2

A New Approach to Identifying Tradable Services

The previous chapter highlighted a seemingly insurmountable obstacle to understanding the potential of trade in services. Information on the domestic activities of service firms is minimally sufficient for analysis, but data on international service flows are wholly unsatisfactory. Which industries and occupations are likely to be most affected by increased service trade? How large an impact will such trade have on service production and employment in the United States? Which service activities are likely to be offshored to lower-cost countries, and which are likely to be "inshored" to the United States? As chapter 1 showed, services are an important part of the economy, dominating all other sectors in terms of output and jobs both in the United States and in most other advanced economies. Chapter 1 also documented that service trade is growing, and there is potential for more rapid growth with active, liberalizing policy support. But who knows without data?

To address this data gap, I develop a concept called "tradability" and apply it empirically to a range of service industries and occupations. The concept of tradability is based on the geographic concentration of production within the United States. Using geographic concentration as an indicator of international trade potential, one can arguably measure what has so far gone unmeasured: identify at a detailed level which service activities appear to be "traded" within the United States and thus "ought" to be traded internationally. These are the activities that this book claims are tradable.

Of course, this method does not measure exactly what is desired but only an indicator of it. But when coupled with the other components of this mosaic, this component, too, tells a story. Being able to identify which activities are potentially tradable is a crucial piece of the mosaic.

New Methodology

The methodology described in this chapter is novel and relies on the geographic concentration of production within the United States to identify industries and occupations that appear to be "traded" within the United States.[1] The basic idea is simple. If one observes more of a service produced in one location than consumers in that location are likely to want to consume, then the excess services must be consumed elsewhere. This implies that the service is somehow being "shipped" to a different location. If a service can be shipped from one US location to another, there is no inherent reason why it cannot be shipped from a US location to a foreign location—that is, traded. Therefore that service is, in principle, tradable.

An important advantage of this methodology is that it can identify both service industries *and service occupations* that appear to be traded within the United States. This matters because many of the service activities that are reportedly being offshored are tasks within larger production processes. For example, bank call centers can be relocated offshore without entire banks or the banking industry moving offshore. Occupations correspond more closely to these distinctions between activities than do industries.

Having used the methodology to classify industries and occupations as tradable or nontradable, one can then examine how large a swath of US service activity is potentially exposed to import competition—and which service activities offer prospects for increased exports. One can also observe the number of workers employed in these activities. Later chapters use this classification system to reveal fascinating patterns in service tradability and trade potential.

The Intuition behind the Approach

Goods that are traded tend to be geographically concentrated (whether to capitalize on increasing returns to scale, or to gain access to inputs like natural resources or workers with specific skills, or for other reasons), whereas goods that are not traded tend to be more evenly distributed across geographic space, or, more precisely, to be distributed coextensively with demand.

The notion of using geographic concentration to identify tradable activities is related to a long tradition among geographers and regional economists of using the geographic concentration of economic activity to identify a region's export or manufacturing base. The idea is that if a region specializes in a manufacturing activity—think Boeing and airplanes in Seattle—it is likely to export the product in which it specializes.

1. Sections of this chapter draw heavily on Jensen and Kletzer (2006). Here and later, when for brevity's sake I say that an industry or occupation is "tradable," I of course mean that its output is tradable.

The measure used to determine whether a region specializes in a particular activity is typically some variant of a location quotient. A location quotient measures a region's share of industry output or employment and compares that share with (that is, divides it by) a measure of the region's share of overall demand (typically measured using the region's share of total population or of total employment, as in table 2.1). If a region has a larger share of an industry's activity than is predicted by demand in the region, the region is considered to be specialized in the activity.

The example of aircraft production in Seattle can be used to illustrate this concept. Seattle's share of US aircraft manufacturing employment is about 11 percent, and its share of total US employment is about 1.6 percent. Thus, Seattle has a much greater share of aircraft production employment than of total employment: Its location quotient for aircraft production is 11 divided by 1.6, or about 6.9. It is safe to assume that this concentration of aircraft production is not due to people in Seattle consuming more airplanes than other parts of the country; rather, they "export" planes to the rest of the country and export them to other countries in exchange for other goods and services. One can be quite comfortable thinking of Seattle as specializing in aircraft production and exporting aircraft.

