

# Which industries are sensitive to business cycles?

*An analysis of the 1994–2005 projections can be used to identify industries that are projected to move differently with business cycles in the future than in the past, and to identify the industries and occupations that are most prone to business cycle swings*

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Industries react in different ways to the business cycle fluctuations of the U.S. economy. Some industries are very vulnerable to economic swings, while others are relatively immune to them. For those industries that are characterized as cyclical, the degree and timing of these fluctuations vary widely—the industries that experience only modest gains during expansionary periods may also suffer only mildly during contractions, and those that recover fastest from recessions may also feel the impact of a downturn earlier and more strongly than other industries.

This article examines those industries in which demand and employment are most sensitive to business cycle movements over time. The Bureau of Labor Statistics develops projections of the labor force, gross domestic product (GDP) and its components, industry output, and industry and occupational employment every 2 years.<sup>1</sup> At the completion of the latest projections round (1994–2005), a new analysis of the projections was conducted that correlates GDP movements over time with changes in demand and employment. In future projections rounds, similar analyses will be conducted during the developmental stages of the projections and will be used:

- to identify industries that are projected to move differently with business cycles in the future than in the past. Upon identifying these industries, the projections staff will then de-

termine the structural change or changes causing the break from the past or review its projections model and make appropriate modifications to ensure consistency between the historical and projected periods.

- to identify the industries and occupations that are most susceptible to business cycle swings for use in preparing career guidance information.<sup>2</sup>

In identifying which industries fluctuate with GDP (business cycle movements over time) and which do not, two factors were analyzed for the 1994–2005 projection rounds: the correlation between industry employment and GDP, and the correlation between industry final demand and GDP. The second factor (industry final demand) was analyzed in two ways. First, the historical period (1977–93) was used as a benchmark to measure the correlation of industry demand and total GDP, with the expectation that the demand-GDP relationship over the projected period (1994–2005) should be the same as that over the historical period. Second, the recession years alone, rather than the entire historical and projected periods, were examined. This method measured, on a yearly percent change basis, how aggregate industry groups (the 183 individual industries specific to the projections program were aggregated into 12 groups for computational purposes) responded to and recovered from the 1980, 1982, and 1991 recessions of the historical period. These

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**Table 1. Correlation coefficients for employment and industry final demand by industry, historical and projected periods**

