Service-providing occupations, offshoring, and the labor market

A BLS analysis identifies 160 service-providing occupations that are susceptible to offshoring; these occupations are diverse in their job functions, associated educational attainment, and wages

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The Bureau of Labor Statistics (BLS) researches trends affecting the labor market as part of its Employment Projections Program. Although the BLS examines all factors affecting employment in industries and occupations, it pays particular attention to new or emerging topics. One such topic is the offshoring of service-providing occupations.[1] In recent years, special efforts have been made to identify the occupations that may be susceptible to offshoring and to account for offshoring in occupational employment projections. This article, representing the culmination of those efforts, identifies 160 occupations considered susceptible to offshoring and reports trends in historical and projected data for those occupations.

For most of recorded history, the majority of goods and services were produced and consumed locally. Developments in transportation—most notably, the locomotive and steamship and, later, the airplane and truck—made the large-scale remote production of goods practical. The result was a rapid increase in the trade of goods, causing manufacturers to face competition from abroad. Recent advances in telecommunications—in particular, the Internet—have enabled information to travel around the globe nearly instantaneously. Consequently, many services that previously needed to be performed domestically now theoretically can be performed anywhere in the world. The movement of work that results from this development, generally termed "offshoring," has the potential to affect U.S. employment, but the nature and scale of its impact remain unclear.

As is common with new phenomena, the terminology used to describe offshoring is not always consistent. It is, therefore, beneficial to clearly define the issue. A report by the National Academy of Public Administration defines offshoring as "U.S. firms shifting service and manufacturing activities abroad to unaffiliated firms or their own affiliates."[2] That definition is consistent with the concept of offshoring identified in the analysis which follows. However, for several reasons, this analysis focuses only on the offshoring of services. First, the offshoring of manufacturing establishments has been occurring for a much longer period and is relatively clearly understood. Second, the factors that lead services to be susceptible to offshoring are different from those affecting manufacturing. Third, few data sources exist that provide insight into the occupations that are affected by services offshoring. These three reasons combined support an independent analysis of the offshoring of services.

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It is important to note that this article addresses only the movement of work from the United States to other countries; occupations that may be affected by flows in the other direction—a movement known as "in-shoring"—are not identified. In general, occupations that are susceptible to being offshored are not necessarily the same as those which may be affected by in-shoring.

Current measures of services offshoring are limited by a dearth of relevant data. Perhaps the most useful indicator is the international trade data from the Bureau of Economic Analysis (BEA). Over the last two decades, these data show a large increase in international trade in both goods and services. In 1986, goods exports were $229.2 billion, while goods imports were $401.8 billion. By 2006, quantities had more than quadrupled, to $928.7 billion and $1.65 trillion, respectively. In 1986, service exports were $128.9 billion, while service imports were $110.7 billion. By 2006, service exports had nearly tripled, to $386.3 billion, while service imports more than doubled, reaching $283.7 billion.[3] It is noteworthy that, although the U.S. economy has been running an overall trade deficit for decades, there has been a consistent surplus in international services trade.

Measures of the value of international trade, however, cannot be used to gauge the scope of offshoring. An increasing surplus in services trade, for example, does not necessarily indicate a change in the level of offshoring in service occupations. In addition, the value of services trade usually is difficult to measure. This situation stems from the fact that goods, as opposed to services, are easier to measure and dominated international trade when the data collection systems were established.[4] In addition, goods are typically traded through a port of entry and are tracked relatively easily. Services, by contrast, are traded through diverse channels, many of which are difficult to observe.

A number of organizations, including Forrester Research, McKinsey Global Institute, Deloitte and Touche, and Goldman Sachs, have published studies trying to quantify the effects of offshoring on U.S. employment. Most of these studies predict that millions of jobs could be offshored over the coming years. Academic economists also have published studies estimating that millions of U.S. jobs are susceptible to offshoring.[5] All of these studies acknowledge the dearth of actionable data on the topic and are based on subjective assumptions.

The manner in which offshoring will affect U.S. employment is unclear. On the one hand, offshoring has the potential to reduce total U.S. employment if jobs are relocated to other nations. On the other hand, services exports may create new jobs within the United States and therefore raise total employment.[6] In addition, individual occupations are not likely to experience these effects uniformly, because some occupations are more susceptible to offshoring than others and some may face additional barriers to offshoring. If individuals lose their jobs in vulnerable occupations, they may need to obtain retraining before moving into another occupation. As a result, it is important to identify which occupations may be affected by offshoring.

Several studies have addressed services offshoring from an occupational perspective. Common among them is an attempt to identify the characteristics that make an occupation susceptible to offshoring. Ashok Bardhan and Cynthia Kroll, among the first to do so, concluded that offshorable occupations have "no face-to-face customer servicing requirement," "high information content," a "work process" that is "telecommutable and Internet enabled," a "high wage differential" with a "similar occupation" in the offshore destination, "low setup barriers," and a "low social networking requirement."[7] On the basis of these characteristics, and using the Standard Occupational Classification (SOC) system,[8] those authors identified 49 occupations as susceptible. The majority of these occupations fall into three SOC occupational groups: office and administrative support occupations, business and financial operations occupations, and computer and mathematical occupations. Bardhan and Kroll used data from the BLS Occupational Employment Statistics (OES) survey to estimate that these 49 occupations accounted for 14 million jobs, or 11 percent of total employment, in 2001. The authors limited their list to occupations that the business literature indicated were already being offshored at the time of their analysis, which may explain why the number of occupations identified in Bardhan and Kroll's study is lower than the number identified herein.

In an attempt to determine which jobs are able to be offshored, and the number of jobs that could be offshored, Alan Blinder created an occupational ranking system.[9] He stated that services which can be transmitted electronically with no reduction in quality can be offshored and all other services cannot. Most occupations, however, provide some services that can be transmitted electronically and some that must be delivered in person. Consequently, some occupations are more offshorable than others, creating an offshorability spectrum. Blinder's system, based on information from the Occupational Information Network (O*NET),[10] in addition to his own judgment, assigned each occupation a position in this spectrum. He then used the results to estimate that about 291 occupations are offshorable. Blinder based his occupational classifications on

the SOC system, but divided several occupations, resulting in additional occupations not included in the SOC system. He used data from the OES survey to estimate that these 291 occupations accounted for about 38 million jobs, or 29 percent of total employment, in 2004.

Blinder's analysis, however, is not directly comparable to the one presented here, because he included about 9 million jobs from production occupations and construction and extraction occupations, two SOC groups that are not considered service-providing groups. In addition, Blinder included residual occupations in his analysis. With the production occupations, construction and extraction occupations, and residual occupations removed to make the two analyses comparable, Blinder would find 152 occupations susceptible to offshoring; about 3 in 4 occupations that appear in his offshorability spectrum would appear here as well, with most of the disagreements occurring among occupations with lower susceptibilities to offshoring.

J. Bradford Jensen and Lori G. Kletzer responded to the previous subjective studies by creating an objective ranking system based on data on occupational characteristics developed by O*NET.[11] According to their analysis, the characteristics that increase susceptibility to offshoring are "getting information," "processing information," "analyzing data or information," "documenting/recording information," and "interacting with computers." The characteristics that decrease susceptibility are "assisting or caring for others," "performing or working directly with the public," "establishing or maintaining interpersonal relationships," "making decisions and solving problems," "thinking creatively," and "inspecting equipment, structures, or material."[12] O*NET attempts to quantify, through numeric ratings, the significance that each characteristic plays in each occupation. Using these ratings, Jensen and Kletzer assigned a score to each occupation and ranked occupations on the basis of that score. They then used the rankings to gauge how susceptible an occupation is to being offshored, thereby creating an offshorability spectrum of 457 SOC occupations.[13] There are some similarities between their spectrum and the list of occupations presented herein, with 131 of the occupations on the latter list appearing in the top half of Jensen and Kletzer's spectrum. There also are some large discrepancies, however, with several of the occupations with the highest levels of susceptibility on the list presented here appearing in the bottom half of Jensen and Kletzer's list.