Table 2.1 reports location quotients for selected large metropolitan areas and selected industries in the United States. It shows clearly that several other manufacturing industries are geographically concentrated just as aircraft is in Seattle (the location quotients for these are highlighted in the table). For example, motor vehicle production is concentrated in the Detroit area, with a location quotient of 11.5. Again, this is not because people in the Detroit area purchase 11.5 times more cars than the rest of the country, but because Detroit has specialized in motor vehicle production and exports cars in exchange for other goods.

Table 2.1 also shows that some manufacturing industries do not exhibit geographic concentration. For example, in none of the metropolitan areas listed do structural metals have a location quotient above 1; the location quotient for gypsum and lime production exceeds 1 in only two areas and never exceeds 2.[2] Both of these industries produce goods with relatively low value by weight, which suggests that shipping them from city to city may be too costly to be worthwhile. Whatever the reason, these manufacturing industries appear to be nontraded.

Economists have long thought of services as nontradable because many services require, or seem to require, face-to-face interaction. The quintessential services of this type are personal services like haircuts or visits to the dentist's office. Because these services are difficult to provide at a distance, they

2. The area with the largest location quotient for this industry, Las Vegas, was experiencing a construction boom in 2007, when these data were gathered. Gypsum and lime are important inputs to construction. Thus, in this case the relatively high location quotient could be due to unusually high local demand for the industry's goods.

Table 2.1 Location quotients for selected industries and US metropolitan areas

Industry	Boston	New York	Raleigh-Durham	Detroit	Las Vegas	Seattle	San Francisco	Los Angeles
Cement, concrete, lime, and gypsum manufacturing	0.5	0.4	0.9	0.4	1.8	1.3	0.4	0.7
Structural metals and tank and shipping container manufacturing	0.7	0.4	0.7	0.7	0.7	0.9	0.6	0.7
Aircraft and parts manufacturing	0.9	0.5	0.3	0.4	0.2	6.9	0.2	1.8
Motor vehicles and equipment manufacturing	0.1	0.1	0.3	11.5	0.1	0.3	0.3	0.4
Grocery stores	1.0	1.0	1.4	1.0	0.9	0.9	0.9	0.9
Software	3.5	0.7	3.9	0.8	0.1	6.9	4.7	1.0
Motion picture and video industries	0.7	1.8	0.5	0.7	0.9	0.7	1.6	5.7
Internet service providers	1.0	0.7	1.3	0.3	0.8	2.2	7.2	1.4
Securities, commodities, funds, and other financial investments	2.5	3.2	0.6	0.6	0.5	0.7	1.5	0.9
Scientific research and development services	2.9	0.9	4.8	0.6	0.3	1.4	3.1	0.9
Travel arrangements and reservation services	1.3	1.2	0.5	1.0	3.0	1.8	1.0	1.3
Offices of dentists	1.1	1.1	1.2	1.3	1.2	1.3	1.4	1.1
Other amusement, gambling, and recreation industries	0.8	0.7	0.7	1.0	7.1	1.4	1.0	1.2
Barber shops and beauty salons	1.0	1.0	0.8	1.1	0.9	0.9	1.0	1.1

Source: Author's calculations using data from the 2007 American Community Survey.

tend to be distributed in proportion to the population in a region—one does not see large concentrations of these service activities in one place. Hence their location quotients are uniformly low. For example, table 2.1 shows that the location quotients for grocery stores, dentists' offices, and barber shops and beauty salons are all close to 1, indicating that these services are not being traded across metropolitan areas.

But other services do not require face-to-face interaction, and many of these do appear to be traded within the United States. For example, in addition to its concentration in aircraft production, Seattle has a disproportionate share of US employment in software publishing, with a location quotient for that industry of about 6.9. Boston, Raleigh-Durham, and San Francisco also show large concentrations of software production activity. Again, this is not because people in Seattle or these other regions consume more software than do people in other parts of the country; rather, Microsoft and other software publishers based in Seattle and these other cities (the San Francisco metro area includes San Jose and Silicon Valley) produce software and then export it in exchange for other goods and services. Software is thus a service that is traded with other regions.[3] (Box 2.1 reports on one San Francisco–area company's success in exporting computer-assisted design software, and box 2.2 describes the international activities of several Bay Area architecture and urban planning firms.)

