survey if there are several establishments within a county.

These “before” OES observations were linked to corresponding “after” observations by UI account number, State, county, and Reporting Unit Number (RUN, a number that identifies a particular physical establishment under a parent company or UI account). The sample included multiple matching pairs of OES observations, to maximize the chance of capturing the establishments that had layoffs. The sample included all branches within the county and UI account that had the same sets of physical establishments report both before and after the layoff. Hence, the study essentially examines the effect of company-level layoffs on staffing across branches within the county.

The study found 4,520 usable sets of “before layoff” and “after layoff” OES observations, a total of 9,040 observations. The 4,520 observations that were in both the OES and MLS data represented slightly more than 10 percent of the layoff events during the 2000–2007 period. Because total OES unweighted employment in these establishments before layoffs was 2,517,133, and total unweighted employment after layoffs was 2,165,688, the net loss was 351,445 jobs.⁶

Approximately 96 percent of the OES observations occurred within the 4 years preceding the layoff event, and nearly 90 percent of OES observations occurred within the 4 years following the layoff event. Table 1 shows the distribution of establishments by the number of years between the OES observation and the first layoff. The lag

Number of years	Observations before layoff	Observations after layoff	Cumulative percentage of total, before	Cumulative percentage of total, after
0	715	416	15.8	9.2
1	1,342	1,081	45.5	33.1
2	1,303	1,237	74.3	60.5
3	754	857	91.0	79.4
4	232	442	96.2	89.2
5	101	230	98.4	94.3
6	55	170	99.6	98.1
7	17	84	100.0	99.9
8	1	3	100.0	100.0
Total	4,520	4,520	n/a	n/a

between data capture and layoff may impose limitations on the research findings. By the time the establishment's staffing was captured the second time, employment may have returned to its original levels, some workers may have been re-hired, or staffing could have been influenced by factors other than the layoff. There is also a chance that an establishment underwent layoffs before the study's time window.

Another limitation is that MLS captures layoffs at the company level within a county, whereas OES samples individual establishments within a company and county. Two-thirds of the study units are known to be establishment-level matches because there exists only one establishment in the company and county. For the other one-third of study units, there is a chance that although MLS captured a layoff event in a company in a particular county, the matching OES units in the sample did not actually lay off any workers. The layoff might have occurred elsewhere in the company within the same county, but not necessarily in the physical units surveyed.

A third limitation is that because this study requires OES observations both before and after the layoff in order to detect staffing changes, firms that go out of business completely before OES is able to sample them again are not included. That is, the study includes only establishments that go out of business if the permanent closure occurred after the second OES observation. According to MLS statistics, there were 6,590 extended mass layoff events that resulted in permanent worksite closures from 2000 to 2007. Because these closures were likely not random with respect to each individual characteristic (e.g., industry, occupation, and region), there is attrition bias in the sample selection.

About half the establishments in the sample had fewer than 250 employees before layoffs. Table 2 shows the distribution of establishments by number of employees. After layoffs, there was an aggregate shift toward smaller establishments. The number of establishments that were either very small (1 to 9 employees), small (10 to 49 employees), or medium-sized (50 to 249 employees) increased, while the number of establishments with either a large (250 to 999 employees) or very large (more than 1,000 employees) size decreased.

Most establishments in the survey were in the West and Midwest regions (defined later in this article). There were also large numbers of establishments in the Southeast, Southwest, and New York-New Jersey regions. The Mountain-Plains, Mid-Atlantic, and New England regions had less representation in the study sample. Table 2 also shows the distribution of establishments by region.

The industry sectors that had more than 100 establishments each were manufacturing; retail trade; construction; health care and social assistance; administrative and support and waste management and remediation services; information; transportation and warehousing; accommodation and food services; finance and insurance; and arts, entertainment, and recreation. Table 2 shows the distribution of establishments by sector.

The primary reasons for layoffs that most establishments in the sample reported were slack work/insufficient demand/nonseasonal slowdown, reorganization or restructuring, contract completion, financial difficulty, an extreme weather-related event, business-ownership change, and contract cancellation. Table 3 shows the distribution of establishments in the sample by primary layoff reason.

Finally, the study categorizes occupations into two general groups: "analytical" and "nonanalytical." This categorization is based on the 2000 Standard Occupational Classification (SOC) system descriptions of tasks performed by each occupation and on *Occupational Outlook Handbook* descriptions, and are supported by O*NET.⁷ The SOC definitions of detailed occupations in the analytical group often include words describing analysis. In addition, occupations in the analytical group are related to skills and abilities such as written expression, speaking, critical thinking, and deductive and inductive reasoning. At the major occupational group level, the analytical group includes occupations such as legal, healthcare, and business and financial operations. On the other hand, occupations in the nonanalytical group are related to skills and abilities such as troubleshooting; repairing; dynamic, explosive, static, and trunk strength; and stamina. The nonanalytical group includes occupations such as production; transportation and material moving; office and administrative support; sales, installation, maintenance, and repair; building and grounds cleaning and maintenance; and protective service.

Employment changes by occupation

A comparison of employment before and after layoffs shows that the largest numbers of jobs lost were in occupations that involved clerical or nonanalytical labor; included among these jobs were those in the production, office and administrative support, and transportation and material moving occupational groups. Table 4 shows that, despite layoffs, seven of the occupational groups grew, including legal occupations; healthcare practitioners and technical; healthcare support; and food preparation and serving occupations. Employment in these occupations

Table 2. Establishments by industry sector, establishment size, and geographic region, sorted by number of establishments in "before layoff" study sample

Category	Number of establishments in full OES dataset, 1999–2008 ¹	Number of unique company/county layoff events in full MLS dataset, 2000–2007	Number of establishments in "before layoff" study sample	Number of establishments in "after layoff" study sample
Total number of establishments	² 2,822,082	24,750	4,520	4,520
Industry group				
Goods-producing industries	374,801	12,778	2,154	n/a
NAICS 31–33 Manufacturing	202,453	9,321	1,604	n/a
NAICS 23 Construction	152,417	3,219	504	n/a
NAICS 21 Mining	10,330	238	46	n/a
NAICS 11 Farming	9,601	0	0	n/a
Service-providing industries	1,597,846	11,972	2,366	n/a
NAICS 44–45 Retail trade	261,270	1,717	560	n/a
NAICS 62 Health care and social assistance	192,536	1,016	298	n/a
NAICS 56 Administrative and support and waste management and remediation services	123,146	1,953	265	n/a
NAICS 51 Information	54,028	940	263	n/a
NAICS 48–49 Transportation and warehousing	79,839	1,381	222	n/a
NAICS 72 Accommodation and food service	129,017	1,235	200	n/a
NAICS 52 Finance and insurance	89,925	1,034	145	n/a
NAICS 71 Arts, entertainment, and recreation	45,099	348	101	n/a
NAICS 81 Other services	124,662	327	84	n/a
NAICS 42 Wholesale trade	134,951	689	82	n/a
NAICS 54 Professional, scientific, and technical services	155,903	853	68	n/a
NAICS 61 Educational services	74,382	117	36	n/a
NAICS 22 Utilities	9,298	70	15	n/a
NAICS 55 Management of companies and enterprises	17,427	92	14	n/a
NAICS 53 Real estate and rental and leasing	61,439	120	8	n/a
NAICS 99 Public administration	44,924	80	5	n/a
Establishment size³				
Establishments with 50–249 employees	544,595	n/a	1,835	1,893
Establishments with 250–999 employees	110,750	n/a	1,701	1,474
Establishments with 1,000 or more employees	20,759	n/a	505	420
Establishments with 10–49 employees	1,106,893	n/a	400	547
Establishments with 1–9 employees	1,039,085	n/a	79	186
Geographic region				
West	454,996	5,696	1,307	n/a
Midwest	539,060	5,680	1,211	n/a
Southeast	568,758	4,262	702	n/a
Southwest	353,174	2,264	492	n/a
New York-New Jersey	210,890	2,730	436	n/a
Mountain-Plains	213,473	1,078	251	n/a
Mid-Atlantic	283,567	1,849	91	n/a
New England	198,164	1,191	30	n/a
¹ Excluding Puerto Rico, Virgin Island, Guam		None of these 849,435 establishments were part of the MLS dataset.		
² There are 849,435 establishments that have only an SIC code and no NAICS code; these establishments are not included in the NAICS data and so the sum of establishments by industry does not equal the total shown.		³ MLS data do not include establishment size. Although the data include the number of separations, they are not comparable because not all establishments lay off the same proportion of employees.		

increased 18 percent, 11 percent, 8 percent, and 4 percent, respectively. The occupational groups that grew were service-providing occupations and, with the exception of food preparation and serving occupations, tended to include higher paying and higher skilled occupations.

Even within the groups with the most job losses, detailed occupations that tended to have workers with more

training and education were least likely to experience layoffs. For instance, the detailed office support occupations whose employment shrank the most tended to have more workers whose educational attainment was a high school diploma and short-term on-the-job training.⁸ Detailed office support occupations with the greatest losses included customer service representatives; general office clerks;

Table 3. Establishments by primary reason for extended mass layoff, 2000–2007

Reason for layoff	Number of unique company/ county layoff events in full MLS dataset, 2000–2007	Number of establishments in "before layoffs" study sample
Total number of establishments	24,750	4,520
Economic difficulties	16,700	3,078
Slack work/insufficient demand/non-seasonal business slowdown	4195	926
Reorganization or restructuring of company	3021	757
Contract completion	2424	346
Financial difficulty	1966	277
Bankruptcy	1003	39
Business-ownership change	940	116
Contract cancellation	726	115
Extreme weather-related event	543	130
Import competition	487	74
Domestic relocation	313	39
Overseas relocation	188	26
Product line discontinued	187	49
Cost control/cost cutting/increase profitability	157	52
Labor dispute/contract negotiations/strike	143	36
Plant or machine repair/maintenance	96	18
Material or supply shortage	63	16
Automation/technological advances	39	15
Model changeover	39	13
Excess inventory/saturated market	35	4
Non-natural disaster	32	8
Energy related	30	3
Hazardous work environment	23	7
Natural disaster (not weather related)	23	8
Governmental regulations/intervention	14	0
Domestic competition	13	4
Seasonal reasons	6,072	1,304
Seasonal	4551	967
Other seasonal	916	184
Vacation period/school related or otherwise	605	153
Other reasons	1,978	138
Data not provided: refusal	1061	60
Data not provided: does not know	917	78

shipping and traffic clerks; first-line supervisors; secretaries (except legal, medical, and executive); bill and account collectors; and data entry keyers. Table 5 shows the 20 occupations with the largest declines in employment levels and table 6 shows those with the largest percent declines. For many of these occupations, most workers had an educational attainment level of high school diploma or equivalent.⁹

Among office support occupations that grew the most following layoffs were interviewers, medical secretaries, and payroll and timekeeping clerks. Table 7 shows the 20 occupations with the largest increases in employment after layoffs, and table 8 shows those with the largest percent increases. More workers in these occupations had the educational attainment of either a bachelor's degree, or some college or no degree.

Within the production occupations group, detailed occu-

pations with the most losses were team assemblers, miscellaneous metal and plastic workers, electrical and electronic equipment assemblers, slaughterers and meat packers, and first-line supervisors. For these types of assembly and fabrication jobs, a high school diploma was the most prevalent level of education, but experience and additional training were often needed for advanced assembly work.¹⁰ Employment declines due to productivity growth and strong foreign competition in manufacturing¹¹ may have contributed to the job losses evident in the layoff study sample. In fact, a control group (to be explained in the next section) shows that employment in production occupations declined by 2 percent among establishments from 2004 to 2008 regardless of layoff status, while employment in production occupations declined by 20 percent during a similar period in establishments with mass layoffs.

Similarly, transportation occupations that lost the most

Table 4. Employment before and after extended mass layoff, by occupational group, 1999–2008, sorted from largest loss to largest gain

Occupational group	Before layoffs	After layoffs	Change after layoffs	Percent change after layoffs
Production	560,997	441,624	-119,373	-21.3
Office and administrative support	379,743	307,211	-72,532	-19.1
Transportation and material moving	227,004	186,961	-40,043	-17.6
Sales and related	146,752	117,806	-28,946	-19.7
Management	116,128	94,388	-21,740	-18.7
Installation, maintenance, and repair	131,028	111,526	-19,502	-14.9
Architecture and engineering	125,699	106,762	-18,937	-15.1
Personal care and service	121,066	105,212	-15,854	-13.1
Construction and extraction	131,891	121,397	-10,494	-8.0
Arts, design, entertainment, sports, and media	34,291	28,389	-5,902	-17.2
Protective service	26,682	21,232	-5,450	-20.4
Computer and mathematical science	102,263	97,675	-4,588	-4.5
Building and grounds cleaning and maintenance	62,563	60,547	-2,016	-3.2
Life, physical, and social science	21,970	20,997	-973	-4.4
Community and social services	7,782	7,908	126	1.6
Business and financial operations	111,618	111,847	229	0.2
Legal	3,532	4,161	629	17.8
Education, training, and library	30,352	31,429	1,077	3.5
Healthcare support	19,209	20,800	1,591	8.3
Food preparation and serving related	81,386	84,849	3,463	4.3
Healthcare practitioners and technical	72,433	80,353	7,920	10.9

employment were those which involved predominantly nonanalytical skills and short-term on-the-job training: hand packers and packagers; freight, stock, and material hand movers; and industrial truck drivers. Conversely, employment increased in transportation occupations for jobs that required either more training, or certification or licensure: driver/sales workers,¹² as well as excavating and loading machine and dragline operators (with moderate-term on-the-job training being the most significant source of training for the two kinds of operators).

Although employment in the computer occupational group declined overall, employment grew in some of the most highly skilled occupations in the group: computer applications software engineers (which also saw the third-highest growth of all detailed occupations across groups) and computer and network systems analysts. Employment declined, however, among computer programmers and computer support specialists—occupations with job functions that, according to SOC definitions, involve less research and analysis.

Among business and financial operations occupations, employment increased in those which involved analysis and technical skills: management analysts, logisticians, accountants, financial analysts, and personal financial advisors. The most significant source of education for the five specified occupations was a bachelor's degree, and several of the occupations had high proportions of workers at the highest educational attainment level (doctoral

or professional degree). Conversely, most employment losses in this group were among occupations that generally required less academic preparation—training and development specialists, buyers, and cost estimators. The most significant source of education for buyers was long-term on-the-job training, and none of the aforementioned three occupations had high proportions of workers who had attained the highest educational level.¹³

The net number of jobs lost in each occupational group is a result of the rates at which companies laid off different types of workers, as well as the types of workers that tended to be employed in companies that had layoffs. To isolate these factors, the percent change is useful for assessing employment growth and decline relative to an occupation's initial employment level. (See tables 6 and 8.) The occupational groups that had the largest percent declines in employment were production, protective service, sales and related occupations, office and administrative support, and management. The groups with the highest percent growth in firms with mass layoffs were legal occupations and healthcare practitioner occupations. Healthcare practitioners; food preparation and serving; healthcare support; and education, training, and library occupations were the occupational groups with the highest levels of growth in employment. Some of the detailed occupations that grew were service-related occupations and included registered nurses, waiters and waitresses, cashiers, and interviewers. (See table 7.)

