Domestic Trade in Services in Regional Input-Output Models

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Abstract: Lack of statistical data on interregional trade in services often leads regional input-output (I-O) models to rely on assumptions about the degree to which services are imported from other regions. One advantage of using an I-O model is that it provides the flexibility to tailor the basic model to provide more accurate estimates. This paper reviews the literature on tradability of services for insights that may improve the design of individual economic impact studies based on regional I-O models.

The degree to which services are imported from different geographic regions plays an important role in regional input-output (I-O) models. These models recognize that an initial change in economic activity leads to diminishing rounds of new spending in a regional economy. New spending diminishes primarily because regional economies must import goods and services to meet their own production and consumption needs.

Because a comprehensive set of statistics on U.S. interregional trade in services does not exist, regional I-O models built to cover many different regional economies must rely on assumptions to identify service imports from other regions.[2] Some regional I-O models base these assumptions on an industry's share of local earnings to the industry's share of national

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[2] Some I-O models exist for particular states that are based on special surveys that collect information on service imports for the state.

earnings. Other models make more general sets of assumptions about the supply of services to an initially affected industry.[3]

Regardless of the assumptions used to identify interregional service imports, the results of an economic impact study based on a regional I-O model may be improved with a bill-of-goods method. This method replaces assumptions in the model with information that is specific to a particular study. This includes the identification of the intermediate inputs that are produced by or purchased from other businesses within the region. If some of this information is not available, which is often the case, reasonable assumptions for the missing information need to be made.

This paper reviews the literature on the ease with which services can be traded across geographic boundaries to draw some conclusions that may be helpful when deciding which assumptions to use in an economic impact study based on the bill-of-goods method.

Little consensus emerges from the existing literature. Yet some practical conclusions for economic impact studies can be drawn: There are at least a few services, such as maintenance and repair, that are highly unlikely to be provided from another location. In contrast, a wide range of financial services and professional services may easily be provided from distant locations. Some characteristics of a particular service, such as the degree to which the production process can be segmented into different tasks that can be performed offsite, may also be helpful to think about when making assumptions about whether the service is produced by or purchased from other businesses within a region.

[3] For a detailed discussion of the alternative assumptions that can be made and are sometimes used in regional I-O models, see Miller and Blair (2009).

Services in the U.S. Economy

The service sector plays an important and growing role in the U.S. economy. In 2012, this sector made up nearly 70 percent of the Nation's gross domestic product (GDP).[4] During the period of 2000-2012, the private service-producing sector grew at an average annual rate of 4.1 percent.[5] In contrast, the private goods-producing sector experienced slower growth at an average annual rate of 2.7 percent.[6]

The service sector employs a large share of the civilian workforce. In 2011, employment in the private service sector made up over 80 percent of private employment. Since 2000, the full-time equivalent (FTE) employment for the private service sector has increased by nearly 6 percent while the FTE employment in the manufacturing sector has declined by over 32 percent.

A large number of service industries employ high-skilled workers and pay high wages. This is particularly the case for the service industries whose output is typically purchased by other businesses and used in production. FTE employment and compensation for some industries are presented in Table 1. This table shows that the business service sector alone employs more than twice the workers and provides, on average, higher compensation than the manufacturing sector as a whole.

[4] The source data for the output and employment statistics for the services sector presented in this section are BEA's industry economic accounts.

[5] Private service-producing industries consist of: utilities; wholesale trade; retail trade; transportation and warehousing; information; finance, insurance, real estate, rental, and leasing; professional and business services; educational services, health care, and social assistance; arts, entertainment, recreation, accommodation, and food services; and other services, except government.

[6] Private goods-producing industries consist of: agriculture, forestry, fishing, and hunting; mining; construction; and manufacturing.

Services in I-O Models

The premise behind regional I-O models is that an initial change in economic activity leads to additional changes in economic activity in other industries in an economy—for example, an increase in furniture manufacturing leads to increased production of wood and textile products. The increased production of wood and textile products, in turn, leads to more logging. Workers benefiting from these increases may also spend more, which also adds to the economic activity.

To account for the relationships between businesses and households, most regional I-O models use information from a set of national I-O accounts. These accounts include the "recipes" of goods and services used by industries to produce their own products by showing how much they spend on particular goods and services—for example, they show how much furniture manufacturers spend on wood and textile products to produce the furniture.

These national relationships are then adjusted using regional economic data to account for the fact that many of the goods and services that are purchased by local industries are imported from outside a given region—for example, a local furniture manufacturing industry may need to purchase lumber that is imported from another region. These imports result in money leaking out of the economy.

Table 2 shows the importance of services as intermediate inputs to other industries in the U.S. economy. More specifically, the table shows the share of the output of service industries used as intermediate inputs by industry sectors and the share of this output purchased by households for final consumption. Many services are used in production by other industries. The services provided by the information, the finance, insurance, real estate renting and leasing, and the professional and business industries stand out as notable examples. The services

provided by other services industries, such as the educational services, healthcare, and social assistance, and the arts, entertainment, recreation, accommodation, and food services industries are primarily purchased by households.

Table 3 demonstrates further the importance of services in production by showing the share of intermediate inputs that are services as a percentage of total intermediate inputs by sector. This share is greatest for the service sector (79 percent) and the trade sector (61 percent). The manufacturing sector uses mainly professional and business services as intermediate inputs (10 percent).

To estimate the economy-wide effects that result from the initial change in economic activity, regional I-O models produce multipliers associated with each of the local industries ultimately affected by the initial change in economic activity. If some of the services used as intermediate inputs are provided by industries outside a region, the economic impacts will be smaller. In other words, the value of the multipliers associated with the local industries that use imported services will be smaller as new rounds of spending in the local economy diminish more quickly.

Interregional Service Trade

Trade consists of a transfer of ownership of a product in exchange for another product or currency. For goods, trade is relatively easy to measure because the transfer of ownership typically involves the movement of a physical object, which is easy to observe.

For services, trade is less easy to measure for at least three reasons. First, interregional service trade can occur electronically, through the movement of people (either service provider

or consumer), or through transactions between establishments in multiunit firms.[7] Second, services can be bundled with goods and other services making it difficult to separately identify when and where a particular service is delivered. Third, both domestic and international service trade is subject to regulation, which creates challenges for collecting quantifiable data to enforce the rules.

For all these reasons, data on interregional service trade is difficult to collect. Information on freight shipments across state borders is available from the Bureau of Transportation Statistics Commodity Flow Survey (CFS). The CFS data is used in the construction of some I-O models to account for interstate trade in goods.[8] However, no comprehensive information on interstate trade in services is available from a U.S. statistical agency.