Nor is it just software and other information media (such as movies in Los Angeles) that are geographically concentrated. Table 2.1 reports several other examples, including internet service providers (concentrated in Seattle and San Francisco), scientific R&D services (Boston, Raleigh-Durham, and San Francisco), and travel arrangements and reservation services (Las Vegas, which, not surprisingly, also has a significant concentration of "other amusement, gambling, and other recreation activities"). Although not reported in the table, travel arrangements and reservation services, which are very similar in nature to call center operations, are also concentrated in some small cities in the upper Great Plains like Minot, North Dakota, and Aberdeen, South Dakota.

One can use the geographic concentration of production to distinguish between service activities that are tradable and those that require face-to-face interaction and are thus less likely to be traded. Again, the idea is that when something, whether a good or a service, is traded, its production can be concentrated in a particular region to take advantage of any economies in production. As a result, most regions will not support local production of the good or service, while one or a few will devote a disproportionate share of their

3. Software and other types of media "goods" have always been a bit in between categories. For example, book publishing used to be classified as a manufacturing industry, but with the introduction of the NAICS, it is now categorized in the information sector (NAICS 51), along with software publishing and other types of publishing (newspapers, greeting cards, databases). The reasoning is that the "information" content of a book (the service) is much more valuable than the physical medium (the paper and binding). A case could be made for placing books and various other "goods" in either the goods or the service category. This book takes the categorization as given and thus treats publishing activities as part of the service sector.

Box 2.1 Exporting by design: Autodesk taps the global market for CAD software

Autodesk, Inc. is a computer-assisted design (CAD) software firm based in San Rafael, California. The company is a leader in engineering software for the manufacturing, building, and construction industries and in entertainment software for the media and entertainment industries. The firm reports that "Fortune 100 companies—as well as the last 14 Academy Award winners for Best Visual Effects—use Autodesk software tools to design, visualize and simulate their ideas to save time and money, enhance quality, and foster innovation for competitive advantage."

Autodesk employs approximately 7,800 people worldwide and had revenue of $2.32 billion in 2009, according to its annual report, with sales outside of North America accounting for two-thirds of its revenue.

Examples of Autodesk's foreign projects include the following:

- Autodesk has combined its Buzzsaw project management suite with Japanese construction and civil engineering firm Maeda Corporation's Naoshiya Matabee facilities management service to manage and share project and facilities data—permits, schedules, estimates, budgets, inspection reports, construction and design documents—across Seven Eleven's network of 10,000 stores in Japan. Seven-Eleven has brought the two companies in to help implement its expansion into China.
- AREP, a French engineering design and architectural firm affiliated with SNCF, the French public railroad company, has used Buzzsaw to communicate, share documents, simultaneously review and modify plans, and otherwise collaborate with Chinese local design institutes over a secure, multilingual platform, on projects such as the Beijing Museum and the Shanghai Railway Station.
- The Chengdu Hydroelectric Investigation and Design Institute utilized Autodesk's Civil 3D mapping and design modeling program to visualize and analyze the terrain and rock structure of the steep mountain gorge along the Yalong River, in the construction of the Jinpin hydropower plant. The $2 billion phase one project includes a 3,600-megawatt power station and a 305-meter double-arched dam, the world's largest.

Source: Excerpted from Bay Area Council Economic Institute (2006, 84–85); Autodesk (2009).

Box 2.2 How US architecture and engineering firms are helping India plan for growth

San Francisco architecture/design firm Gensler decided in 2006 that it needed to be in India, as many US clients, such as Legg-Mason, UBS, and Goldman Sachs, had been expanding their presence there. Managing principal Daniel Winey says the firm first contacted Indian interior design and space planner Space Matrix, using them as architect-of-record in India. (Foreign architecture firms are required to work with Indian counterparts beyond the design drawing phase in a project; Indian firms typically take the completed design drawings and work with developers from that point on, preparing final construction drawings and assisting with permits as needed.)

