## 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

### Jay Berman and Janet Pfleeger

Jay Berman and Janet Pfleeger are economists in the Office of Employment Projections, Bureau of Labor Statistics. Industries react in different ways to the business cycle fluctations 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 determine 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

#### 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
Aiscellaneous 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
	.9255	0252	.2948
Electric lighting and wiring equipment			
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
lillwork, plywood, and structural members	.8955	3770	6968
Ionferrous foundries	.8893	.2886	.3796
Refrigeration and service industry machinery	.8860	.6312	.6659
Converted paper products except containers	.8784	1651	.6429
awmills and planing mills	.8764	4131	4216
Carpets and rugs	.8752	.8036	.4460
Construction	.8635	.8975	.9248
Ietal forgings and stampings	.8559	.5096	.6708
lousehold appliances	.8545	.7248	.8324
Retail trade except eating and drinking places	.8504	.9175	.9760
aints and allied products	.8490	.4824	.6556
Anufactured products	.8490	.4824 .4394	.6048
		.7575	.8826
Notor vehicles and equipment	.8400		
Paperboard containers and boxes	.8381	.4725	.6980
crew machine products, bolts, rivets	.8247	2177	3737
Rubber products, plastic hose and footwear	.8245	.0965	1186
Aiscellaneous fabricated textile products	.8191	.8101	.7430
Vood containers and miscellaneous wood products	.8189	.5066	.6325
Frucking and warehousing	.7621	.3579	.6586
lectrical industrial apparatus	.7581	.3513	.4352
Nonferrous rolling and drawing	.7541	.0292	.7099
ron 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
Vood buildings and mobile homes	.7005	.5045	.6881
liscellaneous fabricated metal products	.6858	.2144	.4183
Aiscellaneous electrical equipment	.6653	.5526	.8443
abricated structural metal products	.6619	.5459	.7210
Blass and glass products	.6605	.0784	0081
Vholesale trade	.6603 .6599	.8412 .6813	.7831 .3868
Real estate	.6527	.7142	.8366
pparel	.6426	.2993	.4862
Initing mills	.6333	.2993	.7327
Aetalworking machinery and equipment	.6313	.7745 –.1135	.4696
Il other primary metals	.6272		.1330
ooks	.6240	.5240	.7 996
commercial printing and business forms	.6240	.5827	.7323
ailroad equipment	.6223	.2708	.5282
assenger transportation arrangement	.6158	.3843	.5218
letal cans and shipping containers	.6057	.1271	.5825
liscellaneous textile goods	.6053	.5701	.5360
ngines and turbines	.5954	.4452	.6886
Veaving, finishing, yarn, and thread mills	.5875	.1498	0382
Research and testing services	.5859	6139	0115
liscellaneous chemical products	.5796	.3506	.2078
ir transportation	.5785	.6625	.3963
liscellaneous business services	.5781	.1706	.1229
Vater and sanitation.	.5769	.3268	0365
Services to buildings	.5747	.6348	0778
lousehold audio and video equipment	.5712	.0537	1685

See footnote at end of table.