The BLS Employment Projections Program has been studying the offshoring of service-providing occupations for the past decade, employing more than 20 economists who study occupations to make 10-year employment projections. Because offshoring is a factor that may affect future employment levels, BLS economists have researched the topic heavily and collectively have amassed a base of knowledge that covers the vast majority of occupations in the U.S. economy.[14] The study described in this article uses that knowledge to analyze the issue of offshoring.

The BLS offshoring scoring system

The BLS offshoring scoring system identifies characteristics that make an occupation susceptible to being offshored and ranks occupations by level of susceptibility. The system covers the 515 service-providing occupations listed in the SOC manual.[15] (See table 1.)

Many of these occupations, however, have no possibility of being susceptible to offshoring, rendering a detailed analysis of them unnecessary. The first step of the analysis, therefore, was to identify the occupations that had insurmountable barriers to offshoring. Most of these occupations either require face-to-face interaction with customers or require the work to be performed in a fixed location. (As examples, physical therapists and barbers belong in the first category, security guards and landscaping workers in the second.) Other occupations that were excluded due to insurmountable barriers were ones that perform intrinsically governmental functions, such as judges and correctional officers. After all occupations that were considered not at all susceptible were removed, the remaining 160 occupations were deemed susceptible to offshoring and were analyzed more closely. (See tables A–1 and A–2 for a full list of these occupations.)

BLS economists answered a series of questions regarding the characteristics of these 160 occupations. The questions were designed to measure each of the four characteristics that make an occupation susceptible to offshoring: inputs and outputs that can travel easily across long distances, such as electronically over the Internet; work that requires little interaction with other types of workers; work that requires little knowledge of the social or cultural idiosyncrasies of the target market; and work that is routine in nature. (See exhibit 1.) For each occupation, all four questions were answered by the economist who specializes in that occupation.

In order for an occupation to be offshored, the services that the worker provides must be able to travel across international borders. The more efficiently this can be done, the easier and more beneficial offshoring becomes. Work in which the main product is information or digital com-

Table 1. Service-providing occupational groups

SOC code	Occupational group	Number of occupations	Offshorable occupations	Highest ranked occupations	Middle-ranked occupations	Lowest ranked occupations
	All service-providing occupations	515	160	33	94	33
11–0000	Management occupations	31	14	0	2	12
13–0000	Business and financial operations occupations	27	21	4	12	5
15–29	Professional and related occupations	204	84	11	60	13
15–0000	Computer and mathematical occupations	14	14	2	11	1
17–0000	Architecture and engineering occupations	32	26	3	17	6
19–0000	Life, physical, and social science occupations	38	23	2	17	4
21–0000	Community and social services occupations	13	0	0	0	0
23–0000	Legal occupations	8	4	2	2	0
25–0000	Education, training, and library occupations	22	1	0	1	0
27–0000	Arts, design, entertainment, sports, and media occupations	36	12	0	10	2
29–0000	Health care practitioners and technical occupations	41	4	2	2	0
31–39	Service occupations	88	2	1	1	0
31–0000	Health care support occupations	14	1	1	0	0
33–0000	Protective service occupations	19	1	0	1	0
35–0000	Food preparation and serving related occupations	16	0	0	0	0
37–0000	Building and grounds cleaning and maintenance occupations	8	0	0	0	0
39–0000	Personal care and service occupations	31	0	0	0	0
41–0000	Sales and related occupations	20	10	2	5	3
43–0000	Office and administrative support occupations	52	27	15	12	0
49–0000	Installation, maintenance, and repair occupations	49	2	0	2	0
53–0000	Transportation and material moving occupations	44	0	0	0	0

NOTE: Occupational groups exclude residual occupations not included in the analysis.

munication can be offshored more readily than work that may occasionally involve face-to-face communication or products that are not as easily transportable. (Mathematicians and telemarketers are examples of the first category, while sales representatives are an example of the second.)

High levels of interaction across an organization's departments can make an occupation difficult to offshore. Logistical problems can arise when such interaction takes place over long distances or across time zones, reducing the benefits of offshoring. General operations managers, for example, must maintain contact with all branches of an organization. Computer programmers, by contrast, can perform their duties with little to no interaction with those in other parts of an organization.

If the duties of an occupation require familiarity with the cultural or social idiosyncrasies of the target market—the kind of knowledge that can be obtained only by living in that market—performing those duties from abroad would be difficult. Marketing managers, for example, must understand the tastes of the population to whom they market their products. Tax preparers, however, need only know tax laws and a client's financial information, both of which can be obtained from places across the globe.

Work that can be routinized or handled by following a script is more susceptible to offshoring because the outputs, as well as the processes by which they should be completed, are easier to define. With such occupations, it is easier for companies to gauge whether the work is being completed, and less management oversight is needed. By contrast, work that is more creative is more difficult to monitor, making companies less likely to have it performed from remote locations. Nuclear engineers, for example, engage in detailed research and development, whereas insurance underwriters generally follow a set of instructions and are not part of an organization's creative functions.

The offshoring scoring system accounts for the degree to which each of the foregoing four characteristics influences an occupation. BLS economists were able to indicate whether each characteristic applied to an occupation to a very low degree, to a low degree, to a high degree, or to a very high degree. By not being limited to a simple binary response, the economists were better able to classify occupations that have a range of duties or specialties, some of which may be more susceptible to offshoring than others. The disadvantage of multiple options, of course, is the risk of inconsistency; to limit this risk, all scoring was reviewed by a team of

Exhibit 1. Offshoring susceptibility questions, 2006–16

1. To what degree can the inputs and outputs of the occupation be transmitted electronically, or otherwise be easily and cheaply transported?	Very low degree (1 point)	Low degree (2 points)	High degree (3 points)	Very high degree (4 points)
2. To what degree do the duties of this occupation require interaction with other types of workers?	Very low degree (4)	Low degree (3)	High degree (2)	Very high degree (1)
3. To what degree is knowledge of social and cultural idiosyncrasies, or other local knowledge, needed to carry out the tasks of this occupation?	Very low degree (4)	Low degree (3)	High degree (2)	Very high degree (1)
4. To what degree can the work of the occupation be routinized or handled by following a script?	Very low degree (1)	Low degree (2)	High degree (3)	Very high degree (4)

economists who had not done the original scoring, in order to ensure that different analysts applied the same standards.

After the questions were answered for all 160 occupations, the responses were used to generate a score for each occupation. Each question was worth a maximum of 4 points and a minimum of 1, with a 4 representing the greatest susceptibility to offshoring. As a result, the highest susceptibility score that an occupation could receive was 16, the lowest, 4. The scores were used to rank the occupations by susceptibility to offshoring.

On the basis of the distribution of the susceptibility scores, the 160 occupations were divided into three groups in order to compare occupations with similar degrees of susceptibility. Those with scores of 13–16 were grouped as the occupations with the highest susceptibility to offshoring, while those with scores of 4–7 were grouped as the occupations with the lowest susceptibility. Thirty-three occupations fell into the highest group, and another 33 fell into the lowest, with the remaining 94 falling into the middle group. (See tables A–1 and A–2.)

It is important to note that the questions posed in the scoring system are based strictly on an occupation's characteristics; thus, the rankings they generate are only a measure of the degree to which the duties of these occupations can be performed from a remote location. They indicate nothing about the likelihood, scale, or any other measure of offshoring. Occupations that exhibit similar levels of susceptibility do not necessarily have the same risk of being offshored.