Gensler is a participant—along with San Francisco landscape architects Hargreaves Associates, New Delhi–based Creative Group, and lead architectural firm Frederic Schwartz Architects of New York—in the expansion and modernization of the Chennai International Airport. The $300 million project's sustainable design will increase capacity and improve security and circulation through a wing-like design centered around two landscaped gardens. Terminal and garage roofs are designed to capture and store rainwater for airport use.

Winey says Gensler is also "short-listed" to design a 10 million-square foot mixed residential, office, and commercial project, to be developed by DLF Ltd., and is in project discussions with the Reliance Group and an India REIT managed by Warburg-Pincus. The firm is exploring several new projects this year with top-tier clients, though Winey adds that "a week doesn't go by when we don't get maybe ten requests for proposals in India…."

Skidmore Owings & Merrill (SOM) partner Gene Schnair points to a satellite photo of the project site for a planned community, Pioneer Park, in Gurgaon. Much of the site is farmland that has to be acquired from individual small landholders in one-acre plots that had been given to them by the government years ago, and, despite official government support, there has been no eminent domain to help jump-start later stage negotiations or keep costs down. A road bisecting the site cannot be moved due to perpetual easement rights of a nearby village. While plans are on the drawing boards for a metro line, modern transit service does not yet extend from Delhi out to Pioneer Park, a 15-mile trip. Nor does utility service—the project will have its own dedicated water, sewage treatment, and electricity service.

Indian developer Pioneer Urban intends to build a new, sustainable urban community on the 75-acre site, including high-rise residential towers with 3, 4, and 5-bedroom condominiums, a hotel, a high-end shopping complex, and a 10-acre park with sports fields and clubhouse facilities. Designs call for an

(continued on next page)

Box 2.2 How US architecture and engineering firms are helping India plan for growth *(continued)*

ecological community incorporating co-generation and centralized utility services to reclaim energy; use of local materials in buildings and landscaping; and structures ranging from 4 to 49 stories that induce cooling breezes and provide shade to public spaces. It is SOM's first master planning project in India, although the firm is well-established in India through its New York office.

Among the firm's other India projects are:

- a 75-acre special economic zone (SEZ) with a combined 8 million square feet of office and industrial space, built in conjunction with the 85-acre Maytas Hill County integrated township near Hyderabad;
- the Jet Airways headquarters building in Mumbai; and
- Unitech's Santa City project, for which SOM will design replacement housing for 22,000 slum dwellers (a task involving master planning, new housing prototypes, and a team of sociologists and anthropologists working with slum residents)….

Three Bay Area firms are among ten global architecture and design consultants hired by Unitech for its ambitious $3 billion, 347-acre Unitech Grande project along the Western Expressway in Mumbai. HOK is designing the floor plans, while San Francisco-based EDAW Inc. and Sausalito-based SWA Group will serve as landscape architects. The project is to feature 12 residential towers, with 100 acres of themed gardens, plus shopping, restaurants, theaters, and recreational facilities.

HOK is also designing the residential and social amenities zone for a Mahindra Group new township project in New Chennai, Mahindra World City. The 50-acre project features 750 residential apartments along with retail and recreational facilities. A joint development of the Mahindra group and the Tamil Nadu Industrial Development Corporation (TIDCO), it has three sector-specific SEZs for information technology, auto ancillaries, and apparel and fashion accessories.

Finally, HOK is preparing the master plan for a 10,000-acre hill station—a term from the British colonial era to describe the hill towns where colonial officials moved to escape the heat and humidity of the lowlands—Lavasa, located between Pune and Mumbai. The new community will be roughly the size of Paris and is the vision of Ajit Gulabchand, managing director of Indian engineering and construction firm HCC.

Source: Excerpted from Randolph and Erich (2009, 166–69).

productive activity to the good or service and then trade it.[4] This book uses the geographic concentration of a service within the United States as an indicator that the service is traded within the United States and thus potentially tradable internationally.

This intuition is conveyed more descriptively by Paul Krugman (1991, 65):

> In the late twentieth century the great bulk of our labor force makes services rather than goods. Many of these services are nontradable and simply follow the geographical distribution of the goods-producing population—fast-food outlets, day-care providers, divorce lawyers surely have locational Ginis pretty close to zero. Some services, however, especially in the financial sector, can be traded. Hartford is an insurance city; Chicago the center of futures trading; Los Angeles the entertainment capital; and so on.... The most spectacular examples of localization in today's world are, in fact, services rather than manufacturing.... Transportation of goods has not gotten much cheaper in the past eighty years.... But the ability to transmit *information* has grown spectacularly, with telecommunications, computers, fiber optics, etc.