Services have been traditionally viewed as less tradable across geographic boundaries than manufactured goods because of characteristics related to production and delivery—for example, Regan (1963), Zeithaml (1985), and Beitner (1993) focus on the characteristics of services and describe services as intangible items that cannot be easily stored or transported. Moreover, services are frequently tailored to individual customers and consumed at the point of delivery. As a result, on-site interaction may be necessary to ensure that all the terms of a contract are fulfilled and that high quality standards are met.

[7] These are variations of the delivery modes specified in the General Agreement on Trade in Services (GATS) administered by the World Trade Organization (WTO). GATS defines service trade as the supply of a service through one of four delivery modes: Mode 1: *cross-border trade* – the supplier and the consumer of the service remain in their respective countries, while the service crosses the border; Mode 2: *consumption abroad* – the consumer from one country travels to another country to receive a service; Mode 3: *commercial presence*– this mode involves transactions with multinational corporations or their affiliates; and Mode 4: *presence of natural persons* – the service provider temporarily travels to a foreign country to supply services. More information on GATS is available at www.wto.org.

[8] The Bureau of Economic Analysis does use information from the Commodity Flow Survey to calculate the trade margins related to the industries that transport goods.

This traditional view of services has changed considerably in more recent years because of notable advances in information technology—for example, Freund and Weinhold (2002) not only argue that the Internet has made it easier to trade services, but they also provide empirical evidence that this technology has stimulated service trade. An interest in the degree to which services can be traded across geographic areas has also grown in recent years because of an interest in outsourcing and offshoring activities.

Since regional I-O models are concerned with the economic activity within a particular region, the focus of this paper is on the interregional trade of services that occurs when production in a regional economy involves services that are produced outside the region of interest. Based on this definition, considerations on how easily a service can be traded across geographic regions fall into three major categories:

- Production process
- Service delivery
- Barriers to interregional trade

Of the three categories, the degree to which the production process can be segmented into tasks that can be performed from other locations is likely the most important. In addition to these considerations, the outsourcing literature also discusses the importance of market conditions such as wage differentials across regions. However, these differentials are much less pronounced across states than across international borders.

Production process

The degree to which the production process of services can be segmented into tasks that can be performed offsite plays an important role in the trade of services. Exchanges of intermediate products between operating units of a business, such as the wiring diagram for the architectural plan of a building, should be thought of as affiliated trade to properly account for where production actually takes place. In other words, even though a firm may deliver a service through a local establishment, it is possible that at least parts of the service are developed or produced by an affiliated establishment in another location. Similarly, a local business may use a non-local subcontractor to develop or produce parts of a service that is provided locally.

Because of the fragmentation of the production process, the industry structure is important to the tradability of services. Multiunit firms supply many service inputs internally through other establishments which may be located in other regions, whereas small local firms are more likely to acquire these inputs locally. As a result, the same type of service – for example human resource management services – can be tradable when supplied to a multiunit firm by an affiliated establishment outside the region, but non-tradable when supplied locally to a local firm.

Advancements in information and communication technologies (ICTs) facilitate both service production and service trade. One reason that recent advances in these technologies are expected to aid affiliated trade in particular is because the exchanges between units in the same business do not have a customer service component. In other words, the business does not need to rely on personal interactions to build a loyal customer base or develop the trust to get a customer to sign a contract.

The role of technological change in the production process of services has also changed service tradability over time. Many services that were once thought to be non-tradable are now tradable and further technological improvements are likely to make even more services tradable—for example, a local real estate agent is no longer required to purchase a commercial property or have it inspected as was the case not too long ago.

Despite advancements in ICTs, trade of a service may be limited by requirements related to the monitoring that may be needed because of the general nature of the service. Monitoring may be required to ensure that a customer's needs are met—for example, frequent inspections of leased equipment may be needed to ensure that it continues to work properly for the duration of a contract. Monitoring may also be required to ensure that customers meet the terms of any contractual agreements—for example, a commercial loan may require monitoring of business activity to ensure that the terms of the contract are met by the borrower.

Service delivery

If a service can be produced offsite, a second consideration is whether or not it is possible for the service to be delivered remotely. The ease with which a service can be delivered from another location depends on how easily the information can be codified and recorded. A service is more likely to be delivered from another location when it consists of primarily passing information along to customers. Customer support services are primary examples of services with high informational content that are easily delivered from another location.

In contrast, services that rely on the judgment and the experience of a service provider may not be easy to write down or verbalize – for example, while instructions to repair a piece of equipment may be easy to record, the diagnosis of a defective part is often aided by distinct

equipment sounds that a service provider is able to identify by experience but that are otherwise difficult to code.[9] In these cases, the delivery of the service requires the physical presence of the service provider.

Technological developments play an important role not only in the production process, but also in how easily a service can be delivered from another location. Advancements in ICTs enable electronic delivery of many services from virtually any location. These services range from routine customer support services to highly specialized services like research and development.

Even though some services may consist of simply passing along information, some businesses may still decide to deliver them personally. Face-to-face interaction helps develop close business relationships and fosters a loyal customer base. It also helps develop the trust needed to get a customer to commit to a large contract. Legal services serve as a good example of a product that can be delivered from a remote location but is often delivered in person.

Other services must be delivered on site simply because their provision is tied to a physical location—for example, maintenance and repair services may require on-site visits to make any necessary repairs. Extermination services, by the very nature of the work, must be delivered on site.

The more a service is customized, the more likely the service needs to be delivered on site. Because the codification of specialized information is difficult and costly, this process is usually limited to more routine applications. This may explain why many routine services, such

[9] Information that is not easy to write down or verbalize is often referred to as "tacit knowledge." The limitations that tacit knowledge place on trade and services are discussed further in Leamer and Storper (2001).

as repairing a desktop operating system, are often delivered from a remote location, while many customized services, such as developing a computer network, are often delivered on site.

For services that involve more specialized knowledge, remote provision is possible if the information to be exchanged between the service provider and the consumer is transparent. Garner (2004) illustrates this by pointing out that it is easier for a firm to outsource the analysis of its financial ratios than the performance assessment of its management team.

Barriers to interregional service trade

Even though interstate service trade is not subject to tariffs and quotas, there are some potential impediments to trade in services across U.S. state borders. These impediments influence the results of regional I-O models because they favor regional provision of services. Thus, higher overall effects are expected to result from an initial change in economic activity that involves services that are highly regulated in a state relative to the overall effects from other industries or states with fewer barriers.

Mattoo and Mishra (2008) summarize the domestic trade impediments to include the qualification requirements, licensing procedures, and other technical regulations that state governments impose by means of state professional boards to regulate an industry or an activity. More specifically, the state boards establish entry requirements, rules of conduct, and disciplinary measures for individual industries, such as transportation services, or activities, such as the practice of law.

Licensing is the most common and restrictive form of service regulation. Licensing is required for many services from business and professional services to maintenance and repair

services.[10] Depending on the kind of service, licensing requirements can be quite extensive. In particular, they can include possessing a professional degree, passing a professional examination, gaining experience in the field, or establishing residence in a given jurisdiction.