Industry	Employment Historical correlation with GDP	Industry final demand	
		Historical correlation with GDP	Projected correlation with GDP
liccollencous publishing	0.5708	0.6207	0 7020
Aiscellaneous publishing	0.5708 .5566	0.6307 .4390	0.7232 .4522
ndustrial machinery, n.e.c tate and local government enterprises, n.e.c	.5503	.7375	.4322
pecial industry machinery	.5493	.5002	.7018
eauty and barber shops	.5415	.5303	.4358
phthalmic goods.	.5373	.2167	.7369
easuring and controlling devices	.5365	.3627	.5435
rdnance and ammunition	.5360	.1353	1044
ondepository; holding and investment offices	.5296	.0209	.5583
otels and other lodging places	.5238	.7391	.2311
liscellaneous transportation services	.5225	0171	.2957
last furnaces and basic steel products	.5202	3551	.0074 2407
uggage, handbags, and leather products, n.e.c.	.5133 .5066	4494 .6321	2407
leat products	.5058	4986	.3840
ervice industries for the printing trade	.5034	2253	.0411
liscellaneous equipment rental and leasing	.4986	.4063	0015
ngineering and architectural services	.4882	.2891	.6077
lastics materials and synthetics	.4844	.4717	.4313
oap, cleaners, and toilet goods	.4797	.6822	.7699
lectronic components and accessories	.4672	2562	5644
dvertising	.4630	.5293	4852
utomobile parking, repair, and services	.4591	.8210	.5638
tate and local general government, n.e.c.	.4561	.2935	2691
arm and garden machinery and equipment	.4502 .4484	.4571 .7198	.4073 .5392
General industrial machinery and equipment	.4460	.7389	.5392
liscellaneous repair services	.4400	.0788	.1512
liscellaneous transportation equipment	.4243	2168	.0207
ledical equipment, instruments, and supplies	.4139	.0190	.5812
J.S. Postal Service	.4017	.5271	2449
Vatches, clocks, and parts	.4008	.1701	.5734
ewelry, silverware, and plated ware	.4006	.4240	.3416
aundry, cleaning, and shoe repair.	.3992	.6142	.3402
computer and data processing services	.3957	.1723	.3213
ires and inner tubes roducers, orchestras, and entertainers	.3944 .3787	–.3310 .1915	.7768 .4708
ob training and related services	.3738	.5851	.5114
Sugar and confectionery products	.3712	.0583	.8021
lanagement and public relations	.3704	3863	2485
ogging	.3593	0640	.1 299
ydraulic cement	.3584	1628	.6071
rimary nonferrous smelting and refining	.3580	0368	2199
letal mining	.3268	0675	.4464
ewspapers hip and boat building and repairing	.3242 .3117	.1271 .4702	.3531 .6495
bys and sporting goods	.2981	.2014	0553
erospace	.2900	4403	5737
eriodicals	.2852	.5646	.7968
ideo tape rental	.2734	.6558	.5176
rugs	.2726	.0858	2178
earch and navigation equipment	.2714	.1245	.4409
owling centers	.2679	0043	.4442
surance agents, brokers, and service	.2673	.0706	.2957
airy products	.2597	.1599	.1290
onstruction and related machinery	.2522	.6281	.1677
liscellaneous food and kindred products	.2441	0639	.7034
Vater transportation Pulp, paper, and paperboard mills	.2375 .2275	.6726 .5161	.6613 .1464
מוף, פמפטי, מות פמפרטטמות וווווס	.2213		. 1404
ederal 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