The "locational Gini," or locational Gini coefficient, to which Krugman refers is another measure of geographic concentration. It is a way of summarizing the location quotients from many regions into one statistic that describes the distribution of location quotients across regions. The locational Gini ranges from zero to 1: the higher the Gini, the more concentrated the industry in one or a few locations.[5] The rest of this chapter extensively uses this measure.

Adjusting for Demand-Induced Concentration and Intermediate Services

First, however, I address one more technical issue. The measure of concentration just described does not distinguish among the many possible reasons an activity is concentrated. It does not tell us whether a given activity is concentrated because of the location of natural resources, or because of increasing returns to scale, or because of spillovers of technical know-how due to the presence of many workers in the same industry or occupation in close proximity. All the measures indicate is that much of the good or service is being produced in a location different from where most of it is consumed.

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4. The relationship between the geographic concentration of production and trade, particularly exports, has a long tradition in both economic geography (where the measure used is the location quotient) and trade analysis (where the measure used is revealed comparative advantage). The measure of economic concentration used here is different from both these measures, but all the measures have a similar flavor in that they compare the share of production (or exports) in a particular region to an "expected" baseline.

5. Gini coefficients can be used to measure many other kinds of concentration or dispersion besides that by location—perhaps its most common use is in measuring the distribution of income.

In general, the reasons for the concentration do not matter for the purposes of this book. But in one instance the reason does matter. If *demand* for a service is concentrated because industries using that service as an input are concentrated, then that service industry may be geographically concentrated even if it is not tradable. If the concentration measure were used without taking this possibility into account, one might incorrectly infer that the service is tradable.

A paper that I cowrote with Lori Kletzer (Jensen and Kletzer 2006) shows how to correct for this possibility. If a nontradable industry provides intermediate inputs to a downstream industry, one will expect the geographical distribution of the nontraded intermediate industry to follow the distribution of the downstream industry. Instead of being distributed with income, the nontraded good or service will be distributed in proportion to the geographical distribution of demand for that industry. The implementation of this correction is described in appendix D.

Implementing the Method

In that same paper, Kletzer and I implemented our geographic concentration measures using employment information from the 2000 Decennial Census of Population Public Use Micro Sample (PUMS) files. We defined geographic areas using the Census-defined Metropolitan Statistical Areas (MSAs) and Consolidated Metropolitan Statistical Areas: A worker's MSA is the one where that worker reports himself or herself as working. We then constructed Gini coefficients of geographic concentration for each industry,[6] using the formula described in appendix D.

Our use of worker-level data to investigate economic concentration is somewhat unusual. We pursued this strategy because, as mentioned above, we are interested in both industrial concentration and occupational concentration.

Classifying Industries and Occupations by Tradability

Industries

Having constructed the locational Gini coefficient for each industry and occupation, we also had to specify the level of geographic concentration that indicates that an industry or occupation is tradable. In our 2006 paper, Kletzer and I first explored where to set the threshold for industries, because we have a much better sense of which industries, especially goods-producing industries, are tradable than of which occupations are tradable.

6. For regions we used the Place of Work Consolidated Metropolitan Area (POWCMA5) field on the decennial PUMS. When a POWCMA is coded as a nonmetropolitan area or as a mixed area, we concatenated the Place of Work state code with the POWCMA5 code. For more information on the 5 percent sample PUMS, see www.census.gov/Press-Release/www/2003/PUMS5.html.

We initially sorted industries into three roughly equal groups: those with a locational Gini coefficient of less than 0.1 (the least geographically concentrated, which we called class 1), those with Ginis between 0.1 and 0.3 (class 2), and those with Ginis of 0.3 or above (class 3, the most geographically concentrated). Approximately 36 percent of industries are in class 1, about 37 percent are in class 2, and 27 percent are in class 3.