Table 5. The 20 occupations¹ with the largest decline in employment level after extended mass layoff, 1999–2008, sorted by size of decline

SOC	Occupation	Occupational group	Employment				Establishments		
			Before layoffs	After layoffs	Change	Percent change	Number reporting before layoffs	Number reporting after layoffs	Percent change in number reporting
51–2092	Team assemblers	Production	85,058	63,870	–21,188	–24.9	496	507	2.2
41–2031	Retail salespersons	Sales and related	45,972	34,116	–11,856	–25.8	491	508	3.5
43–4051	Customer service representatives	Office and administrative support	55,650	43,832	–11,818	–21.2	1394	1429	2.5
51–4199	Metal workers and plastic workers, all other	Production	16,930	6,341	–10,589	–62.5	105	80	–23.8
51–2022	Electrical and electronic equipment assemblers	Production	22,914	14,684	–8,230	–35.9	186	177	–4.8
51–3023	Slaughterers and meat packers	Production	14,358	6,149	–8,209	–57.2	30	21	–30.0
53–7064	Packers and packagers, hand	Transportation and material moving	23,890	15,736	–8,154	–34.1	596	491	–17.6
51–1011	First-line supervisors/managers of production and operating workers	Production	30,617	22,657	–7,960	–26.0	1678	1578	–6.0
39–3091	Amusement and recreation attendants	Personal care and service	13,936	6,508	–7,428	–53.3	77	90	16.9
43–9061	Office clerks, general	Office and administrative support	29,746	22,661	–7,085	–23.8	2004	1921	–4.1
15–1021	Computer programmers	Computer and mathematical science	13,857	7,183	–6,674	–48.2	697	528	–24.2
51–9061	Inspectors, testers, sorters, samplers, and weighers	Production	31,934	25,396	–6,538	–20.5	1170	1148	–1.9
51–9199	Production workers, all other	Production	25,968	19,498	–6,470	–24.9	375	309	–17.6
53–7062	Laborers and freight, stock, and material movers, hand	Transportation and material moving	52,270	45,992	–6,278	–12.0	1269	1244	–2.0
43–5071	Shipping, receiving, and traffic clerks	Office and administrative support	20,581	14,607	–5,974	–29.0	1678	1582	–5.7
41–9041	Telemarketers	Sales and related	13,182	7,586	–5,596	–42.5	117	113	–3.4
49–9042	Maintenance and repair workers, general	Installation, maintenance, and repair	32,387	26,801	–5,586	–17.2	1831	1907	4.2
17–2199	Engineers, all other	Architecture and engineering	18,085	12,579	–5,506	–30.4	405	311	–23.2
53–7051	Industrial truck and tractor operators	Transportation and material moving	24,398	18,943	–5,455	–22.4	919	858	–6.6
11–9199	Managers, all other	Management	15,221	9,852	–5,369	–35.3	914	739	–19.1

¹ Excluded are any occupations with fewer than 10 reporting establishments before layoffs.

Comparison with a control group. A control group serves to compare staffing changes among establishments that experienced layoffs with occupational changes in the economy as a whole. The change in published OES estimated employment from May 2004 to May 2008 was used as the control group. The May 2004 estimates are based on employment staffing patterns from November 2001 to May 2004. Likewise, the May 2008 estimates are based on staffing patterns from November 2005 to May 2008. These periods cover a large portion of the study sample frame. The employment changes for establishments that had layoffs and for the economy as a whole are shown in chart 1. The distance and direction from the 45-degree line show the differences in behavior between establish-

ments with layoffs and the economy as a whole. Legal occupations make up the only occupational group above the 45-degree line; the group is the only one that grew more in establishments with layoffs than in the control group

Quadrant I comprises occupational groups with employment growth in establishments that had layoffs (the study group) and in the economy as a whole (the control group). Groups that grew in employment in both the study and control subsets included healthcare and legal occupations; food preparation and serving; and education, training, and library occupations.

Occupational groups whose employment shrank in the study subset but grew in the control subset are shown in quadrant II. These groups were the most vulnerable to

Table 6. The 20 occupations¹ with the largest percent decline in employment after extended mass layoff, 1999–2008, sorted by size of decline

SOC	Occupation	Occupational group	Employment				Establishments		
			Before layoffs	After layoffs	Change	Percent change	Number reporting before layoffs	Number reporting after layoffs	Percent change in number reporting
53-7072	Pump operators, except wellhead pumpers	Transportation and material moving	511	36	-475	-93.0	19	7	-63.2
33-2011	Fire fighters	Protective service	2,850	240	-2,610	-91.6	16	11	-31.3
43-2099	Communications equipment operators, all other	Office and administrative support	615	57	-558	-90.7	33	8	-75.8
15-2099	Mathematical scientists, all other	Computer and mathematical science	365	37	-328	-89.9	17	10	-41.2
51-6091	Extruding and forming machine setters, operators, and tenders, synthetic and glass fibers	Production	3,933	427	-3,506	-89.1	17	15	-11.8
49-2095	Electrical and electronics repairers, powerhouse, substation, and relay	Installation, maintenance, and repair	888	112	-776	-87.4	24	14	-41.7
51-8012	Power distributors and dispatchers	Production	276	36	-240	-87.0	15	5	-66.7
51-7099	Woodworkers, all other	Production	621	91	-530	-85.3	24	12	-50.0
39-9021	Personal and home care aides	Personal care and service	2,140	323	-1,817	-84.9	26	14	-46.2
53-2012	Commercial pilots	Transportation and material moving	1,438	273	-1,165	-81.0	30	32	6.7
51-2093	Timing device assemblers, adjusters, and calibrators	Production	431	106	-325	-75.4	13	10	-23.1
43-5111	Weighers, measurers, checkers, and samplers, recordkeeping	Office and administrative support	5,560	1,407	-4,153	-74.7	325	251	-22.8
51-4194	Tool grinders, filers, and sharpeners	Production	1,253	321	-932	-74.4	125	64	-48.8
17-3021	Aerospace engineering and operations technicians	Architecture and engineering	2,618	735	-1,883	-71.9	30	21	-30.0
51-2021	Coil winders, tapers, and finishers	Production	1,490	432	-1,058	-71.0	35	23	-34.3
29-1199	Health diagnosing and treating practitioners, all other	Healthcare practitioners and technical	1,689	503	-1,186	-70.2	43	22	-48.8
27-1027	Set and exhibit designers	Arts, design, entertainment, sports, and media	156	47	-109	-69.9	16	12	-25.0
51-7031	Model makers, wood	Production	318	96	-222	-69.8	25	16	-36.0
49-9045	Refractory materials repairers, except brickmasons	Installation, maintenance, and repair	81	25	-56	-69.1	10	6	-40.0
27-4014	Sound engineering technicians	Arts, design, entertainment, sports, and media	277	86	-191	-69.0	30	19	-36.7

¹ Excluded are any occupations with fewer than 10 reporting establishments before layoffs.

layoff in struggling businesses despite overall growth elsewhere in the economy. The occupations with the greatest inverse relationship were arts, design, entertainment, sports, and media; sales; and protective service occupations. Quadrant III shows occupational groups whose employment shrank in both the control and study groups: production, transportation, and material moving; and management occupations.¹⁴

Finally, for comparison with another type of control, table 2 shows the distribution of the full OES dataset from 1999 to May 2008 by region, industry sector, and establishment size. Table 3 shows the distribution of the full MLS dataset of unique company/county layoff events from 2000 to 2007 by reason for layoff. A comparison shows

that the sample is representative of the full data set, but there are some exceptions. For example, manufacturing had more representation in the study sample than in the control group, which might explain why we see such large employment changes in production occupations.

Regression analysis. Comparing the employment change in the study group with published estimates of employment change is useful in assessing whether the study's results are reflected in the economy overall. Formal regression analysis achieves the same goal but also lets us empirically control for other factors, such as industry, geographic region, establishment size, and time between observations.

Table 7. The 20 occupations¹ with the largest increase in employment level after extended mass layoff, 1999–2008, sorted by size of increase

SOC	Occupation	Occupational group	Employment				Establishments		
			Before layoffs	After layoffs	Change	Percent change	Number reporting before layoffs	Number reporting after layoffs	Percent change in number reporting
29-1111	Registered nurses	Healthcare practitioners and technical	34,917	40,876	5,959	17.1	321	291	-9.3
51-2031	Engine and other machine assemblers	Production	2,925	8,015	5,090	174.0	46	37	-19.6
15-1031	Computer software engineers, applications	Computer and mathematical science	16,704	21,679	4,975	29.8	393	447	13.7
51-2099	Assemblers and fabricators, all other	Production	42,913	46,901	3,988	9.3	257	190	-26.1
35-3031	Waiters and waitresses	Food preparation and serving related	18,934	22,356	3,422	18.1	211	200	-5.2
41-2011	Cashiers	Sales and related	23,293	26,514	3,221	13.8	669	655	-2.1
43-4111	Interviewers, except eligibility and loan	Office and administrative support	4,294	7,057	2,763	64.3	79	90	13.9
13-1111	Management analysts	Business and financial operations	8,645	11,408	2,763	32.0	461	568	23.2
35-3022	Counter attendants, cafeteria, food concession, and coffee shop	Food preparation and serving related	4,183	6,928	2,745	65.6	174	155	-10.9
17-2072	Electronics engineers, except computer	Architecture and engineering	6,205	8,779	2,574	41.5	205	224	9.3
51-9023	Mixing and blending machine setters, operators, and tenders	Production	3,293	5,558	2,265	68.8	188	172	-8.5
13-1081	Logisticians	Business and financial operations	1,857	4,098	2,241	120.7	219	342	56.2
41-3099	Sales representatives, services, all other	Sales and related	6,002	7,879	1,877	31.3	214	458	114.0
31-1012	Nursing aides, orderlies, and attendants	Healthcare support	9,278	11,134	1,856	20.0	78	82	5.1
49-2022	Telecommunications equipment installers and repairers, except line installers	Installation, maintenance, and repair	4,898	6,708	1,810	37.0	141	158	12.1
49-9041	Industrial machinery mechanics	Installation, maintenance, and repair	10,244	11,929	1,685	16.4	484	558	15.3
19-1042	Medical scientists, except epidemiologists	Life, physical, and social science	1,522	3,203	1,681	110.4	37	36	-2.7
47-2081	Drywall and ceiling tile installers	Construction and extraction	2,349	4,027	1,678	71.4	30	34	13.3
13-1079	Human resources, training, and labor relations specialists, all other	Business and financial operations	2,586	4,247	1,661	64.2	517	889	72.0
19-3021	Market research analysts	Life, physical, and social science	4,769	6,405	1,636	34.3	387	477	23.3

¹ Excluded are any occupations with fewer than 10 reporting establishments before layoffs.

Two sets of OES observations were created to run a regression. The study group was the set of 4,520 establishments that had layoffs. The control group was the set of 205,339 establishments that reported twice to the OES survey in the study period—once in the 1999–2000 period and then again between November 2005 and May 2008—that was not in the study group.

There were 206,377 establishments that reported to OES in both sets. Approximately 1,000 establishments that had been in both the control group and the study group were deleted from the control group to prevent duplication, resulting in 205,339 remaining control observations. For

each pair of matching establishments, the change in employment by occupational group was calculated. The other variables for this data set were region, goods-producing or service-providing industry groups, establishment size, and time between observations. The regression was based on a total of 209,859 records.

The econometric model used was

$$\Delta \text{employment}_{\text{SOC major group}} = \beta_0 + \beta_1 \text{layoff}_i + \beta_2 \text{goods} + \beta_3 \text{totalemp_first}_i + \sum_j \delta_j I(\text{geographic region}_{ij}) + \sum_j \gamma_j I(\text{number of years between observations}_{ij}) + \varepsilon_i$$

Table 8. The 20 occupations¹ with the largest percent increase in employment after extended mass layoff, 1999–2008, sorted by size of increase

SOC	Occupation	Occupational group	Employment				Establishments		
			Before layoffs	After layoffs	Change	Percent change	Number reporting before layoffs	Number reporting after layoffs	Percent change in number reporting
43-4061	Eligibility interviewers, government programs	Office and administrative support	98	412	314	320.4	15	15	0.0
19-1012	Food scientists and technologists	Life, physical, and social science	60	191	131	218.3	19	44	131.6
39-9041	Residential advisors	Personal care and service	78	237	159	203.8	13	12	-7.7
51-9193	Cooling and freezing equipment operators and tenders	Production	139	405	266	191.4	20	32	60.0
19-2012	Physicists	Life, physical, and social science	179	509	330	184.4	14	16	14.3
51-2031	Engine and other machine assemblers	Production	2,925	8,015	5,090	174.0	46	37	-19.6
29-1129	Therapists, all other	Healthcare practitioners and technical	43	114	71	165.1	13	13	0.0
19-4011	Agricultural and food science technicians	Life, physical, and social science	194	506	312	160.8	42	40	-4.8
35-2019	Cooks, all other	Food preparation and serving related	67	174	107	159.7	11	24	118.2
47-3011	Helpers—brickmasons, blockmasons, stonemasons, and tile and marble setters	Construction and extraction	159	395	236	148.4	12	14	16.7
39-6032	Transportation attendants, except flight attendants and baggage porters	Personal care and service	933	2,239	1,306	140.0	29	31	6.9
11-9039	Education administrators, all other	Management	61	141	80	131.1	16	23	43.8
47-3014	Helpers—painters, paperhangers, plasterers, and stucco masons	Construction and extraction	131	300	169	129.0	12	19	58.3
29-9011	Occupational health and safety specialists	Healthcare practitioners and technical	438	992	554	126.5	180	293	62.8
27-1025	Interior designers	Arts, design, entertainment, sports, and media	175	394	219	125.1	37	67	81.1
29-9012	Occupational health and safety technicians	Healthcare practitioners and technical	142	316	174	122.5	44	85	93.2
13-1081	Logisticians	Business and financial operations	1,857	4,098	2,241	120.7	219	342	56.2
19-1042	Medical scientists, except epidemiologists	Life, physical, and social science	1,522	3,203	1,681	110.4	37	36	-2.7
49-2098	Security and fire alarm systems installers	Installation, maintenance, and repair	271	563	292	107.7	20	13	-35.0
11-3049	Human resources managers, all other	Management	909	1,851	942	103.6	331	637	92.4