correlation correlation	Industry	Employment	Industry final demand	
Depository institutions         2074         5090           Preserved fruits and vegetables         2059         -3385           Electrical repair shops         2054         4157           State and local government education         1992         22766           Offices of health practitioners         1992         1998           Federal electric utilities         1926         1998           Computer and folice equipment         1672         22652           Insurance carriers         11527         -1723           State and local electric utilities         1476         7774           State and local electric utilities         1476         7723           State and local electric utilities         1476         7723           Individual and miscellaneous social services         1189         7786           Individual and miscellaneous social services         0962         5167           Funeral services and crematories         09920         1937           Fueral services, n.e.         0869         1602           Footwear, except rubber and plastic         0757         -2338           Grain mill products and fats and oils         0602         -0917           Membership organizations         0543         4225           O		correlation	Historical correlation with GDP	Projected correlation with GDP
Depository institutions         2074         5092           Preserved fulls and vegetables         20659         -3385           Electrical repair shops         20654         4157           State and local government deducation         1992         2706           Offices of health practitioners         1984         4048           State and local government deducation         1851		0.2122	0.2408	0.7991
Preserved futits and vegetables         2059         -3385           Electrical repairs shops         2054         4157           State and local government education         1992         2706           Offices of health practitioners         1992         2707           State and local government education         1992         2706           Orgenter and office equipment         1926         1998           Adda care services         11672         2866           State and local electric utilities         1475         —           Cocal and interruban passenger transit         1138         6524           Adda care services         1189         4786           ergal services         1189         7209           ergal services         1189         7209           and interruban passenger transit         1245         5736           ergal services         0890         1602           orgent and office and plastic         0757         -2338           argin mill products and fats and oils         06602         -0917           alakery products         0543         4276           Meembership organizations         0541         1292           Grain mill products and fats and oils         06602         -0917 <td></td> <td></td> <td></td> <td></td>				
Electrical repair shops         2054         4157           State and local government education         1992         2706           Offices of health practitioners         1994         4048           State and local government education         1982         2706           Computer and folice equipment         1672         2862           Insurance carriers         1527         -1723           State and local electric utilities         1475         -           Cocal and interurban passenger transit         1245         5736           Individual and miscellaneous social services         1169         4786           Cocal and interurban passenger transit         0425         5167           Cortwers, except rubber and plastic         0767         -2338           Frivate households         0662         -0817           Cortwers, except rubber and plastic         0767         -2338           Forin mil products and fats and ois         0664         1285           Cortwers, equipment         0426         146           Measurity brokers         0434         4276           Measurity brokers         0345         -2027           Cortwer, except rubber and plastic         0541         4276           Measurity brokers				.0109
State and local government education         1992         2706           Offices of health practitioners         1994         4048           Nonmetallic minerals, except fuels         1926         1998           Computer and office equipment         1672         2862           Insurance carriers         11527         -1723           State and local electric utilities         1475         -           Child day care services         1393         7278           State and local electric utilities         11438         6324           .ccal and interurban passenger transt         1159         7405           .ccal and interurban passenger transt         0962         5167           Fureals services         0920         1937           Fureal service and crematories         0999         1602           Footwar, except rubber and plastic         0757         -2338           Grain mill products         0543         4295           Membership organizations         0512         4169           Commodity brokers         0446         0299           Commodity brokers         0446         265           Security and commodity brokers         0446         26572           Severages         0091         3927     <				.3057
Offices of health practitioners       .1984       4048         Pederal electric utilities       .1926       1998         Federal electric utilities       .1657       .2862         Insurance carriers       .1527       .1123         State and local electric utilities       .1475	Electrical repair shops		.4157	.4692
Offices of health practitioners	State and local government education	1992	.2706	2047
Normetallic minérals, except fuels         1926         1998           Computer and office equipment         1672         2862           Computer and office equipment         1672         2862           Istate and local electric utilities         1475         —           Child day care services         1393         7278           State and local electric utilities         1343         6324           .ccal and interurban passenger transit         .1245         5736           .cdal and interurban passenger transit         .1999         7205           .math socellanceus social services         .1169         .4786           .egal services         .0990         1502           .math services, n.e.c.         .0920         1937           .math services, n.e.c.         .0920         .0931           .akery products         .0662         .6167           .users, botanical, zoological gardens         .0643         .4276           .dkerb products         .0654         .1295           .duebreship organizations         .0512         .4169           .commodity brokers         .0446         .0299           .commodity brokers         .0416         .0292           .anding auditing, and other services         .0314			.4048	.1398
Tederal electric utilities         1851         —           Computer and office equipment         1672         2862           State and local electric utilities         1475         —           State and local electric utilities         1475         —           Cocal and intervitabn passenger transit         1245         5736           Cocal and intervitabn passenger transit         1245         5736           Cocal and intervitabn passenger transit         1245         5736           Cocal and intervitabn passenger transit         0820         5167           Turneral services         0920         1169         7205           Transit and transition         0662         -0617         -2338           Train mill products and fats and oils         0662         -0617         -2338           Train mill products and fats and oils         0662         -0617         -2338           Sommercial sports         0543         4225         1668           Security and commodity brokers         0616         0629         -0246           Sommercial sports         0343         3000         2572           Severages         0091         3227         -2246         3664           Soproducts         -0246         3604				5380