Because state professional boards have the authority to work independently from one another, established competency standards and licensing requirements vary considerably across states. Some state professional boards choose to collaborate with the respective national organizations—for example, state Boards of Architecture collaborate closely with the National Council for Architectural Registration Boards (NCARB). This practice introduces some consistency in the licensing and practicing requirements across states.

State governments may also impose rules on business practices or regulate the product that is being delivered by an industry—for example, a set of architectural plans may need to meet the safety codes established for a particular jurisdiction. Some states may also require the licensing of a business as well as the licensing of the employees who produce or deliver the services of the business.

Table 4 shows the degree to which the licensing and practicing requirements for legal services can vary across states—for example, thirteen states have adopted or are in the process of adopting the uniform bar exam that allows lawyers to more easily meet the requirements to practice law in other states that also use a uniform bar exam. Some of these requirements are unique to a particular state—for example, Louisiana's legal code is based on civil rather than common law, so out-of-state lawyers cannot acquire a license to practice law in Louisiana without passing the state's bar exam.

[10] For a detailed discussion on regulation of service occupations see Cox and Foster (1990).

One of the main differences between the licensing requirements to practice law relates to rules on admission on motion. Admission on motion is the procedure by which a practicing attorney can file a petition to practice law in a state without passing the state's bar exam. Twenty-five states grant admission to practice law simply through reciprocity agreements with other states. Fourteen states grant admission on motion based on other requirements, such as the passing of an attorney's exam that is more limited in scope than the states full bar exam. Only twelve states require the passing of the state's full bar exam.

Certification of service providers may also have some impact on the degree in which services can be traded across geographic locations. Certification is granted by a private agency to recognize that an individual possesses the knowledge or skills required to practice in a particular profession. One of the main differences between licensing and certification is that certification is not a requirement to practice in a profession.

The impact of certification on the degree to which services can be traded is likely to be less pronounced than the impact of licensing. Moreover, certification is likely to facilitate trade in services because it serves as an independent assessment of an individual's qualifications—for example, many states allow non-licensed architects with a NCARB certificate to offer services within the state.[11]

Advancements in ICTs have also opened up many unregulated venues for trade in services. Preparation of architectural designs and legal research are examples of services that are easily provided from any location and do not require locally licensed providers. However, local regulatory compliance requires locally licensed professionals to implement the architectural

[11] More information on states' requirements for architects is available at www.ncarb.org.

designs or represent a litigant in court. Thus, there is an interconnection between these digitally-enabled services and the downstream user (the builder or the lawyer) that still makes trust, reputation, and local knowledge important.

Service Tradability Indexes (Methodology)

The work that has been done to quantify the degree to which services can be traded across geographic areas can be classified into three categories:

- Industry-based indexes
- Occupation-based indexes
- Trade barrier-based indexes

The trade barrier-based indexes mainly apply to cross-country analysis because they focus on barriers to trade resulting from the international trade policies of individual countries. Because these barriers do not exist at the subnational level, the findings from this literature are not reviewed in this paper.[12] Even in the absence of such indexes domestically, the industry- and occupation-based indexes provide a quantitative measure of the tradability potential of various services that can help inform the assumptions needed in regional impact studies regarding the interregional trade in services.

General framework

All tradability indexes consolidate measures of various factors thought to affect the degree to which services can be traded across geographic areas to create a quantitative measure of

[12] Examples of international trade barriers include nationality and residency requirements, restrictions on practices, ownership, and investment, social networking and language barriers. See, for example, Nguyen-Hong (2000) for a discussion of barriers on international trade in professional services.

tradability. Each factor is weighted in terms of its importance to the provision of a particular service—for example, personal interaction is more important, hence would be weighted more heavily, for services rendered by healthcare providers than services provided by web developers.

The direction of the effect of a particular factor on service tradability is also incorporated in the index—for example, the need for personal interaction in the provision of a service is expected to hinder its tradability; hence, its inclusion is done so that it reduces the tradability value given to the service in the tradability index. Once the index is created, thresholds are typically established to divide its values into classes, such as tradable, semi-tradable, and non-tradable.

One advantage of the index framework is that it allows for the use of the same set of measures to summarize the tradability of a service in a single value that can be directly compared with the values of other services. It also allows for a number of different indicators to be summarized by a single statistic.

One disadvantage of this framework is that it is unlikely to capture the tradability of services equally well. In other words, the measures used to calculate the index are primarily driven by data availability and may not consider the main factors that may limit trade in a given industry. Another disadvantage is that there is a certain degree of subjectivity that is introduced in the indexes by the selection of the items used to construct the indexes and the relative weights that are given to each item.

Industry-based indexes

These indexes are most directly related to regional I-O models for two reasons. First, they are based on measures of industry activity. Second, these indexes use regional information to draw

inferences about trade in services. However, research related to these indexes is relatively new and largely limited to the work of Jensen and Kletzer.

Jensen and Kletzer (2006) construct industry-based tradability indexes for services based on measures of geographic concentration of service production within a region in the U.S. Their notion is that businesses tend to locate in regions to take advantage of economies of scale and benefits of agglomeration, leading some regions to have a disproportionate share of employment in the production of a particular good or service. The disproportionate share of the production activity in a region is indicative of the output being traded with other regions.[13]

Seattle, for example, has a disproportionately large share of U.S. employment in the aircraft and software publishing industries. Seattle residents do not consume disproportionally more aircraft and software than residents in other regions; Seattle exports aircraft and software to other economies outside the region. Regardless of the economic justification, export base studies in regional analysis have long attempted to identify exporting industries by identifying where local production exceeds local demand.

Using industry- and region-specific employment and output data from BEA's Regional Accounts and national data from BEA's Input-Output Tables, Jensen and Kletzer (2006) construct a region-specific measure of demand for each industry's output in the region.[14] They then compare the region's share of industry employment to the region's share of demand for the industry's output. The argument that is made is that an industry's local employment in excess of

[13] Jensen and Kletzer are interested in the international trade of services, so they make the additional assumption that if a service is traded domestically, it can potentially be traded internationally.

[14] This measure of regional demand does not consider the final use of an industry's output by households.

the employment needed to satisfy local demand shows that some of an industry's output is likely to be exported from the region.

The extent of concentration of an industry's economic activity in a region is summarized by a Gini coefficient, which measures the inequality between the region's share of industry employment and its share of industry demand.[15] A large Gini coefficient is interpreted as an indication that the industry's output is likely exported from the region. Each industry is then classified into one of three Gini classes with industries that have a Gini value greater than .1 classified as potentially tradable.[16]

Jensen and Kletzer apply the same concentration approach to service occupations to address concerns that a service offered under an industry that is considered non-tradable, may, in fact, be tradable—for example, the servicing of customer bank accounts offered by various financial institutions may be tradable even though the banking industry as a whole may be classified as non-tradable.