For example, tax preparers and physicists are 2 occupations that score among the top 33 on the basis of occupational characteristics, but other factors significantly limit the extent to which these occupations actually may be moved offshore. Electronic documents and electronic filing allow tax preparers to be located almost anywhere in the world, but these developments, along with new software, also allow individuals to do their own taxes more easily. This factor may reduce the demand for these workers, as well as the likelihood that they will be moved offshore. Physicists, by contrast, face other restrictions to offshoring, including the fact that many physicists are employed by, or receive significant funding from, the Federal Government—funding that would not be available to them overseas.

The offshoring analysis system was initially created to account for an emerging trend in a systematic manner. After the development of the 2006–16 employment projections, the project was expanded to address a broader range of goals. In addition to improving the accuracy of the projections, it was determined that the results would be used to contribute to the publicly available information on offshoring, a topic of concern for many individuals, groups, and organizations. The occupational rankings can provide further insight into the topic, one that is still largely misunderstood and difficult to measure. In addition, detailed data are presented here on individual occupations, as well as on the offshorable occupations as a whole. Offshoring is only one of many factors that can affect occupations. No attempt should be made to attribute growth rates in an occupation, or differences between occupations, to offshoring.

Data

Occupational employment and wage data for the 2001–07 period come from the OES survey, which collects data on 801 detailed SOC occupations, including all of the 160 service-providing occupations analyzed in this article. An establishment-based instrument, the OES survey provides estimates on employment and wages for wage and salary workers in nonfarm establishments, but does not provide estimates for self-employed workers.

The OES data presented in this study span the years 2001–07, starting with the first year of data available on the 2000 SOC system.[16] Although 2007 data are available for all occupations, changes in survey methodology since 2001 do not allow for historical comparisons for 19 occupations. Therefore, rates of change for employment and wages in these occupations were not included in this analysis.

The analysis also presents several other data series from the Employment Projections Program, including the 2006–16 employment projection for each of the occupations deemed susceptible to offshoring. In addition, educational attainment data are presented to provide further demographic information. In an effort to reflect current educational needs, the analysis examines the educational attainment of younger workers—the percentage of 25- to 44-year-olds working in the occupation who have a high school diploma or less, some college or an associate's degree, or a college diploma (a bachelor's degree) or higher.[17]

Tables 2 and 3 present summary figures for these data series, and tables A–1 and A–2 contain detailed data on each of the 160 susceptible occupations. In addition, for comparison purposes, data also are presented on all service-providing occupations aggregated together. (See table 1.) Note that, although comparison against a benchmark provides some context for the data on offshorable occupations, differences should not be ascribed to offshoring; many other factors also are in play that will cause differences between sets of occupations.

Overall results

The offshorable occupations are quite diverse in their job functions, educational attainment, and wages. More than half of the 160 offshorable occupations are classified as professional and related occupations, a classification that includes a variety of professional and technical occupations. Particularly noteworthy is that almost every computer and mathematical science occupation has some degree of susceptibility to offshoring. One of the reasons that, for example, computer specialists are susceptible to being offshored is the ease with which computer programs and services can be transmitted electronically. There are also 27 office and administrative support occupations on the list. Fourteen managerial occupations appear on the list as well, although most of them are classified as occupations least susceptible to being offshored.

Table 2. Average annual percent change in employment and earnings of susceptible occupational categories, 2001–07

Susceptible occupational categories	Number of occupations	Average annual percent change in employment	Average annual percent change in earnings
All service-providing occupations	515	1.3	3.1
All offshorable occupations	160	1.5	3.6
Highest ranked occupations	33	.4	2.8
Middle ranked occupations	94	2.2	3.7
Lowest ranked occupations	33	1.8	3.4

SOURCE: Occupational Employment Statistics (OES). Table excludes data for occupations in SOC 11–0000 (management occupations) and for five additional occupations for which 2001 data are not available.

As a group, these 160 occupations accounted for about 30 million jobs in 2007, more than one-fifth of total employment. (See table 3.) The occupations grew at an average annual rate of 1.5 percent from 2001 to 2007, faster than the 1.3-percent rate for all service-providing occupations. Furthermore, the 160 offshorable occupations are projected to continue to grow faster than all service-providing occupations from 2006 to 2016, at an average annual rate of 1.2 percent, compared with 1.1 percent for the latter occupations. Wages in the offshorable occupations grew by 3.6 percent per year from 2001 to 2007, also faster than the 3.1-percent annual growth for all service-providing occupations. The 2007 mean annual wages of $61,473 in the offshorable occupations were significantly higher than the 2007 mean wages of $41,610 for all service-providing occupations. Fifty-four percent of the workers in the offshorable occupations possessed a bachelor's or higher degree, and more than 80 percent had at least some college education. These numbers, again, are higher than those for all service-providing occupations, in which 37 percent of workers had a bachelor's or higher degree and another 31 percent had some college education.

Highest ranked. The 33 occupations most susceptible to offshoring accounted for 9.5 million jobs in 2007. (See table 3.) The characteristics of these occupations reflect a wide range of skills and education. Fifteen are office and

administrative support occupations, with relatively low education or training requirements. Another 11 are professional and related occupations, which generally possess higher educational requirements. No management occupations are found in this group.

Wage and salary employment of the occupations most susceptible to offshoring grew slowly, just 0.4 percent per year from 2001 to 2007. (See table 2.) This rate of growth was significantly lower than the 1.3 percent exhibited by all service-providing occupations over the period. As a group, these 33 occupations are projected to grow by 1.1 percent per year from 2006 to 2016, equivalent to the projection for all service-providing occupations. (See table 3.) Individually, 20 of the 33 occupations most susceptible to offshoring are expected to experience employment growth, while 13 are expected to decline.

Mean annual wages for the most susceptible occupations were $38,201 in 2007, compared with $41,610 for all service-providing occupations. Wages for the most susceptible occupations grew more slowly (2.8 percent per year) than wages for all service-providing occupations (3.1 percent). The educational attainment of workers in the most susceptible group also was relatively low, with about 30 percent holding a bachelor's or higher degree, compared with 37 percent for all service-providing occupations.

Middle ranked. The 94 occupations that scored in the middle range of the offshoring analysis accounted for 14.3 million jobs in 2007. (See table 3.) The makeup of these occupations reflects the wide range of service-providing occupations that are susceptible to offshoring, but is weighted toward the more highly skilled occupations. Sixty-two of these occupations are professional and related occupations, and 12 are management, business, and financial occupations. Among the professional and related occupations are sizable numbers of architecture and engineering occupations; life, physical, and social science occupations; and computer and mathematical science occupations. Other occupational groups that are well represented include arts, design, entertainment, sports, and media occupations, as well as office and administrative support occupations.

Wage and salary employment in the middle-ranked occupations grew by 2.2 percent per year from 2001 to 2007, much faster than the 1.3-percent growth rate for all service-providing occupations. (See table 2.) The middle-ranked occupations are projected to grow by 1.3 percent per year over the 2006–16 period, compared with 1.1 percent for all service-providing occupations. Ninety of the middle-ranked occupations are projected to grow, while 4 are projected to decline.

Average annual wages for the middle-ranked occupations in 2007 were much higher ($62,564) than those for all service-providing occupations ($41,610). Wage growth from 2001 to 2007 averaged 3.7 percent per year, faster than the 3.1-percent growth rate for all service-providing occupations. The educational attainment of workers in the middle-ranked occupations also was higher, with 61.7 percent holding a bachelor's or higher degree, compared with 37 percent for all service-providing occupations; only 12.9 percent of workers in the middle group had no more than a high school diploma, as opposed to 32.0 percent of all service-providing workers.