Industry	Employment	Industry final demand	
	Historical correlation with GDP	Historical correlation with GDP	Projected correlation with GDP
Household furniture .....	0.9591	0.7713	0.8589
Miscellaneous plastics products, n.e.c. ....	.9388	.4235	.5224
Personnel supply services .....	.9381	.2487	-.0829
Plumbing and nonelectric heating equipment .....	.9307	-.0523	.1370
Stone, clay, and miscellaneous mineral products .....	.9253	.1351	.2985
Electric lighting and wiring equipment .....	.9151	-.0252	.2948
Metal coating, engraving, and allied services .....	.9131	-.0016	.2960
Concrete, gypsum, and plaster products .....	.9096	.0713	.2664
Partitions and fixtures .....	.9093	.6743	.4637
Cutlery, hand tools, and hardware .....	.9036	.5510	.4680
Millwork, plywood, and structural members .....	.8955	-.3770	-.6968
Nonferrous foundries .....	.8893	.2886	.3796
Refrigeration and service industry machinery .....	.8860	.6312	.6659
Converted paper products except containers .....	.8784	-.1651	.6429
Sawmills and planing mills .....	.8764	-.4131	-.4216
Carpets and rugs .....	.8752	.8036	.4460
Construction .....	.8635	.8975	.9248
Metal forgings and stampings .....	.8559	.5096	.6708
Household appliances .....	.8545	.7248	.8324
Retail trade except eating and drinking places .....	.8504	.9175	.9760
Paints and allied products .....	.8490	.4824	.6556
Manufactured products, n.e.c. ....	.8476	.4394	.6048
Motor vehicles and equipment .....	.8400	.7575	.8826
Paperboard containers and boxes .....	.8381	.4725	.6980
Screw machine products, bolts, rivets .....	.8247	-.2177	-.3737
Rubber products, plastic hose and footwear .....	.8245	.0965	-.1186
Miscellaneous fabricated textile products .....	.8191	.8101	.7430
Wood containers and miscellaneous wood products .....	.8189	.5066	.6325
Trucking and warehousing .....	.7621	.3579	.6586
Electrical industrial apparatus .....	.7581	.3513	.4352
Nonferrous rolling and drawing .....	.7541	.0292	.7099
Iron and steel foundries .....	.7514	.0990	-.1886
Office and miscellaneous furniture and fixtures .....	.7311	.5227	.3861
Eating and drinking places .....	.7310	.4917	.6203
Blankbooks and bookbinding .....	.7155	-.3473	-.4786
Wood buildings and mobile homes .....	.7005	.5045	.6881
Miscellaneous fabricated metal products .....	.6858	.2144	.4183
Miscellaneous electrical equipment .....	.6653	.5526	.8443
Fabricated structural metal products .....	.6619	.5459	.7210
Glass and glass products .....	.6605	.0784	-.0081
Wholesale trade .....	.6603	.8412	.7831
Electric distribution equipment .....	.6599	.6813	.3868
Real estate .....	.6527	.7142	.8366
Apparel .....	.6426	.2993	.4862
Knitting mills .....	.6333	.5705	.7327
Metalworking machinery and equipment .....	.6313	.7745	.4696
All other primary metals .....	.6272	-.1135	.1330
Books .....	.6240	.5240	.7996
Commercial printing and business forms .....	.6240	.5827	.7323
Railroad equipment .....	.6223	.2708	.5282
Passenger transportation arrangement .....	.6158	.3843	.5218
Metal cans and shipping containers .....	.6057	.1271	.5825
Miscellaneous textile goods .....	.6053	.5701	.5360
Engines and turbines .....	.5954	.4452	.6886
Weaving, finishing, yarn, and thread mills .....	.5875	.1498	-.0382
Research and testing services .....	.5859	-.6139	-.0115
Miscellaneous chemical products .....	.5796	.3506	.2078
Air transportation .....	.5785	.6625	.3963
Miscellaneous business services .....	.5781	.1706	.1229
Water and sanitation .....	.5769	.3268	-.0365
Services to buildings .....	.5747	.6348	-.0778
Household audio and video equipment .....	.5712	.0537	-.1685

See footnote at end of table.

**Table 1. Continued—Correlation coefficients for employment and industry final demand by industry, historical and projected periods**