A major advantage of the economic concentration approach is that it is objective. Moreover, it uses regional industry and employment data which makes it particularly applicable to regional impact analysis. A disadvantage of this approach is that it fails to distinguish among the many reasons why services production or service occupations may be concentrated within a

[15] Jensen and Kletzer also use a modified Ellison-Glaeser index, but given that the results are qualitatively similar, they only report the results from the Gini coefficient.

[16] The thresholds used for the Gini classes are as follows: Gini class 1 (least concentrated) contains industries with Gini value less than .1, Gini class 2 contains industries with Gini value between .1 and .3, and Gini class 3 (most concentrated) contains industries with Gini value greater or equal to .3. Industries in Gini classes 2 and 3 are classified as potentially tradable.

region. Thus, it may misclassify service activities that are geographically concentrated for reasons other than production economies.[17]

Occupation-based indexes

These are the most commonly constructed indexes. However, their results are difficult to apply to regional I-O models because occupations are often spread across many industries—for example, a data entry clerk could work in almost any service industry.

Occupation-based indexes use measures of characteristics of occupations to create a single measure for how easily a job can be outsourced to a foreign country.[18] Even though some studies are based on occupational measures that are unique to the individual study, several studies are based on U.S. occupational data from the Occupational Information Network (O*Net).

O*Net was developed for the U.S. Department of Labor to succeed the Dictionary of Occupational Titles used to classify occupations.[19] For each occupation, O*Net provides information on education, skills, and other requirements needed to perform a job. It also provides information on the typical tasks and activities related to each occupation.

Much of this information is presented in the form of standardized lists to provide comparable data across occupations but with different relative importance ratings across occupations. For example, the work activity "interacting with computers" is assigned a high

[17] Jensen and Kletzer modify their Gini coefficient to adjust for concentration due to a concentration in domestic demand. However, they recognize that their measure is not able to identify tradable services that are not geographically concentrated or service activities that are not tradable although they are geographically concentrated.

[18] A service occupation that is potentially offshorable is just as easily outsourceable to another region.

[19] For more information on the O*Net database, see www.onetonline.org.

relative importance rating for data entry keyers but a much lower relative importance rating for maintenance and repair workers.

Even though O*Net provides a wealth of quantitative information on the tasks and activities of an occupation, only a limited subset of this information can be used to construct occupation-based indexes to assess tradability. The most commonly used characteristics for an occupation-based index are activities that relate to information content, internet usage, personal interaction, and creative thinking.[20]

For example, Jensen and Kletzer (2010) use the following occupation tasks and activities: information content, internet enabled, face-to-face contact, nature of work, and on-site nature of work. In contrast, Blinder (2007) uses the occupation activities that establish whether or not the occupation requires personal contact or is difficult to perform remotely such as establishing and maintaining personal relationships, assisting and caring for others, performing for or working directly with the public, selling or influencing others, and social perceptiveness.

If one of these characteristics, such as maintaining relationships, is believed to hinder the possibility of outsourcing of a job, then the O*Net rating for this activity is recorded as a negative value. A weighted average is then calculated across all categories of both positive and negative scores.

One advantage of using the O*Net database is that, with a known set of occupation activities and their respective rankings, the resulting occupation index is replicable. However,

[20] Similar occupation characteristics are also used by studies that use other data sources. Bardhan and Kroll (2003) use the following attributes of occupations vulnerable to offshoring: no face-to-face customer contact, high information content, internet enabled/ telecommutable work process, low set up barriers, low social networking requirements, and high wage differentials. Van Welsum and Vickery (2005a, 2005b) use ICT-related attributes such as intensive use of ICTs to produce output, use of ICTs to deliver the output, "codified knowledge" content, no face-to-face contact. Autor, Levy, and Murnane (2003) emphasize the routinization (or computerization) of job tasks.

subjectivity is still present through the selection of the activities that are used to construct the index and the relative weights given to each activity.

One disadvantage of using this database is that the effect of the chosen task or activity on offshorability is not always clear—for example, "getting information" may refer to collecting information online, by telephone, or in person. Unlike the first two collection modes, collecting information in person would affect the possibility of outsourcing a job negatively.

Blinder (2007) argues that an index constructed mechanically using O*Net's occupation activities and ratings may results in rankings that do not make much sense. As an alternative, he constructs an index based on whether or not service production and delivery is location dependent. Blinder considers this index to be more subjective but more sensible.

Blinder's subjective index is derived from a tree-like decision structure with several decision layers that determine if service production and delivery requires geographic proximity. The decision layers consist of whether a worker is required at a specific work location in the United States, whether a worker must be physically close to his work unit, and whether the work unit must be at a U.S. location. A comparison of the occupation rankings from the two indexes reveals a low rank correlation drawing attention to the challenge of assessing tradability of service occupations.

Occupation-based indexes are not limited to the use of the O*Net database. Blinder and Krueger (2009) use three alternative household survey methods. The first method asks responders to assign their job to an offshorability scale by considering the difficulty of having their job performed from a remote location. The second method infers offshorability of an occupation based on the respondents' description of the nature of the job. The third method uses

professional coders to assign the respondents jobs to an offshorability scale based on a description of job tasks.

This survey methods approach is valuable in two respects. First, it enables a comparison of the offshorability classifications of occupations across the three alternative methods. Second, since some of the methods use occupation information from existing surveys, it provides a way to track offshorability of occupations with existing data. Finally, since the respondents can identify the industry that they work for, offshorability of occupations can be also summarized by industry.

Service Tradability Indexes (Results)

Since the results of industry-based indexes are more directly related to regional I-O models, they are discussed first. Then some findings from the occupation-based indexes are discussed to see if they can be used to corroborate the results of industry-based indexes.

Industry-based indexes

The economic concentration measure proposed by Jensen and Kletzer (2006) provides direct tradability classifications for service industries. This classification is presented in Table 5 for a subset of service industries whose output is used as an intermediate input in production by other industries.

Table 5 shows that the industries in the real estate and rental and leasing and the professional, scientific, and technical service sectors are largely classified as potentially tradable. One exception is accounting, tax preparation, bookkeeping, and payroll services. Among the

professional services classified as potentially tradable are architectural, engineering, and technical services, legal services, and management, scientific, and technical consulting services.

On the other end of the tradability spectrum are many of the industries in the finance and insurance, the administrative support, and the “other services" sectors. Among these non-tradable industries are savings institutions; banking and related activities; waste management and remediation services; services to buildings and dwellings; landscaping services; and maintenance and repair to equipment and machinery.

Jensen and Kletzer look further at the shares of sector employment by tradability class to give a sense of how much employment is associated with the potentially tradable industries. The authors estimate more than 50 percent of the sector’s employment for the information; finance and insurance; and professional, scientific, and technical services sectors to fall into the potentially tradable category (Table 6). A large share of employment for the administrative support, waste management, and remediation services sector also falls into the potentially tradable category (40 percent).