Lowest ranked. The 33 occupations in the least susceptible group accounted for 6.5 million jobs in 2007. (See table 3.) This group consists largely of highly skilled occupations, 30 of which are professional and related occupations or management, business, and financial operations

Table 3. Employment, projected employment change, educational attainment, and earnings of susceptible occupational categories

Susceptible occupational categories	Number of occupations	Employment, 2007 (in thousands)	Average annual percent change in employment, projected 2006–16	Percent distribution by educational attainment			Mean annual wages, 2007
				High school	Some college	College	
All service-providing occupations ...	515	117,052	1.1	32.0	31.0	37.0	$41,610
All offshorable occupations	160	30,310	1.2	16.6	29.3	54.0	61,473
Highest ranked occupations.....	33	9,476	1.1	27.2	42.4	30.4	38,201
Middle-ranked occupations.....	94	14,306	1.3	12.9	25.4	61.7	62,564
Lowest ranked occupations	33	6,527	1.1	14.0	24.9	61.1	92,868

SOURCES: Projected employment change, 2006–16: BLS National Employment Matrix; employment and mean annual wages, 2007: BLS Occupational Employment Statistics, percent distribution by educational attainment: authors' calculation from American Community Survey Public Use Microdata.

occupations. Management occupations are heavily represented, accounting for 12 of the 33 in the group. No office and administrative support occupations are included.

Employment of the lowest ranked occupations grew by 1.8 percent per year from 2001 to 2007, faster than the 1.3-percent rate for all service-providing occupations. Employment of the lowest-ranked occupations is projected to grow by 1.1 percent per year from 2006 to 2016, the same rate as that projected for all service-providing occupations. Growth is expected in all but one of these occupations—wholesale and retail buyers, except farm products—which is projected to decline by a negligible amount.

Average annual wages for the least susceptible group in 2007 were $92,868, compared with $41,610 for all service-providing occupations. In addition, the wages for each of the 33 occupations in the least susceptible group were above the average for all service-providing occupations. Wage growth in the group averaged 3.4 percent per year from 2001 to 2007, faster than the 3.1-percent growth rate for all service-providing occupations. Educational attainment of the workers in the least susceptible occupations was high, with 61.1 percent of workers holding a bachelor's or higher degree.

Education groupings. Another method of analyzing the susceptible occupations is to group them by educational attainment and observe the differences among the groups. During the projections process, analysts assign an education or training category to each occupation.[18] Occupations classified as bachelor's degree or higher were placed into one group, while occupations classified as associate's degree or less were placed into another.[19] Ninety-seven offshorable occupations, accounting for 15.2 million jobs in 2007, were classified as bachelor's degree or higher, with the remaining 63 offshorable occupations accounting for 15.1 million jobs in 2007. (See table 4.) For comparison purposes, all service-providing occupations also were placed into corresponding education groups.

Over the 2001–07 period, offshorable occupations in the bachelor's-degree-or-higher group grew by 3.0 percent per year, faster than the 2.5-percent growth rate for all bachelor's-degree-or-higher service-providing occupations. (See table 4.) In contrast, offshorable occupations in the associate's-degree-or-less group grew by 0.5 percent per year, slower than the 1.1-percent growth rate for all associate's-degree-or-less service-providing occupations. Offshorable occupations in the bachelor's-degree-or-higher group are projected to grow slightly faster than service-providing occupations in that same group—1.5 percent, compared with 1.4 percent—and offshorable occupations in the associate's-degree-or-less group are projected to grow slightly more slowly than service-providing occupations in that group—0.9 percent, compared with 1.0 percent. Wages in the bachelor's-degree-or-higher offshorable occupations grew by 3.5 percent per year from 2001 to 2007, compared with 3.4 percent for all bachelor's-degree-or-higher service-providing occupations. Wages for the associate's-degree-or-less offshorable occupations grew by 2.9 percent per year over the same period, compared with 2.6 percent for all associate's-degree-or-less service-providing occupations.

THE PHENOMENON OF OFFSHORING, together with its potential effects on the U.S. labor market, has generated much attention. This article does not quantify those effects, but instead attempts to determine the occupations that may be affected by offshoring. The article finds that

Table 4. Average annual change in employment and wages and projected employment growth, by education group

Education group	Number of occupations	Employment, 2007 (thousands)	Percent change in employment, 2001–07	Average annual percent change in wages, 2001–07	Average annual percent change in employment, projected 2006–16
High education, all service-providing occupations	108	27,337	2.5	3.4	1.4
High education, offshorable occupations	97	15,192	3.0	3.5	1.5
Low education, all service-providing occupations	302	89,715	1.1	2.6	1.0
Low education, offshorable occupations	63	15,118	.5	2.9	.9

NOTE: High education: bachelor's degree or higher; low education: associate's degree or less.

SOURCES: Projected employment change, 2006–16: BLS National Employment Matrix; 2007 employment, and percent change in employment and wages, 2001–07: BLS Occupational Employment Statistics.

160 occupations are susceptible to offshoring and presents considerable data on those occupations. Although the effects of offshoring cannot be measured, it is noteworthy that the offshorable occupations grew slightly faster than all service-providing occupations from 2001 to 2007 and are projected to grow slightly faster than all service-providing occupations from 2006 to 2016. In addition, the offshorable occupations are quite diverse in their job functions, educational attainment, and wages. These findings warrant further research and analysis, but the dearth of additional relevant data, from either the BLS or other sources, makes most conclusions speculative at this point. As a result, the analysis undertaken here attempts only to add to the discourse on offshoring by compiling a list of susceptible occupations, as well as presenting data, both historical and projected, on those occupations. □

Notes

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[1] In this article, *service-providing occupations* refers to occupations in Standard Occupational Classification (SOC) major groups 11 through 43, 49, and 53. It does not denote the SOC intermediate aggregation service occupations, which cover only major groups 31 through 39. (See table 1.)

[2] *Offshoring: An Elusive Phenomenon*, report for the U.S. Congress and the Bureau of Economic Analysis (National Academy of Public Administration, January 2006).

[3] Bureau of Economic Analysis, National Income and Product Accounts Table, "Table 4.6.2, Real Exports and Imports of Goods and Services by Type of Product, Chained Dollars."

[4] *Why We Can't Measure the Economic Effects of Services Offshoring: The Data Gaps and How to Fill Them,* Services Offshoring Working Group final report (Cambridge, MA, Massachusetts Institute of Technology, Industrial Performance Center, Sept. 10, 2006).

[5] See, for example, Alan Blinder, *How Many U.S. Jobs Might Be Offshorable*? Princeton University CEPS Working Paper No. 142 (Princeton, NJ, Princeton University Press, March 2007); and Ashok Bardhan and Cynthia Kroll, T*he New Wave of Outsourcing*, Fisher Center for Real Estate and Urban Economics Research Report Series No. 1103, October 2003, on the Internet at **ssrn.com/abstract=985741**.

[6] For a discussion of the uncertainty of the effect of offshoring on unemployment, see Jagdish Bhagwati, Arvind Panagariya, and T. N. Srinivasan, "The Muddles over Outsourcing," *Journal of Economic Perspectives*, fall 2004, pp. 93–114.

[7] Bardhan and Kroll, *The New Wave*, p. 4.

[8] See *Standard Occupational Classification Manual: 2000* (Bureau of Labor Statistics, 2000).

[9] Blinder, *How Many U.S. Jobs*?

[10] The Occupational Information Network is an occupational information resource developed by the Employment and Training Administration of the U.S. Department of Labor.

[11] J. Bradford Jensen and Lori G. Kletzer, "Measuring Tradable Services and the Task Content of Offshorable Service Jobs," paper prepared for the National Bureau of Economic Research Conference on Research in Income and Wealth, titled "Labor in the New Economy," Nov. 16–17, 2007, Washington, DC.

[12] *Ibid*., p. 9.

[13] Jensen and Kletzer's analysis covers SOC major groups 11 through 43.