Industry	Employment	Industry final demand	
	Historical correlation with GDP	Historical correlation with GDP	Projected correlation with GDP
Miscellaneous publishing .....	0.5708	0.6307	0.7232
Industrial machinery, n.e.c. ....	.5566	.4390	.4522
State and local government enterprises, n.e.c. ....	.5503	.7375	.2057
Special industry machinery .....	.5493	.5002	.7018
Beauty and barber shops .....	.5415	.5303	.4358
Ophthalmic goods .....	.5373	.2167	.7369
Measuring and controlling devices .....	.5365	.3627	.5435
Ordnance and ammunition .....	.5360	.1353	-.1044
Nondepository; holding and investment offices .....	.5296	.0209	.5583
Hotels and other lodging places .....	.5238	.7391	.2311
Miscellaneous transportation services .....	.5225	-.0171	.2957
Blast furnaces and basic steel products .....	.5202	-.3551	.0074
Luggage, handbags, and leather products, n.e.c. ....	.5133	-.4494	-.2407
Automotive rentals, without drivers .....	.5066	.6321	.4427
Meat products .....	.5058	-.4986	.3840
Service industries for the printing trade .....	.5034	-.2253	.0411
Miscellaneous equipment rental and leasing .....	.4986	.4063	-.0015
Engineering and architectural services .....	.4882	.2891	.6077
Plastics materials and synthetics .....	.4844	.4717	.4313
Soap, cleaners, and toilet goods .....	.4797	.6822	.7699
Electronic components and accessories .....	.4672	-.2562	-.5644
Advertising .....	.4630	.5293	-.4852
Automobile parking, repair, and services .....	.4591	.8210	.5638
State and local general government, n.e.c. ....	.4561	.2935	-.2691
Farm and garden machinery and equipment .....	.4502	.4571	.4073
General industrial machinery and equipment .....	.4484	.7198	.5392
Railroad transportation .....	.4460	.7389	.7707
Miscellaneous repair services .....	.4400	.0788	.1512
Miscellaneous transportation equipment .....	.4243	-.2168	.0207
Medical equipment, instruments, and supplies .....	.4139	.0190	.5812
U.S. Postal Service .....	.4017	.5271	-.2449
Watches, clocks, and parts .....	.4008	.1701	.5734
Jewelry, silverware, and plated ware .....	.4006	.4240	.3416
Laundry, cleaning, and shoe repair .....	.3992	.6142	.3402
Computer and data processing services .....	.3957	.1723	.3213
Tires and inner tubes .....	.3944	-.3310	.7768
Producers, orchestras, and entertainers .....	.3787	.1915	.4708
Job training and related services .....	.3738	.5851	.5114
Sugar and confectionery products .....	.3712	.0583	.8021
Management and public relations .....	.3704	-.3863	-.2485
Logging .....	.3593	-.0640	.1 299
Hydraulic cement .....	.3584	-.1628	.6071
Primary nonferrous smelting and refining .....	.3580	-.0368	-.2199
Metal mining .....	.3268	-.0675	.4464
Newspapers .....	.3242	.1271	.3531
Ship and boat building and repairing .....	.3117	.4702	.6495
Toys and sporting goods .....	.2981	.2014	-.0553
Aerospace .....	.2900	-.4403	-.5737
Periodicals .....	.2852	.5646	.7968
Video tape rental .....	.2734	.6558	.5176
Drugs .....	.2726	.0858	-.2178
Search and navigation equipment .....	.2714	.1245	.4409
Bowling centers .....	.2679	-.0043	.4442
Insurance agents, brokers, and service .....	.2673	.0706	.2957
Dairy products .....	.2597	.1599	.1290
Construction and related machinery .....	.2522	.6281	.1677
Miscellaneous food and kindred products .....	.2441	-.0639	.7034
Water transportation .....	.2375	.6726	.6613
Pulp, paper, and paperboard mills .....	.2275	.5161	.1464
Federal general government .....	.2127	-.0236	-.0533

See footnote at end of table.

**Table 1. Continued—Correlation coefficients for employment and industry final demand by industry, historical and projected periods**