Blinder and Krueger (2009) report qualitatively similar findings regarding the percentage of jobs classified as offshorable by sector. The services sectors of information; finance and insurance; and professional, scientific, and technical services have the largest percentages of offshorable jobs. This percentage is also sizable for the administrative support, waste management, and remediation services sector (Table 7).

Occupation-based indexes

Drawing inferences about how easily an industry’s services can be traded from the findings of occupation-based indexes is difficult for most industries for at least two reasons. First, a link

between occupations and industries is hard to establish because the occupational composition of many industries is diverse and many occupations are not specific to one industry. Second, the results of these indexes can vary even within an individual study.

Table 8 shows that many occupations are not specific to one industry. A few occupations are heavily associated with almost all industries—for example, office and administrative support makes up the largest share of employment in the finance and insurance industry (47 percent), but it also makes up a sizable share in almost all other industries.

Tables 9 and 10 demonstrate these points further by looking at a higher degree of occupational detail. Tellers are an example of an occupation that is specific to the finance and insurance industry. Almost all tellers are employed by this industry (98 percent), and they make up nearly 10 percent of the employment. Yet the same cannot be said for the real estate agents. Real estate sales agents make up a large share of employment in the real estate, rental, and leasing industry (7 percent), but only 39 percent of real estate sales agents are employed by this industry.

Table 11 shows that a conclusive link between occupations and industries is difficult to establish even at higher levels of industry detail. Lawyers, along with paralegals and legal assistants, have the largest employment shares in the legal services industry, 33 percent and 16 percent, respectively. All legal occupations, however, make up just about 50 percent of the total legal services industry employment.

Other difficulties arise because different methodologies can yield different results even in the same study. Jensen and Kletzer (2010) use two tradability rankings of service occupations to compute occupation employment shares by tradability class: a ranking based on the values of

Gini coefficients and an offshorability ranking based on the job task content from the O*Net occupation data. The two methods result in different employment shares by tradability class for many occupations (Table 12).

Jensen and Kletzer (2010) report that, overall, 41 percent of occupations are classified in the same tradability class by both measures. By tradability class, 48 percent of occupations classified as non-tradable from the Gini measure are also classified as non-tradable using the job task content offshorability index while 55 percent of occupations are mutually classified as highly tradable by both measures.

Blinder and Krueger (2009) also report discrepancies in offshorability ratings across many occupations due to the alternative survey methods used—for example, the survey respondents rate about 50 percent of the occupations under "management, business, and financial operations" as offshorable, whereas the professional coders rank as offshorable only 16 percent of the occupations in this group (Table 13).

Differences are present even at higher degree of occupational detail. A comparison of the thirty most offshorable occupations reported in Jensen and Kletzer (2010) to the occupation rankings from Blinder's (2007) subjective index shows that only half of these occupations fall in Blinder's highly offshorable category, five fall in the offshorable category, two in the non-offshorable category, and eight in the highly non-offshorable category (Table 14).[21]

Despite these differences, some occupation offshorability classifications are consistent across the studies. A major occupation group that is consistently classified as offshorable is management, business, and financial operations. Major occupation groups consistently classified

[21] The highly non-offshorable occupations in Blinder (2007) are inferred by omission because these occupations are not explicitly reported.

as non-offshorable include healthcare support, food preparation, buildings and grounds cleaning and maintenance, personal care, construction and extraction, installation, maintenance, and repair, and transportation and material moving. These classifications seem to be generally in-line with the results of the industry-based indexes.

Findings regarding the professional and related occupations, sales, and office and administrative support are fairly mixed. For example, Jensen and Kletzer (2010) estimate based on their Gini measure that 93 percent of the employment in the office and administrative support occupations (SOC 43) falls in the non-tradable class (Table 12). In contrast, the professional coders in the Blinder and Krueger study classify over 40 percent of the jobs in this occupation category as offshorable (Table 13).

Similarly, for professional and related occupations (SOC 15-29), Jensen and Kletzer estimate a significant share of occupation employment to be in the tradable class for the computer and mathematical; architecture and engineering; life, physical, and social science; legal; and arts, design, entertainment, sports and media occupations. Exceptions are community and social services, education training and library, and healthcare practitioners and technical occupations. Blinder and Krueger report a rather low percentage of offshorable jobs (20-30 percent) for the professional and related occupations.

Conclusions

The degree to which services are traded across geographic areas plays an important role in determining the results generated from a regional I-O model. The results of these models may be improved with information specifically collected for the study on the local supply of

intermediate inputs. Even though much of this information may be available, an analyst often needs to make assumptions on whether a particular service is supplied by local businesses.

This paper reviews the literature on the tradability of services to inform these assumptions by discussing factors that likely affect tradability of services domestically and describing available tradability rankings of services. Even though there is often disagreement between studies on the tradability rankings of services, there are a handful of services, such as maintenance and repair, waste management, and landscaping, that are consistently classified as non-tradable. In contrast, professional, scientific, and technical services are consistently classified as tradable.

An additional finding is that even within service industries that are classified as non-tradable, there are services provided by these industries that can be tradable—for example, banking is often classified as a non-tradable industry, but financial investment services are often classified as highly tradable.

A bill-of-goods approach can be used to improve the results of a regional impact study with location and industry-specific information. In the absence of such information on interregional service trade, good judgment can help when making assumptions on whether a particular service is supplied locally. Factors to consider are the production process, service delivery, and barriers to trade for the particular region, industry, and study application.

This paper provides insights on how these factors affect the results of a regional impact study. A multiunit firm is more likely to import services than a single establishment, leading to an overall smaller effect on the regional economy. A higher overall effect may be more appropriate for services provided in a highly regulated state. Technological change can quickly

erode the multiplier effects for industries where ICTs are rapidly changing the typical manner in which services are delivered.

These insights stress the importance of understanding the local economy and making conservative assumptions when using the bill-of-goods method with a regional I-O model. Many services that have traditionally been viewed as non-tradable have likely become much more tradable in recent years as technology has facilitated the fragmentation of the production process across locations and allowed for the delivery of services from alternative locations—for example, a local architectural firm may be hired by a business, but much of the work may be completed outside the area. In this case, the most conservative assumption that can be made when the bill-of-goods method is used is that the service is produced outside the region.

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Table 1. Full-Time Equivalent Employment and Compensation for Select Industries, 2011

Industry	Full-Time Equivalent Employees (thousands)	Compensation Per Full-Time Equivalent Employee (dollars)
Private industries	102,387	64,560
Manufacturing	11,456	78,991
Services	60,882	64,792
Business services[1]	26,288	86,678
Personal services [2]	28,924	49,109

[1] Information; finance and insurance; real estate, rental, and leasing; professional, scientific, and technical services; management of companies and enterprises; administrative and waste management services.