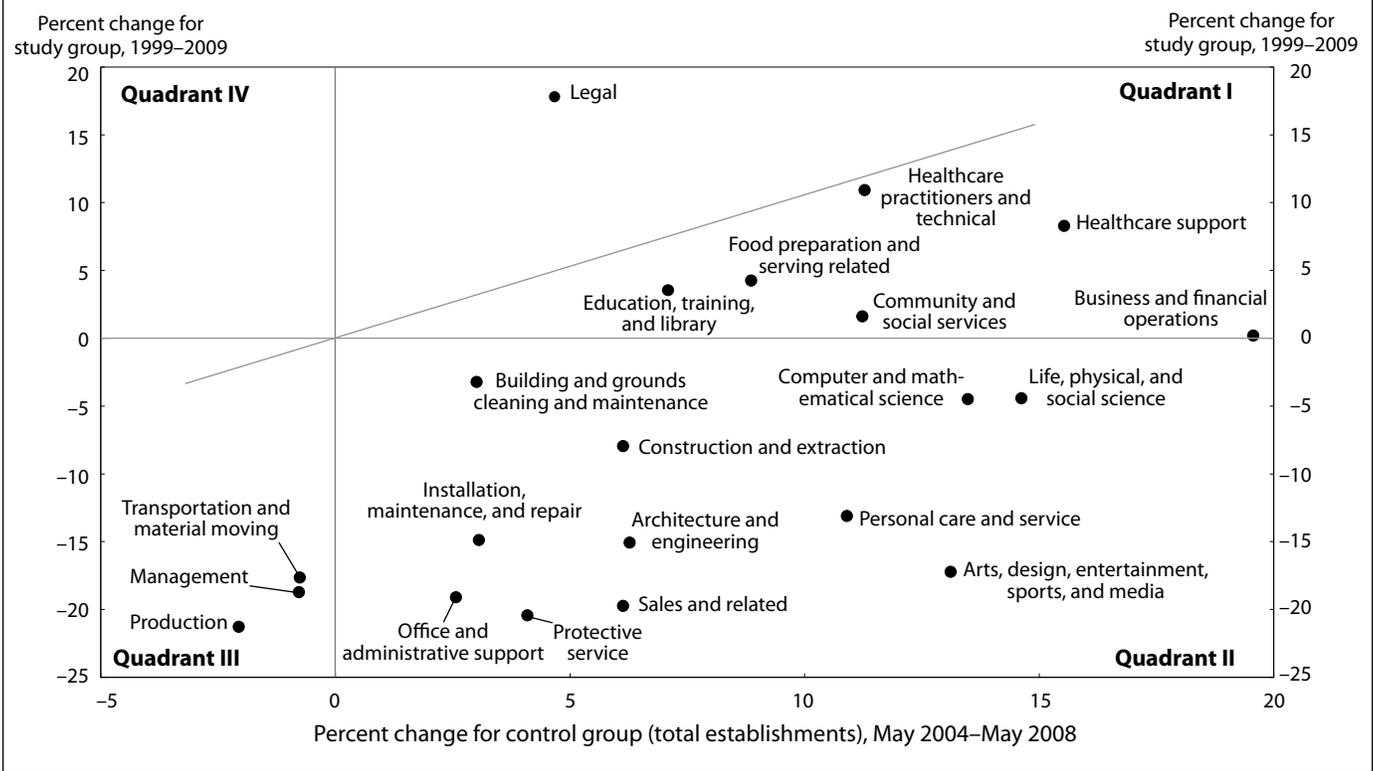
¹ Excluded are any occupations with fewer than 10 reporting establishments before layoffs.

where the dependent variable was the change in employment level for each major occupational group, calculated with the use of the first and second employment levels reported for each occupational group. *Layoff* was an indicator dummy variable for whether the establishment had a layoff; where $layoff_i = 1$, a layoff occurred. *Goods* was a dummy variable for the combined goods-producing industries, as opposed to the service-providing industries. *Totalemp_first* was the total employment at the time of the first observation of the establishment. The *geographic region* dummy variables indicated geographic regions: West,

Southwest, Southeast, Mountain-Plains, New York-New Jersey, Midwest, Mid-Atlantic, and New England (captured in the intercept). Finally, there were nine dummy variables representing the number of years between observations, ranging from 1 to 9; 9 years was captured in the intercept.

In each of the 21 regressions, the significance of the layoff coefficient indicates whether the establishments in the study group were statistically different from establishments in the control group after controlling for these other variables. For example, some of the employment

Chart 1. Change in employment after extended mass layoffs in study control groups



change in production occupations in the study group may have been affected by the manufacturing plants that were letting production workers go regardless of whether the plant had mass layoffs. Appendix table A-1 shows the output for these regressions.

Of the 21 layoff indicator coefficients, 14 were statistically different from zero at the 5-percent significance level. Appendix table A-1 shows the layoff variable coefficients and their p-values. Because the dependent variable is the change in employment level, the coefficients of the variables are interpreted as the *additional* change in the employment of an occupation because of layoff.

Controlling for the preceding variables, the model indicated that an extended mass layoff was associated with a decline in employment for the following occupational groups: production; office and administrative support; sales and related; management; transportation and material moving; architecture and engineering; installation, maintenance, and repair; construction and extraction; personal care and service; and arts, design, entertainment, sports, and media. An extended mass layoff was associated with an additional employment decline of 20.8 percent in production occupations, on average.

Conversely, with the same variables controlled for, an extended mass layoff was associated with growth in employ-

ment for the following occupational groups (presented in descending order of magnitude of growth): food preparation and serving related; building and grounds cleaning and maintenance; business and financial operations; and legal.

These results are consistent with those set forth in the previous section, with some exceptions. The occupational groups with the largest declines in employment using regression also shrank relative to the control group in the first comparisons. That is, the occupations with the largest declines in the regression were generally in the lower left area of chart 1 (quadrant III and part of quadrant II); this is where declines were large in the group with layoffs relative to the economy as a whole. For the most part, occupational groups with differences that were not significant in the regression comparison were closest to the 45 degree line in the chart.

The largest differences between outcomes were in building and grounds cleaning and maintenance occupations and food preparation and serving related occupations. In the initial comparison, building and grounds cleaning and maintenance occupations grew in the economy and shrank in the layoff group. The regression comparison indicates that building and grounds cleaning and maintenances occupations grew more in the layoff group relative to the

control group. In both comparisons, food service occupations grew in the layoff group and in the control group. In the initial comparison to the economy as a whole, food service occupations grew less in the layoff group than in the control group; in the regression comparison to a control group, the food service occupations grew more in the layoff group than in the control group.

Differences in the comparison may in part be due to the differences in the control groups. The first control group, where the control is the entire economy, captures growth as a result of new establishments and may include a better representation of smaller establishments. The second control group, which matches existing establishments at two points in time, does not capture any “births,” or new establishments, in the comparison period. Also, because the OES survey uses a probability-proportional-to-size sample, it is less likely that the matched set includes smaller establishments.

Seasonal versus “economic difficulties” reasons for layoffs. Another regression analysis was conducted to determine whether occupational changes differed significantly—after controlling for industry, region, time between observations, and establishment size—depending on whether the layoff was due to seasonal reasons. On the basis of the 4,520 observations from the study sample, the primary layoff reasons were grouped into three broad categories: “economic difficulties,” “seasonal,” and “other.” The “economic difficulties” category included business demand, financial difficulty, reorganization or restructuring of the company, production, and domestic and overseas relocation reasons. The “other” category covered disaster/safety reasons and unidentified reasons. The “seasonal” category included seasonal, vacation period/school related or otherwise, and other seasonal reasons.¹⁵

The regression model used was

$$\Delta \text{employment}_{\text{SOC major group}} = \beta_0 + \beta_1 \text{layoff}_i \times \text{economic}_i + \beta_2 \text{layoff}_i \times \text{seasonal}_i + \beta_3 \text{goods} + \beta_4 \text{totalemp_before}_i + \sum_j \delta_j I(\text{geographic region}_{ji}) + \sum_j \gamma_j I(\text{number of years between observations}_{ji}) + \varepsilon_i$$

where the dependent variable was the change in employment level for each SOC major occupational group, calculated with the use of employment levels reported for each occupational group in each establishment before and after layoff. *Layoff* was a dummy variable indicating whether the establishment had a layoff; where $\text{layoff}_i = 1$, a layoff occurred. (In this data set, all observations had a *lay-*

off; value of 1.) *Economic*, *seasonal*, and *other* were dummy variables indicating the broad category of “reason for layoff.” *Goods* was a dummy variable for the combined goods-producing industries, as opposed to the service-providing industries. *Totalemp_before* was the total employment at the time of the first observation of the establishment. The *geographic region* dummy variables indicated geographic region: New England (captured in the intercept), New York-New Jersey, Mid-Atlantic, Southeast, Midwest, Southwest, Mountain-Plains, and West. Finally, there were nine dummy variables representing the number of years between observations, ranging from 1 to 9; 9 years was captured in the intercept.

Appendix table A-2 shows the output of these regressions. In none of the 21 regressions were the two reason variables (*economic* and *seasonal*) statistically different from each other at the 90-percent confidence level. This finding suggests that, after other variables were controlled for, the occupational changes did not differ significantly between seasonal and economic layoff reasons. The data show that, in the long term, establishments that had seasonal layoffs had staffing changes that were similar to establishments that had layoffs because of economic difficulties.¹⁶ It should be noted that some establishments that report seasonal change as their primary reason for layoff might also be undergoing other staffing changes. Because OES surveys take place at the same time each year, changes as a result of seasonal effects are mixed with other effects.

Occupations eliminated from establishments after layoffs. Another way to examine the effects of mass layoffs on jobs in a particular occupation is to look at the change in the number of establishments reporting employment in that occupation after the layoff. This approach allows an examination of whether and how often establishments choose to eliminate all workers in a certain occupation or, alternatively, choose to retain at least some employees in that occupation.

The occupations whose employment count changed from positive to zero were those which performed functions that businesses shed completely or outsourced after layoffs. These occupations were predominantly auxiliary administrative and managerial. The group whose occupations were most likely to be eliminated from establishments after layoffs was office and administrative support. Switchboard operators, including answering service, topped the list, with 363 establishments eliminating the occupation completely; the number of establishments reporting them dropped from 781 to 418. Several human resources occupations had the same fate: employment,

recruitment, and placement specialists; training and development specialists; human resources assistants; and payroll and timekeeping clerks. Other supporting administrative occupations affected were computer operators, data entry keyers, file and procurement clerks, and janitors and cleaners.

Conversely, establishments reporting occupations commonly found in many businesses such as general managers and administrative clerks (bookkeeping, general office, shipping, and payroll) tended to keep at least one of the employees in those occupations. The share of establishments completely eliminating these occupations was relatively low, ranging from 1 percent to 12 percent. Workers fulfilling these business functions apparently were considered essential for maintaining the basic operations of the company.

Many of the occupations with the largest employment losses overall were essential, or core, to their business, so the occupations tended to be retained within the establishment, although at much lower levels of employment. In fact, the three occupations with the largest employment declines—team assemblers, retail salespersons, and customer service representatives—existed in more establishments after layoffs than before; the number of jobs in the occupation, however, was smaller after the layoffs. Similarly, although employment in sales occupations declined overall by almost 29,000 jobs, more establishments reported having employment in sales occupations after layoffs. This finding could be a result of shifts in staffing patterns after restructuring. The effect of layoffs on employment in core occupations is discussed further in the next section.

Occupational changes by industry sector

This section examines occupational employment changes within and across industry groups. The first analysis shows that, within sectors, core occupations generally were retained. Looking across sectors, the second analysis uses regression to see how these changes differed between the goods-producing and service-providing industry groups.

Employment changes within sectors. Examining employment changes by industry sector provides insight into the effects of mass layoffs on the occupational structure of specific types of businesses. It allows the identification of core and support business functions in different industries and shows that the severity of mass layoffs in terms of job loss varied by occupation and the industry of the business experiencing a layoff.

After layoffs, industry sectors that followed the pattern of reducing employment in occupations requiring less specialized skills and maintaining or increasing employment in analytical occupations included information; finance and insurance; professional, scientific, and technical services; and the durable goods portion of the manufacturing sector. Examples of occupations with reduced employment in these sectors were sales and office workers; examples of occupations with increased employment were various types of analysts and engineers. These industry sectors—and particularly the durable goods manufacturing portion of the manufacturing sector—experienced large numbers of layoff events during the study period.

Establishments were more likely to retain employment in occupations that were core to their industry. (See table 9.) For example, employment in business and financial operations occupations grew in finance and insurance establishments with layoffs. The same was observed among teachers in the education sector, as well as among health-care workers in hospitals, extraction workers in mining, and computer and mathematical science occupations in the information sector. Other sectors saw smaller declines in core occupations than in occupations that have support functions. For example, in the manufacturing industries, most occupational groups saw decreases, but production workers had lower percent declines in manufacturing than in several other industries. The same pattern was observed in core occupations for other industries, including installation and maintenance occupations in the utilities sector, transportation and material moving occupations in the transportation sector, and personal care and service and food preparation occupations in the accommodation and food services sector.

The overall pattern of reducing the number of jobs in occupations requiring less specialized skills and retaining jobs in analytical occupations was driven by the industry sectors with relatively large numbers of layoff events. These sectors included information (NAICS 51); finance and insurance (NAICS 52); professional, scientific, and technical services (NAICS 54); and the durable goods portion of the manufacturing sector (NAICS 33). Employment declined in these sectors for occupations requiring less specialized skills, such as sales and office workers, while increasing for various types of analysts and engineers.