Panel A of figure 2.1 plots the Gini coefficients from the Decennial Census data for all industries by their two-digit NAICS codes. The resulting pattern is generally consistent with our expectation that industries known to be tradable will be geographically concentrated. For example, industries in the goods-producing sectors (agriculture, mining, and manufacturing) are typically in the top two Gini classes. Only 5 of the 92 industries in these sectors are in class 1: cement and concrete, machine shops, miscellaneous manufacturing, structural metals and tanks, and printing and related activities. All of these industries seem to be nontraded either because of a high weight-to-value ratio (such as cement and concrete) or because they include a range of potentially dissimilar activities (miscellaneous manufacturing). Most agriculture, mining, and manufacturing products are considered tradable; so, as a first approximation, defining only the lowest geographic concentration category (class 1) as nontradable seems appropriate for these sectors.

Another check on the industry classification is to examine how the geographic concentration of manufacturing industries correlates with the level of trade intensity in those industries—that is, the degree to which trade actually occurs in them. In our paper, Kletzer and I calculated the mean industry trade share as follows:

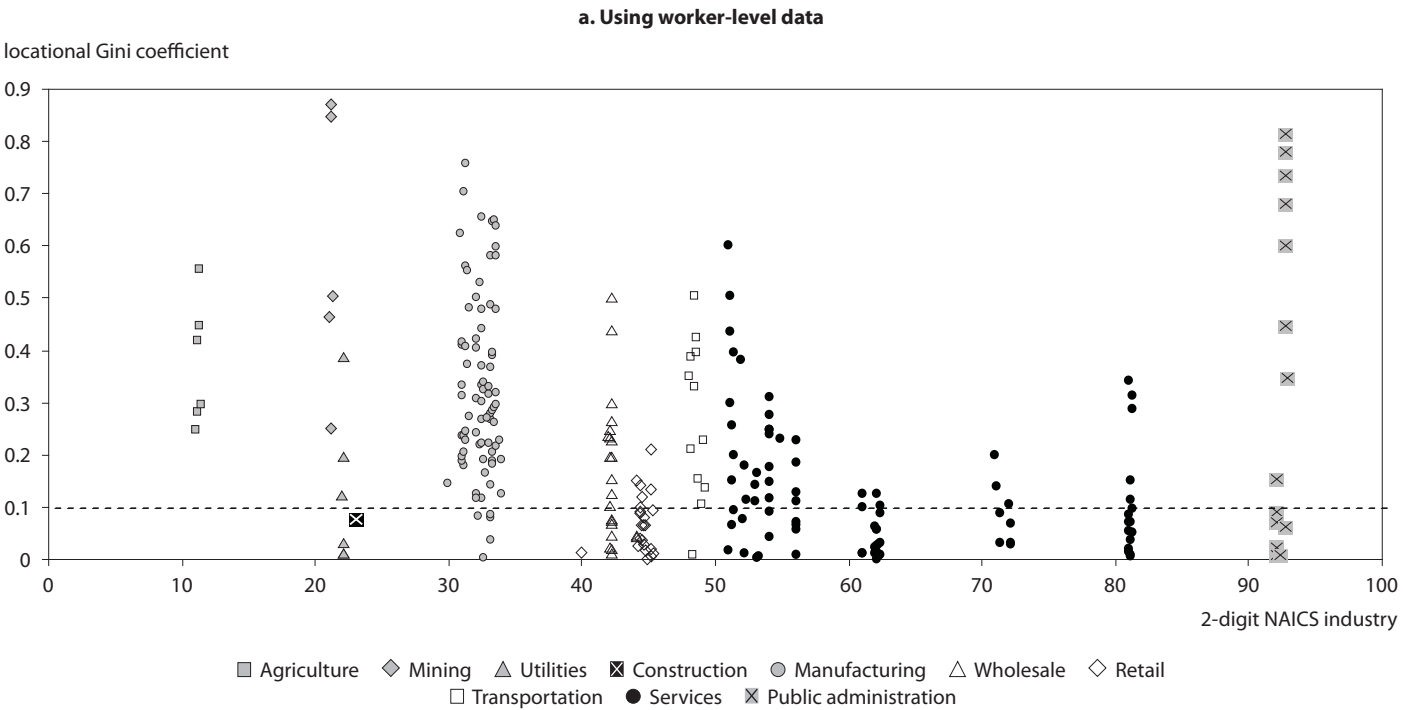
trade share = (imports + exports)/domestic production.