[2] Educational services; healthcare and social assistance; arts, entertainment, and recreation; and accommodation and food services.

Source : BEA NIPA Table 6.2D and Table 6.5D.

Table 2. Service Commodity Output Shares, 2010

Commodities/Industries	Total Intermediate					Personal Consumption Expenditures
	Agriculture, Mining, Construction	Manufacturing	Trade	Transportation	Services [1]	
Information	0.80%	1.89%	1.91%	0.39%	32.79%	42.80%
Finance, insurance, real estate, rental, and leasing	1.79%	2.29%	3.09%	0.86%	36.94%	49.71%
Professional and business services	4.70%	11.14%	7.45%	1.69%	42.59%	7.59%
Educational services, healthcare, and social assistance	0.03%	0.00%	0.15%	0.00%	1.99%	96.54%
Arts, entertainment, recreation, accommodation, and food services	0.36%	1.50%	1.11%	0.57%	17.63%	75.29%
Other services, except government	2.50%	2.33%	2.39%	0.55%	17.88%	70.79%

Note: Percentages across rows do not sum to 100 percent because the table presents a selection of intermediate and final uses of services.

[1] This sector consists of: information; finance and insurance; real estate, rental, and leasing; professional and business services; educational services, healthcare, and social assistance; arts, entertainment, recreation, accommodation, and food services; and other services, except government.

Source : BEA 2010 Input-Output table.

Table 3. Service Share of Total Industry Intermediate Inputs, 2010

Commodities/Industries	Agriculture, Mining, Construction	Manufacturing	Trade	Transportation	Services [(1)]
Information	0.88%	0.58%	2.75%	1.14%	6.86%
Finance, insurance, real estate, rental, and leasing	9.76%	3.49%	21.90%	12.34%	38.15%
Professional and business services	15.21%	10.11%	31.42%	14.34%	26.16%
Educational services, healthcare, and social assistance	0.07%	0.00%	0.48%	0.02%	0.94%
Arts, entertainment, recreation, accommodation, and food services	0.43%	0.50%	1.72%	1.79%	3.98%
Other services, except government	1.89%	0.49%	2.36%	1.09%	2.56%
Total Intermediate Service	**28.25%**	**15.18%**	**60.62%**	**30.72%**	**78.66%**

[(1)] This sector consists of: information; finance and insurance; real estate, rental, and leasing; professional and business services; educational services, healthcare, and social assistance; arts, entertainment, recreation, accommodation, and food services; and other services, except government.

Source : BEA 2010 Input-Output table.

Table 4. State Requirements for Lawyers, 2013

State	Licensing				Practice	
	Professional degree from ABA-approved law schools required	Uniform Bar Exam (UBE)	Multistate Professional Responsibility Exam (MPRE)	Continuing legal education (CLE) required to maintain license	Admission on motion based on reciprocity	Admission on motion based on other criteria
Alabama		x[1]	x	x	x[2]	
Alaska			x	x	x	
Arizona		x[1]	x	x	x[2]	
Arkansas	x		x	x	x	
California			x	x		
Colorado		x	x	x	x[2]	
Connecticut			x		x	
Delaware	x		x	x		
District of Columbia			x			x
Florida			x	x		
Georgia	x		x	x	x	
Hawaii			x	x		
Idaho	x	x	x	x	x[2]	
Illinois			x	x		x
Indiana	x		x	x		x
Iowa	x		x	x		x
Kansas	x		x	x	x	
Kentucky			x	x	x	
Louisiana			x	x		
Maine			x	x	x	
Maryland						
Massachusetts			x			x
Michigan			x			x
Minnesota		x (Feb.2014)	x	x		x [2], Feb. 2014
Mississippi	x		x	x	x	
Missouri		x[1]	x	x	x[2]	
Montana	x	x[1], July 2013	x	x		
Nebraska	x	x	x	x		x[2]
Nevada			x	x		
New Hampshire		x (Feb.2014)	x	x	x [2], Feb. 2014	
New Jersey	x		x	x		
New Mexico			x	x		
New York			x	x	x	
North Carolina	x		x	x	x	
North Dakota	x	x	x	x		x[2]
Ohio			x	x		x
Oklahoma	x		x	x	x	
Oregon			x	x	x	
Pennsylvania			x	x	x	
Rhode Island			x	x		
South Carolina	x		x	x		
South Dakota	x		x		x	
Tennessee			x	x		x
Texas			x	x		x
Utah		x	x	x	x [2]	
Vermont			x	x		x
Virginia			x	x	x	
Washington		x[1], July 2013	x (July 2013)	x	x[2], July 2013	
West Virginia			x	x	x	
Wisconsin				x		x
Wyoming		x (July 2013)	x	x	x [2], July 2013	

Note: All states require successful completion of a law degree and internship.

[1] These states, in addition to UBE, administer a jurisdiction-specific component to assess candidate's knowledge of jurisdiction-specific law.

[2] Because they are UBE jurisdictions, these states also offer admission by transferred UBE scores.

Source : www.ncbex.org

Table 5. Tradability Classification of Select Service Industries

2-digit NAICS code	Industry description	Tradable	Non-tradable
52	**Finance and Insurance**		
	Savings institutions, including credit unions		x
	Banking and related activities		x
53	**Real estate and rental**		
	Comm, ind, and other intangible assets rental and leasing	x	
	Real estate	x	
	Automotive equipment rental and leasing	x	
54	**Professional, scientific, and technical services**		
	Accounting, tax preparation, bookkeeping, and payroll svcs		x
	Architectural, engineering, and technical services	x	
	Legal services	x	
	Specialized design services	x	
	Computer systems and related services	x	
	Advertising and related services	x	
	Management, scientific, and technical consulting services	x	
56	**Administrative support**		
	Waste management and remediation services		x
	Business support services		x
	Services to buildings and dwellings		x
	Landscaping services		x
81	**Other Services**		
	Automotive repair and maintenance		x
	Comm and ind machinery and equip repair and maint.		x
	Electronic and precision equip repair and maint.		x

Note: The 'tradable' class includes industries that were classified under Gini class 2 or 3.

Source : Jensen and Kletzer (2006)

Table 6. Share of Sector Employment by Tradability Class

2-digit NAICS code	Description	Non-tradable	Tradable
23	Construction	100.00	0.00
31	Manufacturing	0.00	100.00
44	Retail trade	81.72	18.28
48	Transport and warehousing	42.81	57.20
51	Information	33.25	66.75
52	Finance and Insurance	32.05	67.95
54	Professional, Scientific, and Technical Services	13.95	86.04
56	Administrative Support, Waste Management, Remediation Services	59.53	40.47
61	Education Services	98.89	1.11
62	Health Care and Social Assistance	97.80	2.20
71	Arts, Entertainment, and Recreation	67.35	32.65
72	Accommodation and Food Services	81.92	18.08

Note: The 'tradable' class aggregates the employment shares for Gini classes 2 and 3.