In the fourth quarter of 2007, manufacturing industries accounted for 24 percent of private nonfarm extended layoff events. This study reflects that distribution, with the three manufacturing components—food, wood, and durable goods—experiencing the largest net losses in employment compared to other industries. In durable

Table 9. Percent change in employment after extended mass layoff, by (NAICS) industry and occupation, 1999–2008

Occupational group	Goods-producing industries group					Information	Financial activities		Professional and business services		
	Mining (21)	Construction (23)	Manufacturing (31)	Manufacturing (32)	Manufacturing (33)	Information (51)	Finance and insurance (52)	Real estate and rental and leasing (53)	Professional, scientific, and technical services (54)	Management of companies and enterprises (55)	Administrative and support and waste management and remediation services (56)
Management	18.7	-3.4	-43.2	-11.5	-13.9	-51.0	2.4	-43.8	5.3	-59.2	-27.7
Business and financial operations	118.6	20.2	-29.2	-17.0	-1.7	6.6	2.1	2.5	59.8	-26.7	2.9
Computer and mathematical science	57.6	-5	-43.4	.1	-10.6	13.8	11.6	-28.7	-16.1	3.3	-17.9
Architecture and engineering	2.2	-14.0	-48.5	-32.7	-13.8	-19.6	29.8	.0	-14.1	67.6	-48.9
Life, physical, and social science	50.9	26.3	8.2	-15.3	-23.6	9.5	80.0	(¹)	-2.1	(¹)	8.0
Community and social services	.0	.0	(¹)	(¹)	.0	(¹)	-54.5	.0	(¹)	(¹)	218.0
Legal	(¹)	211.1	-47.6	85.0	25.5	13.4	9.7	(¹)	-14.0	2.6	-3.8
Education, training, and library	.0	(¹)	(¹)	-100.0	-6.7	-71.9	94.1	.0	37.5	12.8	91.2
Arts, design, entertainment, sports, and media	(¹)	-54.0	-19.1	108.2	.4	-5.9	1.5	-67.7	-4.2	-1.0	-41.5
Healthcare practitioners and technical	-11.7	-20.6	12.6	91.0	-19.7	73.9	14.3	(¹)	-70.0	-17.5	8.6
Healthcare support	.0	(¹)	(¹)	.0	-50.0	.0	-23.3	.0	(¹)	(¹)	-64.9
Protective service	6.7	-2.2	-55.0	-50.8	-27.0	-54.0	-7.9	-42.9	.0	-14.3	-14.5
Food preparation and serving related	(¹)	-27.1	216.8	-90.9	-63.0	-75.0	138.1	-24.7	(¹)	-23.9	16.4
Building and grounds cleaning and maintenance	70.0	-18.4	-16.7	-38.6	-42.4	-60.2	-48.9	(¹)	46.0	.6	-1.5
Personal care and service	(¹)	-50.7	(¹)	(¹)	-50.0	-55.4	(¹)	.0	(¹)	-7.8	30.1
Sales and related	208.6	-31.6	-24.0	61.8	-16.5	-41.7	-35.2	-71.0	-5.9	-73.8	-36.9
Office and administrative support	6.1	4.1	-21.2	-16.5	-21.6	-34.3	-33.2	31.6	-21.7	-21.2	-20.6
Construction and extraction	25.5	-2.8	-42.6	-35.9	-29.2	-57.3	(¹)	(¹)	-71.9	(¹)	21.4
Installation, maintenance, and repair	3.9	7.4	-13.0	-27.2	-22.6	8.1	-26.8	.0	-60.4	-22.3	12.1
Production	-30.4	42.2	-23.4	-20.2	-22.8	-28.1	61.2	(¹)	-58.2	-34.9	11.0
Transportation and material moving	-12.8	.0	-17.0	-30.9	-22.1	-47.9	31.4	.2	3.4	-65.9	8.2

See note at end of table.

goods manufacturing—which had the largest net employment loss of the three manufacturing components in the study—losses in employment levels were mostly in production occupations, such as team assemblers, electrical equipment assemblers, and weighers. Durable goods manufacturers hired workers in analytical occupations, such as electronics engineers, computer applications software engineers, and logisticians.

Within durable goods manufacturing, transportation

equipment manufacturing (NAICS 336) had the highest net employment loss. Table 10 shows the transportation equipment manufacturing occupations that shrank by more than 1,000 jobs in the study group. Most of the losses were in production occupations. Some occupations that grew were related to product design and engineering: computer software applications engineers, logisticians, commercial and industrial designers, and mechanical engineers.

Table 9. Continued—Percent change in employment after extended mass layoff, by (NAICS) industry and occupation, 1999–2008

Occupational group	Trade, transportation, and utilities						Education and health care		Leisure and hospitality		Other services	Public administration
	Utilities (22)	Wholesale trade (42)	Retail trade (44)	Retail trade (45)	Transportation (48)	Warehousing (49)	Educational services (61)	Health care and social assistance (62)	Arts, entertainment, and recreation (71)	Accommodation and food services (72)	Other services (81)	Public administration (99)
Management	-21.9	-28.4	-34.4	-17.0	-25.1	-26.0	-6.9	-7.7	-7.6	-25.1	-11.3	-3.5
Business and financial operations	-24.1	-22.7	1.4	8.6	-11.2	13.9	-2.3	6.4	48.2	9.9	25.4	-16.4
Computer and mathematical science	-37.3	-26.5	-1.8	-9.6	13.2	31.9	1.6	4.0	57.9	-2.4	86.4	-30.1
Architecture and engineering	-74.4	21.8	-43.0	-55.8	-45.6	78.4	35.0	-46.1	409.4	-54.8	-4.4	-69.7
Life, physical, and social science	-94.5	-34.3	9.4	-40.4	-10.6	.0	84.5	-7.7	-8.8	-62.7	14.3	(¹)
Community and social services	.0	.0	.0	.0	(¹)	.0	-33.9	10.4	(¹)	(¹)	-29.3	.0
Legal	20.8	-31.5	270.0	81.3	-29.5	(¹)	33.3	104.5	472.7	109.1	(¹)	(¹)
Education, training, and library	(¹)	(¹)	(¹)	(¹)	-46.0	.0	2.7	5.0	-23.2	-22.2	13.5	(¹)
Arts, design, entertainment, sports, and media	161.4	-19.2	21.1	34.4	-9.9	-90.0	12.6	22.9	-48.6	9.4	126.6	-42.8
Healthcare practitioners and technical	(¹)	-47.1	55.1	13.8	-33.8	31.3	-2.0	12.1	-10.6	93.6	21.1	(¹)
Healthcare support	.0	.0	-38.0	108.2	-19.4	(¹)	-5.0	11.4	-91.4	48.7	(¹)	.0
Protective service	-91.9	-44.7	-68.1	-12.3	-10.2	-34.1	-11.0	9.7	-35.9	-1.8	-42.0	(¹)
Food preparation and serving related	.0	-99.0	13.2	-30.4	24.4	(¹)	15.4	.5	76.3	-6.5	23.5	(¹)
Building and grounds cleaning and maintenance	-81.4	35.9	-49.0	-22.2	13.0	-64.7	-2.2	8.7	52.4	-5.0	-16.4	-35.9
Personal care and service	(¹)	.0	-43.1	-4.3	-9.7	(¹)	-59.2	-39.0	-24.9	-5.0	-6	.0
Sales and related	90.8	-46.1	14.2	-21.6	-14.4	-19.0	7.6	23.6	-40.3	-13.9	-32.5	2400.0
Office and administrative support	-40.5	-33.7	-10.7	-11.9	-21.3	42.9	2.1	6.7	-8.0	-5.2	-25.8	-45.3
Construction and extraction	85.5	50.3	-41.3	-80.4	32.3	(¹)	-23.9	-37.0	-39.1	19.9	-34.2	50.9
Installation, maintenance, and repair	-18.4	12.5	-9.7	-16.4	-15.5	-79.1	26.6	31.4	-11.3	-6.3	-49.5	-28.6
Production	-71.6	-9.0	-39.3	-10.0	8.3	20.3	-43.2	-10.5	43.8	-12.9	-22.7	-30.9
Transportation and material moving	-12.5	-25.5	-16.4	-19.0	-15.0	12.7	348.3	-40.6	-21.4	-9.5	-65.8	-53.9

¹ Percent change excluded because it is based on fewer than 5 establishments reporting occupations in the occupational group before layoffs.

Establishments that had layoffs in the information sector reduced employment in occupations that require less specialized training: sales supervisors and representatives, customer service representatives, and stock clerks. After layoffs, they had higher employment in occupations involving technical skills: computer software engineers; telecommunications equipment repairers; management, computer systems, and network systems analysts; and accountants and auditors.

Similarly, most finance and insurance businesses which had layoffs shed jobs in occupations that tended to pay less and that did not include analysis as a primary job function: clerical workers, such as customer service representatives, telemarketers, brokerage clerks, and general office clerks. These establishments increased employment in analytical occupations, such as computer systems analysts, financial analysts, market research analysts, and management analysts. They also added technical positions that tended to

Table 10. Transportation equipment manufacturing (NAICS 336) occupations whose employment declined by at least 1,000 after extended mass layoff, 1999–2008

SOC	Occupation	Employment			Establishments	
		Before layoffs	After layoffs	Change	Number reporting before layoffs	Number reporting after layoffs
51–2092	Team assemblers	36,788	23,907	–12,881	104	93
51–4199	Metal workers and plastic workers, all other	13,208	5,068	–8,140	39	42
51–9199	Production workers, all other	10,973	6,496	–4,477	59	55
51–1011	First-line supervisors/managers of production and operating workers	8,683	5,681	–3,002	228	205
17–2011	Aerospace engineers	8,266	5,360	–2,906	24	18
51–2011	Aircraft structure, surfaces, rigging, and systems assemblers	6,801	4,228	–2,573	15	11
51–4121	Welders, cutters, solderers, and brazers	6,720	4,493	–2,227	126	109
51–4111	Tool and die makers	6,629	4,651	–1,978	126	121
53–7051	Industrial truck and tractor operators	5,090	3,195	–1,895	117	115
51–9061	Inspectors, testers, sorters, samplers, and weighers	9,020	7,357	–1,663	184	175
43–5061	Production, planning, and expediting clerks	3,060	1,469	–1,591	159	143
49–9042	Maintenance and repair workers, general	5,623	4,079	–1,544	166	163
53–7062	Laborers and freight, stock, and material movers, hand	4,831	3,371	–1,460	99	97
51–9122	Painters, transportation equipment	3,998	2,564	–1,434	61	56
13–1199	Business operations specialists, all other	6,966	5,698	–1,268	105	88
53–6051	Transportation inspectors	1,508	332	–1,176	20	7
51–4031	Cutting, punching, and press machine setters, operators, and tenders, metal and plastic	3,570	2,404	–1,166	74	59

be highly paid, such as computer software engineers, accountants and auditors, and personal financial advisors.

The professional, scientific, and technical services sector also followed this pattern. These businesses reduced the employment of general office clerks, computer support specialists, customer service representatives, and data entry keyers. They added computer systems analysts, management analysts, and market research analysts, in addition to accountants and auditors.

Most establishments in the health care and social assistance sector tended to lay off administrative support occupations not directly related to healthcare, such as general office and billing clerks. They hired health care workers including registered nurses, nursing aides, and licensed practical nurses. The number of medical secretaries grew, but by less than the employment decline among other administrative support occupations.

Four sectors fared relatively well after layoffs and grew in total employment. Those with net gains in employment were health care and social assistance (NAICS 62); educational services (NAICS 61); mining (NAICS 21); and postal service/couriers/warehousing (NAICS 49). (See table 9.) Within health care and social assistance—which was the sector with the highest net gain in employment—hospitals and ambulatory health care services grew the most, increasing the number of jobs with functions related to health care and administration: office and administrative

support, business and financial operations, management, and computer and mathematical science occupations. Production occupations experienced the largest losses; hospitals especially reduced the number of laundry and drycleaning jobs.

It is informative to examine the occupations that declined in employment after layoffs in sectors which nonetheless experienced net employment gains. Personal and home care aides lost the most employment overall in the health care sector. Mining establishments that underwent layoffs shed several occupations that required less specialized training and skills: general maintenance and repair workers, industrial truck and tractor operators, and machinery maintenance workers. They added operating engineers, industrial machinery mechanics, heavy and tractor-trailer truck drivers, and mobile heavy equipment mechanics.

Occupational changes in goods-producing versus service-providing establishments. A regression analysis was conducted to analyze the effect of layoffs by goods-producing and service-providing aggregations (simply termed “groups”) on occupational employment, controlling for region, time between observations, and establishment size. The variables of interest were the two interaction dummy variables for layoff × group. To see if the large employment decline in production occupations in goods-producing industries

was due to the overall decline in employment in production industries, the model also includes a non-interaction dummy variable for the group of goods-producing establishments. The regression was based on a total of 209,858 observations—205,339 control observations and 4,520 study observations.

The model used was

$$\Delta \text{employment}_{\text{SOC major group}} = \beta_0 + \beta_1 \text{layoff}_i \times \text{goods-producing group} + \beta_2 \text{layoff}_i \times \text{service-providing group} + \beta_3 \text{totalemp_first}_i + \beta_4 \text{goods-producing group} + \sum_j \delta_j I(\text{geographic region}_{ji}) + \sum_j \gamma_j I(\text{number of years between observations}_{ji}) + \varepsilon_i$$

where the dependent variable was the change in employment level for each occupational group between the first observation and the second. *Layoff* was a dummy variable indicating whether the establishment had a layoff; where $\text{layoff}_i = 1$, a layoff occurred. *Goods* was a dummy variable for the goods-producing aggregation, as opposed to the service-providing aggregation. *Layoff* \times *goods* and *layoff* \times *service* were interaction dummy variables. *Totalemp_first* was the total employment at the time of the first observation of the establishment. The *geographic region* dummy variables indicated geographic region: West, Southwest, Southeast, Mountain-Plains, New York-New Jersey, Midwest, Mid-Atlantic, and New England (captured in the intercept). Finally, there were nine dummy variables representing the number of years between observations, ranging from 1 to 9; 9 years was captured in the intercept.

With region, time between observations, and establishment size controlled for, an extended mass layoff in the *goods-producing* aggregation was associated with a greater employment decline than in the service-providing aggregation for two occupational groups: architecture and engineering; and installation, maintenance and repair. For production occupations, layoffs were associated with employment decline in the goods-producing group, while layoffs in the service-providing group were actually associated with slight employment growth (significant only at the 11-percent level). The differences between the interaction term coefficients were statistically significant, and the coefficients themselves were statistically significant. Appendix table A-3 shows the regression parameter estimates and statistics for the goods-producing and service-providing interaction variables.

With region, time between observations, and establishment size controlled for, an extended mass layoff in the *service-providing* aggregation was associated with a greater employment decline than in the aggregation of goods-

producing sectors for management and for sales and related occupations. For sales and office and administrative occupations, the employment decline was substantially greater in the service-providing group. In protective service occupations and personal care and service, a layoff in the service-providing group was associated with employment decline, while a layoff in the goods-producing group was associated with employment growth.

Conversely, in building and grounds cleaning and maintenance occupations, an extended mass layoff in the service-providing group was associated with greater employment growth than in the goods-producing group.

Finally, for three occupational groups, the individual goods-producing and service-providing group parameter estimates were significant, but the differences between the two were not. Employment in transportation and material moving occupations declined the same amount in both groups. The difference between them was not statistically significant. Similarly, employment in legal occupations and food preparation and serving-related occupations grew significantly in both the goods-producing and service-providing groups, but the difference between the two coefficients was not statistically significant.