The shares thus calculated were 0.40, 0.57, and 0.71 for classes 1, 2, and 3, respectively. (If manufacturing machinery not elsewhere classified is removed from class 1, on the grounds that it includes a broad range of unrelated activities, the mean trade share for that class falls to 0.35.) As expected, the mean trade share rises as one goes from Gini class 1 to Gini class 3. This evidence supports the idea that geographic concentration is a useful proxy for identifying activities that are tradable.

Although manufacturing industries tend to be more geographically concentrated than industries in the service sector, many service industries also exhibit levels of concentration consistent with their being traded within the United States. In addition, these same industries conform to expectations about which service activities might be tradable. For example, software publishing, sound recording, motion picture production, and securities and commodities trading all exhibit high geographic concentration. By contrast, retail banking and videotape rental exhibit low geographic concentration, again consistent with what one would expect.

Using a Gini coefficient of 0.1 as the threshold for tradability seems to make sense in other sectors as well. Industries in the retail trade sector

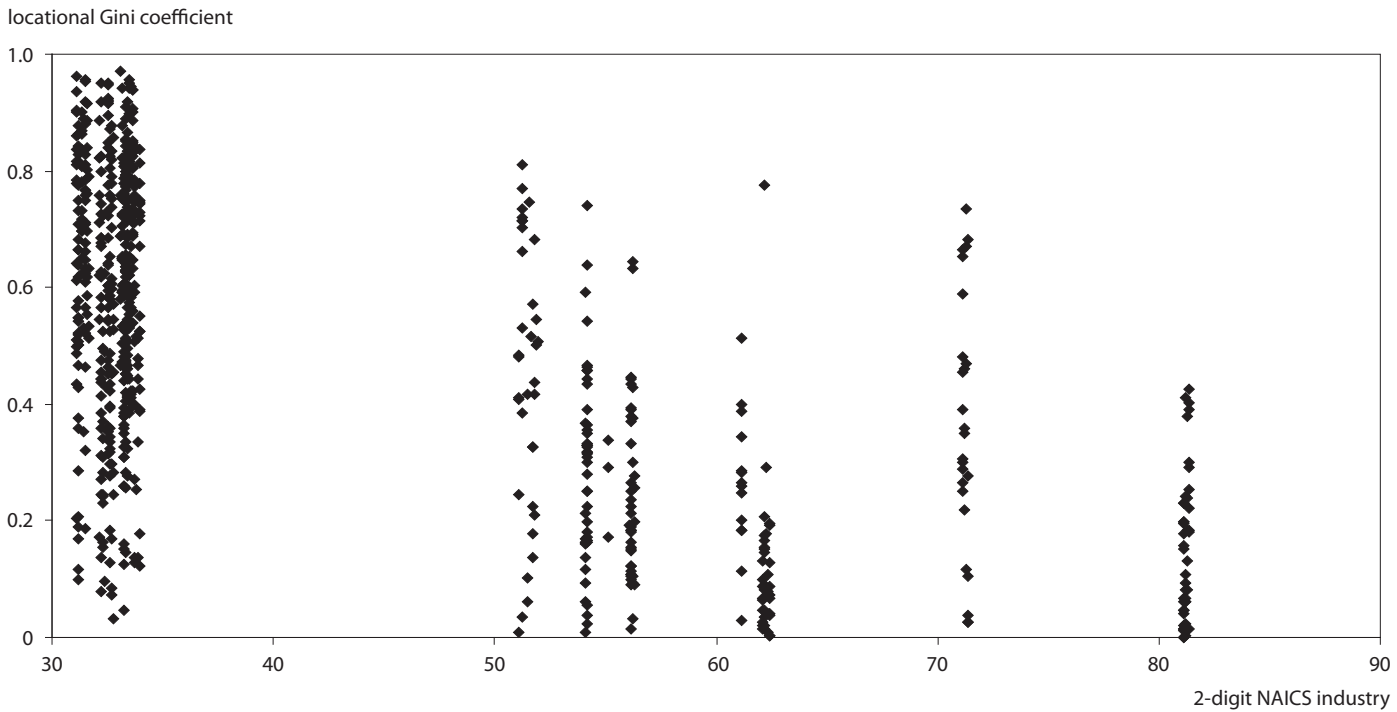
Figure 2.1 Geographic concentration of industries in the United States



NAICS = North American Industry Classification System

Source: Author's calculations using 2000 Decennial Census of Population.

b. Using establishment-level data



NAICS = North American Industry Classification System

Source: Author's calculations from 2002 Economic Census data.