Computer and office equipment         .1672         2662           nsurance carriers         .1527        1723           State and local electric utilities         .1475			.1000	.0000
Ister and local electric utilities       1527       -1723         State and local electric utilities       1475			.2862	.5878
itate and local electric utilities         1475         —           itate and local electric utilities         1393         7278           residential care         1318         6324           cecid and interurban passenger transit         1245         5736           ndividual and miscellaneous social services         1159         7205           riveral services         0.920         1937           iuneral services on e.c.         0.0999         1602           cotwear, except rubber and plastic         0.757         -2338           rain mil products and fats and oils         0.6042         -0817           Alkery products         0.0544         1295           Ausery products         0.0543         4276           commodity brokers         0.0416         0.299           Communications equipment         0.0425         1.868           contructs, auditing, and other services         0.0343         3.000           dericutural chemicals         -0.0246         3604           coround ty brokers         -0.0416         0.299           coround ty brokers         -0.0446         3604           coround ty brokers         -0.0446         3604           coround ty brokers         -0.044         4539     <				
Thild agy care services       1333       7278         Residential care       1318       6324         .ccal and interurban passenger transit       1245       5736         Individual and miscellaneous social services       1159       7205         Private Induscholds       0862       5167         Interal services and crematories       0820       1337         Footwear, except rubber and plastic       0757       -2338         Footwear, except rubber and oils       0602       -0917         Salar mill products and fats and oils       0602       -0917         Jaker products       0543       4276         Argential services       0.0425       1668         Jommunications equipment       0.425       1668         Sourmercial sports       0.343       .2027         Educational services, n.e.c.       0.0343       .2027         Educational services, n.e.c.       0.0416       .0239         Severages       0.0091       .3927         Gricultural dremicals       -0.0246       .3004         Accounting, auditing, and other services       -0.0417       .4539         State and local government hospitals       -0.0741       .1593         Calectric utilities       -1025			1723	.6195
Residenfial care         1318         6324           cocal and interurban passenger transit         1245         5736           ndividual and miscellaneous social services         1169         4786           e.gal services         1159         7205           "Wrate households         0962         5167           "Uneral service and crematories         0920         1937           "Latiff services, n.e.c.         0889         1602           "Totath ouseholds         0602         -0917           "Jakery products and fats and oils         0602         -0917           Jakery products         0554         1295           Weseums, botanical zoological gardens         0642         1688           Security and commodity brokers         0385         -2027           Ciducational services         0343         3000           Ommercial sports         0385         -0246           Agricultural chemicals         -0447         4539           Agricultural services         -0314         5102           Agricultural services         -0344         2016           Commercial goverment hospitals         -0741         -1599           -0741         -1593         -1448         5277 <td< td=""><td></td><td></td><td></td><td></td></td<>				
.ccal and interurban passenger transit         1245         5736           ndividual and miscellaneous social services         1169         4786           .egal services         .0962         5167           Private households         .0920         .1937           ineral services n.e.c.         .0892         .0167           Fain mill products and fata and oils         .0602         .0917           Fain mill products and fata and oils         .0602         .0917           Jakery products         .0543         .4276           Meembership organizations         .0513         .4168           Sourmerical sports         .0346         .0292           Communications equipment         .0425         .1668           Sourmerical sports         .0343         .2027           Ciducational services         .0343         .2027           Ciducational services         .0416         .0299           Personal services, n.e.c.         .0186         .2672           Beverages         .0041         .2927           Ciducational services         .0246         .3604           Accounting, auditing, and other services         .0241         .5102           Ciducational services         .0247         .4339 <tr< td=""><td>Child day care services</td><td>1393</td><td></td><td>.4479</td></tr<>	Child day care services	1393		.4479
Individual and miscellaneous social services       1169       4786         egal services       1159       7205         Yinate households       0962       5167         'uneral services and crematories       0920       1937         'eath services, n.e.c.       0899       1602         'orotwear, except rubber and plastic       0757       -2338         'arain mil products and fats and olis       0602       -0917         'dakery products       0554       4295         /dakery products       0543       4276         /dakery products       0543       4276         /dakery products       0416       0299         /ormmications equipment       0425       1668         /escurity and commodity brokers       0343       3000         /orestonal services, n.e.c.       0186       2572         //gricultural chemicals       -0246       3604         //gricultural services       -0246       3604         //gricultural services       -0246       3604         //gricultural services       -0246       3604         //gricultural services       -0741       -1599         //gricultural services       -0741       -1593         //gricultural services <td>Residential care</td> <td>1318</td> <td>.6324</td> <td>.5774</td>	Residential care	1318	.6324	.5774
ndividual and miscellaneous social services       1169       4786         egal services       1159       7205         Finate households       0962       5167         Funeral services and crematories       0980       1937         Feathl services, n.e.c.       0899       1602         Footwear, except rubber and plastic       0757       -2338         Grain mill products and fats and oils       0602       -0917         Askery products       0554       4295         Unseums, botanical, zoological gardens       0543       4276         Communications equipment       0425       1668         Communications equipment       0446       0299         Commercial sports       0343       3000         Personal services, n.e.c.       0186       2572         Severages       0091       3927         Agricultural chemicals       -0246       3604         Accounting, auditing, and other services       -0246       3604         Agricultural services       -0647       4339         Peroleum refining       -07741       -0455         Agricultural services       -0274       2459         Communications       -1878       -1107         Dil and gas field	_ocal and interurban passenger transit	1245	.5736	.5425