Occupational changes by reason for layoff

The MLS program asks employers for a primary reason for the layoff. Employers could report 30 reasons for extended mass layoffs over the study period. These reasons can be grouped into six broad categories: business demand, financial, organizational, production, disaster/safety, and seasonal. Business demand accounted for 34 percent of the events in the fourth quarter of 2007, the highest in the economic reasons category excluding seasonal and other reasons. Extended mass layoffs stemming from financial issues accounted for 7 percent of layoff events, the next highest in the economic reasons category. (See table 11.)¹⁷

The pattern of employers retaining or adding workers in higher skilled analytical or technical occupations while letting go of workers in occupations that require nonanalytical or office and clerical skills was, in general, evident regardless of the reason for the layoff. It is apparent from table 11 that workers in production, material moving, installation and maintenance, and office and administrative support occupations were let go after almost all types of layoffs. The number of jobs in computer and mathematical science occupations, architecture and engineering occupations, and business and financial operations occupations either grew, or declined proportionally less than the number of jobs for lesser skilled workers, regardless of the

Table 11. Percent change in employment in the study group after extended mass layoff, by primary reason for layoff and occupation, 1999–2008

Occupational group	Business demand						Disaster/safety				Financial		
	Contract cancellation	Contract completion	Domestic competition	Excess inventory/saturated market	Import competition	Slack work/insufficient demand/non-seasonal business slowdown	Hazardous work environment	Natural disaster (not weather related)	Non-natural disaster	Extreme weather-related event	Bankruptcy	Cost control/cost cutting/increase profitability	Financial difficulty
Management	-21.4	1.3	-55.0	-24.3	-36.7	-22.0	9.3	-9.1	-32.9	13.1	-16.9	-39.5	-13.0
Business and financial operations	9.4	21.8	-78.6	-23.5	-10.6	-7.5	-21.4	-16.1	280.0	4.2	-27.0	.3	9.0
Computer and mathematical science	-29.8	-10.1	(¹)	(¹)	-25.1	-12.4	5.0	77.8	(¹)	5.9	-27.0	41.3	-20.3
Architecture and engineering	-51.2	23.5	-43.8	-44.4	-25.2	-26.2	-2.0	170.4	(¹)	-7.2	-46.3	-76.1	-15.5
Life, physical, and social science	-49.6	11.5	.0	.0	25.0	19.6	57.1	(¹)	.0	-40.2	218.4	-36.8	-2.1
Community and social services	-69.4	92.2	.0	.0	.0	7.4	.0	.0	.0	107.4	(¹)	.0	10.8
Legal	46.7	8.7	.0	.0	(¹)	10.8	.0	.0	.0	(¹)	-22.5	11.4	.3
Education, training, and library	32.6	-14.8	.0	.0	(¹)	-35.3	.0	.0	.0	281.3	(¹)	(¹)	2.5
Arts, design, entertainment, sports, and media	14.2	-81.4	.0	.0	-51.3	-10.1	(¹)	(¹)	.0	111.8	-40.5	40.6	-12.0
Healthcare practitioners and technical	-37.2	27.3	(¹)	(¹)	-50.0	-7.3	(¹)	(¹)	(¹)	-30.5	-7.0	32.5	23.3
Healthcare support	(¹)	(¹)	.0	.0	.0	-42.5	.0	.0	.0	-47.8	-1.3	(¹)	6.8
Protective service	-16.7	-8.2	.0	.0	-44.4	-5.2	(¹)	(¹)	-29.4	-35.6	-23.2	50.3	30.4
Food preparation and serving related	-72.7	-16.3	.0	.0	(¹)	0.6	-100.0	-3.3	-23.9	-23.4	-15.6	7.9	21.2
Building and grounds cleaning and maintenance	-6.9	-6.2	(¹)	(¹)	-57.2	-4.5	(¹)	-68.4	9.4	-40.4	-57.2	32.8	2.3
Personal care and service	-31.4	-43.0	.0	.0	.0	-16.3	(¹)	(¹)	-68.4	-40.2	-9.1	50.3	-11.6
Sales and related	-.5	-38.2	.0	.0	-58.3	-24.3	(¹)	-32.4	-16.1	-29.1	-29.3	-17.4	-21.8
Office and administrative support	-34.9	1.0	-55.6	-2.9	-36.8	-15.6	-36.7	-51.2	22.7	-27.4	-17.7	-27.7	-11.2
Construction and extraction	19.8	1.2	-42.0	(¹)	-39.2	-13.8	-28.8	22.3	(¹)	49.7	-56.6	88.2	3.7
Installation, maintenance, and repair	-14.5	-22.2	-21.1	-27.7	-51.9	-14.3	-4.6	-9.1	-20.5	12.7	-27.0	-26.6	-14.0
Production	-16.1	-9.1	-66.1	-7.5	-50.4	-17.8	-28.2	5.6	-41.3	13.5	-5.4	-36.7	-32.8
Transportation and material moving	-12.1	14.8	-69.4	-72.7	-52.5	-7.5	-46.1	-41.0	75.6	-31.0	-12.2	2.6	-34.4

See notes at end of table.

reason for the layoff, although there were some exceptions. At the detailed occupation level, employment of customer service representatives, general office clerks, and book-keeping clerks declined after most types of layoffs.

This overall pattern was driven, in part, by layoffs due to a number of reasons: the reorganization or restructuring of a business, a change in ownership, financial difficulty, slack work, competition from imports, cost control or cost

Table 11. Continued—Percent change in employment after extended mass layoff, by primary reason for layoff and occupation, 1999–2008

Occupational group	Organizational		Production								Other	
	Business-ownership change	Reorganization or restructuring of company	Automation/technological advances	Energy related	Governmental regulations/intervention	Labor dispute/contract negotiations/strike	Material or supply shortage	Model change-over	Plant or machine repair/maintenance	Product line discontinued	Domestic relocation	Overseas relocation
Management	-37.3	-12.5	-45.0	-36.8	0.0	21.1	-19.0	-31.1	-13.0	-31.8	11.5	-60.1
Business and financial operations	25.1	-4.0	-7	-18.6	.0	8.9	-20.7	-30.9	16.2	146.5	40.6	-16.0
Computer and mathematical science	-17.1	9.3	57.7	(¹)	.0	20.8	30.0	-45.5	5.9	112.7	2.4	-61.1
Architecture and engineering	-26.6	-12.7	111.6	(¹)	.0	48.5	-7.2	-47.1	-3.8	36.3	14.0	-57.7
Life, physical, and social science	-47.4	-11.3	-75.5	(¹)	.0	-61.7	-41.7	-73.3	-37.3	-56.4	-77.7	-88.5
Community and social services	-14.0	-17.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Legal	12.4	14.7	(¹)	.0	.0	.0	.0	.0	.0	(¹)	(¹)	-46.2
Education, training, and library	-95.3	-31.4	.0	.0	.0	-45.5	.0	.0	.0	(¹)	(¹)	(¹)
Arts, design, entertainment, sports, and media	-55.7	46.1	-14.3	.0	.0	-1.8	(¹)	-100.0	(¹)	33.0	111.5	54.2
Healthcare practitioners and technical	-17.5	5.9	-15.8	(¹)	.0	39.0	(¹)	-57.1	(¹)	-16.3	-15.6	-84.6
Healthcare support	-16.5	13.1	(¹)	.0	.0	48.7	.0	(¹)	.0	(¹)	(¹)	(¹)
Protective service	-57.9	-19.9	-21.3	(¹)	.0	-4.8	(¹)	(¹)	(¹)	51.0	-95.7	-12.5
Food preparation and serving related	-12.8	10.7	-19.7	.0	.0	3.4	.0	24.7	-24.7	(¹)	25.9	-100.0
Building and grounds cleaning and maintenance	-25.4	-6.3	-57.2	(¹)	.0	-34.6	(¹)	14.3	355.6	-26.4	-85.7	-15.9
Personal care and service	9.9	-8.4	33.8	-3.1	.0	-87.5	.0	(¹)	.0	.0	5.7	.0
Sales and related	-32.6	-23.3	-32.9	(¹)	.0	24.7	(¹)	-89.3	4.7	52.2	-2.2	-55.1
Office and administrative support	-18.7	-23.4	-35.1	6.0	.0	-21.2	-61.1	-76.7	3.8	-6.1	-40.3	12.2
Construction and extraction	-92.7	-28.6	-47.6	(¹)	.0	-70.4	2.1	-1.0	-70.0	-18.3	-93.8	-75.0
Installation, maintenance, and repair	-26.7	-14.2	-40.1	-4.4	.0	5.3	-28.1	13.6	-7.7	-30.1	-59.8	-21.3
Production	-31.4	-29.3	160.7	-28.9	.0	-26.4	-13.4	-8.6	1.9	-29.2	-68.8	-36.7
Transportation and material moving	-43.5	-34.4	-57.3	-31.4	.0	-14.2	-25.2	176.3	-38.9	14.4	-56.9	-56.8

NOTE: Table does not show "data not provided (refusal);" "data not provided (does not know);" "seasonal;" "vacation period/school related or otherwise;" or "other seasonal."

¹ Percent change excluded because it is based on fewer than 5 establishments reporting occupations in the occupational group before layoffs.

cutting, and the relocation of domestic work.¹⁸ These reasons accounted for a large number of layoffs and a large share of the employment losses among lesser

skilled occupations and increased employment in analytical or technical occupations during the period studied. Layoffs that occurred after either the reloca-

tion of domestic work or the discontinuation of a product line followed the pattern closely. However, the types of jobs affected by layoffs often depended on the reason for the layoff. Patterns within each group are examined next.

Organizational change. The largest cause of job loss from layoffs was organizational change, which includes the reorganization or restructuring of companies and changes in business ownership. Establishments that *reorganized or restructured* (representing 10 percent of all layoffs, the third most commonly reported reason for a layoff event¹⁹) tended to eliminate jobs in production occupations—these jobs declined by more than 27,000—and in administrative support occupations, such as customer service representatives, general office clerks, and data entry keyers; employment in administrative support occupations declined by 23,000. Businesses that reorganized or restructured also reduced jobs for occupations that involved less technical skill, such as retail salespersons, hand laborers, hand packers, team assemblers, and general maintenance workers. Employers cut back on jobs in some technical occupations and added jobs in others, resulting in a net gain in computer and mathematical occupations.

Reorganized and restructured establishments hired more workers in occupations that develop new software and applications—occupations such as computer systems and applications software engineers, computer systems analysts, computer hardware engineers, engineering managers, electronics engineers, telecommunications equipment installers, and logisticians—while reducing the number of other technical jobs—such as jobs for computer programmers, who primarily code programs for existing software. Some occupational groups, however, fared well after this type of layoff: arts, design, entertainment, sports, and media; education; legal; community and social service; and life, physical, and social sciences occupations.

Establishments with layoffs resulting from *business-ownership changes*, the seventh most commonly reported reason for a layoff event,²⁰ followed the pattern of shedding workers in less technical occupations and hiring additional analytical workers. After production, office and administrative, and transportation and material moving occupations, sales workers accounted for most of the job loss. Following layoffs induced by business-ownership changes, establishments had fewer workers in occupations related to sales, marketing, and maintenance; these occupations included customer service representatives, general office clerks, marketing managers, market research analysts, sales managers, janitors and cleaners, and maintenance and repair workers. The production occupa-

tion that lost the most employment was textile cutting machine setters, operators, and tenders. As was seen in businesses that reorganized, the computer occupations that declined in employment among establishments with business-ownership changes required less technical skill than those which increased in employment. Other occupations that grew involved financial and accounting business functions: among these occupations were payroll and timekeeping clerks; management analysts; bookkeeping, accounting, and auditing clerks; financial managers; and accountants and auditors.

Business demand. The second-largest cause of job loss from layoffs was a decline in business demand. Compared with other reasons for layoffs, business demand factors resulted in relatively greater losses of technical workers and also resulted in large losses of lesser skilled workers. Specifically, layoffs due to slack work, insufficient demand, and nonseasonal business slowdown resulted in the largest employment declines among any of the 30 reasons for layoffs. Production occupations accounted for the most losses after this type of layoff. The production occupations that topped the list of losses were aircraft structure, surfaces, rigging, and systems assemblers; miscellaneous metal and plastic workers; team assemblers; slaughterers and meat packers; electrical and electronic equipment assemblers; and production first-line supervisors.

Employment in computer and mathematical science occupations shrank after layoffs for at least four of the layoff reasons related to business demand, and business and financial occupations and architecture and engineering occupations lost employment from layoffs due to at least four of the reasons.

Layoffs because of *slack work* resulted in employment declines in many occupational groups, about a third of which were production jobs. Most affected were metal and plastic workers, team assemblers, production supervisors, electrical equipment assemblers, and sewing machine operators. The occupations that grew were hand laborers, computer applications software engineers, customer service representatives, stock clerks, and market research analysts.

After layoffs due to *excess inventory* and *domestic competition*, overall employment levels shrank in every occupational group in which employment had been reported before the layoffs; cutbacks occurred in both core and noncore occupations regardless of business function.

Financial. Financial-related reasons for layoffs include financial difficulty; bankruptcy; and measures to control

costs, cut costs, and increase profitability. As with layoffs related to business demand, financial-related layoffs resulted in job losses among skilled workers, in addition to losses among less skilled workers. Notable outcomes were a large decline in personal care and service occupations after bankruptcy, sales workers after cost control layoffs, and architecture and engineering occupations after financial difficulty.

The largest employment declines in layoffs due to general *financial difficulty* were in production, transportation and material moving, and office and administrative support occupations. Production occupations with job losses included inspectors, testers, and weighers; team assemblers; and production supervisors. This type of layoff also resulted in the employment of fewer transportation workers; recordkeeping weighers, measurers, checkers, and samplers; flight attendants; and parking lot attendants. Among computer and engineering jobs lost were computer programmers and computer systems software engineers, and applications engineers. The same set of establishments eventually hired workers for computer science occupations that were less research intensive in nature: computer systems analysts; network support and data communications analysts; and network and computer systems administrators. They also hired many more registered nurses, cashiers, and accountants and auditors.

Occupations that experienced employment cutbacks after *bankruptcy* were reservation and transportation ticket agents, stock clerks and order fillers, industrial truck and tractor operators, vehicle and equipment cleaners, and electronics engineers (except computer), among others.

Cost control and cost cutting resulted in large employment declines, in terms of both percentages and levels, among architecture and engineering occupations, but the change was concentrated in a few establishments. Establishments with this type of layoff had employment declines in several administrative support and sales occupations directly related to sales functions: customer service representatives; shipping, receiving, and traffic clerks; stock clerks and order fillers; and retail salespersons. These establishments also cut some production and maintenance workers who tended to be paid higher wages: supervisors of mechanics, installers, and repairers; transportation managers; and supervisors of production workers.