Industry	Employment	Industry final demand	
	Historical correlation with GDP	Historical correlation with GDP	Projected correlation with GDP
Motion pictures .....	0.2123	0.2498	0.7991
Depository institutions .....	.2074	.5092	.0109
Preserved fruits and vegetables .....	.2059	-.3385	.3057
Electrical repair shops .....	.2054	.4157	.4692
State and local government education .....	.1992	.2706	-.2047
Offices of health practitioners .....	.1984	.4048	.1398
Nonmetallic minerals, except fuels .....	.1926	.1998	-.5380
Federal electric utilities .....	.1851	—	—
Computer and office equipment .....	.1672	.2862	.5878
Insurance carriers .....	.1527	-.1723	.6195
State and local electric utilities .....	.1475	—	—
Child day care services .....	.1393	.7278	.4479
Residential care .....	.1318	.6324	.5774
Local and interurban passenger transit .....	.1245	.5736	.5425
Individual and miscellaneous social services .....	.1169	.4786	.5565
Legal services .....	.1159	.7205	.1138
Private households .....	.0962	.5167	.1775
Funeral service and crematories .....	.0920	.1937	.3881
Health services, n.e.c. ....	.0899	.1602	.3031
Footwear, except rubber and plastic .....	.0757	-.2338	-.7587
Grain mill products and fats and oils .....	.0602	-.0917	.5411
Bakery products .....	.0594	.1295	.7945
Museums, botanical, zoological gardens .....	.0543	.4276	.5693
Membership organizations .....	.0512	.4169	.5735
Communications equipment .....	.0425	.1868	.6389
Security and commodity brokers .....	.0416	.0299	.1840
Commercial sports .....	.0385	-.2027	.3931
Educational services .....	.0343	.3000	-.0129
Personal services, n.e.c. ....	.0186	.2572	.5577
Beverages .....	.0091	.3927	.7475
Agricultural chemicals .....	-.0246	.3604	.3187
Accounting, auditing, and other services .....	-.0314	.5102	-.2437
Agricultural services .....	-.0647	.4539	.1332
State and local government hospitals .....	-.0741	-.1599	-.0617
Petroleum refining .....	-.0764	.4276	.5892
Watch, jewelry, and furniture repair .....	-.0771	.4046	.1051
Electric utilities .....	-.1025	.2739	.2471
Industrial chemicals .....	-.1448	.5277	.3206
Greeting cards .....	-.1634	.2016	.0699
Communications .....	-.1878	.1107	.4218
Oil and gas field services .....	-.1947	-.0585	-.4111
Coal mining .....	-.1953	-.1486	.3290
Gas utilities .....	-.2023	.0653	.0310
Forestry, fishing, hunting, and trapping .....	-.2168	-.5862	.0610
Amusement and recreation services, n.e.c. ....	-.2168	.5057	.6335
Tobacco products .....	-.2244	.0489	.0139
Local government passenger transit .....	-.2443	—	—
Nursing and personal care facilities .....	-.2589	.3980	.2438
Photographic equipment and supplies .....	-.2851	.3095	.4319
Agricultural production .....	-.3036	.3913	-.1532
Pipelines, except natural gas .....	-.3079	.1137	.8710
Crude petroleum, natural gas, and gas liquids .....	-.3745	.4985	.7708
Federal government enterprises, n.e.c. ....	-.4072	.3899	-.0890
Hospitals, private .....	-.5253	-.4714	.4637
Royalties .....	...	-.0647	.2020
Owner-occupied dwellings .....	...	.2900	.4964
Noncomparable imports .....	...	.4828	.4856
Scrap, used and secondhand goods .....	...	.4558	-.0730
Rest of the world industry .....	...	—	—
Inventory valuation adjustment .....	...	—	—

NOTE: n.e.c. = not elsewhere classified. Dashes indicate no final demand. Ellipses indicate no employment.

**Exhibit 1. Industries with the most (correlation coefficients closest to 1 or -1) and least (correlation coefficients closest to 0) business cycle-prone employment, and the dominant occupations in these industries**

<b>Industry employment most correlated with business cycle fluctuations</b>	<b>Occupations specific to this industry</b>
<p>Household furniture</p> <p>Miscellaneous plastics products, not elsewhere classified</p> <p>Personnel supply services</p> <p>Plumbing and nonelectric heating equipment</p> <p>Stone, clay, and miscellaneous mineral products</p> <p>Electric lighting and wiring equipment</p> <p>Metal coating, engraving, and allied services</p> <p>Concrete, gypsum, and plaster products Partitions and fixtures</p> <p>Cutlery, handtools, and hardware</p>	<p>Upholsterers; precision woodworkers such as cabinet makers, furniture finishers, and wood machinists</p> <p>Operators, fabricators, and laborers</p> <p>Administrative support occupations, including clerical; helpers, laborers, and material movers (by hand)</p> <p>Operators, fabricators, and laborers; and precision production, craft, and repair occupations</p> <p>Machinery and related mechanics, installers, and repairers</p> <p>Operators, fabricators, and laborers; and precision production, craft, and repair occupations</p> <p>Operators, fabricators, and laborers; and precision production, craft, and repair occupations</p> <p>Truckdrivers; mechanics, installers, and repairers; construction trades Precision woodworkers, including cabinetmakers and wood machinists</p> <p>Machinists</p>
<b>Industry employment least correlated with business cycle fluctuations</b>	<b>Occupations specific to this industry</b>
<p>Beverages</p> <p>Personal services, not elsewhere classified</p> <p>Agricultural chemicals</p> <p>Accounting, auditing, and other services</p> <p>Educational services</p> <p>Commercial sports</p> <p>Communications equipment</p>	<p>Packing and filling machine operators and tenders; truck drivers; industrial truck and trailer operators; industrial machinery mechanics; and administrative support occupations, including clerical</p> <p>Photographers; management support occupations</p> <p>Chemical plant and system operators; blue-collar worker supervisors; industrial machinery mechanics; chemical equipment controllers; crushing and mixing and packing and filling machine operators and tenders; and truckdrivers</p> <p>Accountants and auditors; general managers and top executives; bookkeeping, accounting, and auditing clerks; secretaries; and general office clerks</p> <p>Teachers, librarians, and counselors; teacher aides and educational assistants; janitors and food preparation and service workers</p> <p>Ushers, lobby attendants, and ticket takers; guards; food counter, fountain, and related workers; janitors and cleaners; and cashiers</p> <p>Precision electrical and electronic equipment assemblers; inspectors, testers, and graders; electrical and electronic assemblers; electrical and electronics engineers and computer engineers</p>