Source : Jensen and Kletzer (2006)

Table 7. Percentage of Offshorable Jobs by Industry

2-digit NAICS code	Description	Percent of all jobs	% Offshorable		
			Self-classified	Inferred	Externally coded
23	Construction	5.2	12.8	23.5	10.4
31	Manufacturing	12	27.3	32.6	50.3
44	Retail trade	10.9	17.5	20.8	10.1
48	Transport and warehousing	3.6	11.9	22.9	9.3
51	Information	3.6	46.2	53.6	35.1
52	Finance and Insurance	4.7	53.2	58.2	54.8
54	Professional, Scientific, and Technical Services	8.1	58.3	57.4	34.4
56	Administrative Support, Waste Management, Remediation Services	3.3	23	20.0	27.8
61	Education Services	9.5	15.6	14.1	6.0
62	Health Care and Social Assistance	13	17.4	19.8	8.5
71	Arts, Entertainment, and Recreation	3.2	15.3	21.9	16.0
72	Accommodation and Food Services	6.4	9.7	3.4	0.5

Source : Blinder and Krueger (2009)

Table 8. Occupational Composition of Select Service Sectors

SOC Major Occupation Groups	Percent of Total Sector Employment				
	Finance and Insurance	Real Estate and Rental	Professional, Scientific, and Technical Services	Administrative and Support	Other Services (Except Government)
Management	7.86%	9.81%	7.92%	3.18%	4.45%
Business and Financial Operations	23.27%	4.89%	14.10%	3.59%	5.41%
Computer and Mathematical	5.85%	0.65%	15.56%	1.83%	0.76%
Architecture and Engineering	0.04%	0.13%	10.92%	0.80%	0.20%
Life, Physical, and Social Science	0.04%	0.01%	4.20%	0.24%	0.25%
Community and Social Service	0.09%	0.10%	0.12%	0.19%	2.84%
Legal	0.88%	0.36%	8.09%	0.28%	0.21%
Education, Training, and Library	0.02%	0.01%	0.24%	0.76%	1.81%
Arts, Design, Entertainment, Sports, and Media	0.33%	0.65%	4.12%	0.49%	2.16%
Healthcare Practitioners and Technical	0.50%	0.24%	2.16%	2.11%	0.28%
Healthcare Support	0.03%	0.12%	0.92%	1.37%	1.00%
Protective Service	0.20%	1.43%	0.18%	9.43%	1.14%
Food Preparation and Serving Related	0.02%	0.96%	0.09%	1.00%	2.46%
Building and Grounds Cleaning and Maintenance	0.21%	7.92%	0.40%	21.05%	2.73%
Personal Care and Service	0.02%	1.07%	0.47%	0.92%	20.12%
Sales and Related	13.54%	24.59%	4.41%	6.15%	6.09%
Office and Administrative Support	46.81%	21.95%	22.16%	21.85%	14.70%
Farming, Fishing, and Forestry	0.01%	0.04%	0.05%	0.13%	0.03%
Construction and Extraction	0.02%	1.25%	0.78%	3.01%	0.37%
Installation, Maintenance, and Repair	0.17%	17.10%	0.87%	2.67%	16.51%
Production	0.03%	0.41%	1.48%	8.36%	7.43%
Transportation and Material Moving	0.07%	6.31%	0.77%	10.61%	9.04%
All Occupations	**100%**	**100%**	**100%**	**100%**	**100%**

Source : BLS Occupational Employment Statistics, May 2011

Table 9. Top-ten Occupations with Highest Employment by Select Service Sectors

Sector	Occupations	Percent Employed by Sector
Finance and Insurance	Tellers	98%
	New Accounts Clerks	96%
	Insurance Underwriters	95%
	Brokerage Clerks	94%
	Insurance Appraisers, Auto Damage	94%
	Insurance Claims and Policy Processing Clerks	92%
	Loan Officers	89%
	Securities, Commodities, and Financial Services Sales Agents	85%
	Loan Interviewers and Clerks	85%
	Insurance Sales Agents	78%
Real Estate and Rental and Leasing	Counter and Rental Clerks	47%
	Real Estate Brokers	39%
	Property, Real Estate, and Community Association Managers	36%
	Appraisers and Assessors of Real Estate	35%
	Real Estate Sales Agents	34%
	Concierges	27%
	Maintenance and Repair Workers, General	19%
	Audio and Video Equipment Technicians	10%
Professional, Scientific, and Technical Services	Veterinary Technologists and Technicians	92%
	Veterinary Assistants and Laboratory Animal Caretakers	87%
	Legal Secretaries	85%
	Veterinarians	81%
	Architectural and Civil Drafters	77%
	Tax Preparers	73%
	Paralegals and Legal Assistants	71%
	Survey Researchers	70%
	Architects, Except Landscape and Naval	66%
	Surveyors	66%
Administrative and Support Services and Waste Management and Remediation Services	Pest Control Workers	87%
	Hazardous Materials Removal Workers	80%
	Travel Agents	80%
	Building Cleaning Workers, All Other	66%
	Tree Trimmers and Pruners	60%
	Security Guards	59%
	Telemarketers	56%
	Travel Guides	56%
	Refuse and Recyclable Material Collectors	55%
	Security and Fire Alarm Systems Installers	55%
Other Services (except Federal, State, and Local Government)	Directors, Religious Activities and Education	97%
	Funeral Attendants	96%
	Embalmers	95%
	Religious Workers, All Other	94%
	Cooks, Private Household	93%
	Funeral Service Managers, Directors, Morticians, and Undertakers	92%
	Clergy	91%
	Pressers, Textile, Garment, and Related Materials	82%
	Automotive Glass Installers and Repairers	66%
	Shampooers	63%

Source : O*Net Online, www.onetonline.org.