Some administrative support occupations whose employment grew after cost-cutting layoffs were those related to internal staffing and support: payroll and timekeeping clerks, human resources workers, administrative support supervisors, general office clerks, and bookkeeping and accounting clerks. In addition, employers whose layoffs were

a result of controlling or cutting costs hired workers for several laborer occupations that tended to be paid lower wages: hand laborers and freight and stock movers; and janitors and cleaners.

Production. The kinds of jobs lost from production-related extended mass layoffs related to the specific reason cited for the layoff. Although production worker employment shrank overall, it grew in establishments whose layoffs had been due to automation or technological advances. Transportation and material moving occupations grew in establishments whose layoffs had been due to model changeover or product line discontinuations.

After *product line discontinuation*, employment changes in a few large establishments accounted for the large decreases in production worker employment. Occupations that shrank included slaughterers and meat packers, assemblers and fabricators, transportation equipment painters, synthetic and glass fiber machine setters, inspectors and weighers, welders, semiconductor processors, and engine assemblers. Production occupations that grew included production worker helpers, packaging and filling machine operators, bakers, coating and painting machine operators, and upholsterers.

Layoffs due to *plant or machine repair or maintenance* tended to affect occupations directly related to the operation of machines and production systems, and more production workers were eventually added than dropped. Occupations whose employment decreased included inspectors and weighers, extruding and compacting machine operators, furnace operators and tenders, and chemical plant and system operators. Occupations with employment increases included metal and plastic drilling and boring machine tool operators; meat, poultry, and fish cutters and trimmers; cleaning and metal pickling equipment operators; and coating and spraying machine operators.

Occupations whose employment declined after *automation/technological advances* provide insight into the types of jobs at risk as technology advances. Declines occurred among engine machine assemblers, machine feeders and offbearers, metal and plastic computer-controlled machine tool operators, tool and die makers, data entry keyers, and tool grinders.

Disaster/safety. Disaster/safety concerns comprised a hazardous work environment, a natural (not weather related) disaster, a nonnatural disaster, and extreme weather-related events. Extreme weather-related events were responsible for most of the employment declines in this category. Jobs lost after layoffs that were due to extreme

weather-related events affected primarily service workers providing transportation (transit and intercity bus drivers), security (security guards), food service (waiters and waitresses and restaurant cooks), housekeeping (maids, housekeeping cleaners, and janitors), and entertainment (gaming dealers, and tour guides and escorts); many of these occupations may be affected by tourism. Job gains were in construction occupations.

Domestic and overseas relocation. Although the sample size of establishments that laid off workers due to domestic and overseas relocation is smaller than the sample for other layoff reasons (MLS ended the two series with the 2003 data), the study sample still had almost 300 units reporting under the former reason and more than 200 units under the latter—enough to study the outcomes of layoffs for these reasons.

After layoffs due to *overseas relocation*, only two occupational groups grew in employment: office and administrative support; and arts, design, entertainment, sports, and media. Detailed occupations that shrank included various assemblers, machine operators, hand laborers, and industrial and electronic engineers and their managers. Despite the reductions among major occupational groups, the establishments hired workers in occupations related to sales, shipping, human resources, and computer network support (such as stock, billing, and shipping clerks; sales representatives; network administrators; and human resource specialists).

After layoffs due to *domestic relocation*,²¹ establishments reduced employment in two of the higher skilled groups: healthcare practitioner and technical occupations; and life, physical, and social science occupations. Establishments reduced employment in occupations involving nonanalytical skill, such as production; office and administrative support; transportation and material moving; installation, maintenance, and repair; protective service; building and grounds cleaning and maintenance; construction and extraction; and sales and related occupations. In contrast, the establishments with layoffs due to domestic relocations hired more analytical occupations: business and financial operations; architecture and engineering; management; arts, design, entertainment, sports, and media; computer and mathematical science; as well as personal care and service occupations.

Occupational changes by geographic region

Without regression analysis. The effect of layoffs on occupational employment levels varied across the country

because of differences in industry composition, local labor market conditions, and other economic factors. In the entire MLS data set (the universe of mass layoff events during the 2000–2007 period), the Midwest, West, and Southeast regions had the most worker separations, with losses of 2.5, 2.2, and 1.2 million jobs, respectively. The New York-New Jersey, Mid-Atlantic, and Southwest regions had between 500,000 and 900,000 separations. New England and the Mountain-Plains region had the fewest number of worker separations, each less than 500,000 over the same period.

Table 12 shows the percent change in employment after layoffs, by geographic region and occupational group. The States within each region are shown in figure 1.

Occupational groups that shrank in employment across most regions involved administration, personal service, and mainly nonanalytical skills: production, sales, office and administrative support, protective service, management, transportation, installation, construction, personal care, and building maintenance. Employment in occupation groups involving analytical skills grew in more regions than did other occupations. Business and financial operations, legal, computer and mathematical science, healthcare practitioner and technical, and community and social service occupations had lower percent declines in employment in most regions relative to declines among other occupational groups.

Within regions, the pattern of reducing employment in occupations involving clerical and nonanalytical skills while retaining jobs requiring analytical skills was most prevalent in the Mid-Atlantic, New England, New York-New Jersey, and Southwest regions. The first three regions have high concentrations of industries that experienced relatively large numbers of layoffs. Establishments undergoing layoffs in the Mid-Atlantic region shed team assemblers; data entry keyers; shipping, receiving, and order clerks; retail salespersons; and hand laborers. The Mid-Atlantic establishments added financial analysts, industrial machinery mechanics, and computer systems analysts.

The primary finding in this regional analysis was that when entire industries retained or increased employment in occupations core to their business, the pattern also manifested itself throughout most of the geographic regions. In 6 of the 8 geographic areas—all except the Southeast and Southwest—employers either added workers or lost fewer workers in job functions core to the industries dominant in their economies. The industry distribution of each region's employment was used to estimate which industries were dominant.²²

In the Midwest region, which had the most worker

Table 12. Percent change in employment after extended mass layoff, by geographic region and occupational group, 1999–2008

Occupational group	New England	New York–New Jersey	Mid–Atlantic	Southeast	Midwest	Southwest	Mountain–Plains	West
Management	–38.5	24.7	–47.2	–26.2	–18.0	–34.2	–39.9	–15.5
Business and financial operations	70.4	20.1	–21.5	–12.6	–7.4	8.4	35.7	–3.3
Computer and mathematical science	–25.6	35.9	31.7	–5	–5.5	–13.3	–3.0	–16.4
Architecture and engineering	–63.8	–16.0	–26.4	–9.0	–20.9	–4.9	–9.1	–17.5
Life, physical, and social science	–69.5	17.8	261.4	–7.3	20.6	–50.4	–44.1	–31.1
Community and social services	.0	3.7	67.2	16.8	–2.7	–6.8	–10.6	1.8
Legal	19.57	49.8	.9	7.5	56.4	–27.8	44.1	–2.5
Education, training, and library	–35.6	21.0	–30.8	–33.3	4.4	4.1	–2.2	8.5
Arts, design, entertainment, sports, and media	–78.1	26.7	27.7	–58.0	1.9	–22.0	–12.4	–8.7
Healthcare practitioners and technical	(¹)	5.2	–8	–3.4	–9.9	79.6	–13.5	6.3
Healthcare support	(¹)	26.2	(¹)	12.6	–24.0	78.5	–34.4	–11.3
Protective service	(¹)	–40.4	–12.1	–32.6	–8.0	–20.5	–63.0	–6.0
Food preparation and serving related	(¹)	.7	–42.6	67.0	–27.9	–1.3	–20.0	1.0
Building and grounds cleaning and maintenance	–16.8	–7.6	–30.8	24.1	–3.9	–.8	–50.4	–2.6
Personal care and service	(¹)	–20.3	–39.5	–30.9	–3.7	–3.1	–9.6	–4.2
Sales and related	–64.0	–38.0	–23.9	–24.8	–11.9	–22.6	–19.7	–13.7
Office and administrative support	–29.7	–21.9	–30.5	–21.4	–9.1	–16.2	–21.8	–23.8
Construction and extraction	3.1	–13.0	–16.7	–2.6	–14.0	–11.7	–15.1	–.1
Installation, maintenance, and repair	–39.1	–11.7	–28.5	–25.8	–14.4	27.2	–15.9	–21.4
Production	–52.8	–17.6	–28.1	–31.3	–18.3	–4.9	–24.3	–19.8
Transportation and material moving	–3.0	–29.8	–26.9	–28.8	–12.3	–14.6	9.6	–16.7

¹ Percent change excluded because it is based on fewer than 5 establishments reporting occupations in the occupational group before layoffs

separations, food preparation and serving-related occupations composed the group that experienced the largest percent decline in employment. The Midwest division²³ had relatively high employment concentrations in manufacturing (15.7 percent) and wholesale and retail trade (15.2 percent) in 2004. After layoffs, Midwest region employment in the occupations core to these sectors—production, sales, and transportation and material moving occupations—showed relatively small losses. The other regions had larger percent declines in employment in these occupations.

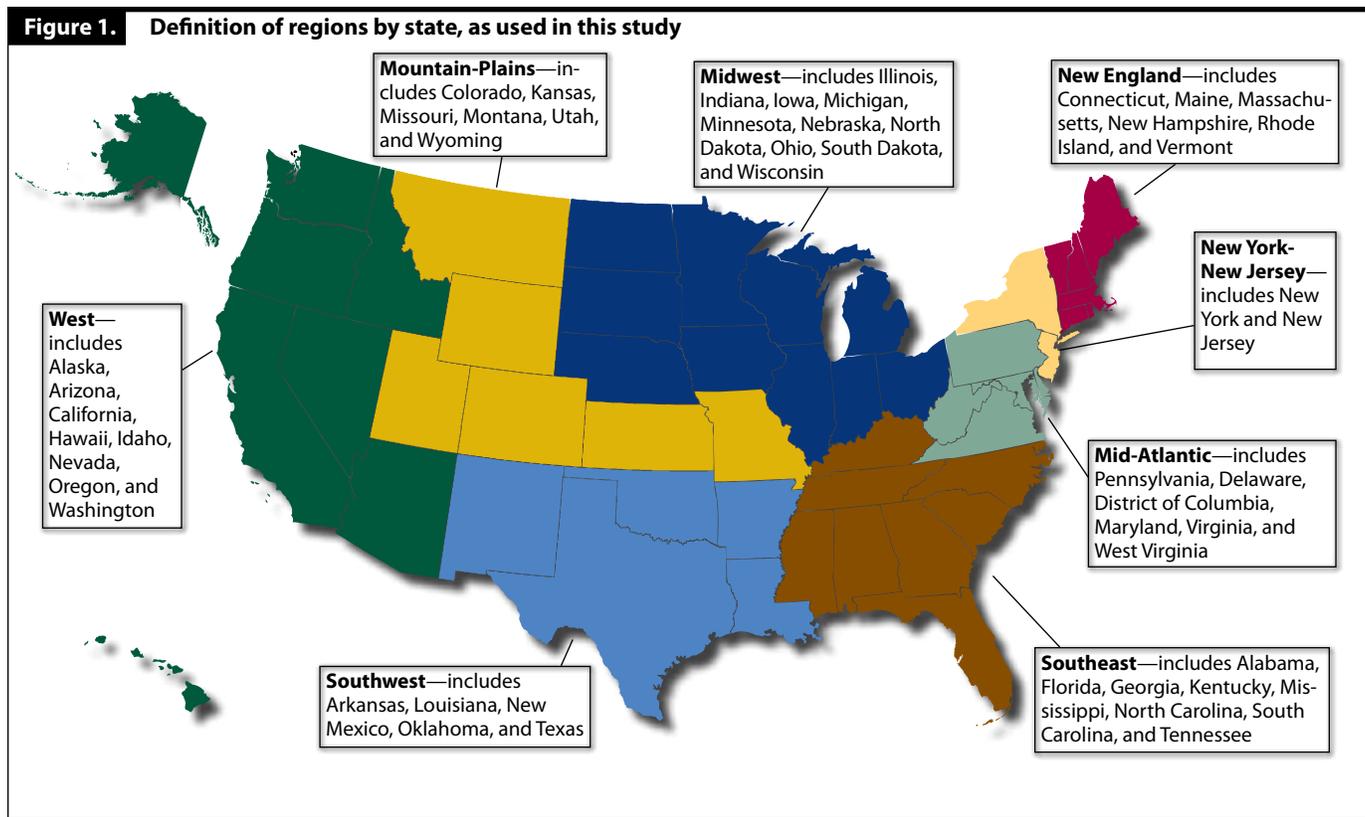
Likewise, the Pacific division²⁴ had relatively high concentrations of employment in the information sector (3.0 percent)—particularly in motion picture and sound recording industries—and the study’s West region lost relatively little employment in the arts, design, entertainment, and media occupations, which are core to this industry.

New York and New Jersey, which both have relatively high proportions of their employment in the information and financial activities sectors, tended to hire workers in the sectors’ core occupations.²⁵ Employers in the New York–New Jersey region hired workers in analytical occupations such as computer applications engineers, management and computer systems analysts, accountants, and industrial engineers; they let go of retail salespersons, parking lot attendants, team assemblers, hand laborers, and telemarketers.

Employers in New England cut jobs of office and production worker supervisors, general maintenance workers, janitors and cleaners, and stock clerks. Meanwhile, they hired accountants and financial managers. New England had relatively high concentrations of employment in the education (9.8 percent), health care (14.4 percent), and finance and insurance (6 percent) sectors. After layoffs, businesses in the region added workers in occupations that are core to some of these industries; employment in business and financial operations occupations increased by 70 percent in the study group.

Employers in the Mountain–Plains region also followed the pattern of shedding relatively few workers in occupations core to the industries that dominate the region’s economy. In 2004, among all Census regions, the Mountain division²⁶ was the geographic area with the highest concentrations of employment in leisure and hospitality (11.2 percent). Perhaps, as a result, the region had lower percent declines in employment in food preparation, personal care, and sales occupations than did other regions.

As noted earlier, however, not every region followed the pattern of retaining or increasing jobs in occupations core to the region’s dominant industries, in part due to changing technology, consumer trends, or business practices. The combined South Atlantic and East South Central Census divisions—together approximating the study’s Southeast region²⁷—had relatively high employment con-



centrations in the transportation and utilities industries but lost a comparatively large number of jobs in transportation and material moving occupations. Similarly, the Southwest region deviated from the pattern of regions retaining occupations core to dominant industries. Relative to other regions, the Census-defined West South Central division²⁸ had a high proportion of employment in the mining sector (1.5 percent) and the telecommunications industry (1.2 percent). In May 2008, telecommunications businesses were one of the largest employers of telemarketers. After layoffs, however, the study's Southwest region had fewer telemarketers.