[14] See "Accounting for Offshoring in Occupational Employment Projections," *Occupational Projections and Training Data, 2006–07*, Bulletin 2602 (Bureau of Labor Statistics, February 2006).

[15] Within SOC groups 11 through 43, 49, and 53, all residual occupations were removed before analysis due to the difficulty of accurately defining the job duties of those occupations. In addition, in keeping with the format of the National Employment Matrix—which displays BLS estimates of current and projected employment by detailed industry and detailed occupation—summary occupations were used for postsecondary teachers and for physicians and surgeons. It is unlikely that the various specialties within these occupations differ in the degree to which offshoring affects them.

[16] Figures for 1999 and 2000 are available, but are considered less reliable due to OES methodology. Because data on the survey's full sample of 1.2 million establishments are collected over a period of 3 years—approximately 200,000 establishments every 6 months—the initial 2 years of data do not represent a full sample. The OES survey first adopted the SOC in 1999 and completed its first full sample in 2001.

[17] Full descriptions of all of these data sources are available in *Employment Projections: Occupational Projections and Training Data* (Bureau of Labor Statistics, 2008–09), on the Internet at **www.bls.gov/emp/optd/home.htm**.

[18] Eleven education or training categories are used, ranging from short-term on-the-job training to first professional degree. These categories reflect the most significant source of education or training for each occupation, but certainly not the only source.

[19] In order to prevent the groupings of occupations from being too small, the susceptibility rankings were ignored for this part of the analysis.

APPENDIX: Employment, wages, and education in offshorable occupations

Table A–1. Data on offshorable occupations: employment and wage variables

SOC code	Occupation title	Susceptibility score	Average annual percent change in employment, 2001–07	Employment, 2007 (thousands)	Average annual percent change in employment, projected 2006–16	Mean annual wages, 2007
	Highest ranked occupations					
15–1021	Computer programmers	16	–3.9	395	–0.4	$72,010
29–2052	Pharmacy technicians	16	6.5	302	2.8	27,560
41–2022	Parts salespersons	16	–1.0	230	–.2	30,540
43–2021	Telephone operators	16	–13.6	24	–4.9	32,690
43–3021	Billing and posting clerks and machine operators	16	1.2	515	.4	31,080
43–9011	Computer operators	16	–6.7	117	–2.8	36,080
43–9021	Data entry keyers	16	–5.6	287	–.5	26,350
43–9022	Word processors and typists	16	–7.9	139	–1.2	31,580
13–2082	Tax preparers	15	.7	62	–.9	34,890
31–9094	Medical transcriptionists	15	–1.3	87	1.3	32,120
41–9041	Telemarketers	15	–3.5	354	–1.0	24,430
43–3051	Payroll and timekeeping clerks	15	1.1	202	.3	34,500
43–9081	Proofreaders and copy markers	15	–7.6	16	.6	30,930
13–2041	Credit analysts	14	1.0	71	.2	62,820
13–2053	Insurance underwriters	14	1.1	99	.6	60,120
17–3013	Mechanical drafters	14	1.2	74	.5	46,690
29–1051	Pharmacists	14	2.1	253	2.0	98,960
43–2011	Switchboard operators, including answering service	14	–5.7	160	–.9	24,460
43–3011	Bill and account collectors	14	1.0	410	2.1	31,630
43–4021	Correspondence clerks	14	–12.3	16	1.1	30,600
13–2051	Financial analysts	13	6.4	228	3.0	81,700
15–1041	Computer support specialists	13	1.1	526	1.2	45,300
17–3011	Architectural and civil drafters	13	2.0	111	.6	45,280
17–3012	Electrical and electronics drafters	13	–3.2	32	.4	51,710
19–1021	Biochemists and biophysicists	13	3.2	19	1.5	85,290
19–2012	Physicists	13	4.3	14	.7	99,900
23–2011	Paralegals and legal assistants	13	4.7	241	2.0	47,600
23–2093	Title examiners, abstracters, and searchers	13	6.5	62	–.1	41,140
43–3031	Bookkeeping, accounting, and auditing clerks	13	1.5	1,859	1.2	32,780
43–3061	Procurement clerks	13	.5	77	–.2	34,570
43–4041	Credit authorizers, checkers, and clerks	13	–2.5	67	–.9	31,200
43–4051	Customer service representatives	13	2.6	2,193	2.2	31,040
43–9041	Insurance claims and policy processing clerks	13	–1.7	233	–.1	33,780
	Middle-ranked occupations					
13–1081	Logisticians	12	–	90	1.6	66,240
15–1061	Database administrators	12	1.8	116	2.5	70,260
15–2031	Operations research analysts	12	.4	59	1.0	71,640
17–2011	Aerospace engineers	12	2.4	86	1.0	92,700
17–2061	Computer hardware engineers	12	2.7	79	.5	94,270
17–2121	Marine engineers and naval architects	12	5.3	7	1.0	78,200
19–1022	Microbiologists	12	–1.0	15	1.1	66,430
19–2031	Chemists	12	–1.0	80	.9	68,520
19–3093	Historians	12	10.2	4	.8	54,630
27–4032	Film and video editors	12	4.0	17	1.2	61,180
41–3041	Travel agents	12	–4.3	86	.1	32,190
43–4011	Brokerage clerks	12	–2.5	71	1.8	39,990
43–4111	Interviewers, except eligibility and loan	12	4.8	227	.9	28,190
43–4141	New-accounts clerks	12	–1.9	89	–1.8	30,450
43–4181	Reservation and transportation ticket agents and travel clerks	12	–1.5	167	.1	31,080
49–2091	Avionics technicians	12	.0	16	.8	48,240
49–3011	Aircraft mechanics and service technicians	12	–2.1	119	1.0	49,670
13–1021	Purchasing agents and buyers, farm products	11	–5.0	13	–.9	53,980
13–2061	Financial examiners	11	.6	26	1.0	73,550

See footnotes at end of table.

Table A–1. Continued—Data on offshorable occupations: employment and wage variables