**Exhibit 1. Continued—Industries with the most (correlation coefficients closest to 1 or -1) and least (correlation coefficients closest to 0) business cycle-prone employment and the dominant occupations in these industries**

Industry employment least correlated with business cycle fluctuations	Occupations specific to this industry
Membership organizations	Clergy, musicians, teachers, and directors, religious activities and education; secretaries, general office clerks; bookkeeping, accounting, and auditing clerks; janitors and cleaners; bartenders; and child care workers
Museums, botanical, zoological gardens	Service occupations such as janitors and cleaners, food preparation and service workers, and protective service occupations; cashiers; curators, archivists, museum technicians, and restorers; teachers and instructors
<p>NOTE: In many of the above-mentioned manufacturing industries, the dominant occupations in the operators, fabricators, and laborers category are machine operators and tenders, hand workers, including assemblers and fabricators, and helpers, laborers and material movers. Within the precision production occupations, they are inspectors, testers and graders, precision metal workers, and blue-collar worker supervisors.</p>	

results were then compared with those for the two recessions assumed in the projected period, between now and 2005, to determine whether the projected behavior was consistent with that of the historical period.<sup>3</sup>

The principle statistical measure used to quantify both the industry final demand and industry employment relationship to GDP was the Pearson product moment coefficient of correlation (*r*).<sup>4</sup> This statistic provides an empirical measure of the degree of association between the movement of GDP and industry final demand or employment. As *r* approaches 1 or -1, the degree of correlation increases, with coefficients closer to 1 showing cyclical industries, and coefficients closer to -1 showing countercyclical industries.

It is important to note that this analysis highlights only those cyclical industries whose movements coincide with GDP movements. The ability to identify cyclical industries that lead or lag GDP is limited by the fact that the BLS projections use annual rather than quarterly data. Because annual data

are used, the leading and lagging industries can be masked. Despite the lack of quarterly data, we attempted to identify lagging cyclical industries by lagging employment in each of the industries by 1 year. The results of the analysis using the lagged data were not very different from those using unlagged data: no additional industries were found to be cyclical. The coincident cyclical industries became, as would be expected, less cyclical (the *r*'s were closer to 0), while the industries that were not coincidentally cyclical (those with *r*'s close to 0) became more cyclical (*r* increased). However, the *r*'s did not increase enough to consider these industries to be cyclical with a lag—they remained close to 0.

**Employment**

Table 1 presents the results of the correlation coefficient analysis for the past projections round. Column 2 of the table is used to determine those industries in which employment has been the least and most sensitive to business cycles in the past. For example, the household furniture industry, with its employment-GDP correlation coefficient of 0.9591, has the most cyclical employment of all industries, while the beverages industry, with its 0.0091 employment-GDP correlation coefficient, has the least. Some interesting results detailed in table 1 are:

- Both employment and final demand are highly correlated with the business cycle in industries such as household furniture, motor vehicles and equipment, household appliances, retail trade, and carpets and rugs. These are industries providing goods that consumers and businesses can postpone purchasing during recessionary periods.
- Neither employment nor final demand is highly correlated with the business cycle in industries such as drugs, educational services, insurance carriers, food-related activities, and Federal, State, and local government-related industries. These are industries that provide necessities or public goods, and demand for these goods remain strong throughout the highs and lows of the economy.