Regression analysis. A final regression analysis was conducted to analyze the effect of layoffs on occupational employment by geographic region, controlling for industry, time between observations, and establishment size. The variables of interest were the eight interaction terms for *layoff* × region. The model included non-interaction dummies for all regions except the Mountain-Plains region, so the interaction terms did not combine the impacts of being located in a particular region with having layoffs in that region. The regression was based on a total of 209,858 observations: 205,339 control observations and 4,520 study observations.

The model used was

$$\Delta \text{employment}_{\text{SOC major group}} = \beta_0 + \beta_1 \text{layoff}_i \times \text{West} + \beta_2 \text{layoff}_i \times \text{Southwest} + \beta_3 \text{layoff}_i \times \text{Southeast} + \beta_4 \text{layoff}_i \times \text{Mountain-Plains} + \beta_5 \text{layoff}_i \times \text{New York-New Jersey} + \beta_6 \text{layoff}_i \times \text{Midwest} + \beta_7 \text{layoff}_i \times \text{Mid-Atlantic} + \beta_8 \text{layoff}_i \times \text{New England} + \beta_9 \text{goods} + \beta_{10} \text{totalemp_first}_i + \sum_j \delta_j I(\text{geographic region}_{ji}) + \sum_j \gamma_j I(\text{number of years between observations}_{ji}) + \varepsilon_i$$

where the dependent variable was the change in employment level for each occupational group between the first and second observations. *Layoff* was a dummy variable indicating whether the establishment had a layoff; where *layoff*_{*i*} = 1, a layoff occurred. The *geographic region* dummy variables indicated geographic region: West, Southwest, Southeast, Mountain-Plains, New York-New Jersey, Midwest, Mid-Atlantic, and New England. *Geographic region* included non-interaction dummies for all regions except the Mountain-Plains region. *Layoff* × [region] was an interaction dummy variable. *Goods* was a dummy variable for the goods-producing aggregation, as opposed to the service-providing aggregation. *Totalemp_first* was the total employment in the establishment at the time of the first observation. Finally, there were nine dummy variables

representing the number of years between observations, ranging from 1 to 9; 9 years was captured in the intercept.

In general, the Mid-Atlantic region saw the most substantial employment change for many occupational groups, compared with other regions. Appendix table A-4 shows the regression output for the eight regional interaction variables. For seven occupational groups, an extended mass layoff was associated with a decline in additional employment in all geographic areas (where a change was statistically significant). Production employment shrank in every region, most noticeably in the Mid-Atlantic, followed by the Southwest, Mountain-Plains, New England, and Midwest regions. Production employment declined the least in New York-New Jersey. Employment in transportation and material moving occupations declined the most in the Mid-Atlantic, Southeast, and New York-New Jersey regions. It grew only in the Mountain-Plains. Employment in office and administrative support occupations declined the most in the Mid-Atlantic region and the least in the Mountain-Plains.

Similarly, employment in sales and related occupations declined in all regions; the largest decline was in New York-New Jersey and the Southeast, and the smallest was in the Midwest. Construction and extraction employment shrank everywhere (where a change was statistically significant), especially in the Midwest. Finally, architecture and engineering employment declined substantially in New England and fell the least in the Southeast.

For four occupational groups, an extended mass layoff was associated with a decline in additional employment in nearly all geographic areas (where statistically significant). Healthcare practitioners and technical employment grew only in the Southwest and actually declined in the Midwest and Southeast. Similarly, healthcare support employment grew only in the Southwest and declined in the West and Midwest. Management employment declined the most in the Mid-Atlantic and Mountain-Plains, and grew only in New York-New Jersey. Employment in the arts, design, entertainment, sports, and media occupational group declined the most in the Southeast and New England, and grew only in New York-New Jersey.

In contrast, for three occupational groups, an extended mass layoff was associated with an increase in additional employment in all geographic areas (where statistically significant). Employment in legal occupations grew the most in New York-New Jersey. The Southeast was the region with the most growth in building and grounds cleaning and maintenance employment, and also in food preparation and serving occupations employment.

Finally, the regression yielded mixed results for five occupational groups. Business and financial operations grew the most in New England and the Mountain-Plains, but declined in the Southeast and Midwest. Computer and mathematical science employment grew the most in the Mid-Atlantic and New York-New Jersey regions, but declined in the West and Southwest. Life, physical, and social science employment grew the most in the Mid-Atlantic, and declined the most in the Southwest. Personal care and service employment grew in the Midwest and declined the most in the Southeast. Installation, maintenance and repair employment grew in the Southwest and shrank the most in the Southeast and New England. Finally, protective service employment grew in the Midwest but declined in New York-New Jersey and the Southeast.

DURING THE PERIOD COVERED BY THIS STUDY, the economy experienced both the dot-com bubble burst and large numbers of layoffs in manufacturing. The occupations that were most affected in establishments with layoffs were those which generally involved nonanalytical skills and abilities and tended to represent business support functions, while the occupations whose employment level was relatively unaffected by the layoffs were those which involved analytical skills and abilities or were core to their business. Today's labor market turbulence can be found in different industries, such as real estate and finance. Repeating the study with newer data would reveal whether the patterns observed in this analysis hold under different economic circumstances. In addition, using data further from the layoff date, rather than the first observation after the first layoff, might reveal different long-term restructuring outcomes. □

NOTES

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¹ According to the MLS, during the first quarter of 2009, there were 3,979 extended mass layoff events, resulting in the separation of

705,141 workers from their jobs for at least 31 days. In the first quarter of 2011, there were 1,397 mass layoff events that resulted in 190,895 separations. Extended mass layoff events and separations have shown an over-the-year decrease for six consecutive quarters. BLS Mass Layoff Statistics are available at <http://www.bls.gov/news.release/mslo.toc.htm> (visited June 28, 2011). Extended mass layoff data have been available since second quarter 1995.

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² Recessions are identified by the National Bureau of Economic Research (NBER). For a list of recession start and end dates, see “U.S. Business Cycle Expansions and Contractions” (Cambridge, MA, National Bureau of Economic Research, June 20, 2011), <http://www.nber.org/cycles/cyclesmain.html> (visited June 20, 2011).

³ This article uses the term “function” differently than does the MLS program, so the data are not comparable.

⁴ Approximately 30 days after a mass layoff begins, the employer is contacted for additional information.

⁵ The universe of OES establishments from which the study sample was drawn includes only usable units that passed all BLS tests and that reported all requested employment data and all or partial wage data.

⁶ Farming, fishing, and forestry occupations were included in the total calculations, but were not included in the analysis, because MLS and OES data include only nonfarm industries.

⁷ See “O*NET OnLine: Browse by O*NET Data,” <http://online.onetcenter.org/find/descriptor/browse/Abilities> (visited July 26, 2010). O*NET identifies six descriptors (categories of occupational information): knowledge, skills, abilities, work activities, interests, and work values. Each descriptor has a set of elements, and each element has importance scores for all O*NET occupations.

Occupations in the “analytical” group have high importance scores in skills such as reading comprehension; writing; speaking; math; science; critical thinking; complex problem solving; judgment and decision making; systems analysis; active listening; monitoring; social perceptiveness; coordination; persuasion; negotiation; instructing; service orientation; and management of time, financial, material, and personnel resources. “Analytical” occupations also have high importance scores in elements such as deductive and inductive reasoning, fluency of ideas, informative ordering, mathematical reasoning, memorization, number facility, oral and written expression and comprehension, perceptual speed, and problem sensitivity.

Occupations in the “nonanalytical” group have high importance scores in nonanalytical skills such as equipment maintenance, troubleshooting, repairing, and quality control analysis. These occupations have high importance scores in nonanalytical abilities such as dynamic and extent flexibility; dynamic, explosive, static, and trunk strength; gross body coordination and equilibrium, and stamina. “Nonanalytical” occupations also tend to possess elements of psychomotor abilities, such as control precision and manual dexterity.

⁸ Education and training data come from “Employment Projections: EPP Tables—Occupations” (U.S. Bureau of Labor Statistics, no date), table 1.11, <http://www.bls.gov/emp/#tables>, (visited July 27, 2010). This observation references an occupation’s distribution of employment by educational attainment (found in the table). See also *Occupational Outlook Handbook, 2010–11 Edition* (U.S. Bureau of Labor Statistics, no date), <http://www.bls.gov/oco> (visited June 13, 2011). Information about general office clerks, customer service representatives, and secretaries and administrative assistants is also from the *Handbook*, at <http://www.bls.gov/oco/ocos130.htm#training>, <http://www.bls.gov/oco/ocos280.htm#training>, and <http://www.bls.gov/oco/ocos151.htm#training>, respectively (visited July 27, 2010).

⁹ “Employment Projections: EPP Tables—Occupations.”

¹⁰ See “Assemblers and Fabricators,” in *Occupational Outlook Handbook, 2010–11 Edition*, <http://www.bls.gov/oco/ocos217.htm> (visited July 27, 2010).

¹¹ See *Career Guide to Industries, 2010–11 Edition* (Bureau of Labor Statistics, no date), <http://www.bls.gov/oco/cg> (visited June 13,

2011).

¹² See “Truck Drivers and Driver/Sales Workers: Training, Other qualifications, and Advancement,” in *Occupational Outlook Handbook, 2010–11 Edition*, <http://www.bls.gov/oco/ocos246.htm#training> (visited July 27, 2010).

¹³ “Employment Projections: EPP Tables—Occupations.”

¹⁴ The reduced employment in management occupations overall may be, in part, a result of improvements in the classification of managers in the OES survey. The interpretation of the employment change in management occupations should be made with caution.

¹⁵ Layoffs because of contract completion or contract cancellation could be attributable to seasonal factors, but, for the purposes of this study, they were included in the “economic difficulties” category.

¹⁶ Because the OES program surveys the same establishment at the same time each year, staffing pattern changes in the seasonal layoffs category are long-term changes rather than the result of seasonal changes.

¹⁷ See “Mass Layoff Statistics” (U.S. Bureau of Labor Statistics, no date), <http://www.bls.gov/mls> (visited Mar. 18, 2010).

¹⁸ MLS ended the domestic/foreign relocation series with the 2003 data. Relocation of work was then replaced by movement of work data. The category of controlling costs was added as a reason in 2007.

¹⁹ The rankings excluded seasonal layoffs—although they were included in the count of total mass layoffs.

²⁰ The rankings excluded seasonal layoffs, refusal to respond, “other,” and “does not know” as reasons for layoffs—although they were included in the count of total mass layoffs.

²¹ The data relating to domestic relocation reflect occupations with at least 10 establishments reporting them initially.

²² From *Geographic Profile of Employment and Unemployment, 2004*, “Table 7. Census regions and divisions: percent distribution of employed persons by industry, sex, race, and Hispanic or Latino ethnicity, 2004 annual averages” (U.S. Bureau of Labor Statistics, January 2009), also available online at http://www.bls.gov/opub/gp/pdf/gp04_07.pdf (visited June 13, 2011).

²³ The Midwest division is similar to the study’s Midwest region but also includes Missouri and Kansas.

²⁴ The Pacific division is similar to the study’s West region but excludes Arizona, Idaho, and Nevada.

²⁵ From *Geographic Profile of Employment and Unemployment, 2004*, “Table 20. States: percent distribution of employed persons by sex, race, Hispanic or Latino ethnicity, and industry, 2004 annual averages” (U.S. Bureau of Labor Statistics, January 2009), also available online at http://www.bls.gov/opub/gp/pdf/gp04_20.pdf (visited June 13, 2011).

²⁶ The Mountain division is similar to the study’s Mountain-Plains region but excludes Missouri and Kansas and includes Arizona and New Mexico.

²⁷ The South Atlantic and East South Central Census divisions are similar to the study’s Southeast region, except that the combined Census-defined divisions include Virginia, Delaware, the District of Columbia and West Virginia; these four jurisdictions are all in the study’s Mid-Atlantic region.

²⁸ The West South Central division is similar to the study’s Southwest region but excludes New Mexico.

Appendix tables: Output for regressions

Table A-1. Output for 21 regressions of occupational group on layoff_j and control variables (industry, region, establishment size, and number of years between observations)

Dependent variable (change in employment in occupational group)	Layoff _j parameter estimate	Standard error on layoff _j parameter estimate	t-value	p-value
Production	-20.76	1.00	-20.86	<.0001
Office and administrative support	-10.97	1.23	-8.91	<.0001
Sales and related	-7.66	.51	-15.05	<.0001
Management	-6.13	.43	-14.27	<.0001
Transportation and material moving	-6.04	.79	-7.69	<.0001
Architecture and engineering	-4.29	.54	-7.96	<.0001
Installation, maintenance, and repair	-3.38	.46	-7.41	<.0001
Construction and extraction	-1.92	.43	-4.42	<.0001
Education	-1.61	1.54	-1.05	.2938
Personal care and service	-1.28	.61	-2.1	.0356
Arts, design, entertainment, sports, and media	-1.13	.32	-3.51	.0004
Computer and mathematical science	-.48	.67	-.71	.4792
Healthcare practitioner and technical	-.05	.78	-.06	.9513
Protective service	-.04	.40	-.09	.9263
Healthcare support	-.03	.39	-.08	.9371
Life, physical, and social science	-.03	.34	-.09	.9309
Legal	.60	.11	5.32	<.0001
Community and social services	.68	.44	1.54	.1225
Business and financial operations	1.28	.48	2.66	.0078
Building and grounds cleaning and maintenance	2.62	.37	7.09	<.0001
Food preparation and serving related	5.36	.58	9.27	<.0001

NOTE: Table excludes output for control variables to conserve space, and excludes farming, fishing, and forestry occupations. Degrees of freedom=1 for all regressions.