SOC code	Occupational title	Susceptibility score	Average annual percent change in employment, 2001–07	Employment, 2007 (thousands)	Average annual percent change in employment, projected 2006–16	Mean annual wages, 2007
	Middle-ranked occupations (continued)					
15–2021	Mathematicians	11	.4	3	1.0	90,930
15–2091	Mathematical technicians	11	–7.5	1	.8	48,490
17–2041	Chemical engineers	11	–1.6	29	.8	84,240
17–2071	Electrical engineers	11	–.3	149	.6	82,090
17–2072	Electronics engineers, except computer	11	1.4	134	.4	85,550
17–2131	Materials engineers	11	–.7	22	.4	78,840
17–2141	Mechanical engineers	11	1.4	222	.4	75,130
19–2011	Astronomers	11	9.1	2	.5	98,200
19–3011	Economists	11	–.8	13	.7	86,700
27–1014	Multimedia artists and animators	11	–.6	29	2.3	61,010
33–9021	Private detectives and investigators	11	3.0	37	1.7	42,660
43–4151	Order clerks	11	–4.6	256	–2.8	28,510
11–3061	Purchasing managers	10	–	66	.3	90,430
13–1023	Purchasing agents, except wholesale, retail, and farm products	10	3.6	282	.0	56,060
13–2011	Accountants and auditors	10	4.0	1,115	1.6	63,180
15–1011	Computer and information scientists, research	10	1.9	29	2.0	100,640
15–1031	Computer software engineers, applications	10	5.4	496	3.8	85,660
15–1071	Network and computer systems administrators	10	5.2	310	2.4	67,850
15–2011	Actuaries	10	5.3	18	2.2	95,420
17–3031	Surveying and mapping technicians	10	4.2	72	1.8	35,900
19–2021	Atmospheric and space scientists	10	4.4	9	1.0	78,960
19–3091	Anthropologists and archeologists	10	3.8	5	1.4	55,490
19–4021	Biological technicians	10	8.0	69	1.5	40,240
19–4031	Chemical technicians	10	–1.6	64	.6	42,420
19–4051	Nuclear technicians	10	2.1	6	.7	65,850
19–4061	Social science research assistants	10	–	16	1.2	38,120
23–1011	Lawyers	10	2.1	556	1.0	118,280
29–2051	Dietetic technicians	10	–2.7	25	1.4	26,680
41–3021	Insurance sales agents	10	3.0	322	1.2	58,580
43–9031	Desktop publishers	10	–2.8	29	.1	37,470
11–3041	Compensation and benefits managers	9	–	42	1.1	88,400
13–1031	Claims adjusters, examiners, and investigators	9	5.7	279	.9	55,470
13–1072	Compensation, benefits, and job analysis specialists	9	5.1	110	1.7	55,740
13–2031	Budget analysts	9	.5	62	.7	66,310
13–2052	Personal financial advisors	9	7.9	132	3.5	89,220
13–2072	Loan officers	9	8.9	357	1.1	62,610
15–1032	Computer software engineers, systems software	9	4.9	349	2.5	90,780
15–1081	Network systems and data communications analysts	9	9.4	216	4.4	70,760
17–2031	Biomedical engineers	9	14.2	15	1.9	79,610
17–2161	Nuclear engineers	9	.1	14	.7	97,130
17–3023	Electrical and electronic engineering technicians	9	–5.0	162	.4	52,470
17–3024	Electromechanical technicians	9	–15.1	16	.3	48,120
17–3027	Mechanical engineering technicians	9	–2.7	46	.6	49,290
19–2032	Materials scientists	9	2.6	10	.8	77,930
19–3021	Market research analysts	9	12.5	221	1.8	66,980
19–3022	Survey researchers	9	1.1	22	1.5	42,880
19–3094	Political scientists	9	–1.1	4	.5	90,050
23–2092	Law clerks	9	–4.2	31	–.1	40,880
27–1012	Craft artists	9	–	5	.8	30,110
27–3042	Technical writers	9	.3	47	1.8	62,780
27–3043	Writers and authors	9	1.3	44	1.2	60,120

See footnotes at end of table.

Table A–1. Continued—Data on offshorable occupations: employment and wage variables

SOC code	Occupational title	Susceptibility score	Average annual percent change in employment, 2001–07	Employment, 2007 (thousands)	Average annual percent change in employment, projected 2006–16	Mean annual wages, 2007
	Middle-ranked occupations (continued)					
41–9031	Sales engineers	9	–1.4	76	.8	86,350
43–1011	First-line supervisors/managers of office and administrative support workers	9	–.5	1,378	.6	47,620
43–4161	Human resources assistants, except payroll and timekeeping	9	–.3	162	1.1	36,000
43–5032	Dispatchers, except police, fire, and ambulance	9	1.9	190	.2	35,500
13–1071	Employment, recruitment, and placement specialists	8	1.8	194	1.7	52,710
13–2021	Appraisers and assessors of real estate	8	1.8	66	1.6	52,290
15–2041	Statisticians	8	2.9	20	.8	72,150
17–1011	Architects, except landscape and naval	8	3.9	107	1.6	73,650
17–1021	Cartographers and photogrammetrists	8	6.6	11	1.9	54,480
17–3021	Aerospace engineering and operations technicians	8	–10.7	8	1.0	56,780
19–1041	Epidemiologists	8	.0	4	1.3	63,600
19–1042	Medical scientists, except epidemiologists	8	11.1	87	1.9	74,160
25–1000	Postsecondary teachers	8	2.4	1,381	2.1	66,211
27–1013	Fine artists, including painters, sculptors, and illustrators	8	1.3	11	1.0	48,110
27–1021	Commercial and industrial designers	8	.6	35	.7	60,540
27–1022	Fashion designers	8	10.8	16	.5	71,170
27–1024	Graphic designers	8	6.7	201	.9	45,340
27–3041	Editors	8	.1	106	.2	55,020
29–1031	Dietitians and nutritionists	8	3.4	53	.8	50,030
41–4011	Sales representatives, wholesale and manufacturing, technical and scientific products	8	1.4	403	1.2	76,460
41–4012	Sales representatives, wholesale and manufacturing, except technical and scientific products	8	1.8	1,506	.8	60,190
43–4131	Loan interviewers and clerks	8	7.2	240	–.1	33,220
43–5031	Police, fire, and ambulance dispatchers	8	.9	94	1.3	34,060
43–9111	Statistical assistants	8	–4.8	19	.7	34,220
	Lowest ranked occupations					
11–3031	Financial managers	7	—	484	1.2	106,200
11–3042	Training and development managers	7	—	28	1.5	90,300
13–1073	Training and development specialists	7	1.4	203	1.7	53,040
13–1121	Meeting and convention planners	7	7.4	45	1.8	47,180
13–2071	Loan counselors	7	.2	30	.4	41,990
17–2111	Health and safety engineers, except mining safety engineers and inspectors	7	–6.2	25	.9	70,970
17–2151	Mining and geological engineers, including mining safety engineers	7	2.7	7	1.0	79,520
19–1012	Food scientists and technologists	7	—	10	1.0	62,580
19–3041	Sociologists	7	12.5	4	1.0	67,330
19–3051	Urban and regional planners	7	2.0	35	1.4	60,480
27–3091	Interpreters and translators	7	10.1	34	2.1	41,690
41–1012	First-line supervisors/managers of nonretail sales workers	7	–1.6	281	.4	78,170
41–3031	Securities, commodities, and financial services sales agents	7	–.1	268	2.2	90,470
11–1011	Chief executives	6	—	299	.2	151,370
11–1021	General and operations managers	6	—	1,655	.1	103,780
11–3011	Administrative services managers	6	—	239	1.1	76,370
11–3021	Computer and information systems managers	6	—	265	1.5	113,880

See footnotes at end of table.

Table A–1. Continued—Data on offshorable occupations: employment and wage variables

SOC code	Occupational title	Susceptibility score	Average annual percent change in employment, 2001–07	Employment, 2007 (thousands)	Average annual percent change in employment, projected 2006–16	Mean annual wages, 2007
	Lowest ranked occupations (continued)					
13–1022	Wholesale and retail buyers, except farm products	6	.1	133	.0	53,580
15–1051	Computer systems analysts	6	.6	464	2.6	75,890
17–1012	Landscape architects	6	3.3	22	1.5	62,250
17–2112	Industrial engineers	6	4.0	204	1.9	73,490
19–1011	Animal scientists	6	—	4	.9	54,290
41–3011	Advertising sales agents	6	1.8	161	1.9	52,290
11–2011	Advertising and promotions managers	5	—	36	.6	91,100
11–2021	Marketing managers	5	—	165	1.4	113,400
11–2022	Sales managers	5	—	322	1.0	106,790
11–2031	Public relations managers	5	—	47	1.6	97,170
11–9041	Engineering managers	5	—	184	.7	115,610
11–9121	Natural science managers	5	—	39	1.1	113,170
13–1111	Management analysts	5	5.4	500	2.0	80,460
17–2051	Civil engineers	5	3.1	247	1.7	75,230
27–1011	Art directors	5	7.5	32	.9	83,230
17–2081	Environmental engineers	4	.8	51	2.3	74,820

NOTE: Dash indicates data not available.