**Exhibit 2. Industries that are projected to respond differently to business cycles relative to the past**

- Hydraulic cement
- Nonferrous rolling and drawing
- Meat products
- Bakery products
- Sugar and confectionery products
- Miscellaneous food and kindred products
- Converted paper products except containers
- Tires and inner tubes
- Trucking and warehousing
- Pipelines, except natural gas
- Insurance carriers
- Advertising
- Hospitals

- Employment is highly correlated with the business cycle, but final demand is not, in industries such as plumbing and nonelectric heating equipment; stone, clay, and miscellaneous mineral products; millwork, plywood, and structural members; screw machine products, bolts, and rivets; iron and steel foundries; and apparel. The output of the majority of these manufacturing industries is either strongly tied to the construction industry or highly sensitive to import penetration. In addition, new production techniques and labor-saving technologies dominate their employment trends.

Exhibit 1 highlights the most and least sensitive industries, as well as the dominant occupations found in these industries.

## Final demand

Columns 3 and 4 of table 1 are compared to highlight the industries in which final demand is projected to respond differently to the business cycle than in past.<sup>5</sup> The historical and projected correlation coefficients in the industry final demand analysis are compared to test if the industry final demand to GDP relationships are similar in the two periods. If they do behave similarly, one would expect the  $r$  value of the projected period to be equal to the  $r$  value of the historical period for each industry. To determine whether the  $r$  values for the historical and projected periods are significantly different, the Fisher ( $z$ ) transformation is used to convert the correlation coefficients to a standard normal distribution and then the difference between the correlation coefficients is tested for significance by referring to the Normal probability distribution.<sup>6</sup> Using a 95-percent confidence level, we found 13 industries to have a different projected industry final demand/GDP relationship than that of the historical period. As

mentioned previously, this test will be used in future projections to identify those industries in which a change from past behavior is projected. These industries will then be examined to determine if the projections are warranted—whether there are valid structural changes causing the new behavior in each industry. These industries are listed in exhibit 2.

The correlation coefficients in columns 3 and 4 of table 1 are presented so that the differences between the historical and projected correlation coefficients can be observed. While a number of industries in the table, other than the 13 cited in exhibit 2, appear to have large differences in correlation coefficients for the two periods, using the 95-percent confidence level cited above, it is only the 13 already mentioned that are significantly different. Because there are some industries that are only slightly beyond the cutoff for being “significantly different,” these industries also will be examined for validity and structural changes in future projections rounds.

THE INITIAL PURPOSE OF THIS ANALYSIS was to provide an internal review of BLS biannual projections of GDP and industry and occupational employment. The study will be used in subsequent projections rounds to ensure consistency between an industry’s historical correlation with GDP and the projected correlation. The important difference between the 1994–2005 analysis and those that will be conducted in the future is timing: the 1994–2005 study was performed upon completion of the projections in an attempt to analyze the projections. In the future, by doing this analysis concurrently with the projections, the projections staff will be able to modify inconsistencies in the projections when warranted as the projections are developed. In addition, the staff will be able to include the information on cyclical industries and the occupations found in these industries in future career guidance materials published by the Bureau. □

## Footnotes

<sup>1</sup> See the projections articles relating to these topics in the November 1995 *Monthly Labor Review*.

<sup>2</sup> For example, see *Career Guide to Industries*, Bulletin 2453 (Bureau of Labor Statistics, 1994); and *Occupational Outlook Handbook*, 1996–97 edition, Bulletin 2470 (Bureau of Labor Statistics, February 1996).

<sup>3</sup> The results of the comparisons are not discussed in this report, but are available from the authors.

$$r = \frac{\sum (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum (X_i - \bar{X})^2 \sum (Y_i - \bar{Y})^2}}$$

where:

$Y_i$  = the annual percent change in employment (or final demand) for a particular industry (or commodity), where  $i$  represents the yearly change

$\bar{Y}$  = average annual percent change in employment (or final demand for the industry (or commodity) for the entire historical (or projected) period

$X_i$  = the annual percent change in total final demand (GDP)

$\bar{X}$  = average annual percent change in GDP for the entire historical (or projected) period.

<sup>5</sup> When comparing an industry’s projected correlation to the business cycle to its historical correlation, industry final demand is used instead of employment because annual employment projections for the years 1995–2004 are not available.

$$z = \frac{1}{2} \ln \left( \frac{1+r}{1-r} \right)$$

where:

$r$  = correlation coefficient for a particular industry.