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Table A-2. Output for 21 regressions of occupational group on economic_t, seasonal_t, and control variables (industry, region, establishment size, and number of years between observations)

Dependent variable (change in employment in occupational group)	Interaction term	Coefficient	Standard error	t-value	p-value	Are the two interaction terms significantly different?
Management	layoff _t *economic _t	0.00	3.49	0	0.9996	no
	layoff _t *seasonal _t	-.65	3.68	-.18	.8608	
Business and financial operations	layoff _t *economic _t	3.73	4.11	.91	.3633	no
	layoff _t *seasonal _t	.12	4.33	.03	.9781	
Computer and mathematical science	layoff _t *economic _t	1.36	5.43	.25	.8022	no
	layoff _t *seasonal _t	-1.56	5.72	-.27	.7858	
Architecture and engineering	layoff _t *economic _t	.69	5.80	.12	.906	no
	layoff _t *seasonal _t	3.53	6.12	.58	.5645	
Life, physical, and social science	layoff _t *economic _t	-.32	2.05	-.16	.8767	no
	layoff _t *seasonal _t	.68	2.16	.31	.7536	
Community and social services	layoff _t *economic _t	-.33	.69	-.48	.6341	no
	layoff _t *seasonal _t	-.14	.73	-.19	.8514	
Legal	layoff _t *economic _t	.04	.38	.1	.9174	no
	layoff _t *seasonal _t	.11	.40	.27	.7853	
Education	layoff _t *economic _t	-1.31	2.13	-.61	.539	no
	layoff _t *seasonal _t	.88	2.25	.39	.6963	
Arts, design, entertainment, sports, and media	layoff _t *economic _t	6.11	4.15	1.47	.1408	no
	layoff _t *seasonal _t	-3.47	4.37	-.79	.4279	
Healthcare practitioner and technical	layoff _t *economic _t	7.60	6.93	1.1	.2726	no
	layoff _t *seasonal _t	6.62	7.31	.91	.365	
Healthcare support	layoff _t *economic _t	3.03	1.85	1.64	.1007	no
	layoff _t *seasonal _t	2.45	1.94	1.26	.2078	
Protective service	layoff _t *economic _t	3.41	1.74	1.96	.0505	no
	layoff _t *seasonal _t	-1.05	1.84	-.57	.5689	
Food preparation and serving related	layoff _t *economic _t	-9.22	7.75	-1.19	.2341	no
	layoff _t *seasonal _t	6.21	8.16	.76	.4465	
Building and grounds cleaning and maintenance	layoff _t *economic _t	-.18	2.80	-.07	.9476	no
	layoff _t *seasonal _t	4.36	2.95	1.48	.1393	
Personal care and service	layoff _t *economic _t	7.66	5.65	1.36	.1752	no
	layoff _t *seasonal _t	-.60	5.96	-.1	.9197	
Sales and related	layoff _t *economic _t	-4.80	5.90	-.81	.4167	no
	layoff _t *seasonal _t	-4.70	6.22	-.76	.4499	
Office and administrative support	layoff _t *economic _t	7.87	9.58	.82	.4114	no
	layoff _t *seasonal _t	11.47	10.10	1.14	.2563	
Construction and extraction	layoff _t *economic _t	-4.50	4.07	-1.11	.2686	no
	layoff _t *seasonal _t	-6.86	4.29	-1.6	.1098	
Installation, maintenance, and repair	layoff _t *economic _t	3.26	5.28	.62	.5374	no
	layoff _t *seasonal _t	4.52	5.57	.81	.4169	
Production	layoff _t *economic _t	-15.62	12.30	-1.27	.2041	no
	layoff _t *seasonal _t	.10	12.96	.01	.9941	
Transportation and material moving	layoff _t *economic _t	-2.67	7.47	-.36	.721	no
	layoff _t *seasonal _t	-4.55	7.88	-.58	.5631	

NOTE: Table excludes output for control variables to conserve space, and excludes farming, fishing, and forestry occupations. Degrees of freedom=1 for all regressions.

Table A-3. Output for 21 regressions of occupational group on layoff_i goods-producing group, layoff_i service-providing group, and control variables (region, establishment size, years between observations, and goods-producing group)

Dependent variable (change in employment in occupational group)	Interaction term	Coefficient	Standard error	t-value	p-value	Are the parameter estimates significantly different at the 5-percent significance level?
Management	$\text{layoff}_i^* \text{goods}_i$	-4.94	0.55	-8.92	<.0001	yes
	$\text{layoff}_i^* \text{service}_i$	-7.12	.52	-13.77	<.0001	
Business and financial operations	$\text{layoff}_i^* \text{goods}_i$	.85	.62	1.36	.173	no
	$\text{layoff}_i^* \text{service}_i$	1.65	.58	2.83	.0046	
Computer and mathematical science	$\text{layoff}_i^* \text{goods}_i$	-.92	.86	-1.06	.2869	no
	$\text{layoff}_i^* \text{service}_i$	-.11	.81	-.13	.8948	
Architecture and engineering	$\text{layoff}_i^* \text{goods}_i$	-7.45	.69	-10.76	<.0001	yes
	$\text{layoff}_i^* \text{service}_i$	-1.66	.65	-2.57	.0102	
Life, physical, and social science	$\text{layoff}_i^* \text{goods}_i$	-.51	.44	-1.16	.2445	yes
	$\text{layoff}_i^* \text{service}_i$	.37	.41	.9	.3694	
Community and social services	$\text{layoff}_i^* \text{goods}_i$	.82	.57	1.44	.1503	no
	$\text{layoff}_i^* \text{service}_i$	.57	.53	1.07	.2838	
Legal	$\text{layoff}_i^* \text{goods}_i$	.62	.14	4.27	<.0001	no
	$\text{layoff}_i^* \text{service}_i$	.58	.14	4.31	<.0001	
Education	$\text{layoff}_i^* \text{goods}_i$	-1.13	1.98	-.57	.5685	no
	$\text{layoff}_i^* \text{service}_i$	-2.01	1.85	-1.09	.2761	
Arts, design, entertainment, sports, and media	$\text{layoff}_i^* \text{goods}_i$	.01	.41	.01	.9898	yes
	$\text{layoff}_i^* \text{service}_i$	-2.06	.39	-5.34	<.0001	
Healthcare practitioner and technical	$\text{layoff}_i^* \text{goods}_i$	-1.29	1.01	-1.27	.203	no
	$\text{layoff}_i^* \text{service}_i$	.98	.94	1.03	.3015	
Healthcare support	$\text{layoff}_i^* \text{goods}_i$	-.11	.50	-.22	.8277	no
	$\text{layoff}_i^* \text{service}_i$	.03	.46	.07	.942	
Protective service	$\text{layoff}_i^* \text{goods}_i$	1.12	.52	2.17	.0298	yes
	$\text{layoff}_i^* \text{service}_i$	-1.00	.48	-2.06	.0392	
Food preparation and serving related	$\text{layoff}_i^* \text{goods}_i$	4.47	.74	6.01	<.0001	no
	$\text{layoff}_i^* \text{service}_i$	6.09	.70	8.75	<.0001	
Building and grounds cleaning and maintenance	$\text{layoff}_i^* \text{goods}_i$	2.17	.47	4.57	<.0001	yes
	$\text{layoff}_i^* \text{service}_i$	2.99	.44	6.72	<.0001	
Personal care and service	$\text{layoff}_i^* \text{goods}_i$	1.82	.78	2.32	.0204	yes
	$\text{layoff}_i^* \text{service}_i$	-3.84	.73	-5.24	<.0001	
Sales and related	$\text{layoff}_i^* \text{goods}_i$	-1.87	.65	-2.86	.0042	yes
	$\text{layoff}_i^* \text{service}_i$	-12.44	.61	-20.32	<.0001	
Office and administrative support	$\text{layoff}_i^* \text{goods}_i$	-1.28	1.58	-.81	.4202	yes
	$\text{layoff}_i^* \text{service}_i$	-18.99	1.48	-12.82	<.0001	
Construction and extraction	$\text{layoff}_i^* \text{goods}_i$	-4.33	.56	-7.76	<.0001	yes
	$\text{layoff}_i^* \text{service}_i$	.08	.52	.15	.8812	
Installation, maintenance, and repair	$\text{layoff}_i^* \text{goods}_i$	-5.16	.59	-8.77	<.0001	yes
	$\text{layoff}_i^* \text{service}_i$	-1.92	.55	-3.48	.0005	
Production	$\text{layoff}_i^* \text{goods}_i$	-48.17	1.28	-37.71	<.0001	yes
	$\text{layoff}_i^* \text{service}_i$	1.91	1.19	1.6	.1093	
Transportation and material moving	$\text{layoff}_i^* \text{goods}_i$	-5.83	1.01	-5.77	<.0001	no
	$\text{layoff}_i^* \text{service}_i$	-6.22	.95	-6.58	<.0001	

NOTE: Table excludes output for control variables to conserve space, and excludes farming, fishing, and forestry occupations. Degrees of freedom=1 for all regressions.

Table A-4. Output for regressions of change in employment in each occupational group on all 8 layoff region interaction variables, and controls

Dependent variable (change in employment in occupational group)	Output for interaction terms	Interaction term							
		New England	New York/ New Jersey	Mid-Atlantic	Southeast	Midwest	Southwest	Mountain-Plains	West
Management	Coefficient Standard error p-value	-12.26 3.85 .00	3.81 1.06 .00	-14.92 2.23 <.0001	-7.06 .84 <.0001	-5.55 .67 <.0001	-10.03 1.04 <.0001	-13.47 1.35 <.0001	-5.80 .67 <.0001
Business and financial operations	Coefficient Standard error p-value	20.99 4.32 <.0001	6.32 1.19 <.0001	-4.36 2.50 .08	-2.06 .95 .03	-.92 .76 .23	2.87 1.17 .01	11.57 1.52 <.0001	.16 .75 .83
Computer and mathematical science	Coefficient Standard error p-value	-8.69 6.02 .15	9.13 1.66 <.0001	9.78 3.49 .01	.50 1.32 .70	-.15 1.05 .88	-3.82 1.62 .02	-1.00 2.12 .64	-3.98 1.04 .00
Architecture and engineering	Coefficient Standard error p-value	-11.21 4.82 .02	-2.81 1.33 .03	-2.65 2.79 .34	-2.05 1.06 .05	-5.25 .84 <.0001	-1.85 1.30 .16	-3.89 1.70 .02	-6.03 .84 <.0001
Life, physical, and social science	Coefficient Standard error p-value	-1.15 3.05 .71	1.49 .84 .08	8.60 1.77 <.0001	-.05 .67 .94	1.36 .53 .01	-2.04 .82 .01	-1.54 1.07 .15	-1.40 .53 .01
Community and social service	Coefficient Standard error p-value	.52 3.97 .90	.23 1.09 .83	1.74 2.30 .45	1.30 .87 .13	.74 .70 .29	.49 1.07 .64	.71 1.40 .61	.45 .69 .51
Legal	Coefficient Standard error p-value	.61 1.01 .54	1.01 .28 .00	.54 .58 .35	.56 .22 .01	.79 .18 <.0001	.22 .27 .42	.75 .36 .03	.39 .17 .03
Education	Coefficient Standard error p-value	-2.69 13.76 .85	3.00 3.79 .43	-3.56 7.97 .66	-4.65 3.01 .12	-.61 2.41 .80	-3.11 3.71 .40	-3.36 4.84 .49	-1.48 2.38 .54
Arts, design, entertainment, sports, media	Coefficient Standard error p-value	-5.61 2.87 .05	1.45 .79 .07	2.14 1.67 .20	-6.31 .63 <.0001	.18 .50 .72	-1.03 .78 .19	-.56 1.01 .58	-.81 .50 .10
Healthcare practitioners and technical	Coefficient Standard error p-value	-1.11 7.02 .87	-1.07 1.94 .58	-2.99 4.07 .46	-2.78 1.54 .07	-3.12 1.23 .01	17.20 1.90 <.0001	-2.61 2.47 .29	-.68 1.22 .58
Healthcare support	Coefficient Standard error p-value	-.13 3.45 .97	.79 .95 .40	.27 2.00 .89	-.11 .75 .89	-1.19 .60 .05	4.74 .93 <.0001	-.20 1.21 .87	-.90 .60 .13
Protective service	Coefficient Standard error p-value	.38 3.60 .92	-1.55 .99 .12	1.29 2.09 .54	-1.63 .79 .04	1.30 .63 .04	-.02 .97 .99	-1.61 1.27 .20	.34 .62 .58
Food preparation and serving related	Coefficient Standard error p-value	3.53 5.18 .50	4.56 1.43 .00	-2.83 3.00 .35	15.58 1.13 <.0001	2.29 .91 .01	4.68 1.40 .00	2.11 1.82 .25	4.77 .90 <.0001
Building and grounds cleaning and maintenance	Coefficient Standard error p-value	1.45 3.30 .66	.71 .91 .44	2.02 1.91 .29	5.12 .72 <.0001	2.91 .58 <.0001	3.06 .89 .00	-.11 1.16 .93	2.23 .57 <.0001
Personal care and service	Coefficient Standard error p-value	2.33 5.45 .67	-3.43 1.50 .02	-7.18 3.16 .02	-10.05 1.19 <.0001	1.76 .95 .07	.89 1.47 .55	.40 1.92 .83	.39 .94 .68
Sales and related	Coefficient Standard error p-value	-9.54 4.56 .04	-16.01 1.26 <.0001	-7.41 2.64 .01	-10.39 1.00 <.0001	-4.05 .80 <.0001	-9.25 1.23 <.0001	-7.05 1.60 <.0001	-6.20 .79 <.0001

See note at end of table.

Table A-4. Output for regressions of change in employment in each occupational group on all 8 layoff region interaction variables, and controls

Dependent variable (change in employment in occupational group)	Output for interaction terms	Interaction term							
		New England	New York/New Jersey	Mid-Atlantic	Southeast	Midwest	Southwest	Mountain-Plains	West
Office and administrative support	Coefficient	-18.65	-13.33	-29.98	-15.98	-0.07	-14.21	-12.41	-15.12
	Standard error	11.02	3.03	6.39	2.41	1.93	2.98	3.88	1.91
	p-value	.09	<.0001	<.0001	<.0001	.97	<.0001	.00	<.0001
Construction and extraction	Coefficient	.80	-2.49	-2.62	.27	-4.14	-2.32	-3.54	-.16
	Standard error	3.88	1.07	2.25	.85	.68	1.05	1.37	.67
	p-value	.84	.02	.25	.75	<.0001	.03	.01	.81
Installation, maintenance, and repair	Coefficient	-8.15	-1.19	-7.78	-10.40	-3.12	9.23	-4.77	-4.52
	Standard error	4.09	1.13	2.37	.89	.72	1.10	1.44	.71
	p-value	.05	.29	.00	<.0001	<.0001	<.0001	.00	<.0001
Production	Coefficient	-29.86	-7.14	-53.37	-48.97	-23.78	-.55	-42.18	-6.93
	Standard error	8.90	2.45	5.16	1.95	1.56	2.40	3.13	1.54
	p-value	.00	.00	<.0001	<.0001	<.0001	.82	<.0001	<.0001
Transportation and material moving	Coefficient	1.66	-12.61	-15.27	-14.35	-4.61	-4.59	7.54	-3.95
	Standard error	7.03	1.94	4.08	1.54	1.23	1.90	2.48	1.22
	p-value	.81	<.0001	.00	<.0001	.00	.02	.00	.00

NOTE: Table excludes output for control variables to conserve space, and excludes farming, fishing, and forestry occupations. Degrees of freedom=1 for all regressions.