Table A–2. Data on offshorable occupations: education variables

SOC code	Occupation title	Percent distribution by educational attainment			Most significant form of postsecondary education or training
		High school	Some college	College	
	Highest ranked occupations				
15–1021	Computer programmers	5.5	21.8	72.7	Bachelor's degree
29–2052	Pharmacy technicians	27.0	57.0	16.0	Moderate-term on-the-job training
41–2022	Parts salespersons	59.0	35.1	5.9	Moderate-term on-the-job training
43–2021	Telephone operators	40.3	48.6	11.1	Short-term on-the-job training
43–3021	Billing and posting clerks and machine operators	36.1	48.5	15.4	Moderate-term on-the-job training
43–9011	Computer operators	26.8	46.4	26.8	Moderate-term on-the-job training
43–9021	Data entry keyers	35.2	47.0	17.7	Moderate-term on-the-job training
43–9022	Word processors and typists	29.0	51.9	19.1	Moderate-term on-the-job training
13–2082	Tax preparers	14.9	30.9	54.2	Moderate-term on-the-job training
31–9094	Medical transcriptionists	30.6	58.9	10.4	Postsecondary vocational award
41–9041	Telemarketers	50.1	35.7	14.2	Short-term on-the-job training
43–3051	Payroll and timekeeping clerks	32.9	49.6	17.5	Moderate-term on-the-job training
43–9081	Proofreaders and copy markers	21.5	31.3	47.2	Short-term on-the-job training
13–2041	Credit analysts	14.9	25.4	59.7	Bachelor's degree
13–2053	Insurance underwriters	15.7	31.6	52.8	Bachelor's degree
17–3013	Mechanical drafters	13.0	62.4	24.6	Postsecondary vocational award
29–1051	Pharmacists	—	2.9	97.0	First professional degree
43–2011	Switchboard operators, including answering service	39.2	50.7	10.1	Short-term on-the-job training
43–3011	Bill and account collectors	38.4	48.2	13.3	Short-term on-the-job training
43–4021	Correspondence clerks	46.8	36.7	16.4	Short-term on-the-job training
13–2051	Financial analysts	3.1	9.6	87.3	Bachelor's degree
15–1041	Computer support specialists	13.4	44.0	42.6	Associate's degree
17–3011	Architectural and civil drafters	13.0	62.4	24.6	Postsecondary vocational award
17–3012	Electrical and electronics drafters	13.0	62.4	24.6	Postsecondary vocational award
19–1021	Biochemists and biophysicists	—	5.3	94.6	Doctoral degree

See footnotes at end of table.

Table A–2. Continued—Data on offshorable occupations: education variables

SOC code	Occupation title	Percent distribution by educational attainment			Most significant form of postsecondary education or training
		High school	Some college	College	
	Highest ranked occupations (continued)				
19–2012	Physicists	—	—	95.2	Doctoral degree
23–2011	Paralegals and legal assistants	12.7	42.7	44.6	Associate's degree
23–2093	Title examiners, abstracters, and searchers	22.5	39.3	38.1	Moderate-term on-the-job training
43–3031	Bookkeeping, accounting, and auditing clerks	33.7	50.3	16.0	Moderate-term on-the-job training
43–3061	Procurement clerks	28.4	47.8	23.8	Moderate-term on-the-job training
43–4041	Credit authorizers, checkers, and clerks	35.3	36.8	27.9	Short-term on-the-job training
43–4051	Customer service representatives	33.8	44.2	22.0	Moderate-term on-the-job training
43–9041	Insurance claims and policy processing clerks	30.5	47.5	22.0	Moderate-term on-the-job training
	Middle-ranked occupations				
13–1081	Logisticians	19.2	37.9	42.9	Bachelor's degree
15–1061	Database administrators	4.6	23.9	71.5	Bachelor's degree
15–2031	Operations research analysts	6.6	22.7	70.7	Master's degree
17–2011	Aerospace engineers	3.3	9.9	86.8	Bachelor's degree
17–2061	Computer hardware engineers	7.2	22.8	70.0	Bachelor's degree
17–2121	Marine engineers and naval architects	—	18.1	78.1	Bachelor's degree
19–1022	Microbiologists	—	5.3	94.6	Doctoral degree
19–2031	Chemists	—	6.5	93.2	Bachelor's degree
19–3093	Historians	—	10.2	89.8	Master's degree
27–4032	Film and video editors	12.8	28.7	58.4	Bachelor's degree
41–3041	Travel agents	25.2	48.7	26.1	Postsecondary vocational award
43–4011	Brokerage clerks	24.4	44.6	31.0	Moderate-term on-the-job training
43–4111	Interviewers, except eligibility and loan	28.0	48.0	24.0	Short-term on-the-job training
43–4141	New-accounts clerks	36.9	35.4	27.7	Work experience in a related occupation
43–4181	Reservation and transportation ticket agents and travel clerks	28.9	42.6	28.5	Short-term on-the-job training
49–2091	Avionics technicians	30.9	64.5	—	Postsecondary vocational award
49–3011	Aircraft mechanics and service technicians	32.9	56.6	10.5	Postsecondary vocational award
13–1021	Purchasing agents and buyers, farm products	35.5	42.5	—	Long-term on-the-job training
13–2061	Financial examiners	—	15.0	76.1	Bachelor's degree
15–2021	Mathematicians	—	6.1	93.3	Doctoral degree
15–2091	Mathematical technicians	—	6.1	93.3	Master's degree
17–2041	Chemical engineers	—	5.9	91.4	Bachelor's degree
17–2071	Electrical engineers	2.9	16.5	80.5	Bachelor's degree
17–2072	Electronics engineers, except computer	2.9	16.5	80.5	Bachelor's degree
17–2131	Materials engineers	—	19.1	77.0	Bachelor's degree
17–2141	Mechanical engineers	3.5	18.3	78.2	Bachelor's degree
19–2011	Astronomers	—	—	95.2	Doctoral degree
19–3011	Economists	—	—	99.7	Master's degree
27–1014	Multimedia artists and animators	13.6	28.5	58.0	Bachelor's degree
33–9021	Private detectives and investigators	17.7	30.2	52.0	Work experience in a related occupation
43–4151	Order clerks	46.8	36.7	16.4	Short-term on-the-job training
11–3061	Purchasing managers	14.9	28.1	57.0	Bachelor's or higher degree, plus work experience
13–1023	Purchasing agents, except wholesale, retail, and farm products	21.8	35.8	42.4	Long-term on-the-job training
13–2011	Accountants and auditors	3.7	17.1	79.1	Bachelor's degree
15–1011	Computer and information scientists, research	7.0	24.6	68.4	Doctoral degree
15–1031	Computer software engineers, applications	2.2	13.0	84.8	Bachelor's degree
15–1071	Network and computer systems administrators	8.3	41.5	50.2	Bachelor's degree
15–2011	Actuaries	—	—	98.9	Bachelor's or higher degree, plus work experience
17–3031	Surveying and mapping technicians	42.2	51.0	6.8	Moderate-term on-the-job training
19–2021	Atmospheric and space scientists	—	—	85.4	Bachelor's degree
19–3091	Anthropologists and archeologists	—	10.2	89.8	Master's degree

See footnotes at end of table.