Table 10. Top-ten Occupations with Highest Employment Shares in Select Service Sectors

Sector	Occupations	Percent of Total Sector Employment
Finance and Insurance	Tellers	9.72%
	Customer Service Representatives	8.67%
	Insurance Sales Agents	5.69%
	Securities, Commodities, and Financial Services Sales Agents	5.35%
	Loan Officers	4.68%
	First-Line Supervisors of Office and Administrative Support Workers	4.32%
	Insurance Claims and Policy Processing Clerks	3.63%
	Claim Adjusters, Examiners, and Investigators	3.48%
	Office Clerks, General	3.06%
	Loan Interviewers and Clerks	2.98%
Real Estate and Rental and Leasing	Maintenance and Repair Workers, General	13.13%
	Counter and Rental Clerks	10.09%
	Real Estate Sales Agents	6.88%
	Property, Real Estate, and Community Association Managers	5.82%
	Office Clerks, General	5.37%
	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	4.29%
	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	4.17%
	Bookkeeping, Accounting, and Auditing Clerks	3.02%
	General and Operations Managers	2.07%
	Customer Service Representatives	2.07%
Professional, Scientific, and Technical Services	Lawyers	5.05%
	Accountants and Auditors	4.85%
	Office Clerks, General	3.11%
	Software Developers, Applications	3.09%
	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	2.77%
	Management Analysts	2.76%
	Bookkeeping, Accounting, and Auditing Clerks	2.73%
	Legal Secretaries	2.54%
	General and Operations Managers	2.50%
	Paralegals and Legal Assistants	2.47%
Administrative and Support Services and Waste Management and Remediation Services	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	10.54%
	Security Guards	8.23%
	Landscaping and Groundskeeping Workers	5.94%
	Laborers and Freight, Stock, and Material Movers, Hand	5.06%
	Customer Service Representatives	4.76%
	Office Clerks, General	3.47%
	Team Assemblers	2.04%
	Telemarketers	1.96%
	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	1.80%
	General and Operations Managers	1.68%
Other Services (except Federal, State, and Local Government)	Hairdressers, Hairstylists, and Cosmetologists	8.47%
	Automotive Service Technicians and Mechanics	5.91%
	Office Clerks, General	3.46%
	Cleaners of Vehicles and Equipment	3.13%
	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	2.78%
	Laundry and Dry-Cleaning Workers	2.78%
	Automotive Body and Related Repairers	2.48%
	Receptionist and Information Clerks	2.20%
	General and Operations Managers	2.15%
	Parking Lot Attendants	2.13%

Source: BLS Occupational Employment Statistics, May 2011

Table 11. Composition of Legal Occupations

Sector	Occupations	Percent Employed by Sector	Percent of Total Sector Employment	Percent of Total Legal Services Industry Employment
Professional, Scientific, and Technical Services	Lawyers	52%	5.05%	33.34%
	Judicial Law Clerks	37%	0.08%	0.55%
	Arbitrators, Mediators, and Conciliators	22%	0.03%	0.11%
	Paralegals and Legal Assistants	71%	2.47%	16.42%
	Title Examiners, Abstractors, and Searchers	41%	0.31%	2.05%
	Legal Support Workers, All Other	16%	0.14%	0.86%
	All Legal Occupations*		**8.08%**	**53.33%**

* The list of legal occupations does not include judges and court reporters because they are employed by the government sector.

Source: BLS Occupational Employment Statistics, May 2011 and O*Net Online, www.onetonline.org.

Table 12. Share of Occupation Employment by Tradability Class

SOC 2-digit code	Description	Gini coefficient			Offshoring index		
		Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
11	Management	34.48	61.15	4.37	11.40	73.60	15.10
13	Business and Financial Operations	31.73	65.96	2.32	8.60	16.70	74.70
15	Computer and Mathematical	0.00	73.07	26.93	0.00	6.60	93.40
17	Architecture and Engineering	36.04	58.31	5.65	0.90	18.20	80.80
19	Life, Physical, and Social Science	16.32	58.61	25.08	9.10	14.90	75.90
21	Community and Social Service	100.00	0.00	0.00	55.10	44.90	0.00
23	Legal	3.78	96.22	0.00	0.00	60.90	39.10
25	Education, Training, and Library	99.54	0.46	0.00	43.70	52.40	3.90
27	Arts, Design, Entertainment, Sports, Media	17.13	75.02	7.85	37.60	48.20	14.20
29	Healthcare Practitioners and Technical	86.56	13.10	0.34	78.00	18.50	3.50
31	Healthcare Support	96.73	3.27	0.00	94.40	2.80	2.80
33	Protective Service	59.83	40.17	0.00	93.20	5.30	1.50
35	Food Preparation and Serving Related	95.68	4.32	0.00	100.00	0.00	0.00
37	Building and Grounds Cleaning and Maintenance	98.54	1.46	0.00	94.00	6.00	0.00
39	Personal Care Service	82.64	7.22	10.13	99.40	0.60	0.00
41	Sales and Related	75.41	21.82	2.77	46.30	48.40	5.20
43	Office and Administrative Support	93.14	6.66	0.20	1.60	34.10	64.30
45	Farming, Fishing, and Forestry Occupations	0.00	81.01	18.99			
47	Construction and Extraction Occupations	61.37	36.18	2.45			
49	Installation, Maintenance, and Repair Occupations	90.00	8.89	1.11			
51	Production Occupations	80.30	17.15	2.55			
53	Transportation and Material Moving	89.20	5.86	4.95			

Source : Jensen and Kletzer (2010)

Table 13. Percentage of Offshorable Jobs by Major Occupations

SOC 2-digit code	Description	Percent of all jobs	% Offshorable		
			Self-classified	Inferred	Externally coded
11-13	Management, Business and Financial Operations	14.1	46.3	53.8	16.4
15-29	Professional and Related Occupations	23.6	31.1	32.2	20.5
31-39	Service Occupations	15.9	11	5.7	0.7
41	Sales and Related	10.1	25.2	24.1	17.8
43	Office and Administrative Support	13.3	29.5	34.7	41.2
45	Farming, Fishing, and Forestry Occupations	1.1	8.4	6.6	0.0
47	Construction and Extraction Occupations	3.9	8.1	10.0	0.0
49	Installation, Maintenance, and Repair Occupations	4.3	22.2	17.0	1.3
51	Production Occupations	6.9	13.5	27.6	80.7
53	Transportation and Material Moving	6.4	10.5	17.4	0.0

Source : Blinder and Krueger (2009)

Table 14. A Comparison of Two Occupation Offshorability Rankings

Occupation Title	Jensen and Kletzer (2010) Rank	Blinder (2007) Rank
Mathematical Technicians	1	56
Biochemists and Biophysicists	2	47
Statisticians	3	5
Title Examiners, Abstractors, and Searchers	4	
Credit Authorizers, Checkers, and Clerks	5	53
Weighers, Measurers, Checkers, and Samplers, Recordkeeping	6	279
Data Entry Keyers	7	1
Accountants and Auditors	8	78
Medical Transcriptionists	9	9
Actuaries	10	5
Market Research Analysts	11	
Astronomers	12	271
Bookkeeping, Accounting, and Auditing Clerks	13	46
Mechanical Drafters	14	3
Economists	15	37
Mathematicians	16	5
Sociologists	17	
Operations Research Analysts	18	51
Survey Researchers	19	30
Credit Analysts	20	162
Payroll and Timekeeping Clerks	21	145
Cartographers and Photogrammetrists	22	40
Statistical Assistants	23	30
Paralegals and Legal Assistants	24	206
Geographers	25	
Computer System Analysts	26	
Financial Examiners	27	
Petroleum Engineers	28	
Budget Analysts	29	169
Court Reporters	30	

Note: Occupations classified as non-offshorable were not reported in Blinder's index.