egal services         1159         7205           Prvate households         0962         5167           Funeral services n.e.c.         0899         1602           Footwar, except rubber and plastic         0757         -2338           Frain mill products and fats and oils         0602         -0917           Jakery products         05543         4276           Wensems, botanical, zoological gardens         05512         4168           Sommunications equipment         0425         1868           Security and commodity brokers         0343         3000           Ormunications equipment         0445         1468           Security and commodity brokers         0343         3000           Personal services, n.e.c.         0116         0229           Opticultural chemicals         -0246         3604           Accounting, auditing, and other services         -0314         5102           Acth, jewerity, and furniture repair         -0741         -1599           Patcheum refining         -0774         4453           Acth, jewerity, and furniture repair         -0771         4046           Decemental services         -1634         2016           Data gas field services         -1634         2016				.5565
Private households         0962         5167           Funeral services and crematories         0980         11937           reath services, n.e.c.         0899         11002           Tootwear, except rubber and plastic         0757         -2338           Grain mill products and fats and oits         0602         -0917           Jakery products         0554         41295           Museums, botanical, zoological gardens         0512         4169           Communications equipment         0425         1868           Dommercial sports         0385         -2027           Ciducational services         0385         -2027           Ciducational services, n.e.c.         0385         -2027           Agricultural chemicals         -0246         3604           Accounting, auditing, and other services         -0314         5102           Parloeum refining         -0764         4276           Vatch, jeweiry, and furniture repair         -0771         4046           Communications         -1878         -1107           Diland gas field services         -1878         -1107           Otal government hospitals         -2771         4046           Sorestry, fishing, hunting, and trapping         -2168				.1138
Luneral service and crematories         0920         1937           realth services, n.e.c.         0899         1602           Footwear, except rubber and plastic         0757         -2338           Frain mill products and fats and oils         0602         -0917           Jakery products         0554         1295           Jommunications equipment         0612         4168           Sourmerical sortices         0343         3000           Dermencial services         0343         3000           Personal services, n.e.c.         0186         2572           Educational services         0343         3000           Personal services, n.e.c.         0186         2572           Severages         0091         3927           Accounting, auditing, and other services         -0314         5102           Actor, jeweiry, and furniture repair         -0764         4539           Actor, jeweiry, and furniture repair         -0771         4046           Dereting and benerators         -1878         1107           Actor, jeweiry, and furniture repair         -0764         4276           Actor, jeweiry, and furniture repair         -0771         4046           Deretricuined services         -1878         1107				.1775
tealth services, n.e.c.       0899       .1602         Footwear, except rubber and plastic       0757       -2338         Grain mill products and fats and oils       0602       -0917         Jakery products       0543       4276         Wuseums, botanical, zoological gardens       0543       4276         Juseums, botanical, zoological gardens       0416       0299         Communications equipment       04425       1468         Security and commodity brokers       0343       3000         Personal services, n.e.c.       0186       2572         Beverages       0091       3927         Agricultural chemicals       -0246       3604         Accounting, auditing, and other services       -0314       5102         Joticultural services       -0647       4539         Jotatia envices       -0741       -1999         Patroleum refining       -0741       4539         Jotatia chemicals       -1025       2739         Jotatia chemicals       -1071       4046         Communications       -1878       .1107         Jotatia chemicals       -1878       .1107         Jotatia solitilies       -2023       0653         Sorestry, fishing, huntli				.3881
Cootwear, except rubber and plastic         0757         -2338           Grain mill products and fats and oils         0602         -0917           Jakery products         0544         .1295           Wuseums, botological gardens         0543         4276           Jommunications equipment         0425         1868           Security and commodity brokers         0343         .0035         -2027           Citucational services, n.e.c.         0343         .00091         .3927           Agricultural chemicals         -0246         .3604         .3604           Accounting, auditing, and other services         -0314         .5102         .7784           Agricultural services.         -0647         .4539         .4276           Vatch, jewelry, and furniture repair         -0764         .4276         .4276           Vatch, jewelry, and furniture repair         -0774         .4048         .22773           Petroleum refining         -1625         .2739         .1148         .2217           Greeting cards         -1634         .2016         .2018         .2018         .2028         .2028         .2028         .2028         .2018         .2018         .2018         .2018         .2012         .2028         .2018				.3881 .3031
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Hospitals, private        5253        4714           Royalties        0647           2900           Noncomparable imports          4828           4828	Federal government enterprises, n.e.c.	–.4072	.3899	0890
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Noncomparable imports				.4964
Scrap, used and secondinand goods				.4856
			.4558	0730
Rest of the world industry —			-	
nventory valuation adjustment — —	nventory 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

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

## 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 edu- cation; 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
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 preci- sion production occupations, they are inspectors, testers and graders, pre- cision metal workers, and blue-collar worker supervisors.

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

# 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 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.

• 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).

 $^{3}\;$  The results of the comparisons are not discussed in this report, but are available from the authors.

$$_{4} \qquad \mathbf{r} = \frac{\sum \left(Xi - \overline{X}\right) \left(Yi - \overline{Y}\right)}{\sqrt{\sum \left(Xi - \overline{X}\right)^{2} \sum \left(Yi - \overline{Y}\right)^{2}}}$$

where:

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

- $\overline{Y}$  = average annual percent change in employment (or final demand for the industry (or commondity) for the entire historical (or projected) period
- $X_i$  = the annual percent change in total final demand (GDP)
- $\overline{X}$  = 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.

<sup>6</sup> 
$$z = \frac{1}{2}ln\left(\frac{(1+r)}{(1-r)}\right)$$

where:

r = correlation coefficient for a particular industry.