Table A–2. Continued—Data on offshorable occupations: education variables

SOC code	Occupation title	Percent distribution by educational attainment			Most significant form of postsecondary education or training
		High school	Some college	College	
	Middle-ranked occupations (continued)				
19–4021	Biological technicians	13.7	25.9	60.4	Bachelor's degree
19–4031	Chemical technicians	30.3	32.5	37.2	Associate's degree
19–4051	Nuclear technicians	19.4	34.9	45.7	Associate's degree
19–4061	Social science research assistants	19.4	34.9	45.7	Associate's degree
23–1011	Lawyers	.2	.7	99.1	First professional degree
29–2051	Dietetic technicians	27.0	57.0	16.0	Postsecondary vocational award
41–3021	Insurance sales agents	18.4	36.4	45.2	Bachelor's degree
43–9031	Desktop publishers	24.7	43.3	31.9	Postsecondary vocational award
11–3041	Compensation and benefits managers	14.8	27.8	57.5	Bachelor's or higher degree, plus work experience
13–1031	Claims adjusters, examiners, and investigators	18.3	35.1	46.7	Long-term on-the-job training
13–1072	Compensation, benefits, and job analysis specialists	14.1	30.4	55.5	Bachelor's degree
13–2031	Budget analysts	4.2	17.8	78.1	Bachelor's degree
13–2052	Personal financial advisors	4.2	15.2	80.5	Bachelor's degree
13–2072	Loan officers	16.4	34.8	48.8	Bachelor's degree
15–1032	Computer software engineers, systems software	2.2	13.0	84.8	Bachelor's degree
15–1081	Network systems and data communications analysts	8.1	34.8	57.1	Bachelor's degree
17–2031	Biomedical engineers	—	18.0	75.7	Bachelor's degree
17–2161	Nuclear engineers	3.0	14.7	82.4	Bachelor's degree
17–3023	Electrical and electronic engineering technicians	27.2	54.4	18.4	Associate's degree
17–3024	Electromechanical technicians	27.2	54.4	18.4	Associate's degree
17–3027	Mechanical engineering technicians	27.2	54.4	18.4	Associate's degree
19–2032	Materials scientists	—	6.5	93.2	Bachelor's degree
19–3021	Market research analysts	4.4	13.5	82.2	Bachelor's degree
19–3022	Survey researchers	4.4	13.5	82.2	Bachelor's degree
19–3094	Political scientists	—	10.2	89.8	Master's degree
23–2092	Law clerks	22.5	39.3	38.1	Bachelor's degree
27–1012	Craft artists	13.6	28.5	58.0	Long-term on-the-job training
27–3042	Technical writers	7.2	18.4	74.4	Bachelor's degree
27–3043	Writers and authors	3.5	12.4	84.1	Bachelor's degree
41–9031	Sales engineers	—	16.4	78.9	Bachelor's degree
43–1011	First-line supervisors/managers of office and administrative support workers	28.1	43.1	28.9	Work experience in a related occupation
43–4161	Human resources assistants, except payroll and timekeeping	25.0	46.0	29.0	Short-term on-the-job training
43–5032	Dispatchers, except police, fire, and ambulance	44.0	45.1	10.9	Moderate-term on-the-job training
13–1071	Employment, recruitment, and placement specialists	14.1	30.4	55.5	Bachelor's degree
13–2021	Appraisers and assessors of real estate	17.0	39.2	43.8	Bachelor's degree
15–2041	Statisticians	—	6.1	93.3	Master's degree
17–1011	Architects, except landscape and naval	1.6	10.1	88.3	Bachelor's degree
17–1021	Cartographers and photogrammetrists	—	17.8	81.6	Bachelor's degree
17–3021	Aerospace engineering and operations technicians	27.2	54.4	18.4	Associate's degree
19–1041	Epidemiologists	—	—	99.3	Master's degree
19–1042	Medical scientists, except epidemiologists	—	—	99.3	Doctoral degree
25–1000	Postsecondary teachers	.2	5.2	94.6	Doctoral degree
27–1013	Fine artists, including painters, sculptors, and illustrators	13.6	28.5	58.0	Long-term on-the-job training
27–1021	Commercial and industrial designers	13.9	31.4	54.6	Bachelor's degree
27–1022	Fashion designers	13.9	31.4	54.6	Associate's degree

See footnotes at end of table.

Table A–2. Continued—Data on offshorable occupations: education variables

SOC code	Occupation title	Percent distribution by educational attainment			Most significant form of postsecondary education or training
		High school	Some college	College	
	Middle-ranked occupations (continued)				
27–1024	Graphic designers	13.9	31.4	54.6	Bachelor's degree
27–3041	Editors	4.0	14.7	81.4	Bachelor's degree
29–1031	Dietitians and nutritionists	14.7	13.6	71.7	Bachelor's degree
41–4011	Sales representatives, wholesale and manufacturing, technical and scientific products	20.6	28.0	51.4	Work experience in a related occupation
41–4012	Sales representatives, wholesale and manufacturing, except technical and scientific products	20.6	28.0	51.4	Work experience in a related occupation
43–4131	Loan interviewers and clerks	31.6	44.9	23.5	Short-term on-the-job training
43–5031	Police, fire, and ambulance dispatchers	44.0	45.1	10.9	Moderate-term on-the-job training
43–9111	Statistical assistants	23.7	46.5	29.8	Moderate-term on-the-job training
	Lowest ranked occupations				
11–3031	Financial managers	12.9	27.2	59.9	Bachelor's or higher degree, plus work experience
11–3042	Training and development managers	14.8	27.8	57.5	Bachelor's or higher degree, plus work experience
13–1073	Training and development specialists	14.1	30.4	55.5	Bachelor's or higher degree, plus work experience
13–1121	Meeting and convention planners	10.6	22.0	67.4	Bachelor's degree
13–2071	Loan counselors	16.4	34.8	48.8	Bachelor's degree
17–2111	Health and safety engineers, except mining safety engineers and inspectors	7.6	18.5	73.9	Bachelor's degree
17–2151	Mining and geological engineers, including mining safety engineers	—	17.6	79.6	Bachelor's degree
19–1012	Food scientists and technologists	—	17.7	82.0	Bachelor's degree
19–3041	Sociologists	—	10.2	89.8	Master's degree
19–3051	Urban and regional planners	—	—	92.2	Master's degree
27–3091	Interpreters and translators	15.9	36.3	47.8	Long-term on-the-job training
41–1012	First-line supervisors/managers of nonretail sales workers	30.8	30.9	38.3	Work experience in a related occupation
41–3031	Securities, commodities, and financial services sales agents	10.3	23.1	66.6	Bachelor's degree
11–1011	Chief executives	13.0	21.8	65.2	Bachelor's or higher degree, plus work experience
11–1021	General and operations managers	19.6	32.5	48.0	Bachelor's or higher degree, plus work experience
11–3011	Administrative services managers	21.4	38.8	39.9	Bachelor's or higher degree, plus work experience
11–3021	Computer and information systems managers	4.6	23.0	72.5	Bachelor's or higher degree, plus work experience
13–1022	Wholesale and retail buyers, except farm products	27.8	36.2	36.0	Long-term on-the-job training
15–1051	Computer systems analysts	7.0	24.6	68.4	Bachelor's degree
17–1012	Landscape architects	1.6	10.1	88.3	Bachelor's degree
17–2112	Industrial engineers	7.6	18.5	73.9	Bachelor's degree
19–1011	Animal scientists	—	17.7	82.0	Bachelor's degree
41–3011	Advertising sales agents	14.3	30.1	55.7	Moderate-term on-the-job–training
11–2011	Advertising and promotions managers	7.1	17.5	75.5	Bachelor's or higher degree, plus work experience
11–2021	Marketing managers	9.2	22.1	68.7	Bachelor's or higher degree, plus work experience
11–2022	Sales managers	9.2	22.1	68.7	Bachelor's or higher degree, plus work experience
11–2031	Public relations managers	8.7	16.3	75.0	Bachelor's or higher degree, plus work experience
11–9041	Engineering managers	4.4	11.9	83.7	Bachelor's or higher degree, plus work experience
11–9121	Natural science managers	—	—	92.8	Bachelor's or higher degree, plus work experience
13–1111	Management analysts	6.6	15.9	77.5	Bachelor's or higher degree, plus work experience
17–2051	Civil engineers	2.7	10.0	87.3	Bachelor's degree
27–1011	Art directors	13.6	28.5	58.0	Bachelor's or higher degree, plus work experience
17–2081	Environmental engineers	—	9.9	86.4	Bachelor's degree

NOTE: Dash indicates value not significant.