(which includes grocers, clothing stores, and the like) are primarily classified as nontradable by this threshold. Industries in the transportation sector are mostly classified as tradable. Within public administration, most activities are nontradable except for public finance and the military. Within the service sector, industries are fairly evenly divided between nontradable and tradable. Table 2.2 provides a complete list of service industries by two-digit NAICS sector and Gini class.[7]

Table 2.3 shows the shares of employment classified in tradable industries by NAICS major group. Again the results across categories and industries conform to expectations. All employment in the agriculture and mining sectors, as well as most manufacturing employment, is classified as tradable. Utilities are mostly nontradable, and construction is entirely nontradable.

The evidence above suggests that a threshold of "tradability" of 0.1 in terms of the locational Gini coefficient is reasonable. Therefore, we categorized industries with a Gini below 0.1 as nontradable and those with a Gini greater than or equal to 0.1 as tradable.[8]

As an alternative to the worker-level data analyzed above, I also calculate locational Gini coefficients for manufacturing and service industries using employment information at the establishment level from the Census Bureau (specifically, from the Business Register, the Census of Manufactures, and the Census of Services, all from the 2002 vintage). These data have the advantage of having more-detailed industry classifications than those available for the worker-level data. These Gini coefficients use the labor market areas defined by the Bureau of Economic Analysis (BEA) as the unit of geography, instead of the Place of Work data reported in the Decennial Census used in the previous analysis. Each labor market area, of which there are 183 in all, consists of a metropolitan area and its surrounding counties. For this book I constructed Gini coefficients of the concentration of employment at the six-digit NAICS industry level. Panel B of figure 2.1 plots the resulting geographic concentration measures by two-digit NAICS industry. The main patterns are very similar to the Gini coefficients constructed using the worker-level data.

Although Gini coefficients for manufacturing industries tend to be higher than those for service industries, a number of service industries have relatively high Gini coefficients. These are evidence of significant geographic concentra-

7. Higher education may appear misclassified in table 2.2 as a nontradable service industry. US colleges and universities, particularly research institutions, do attract many foreign students and have acknowledged global comparative advantage. However, the sector also includes community colleges, which are, by design, geographically dispersed. Also, the types of specialized scientific occupations associated with research institutions (the ones most likely to "export" educational services) are geographically concentrated and thus considered tradable.

8. Although the choice of threshold for nontradable versus tradable is inherently arbitrary, we ran a number of robustness checks on the results reported in the paper (Jensen and Kletzer 2006) to see whether alternative choices made much of a difference in the results. With the exception of the share of employment in the tradable sector (which decreases as the threshold is increased), the results are robust to the choice of threshold.

Table 2.2 Locational Gini classes for individual service industries

Two-digit NAICS code	Industry	Locational Gini class (1 = least tradable)
	Information	
51	Newspaper publishers	1
51	Radio and television broadcasting and cable	1
51	Libraries and archives	1
51	Wired telecommunications carriers	2
51	Data processing services	2
51	Other telecommunication services	2
51	Publishing except newspapers and software	2
51	Other information services	3
51	Motion pictures and video industries	3
51	Sound recording industries	3
51	Software publishing	3
	Finance and insurance	
52	Savings institutions, including credit unions	1
52	Banking and related activities	1
52	Insurance carriers and related activities	2
52	Nondepository credit and related activities	2
52	Securities, commodities, funds, trusts, and other financial investments	3
	Real estate and rental	
53	Video tape and disk rental	1
53	Other consumer goods rental	1
53	Commercial, industrial, and other intangible assets rental and lease	2
53	Real estate	2
53	Automotive equipment rental and leasing	2
	Professional, scientific, and technical services	
54	Veterinary services	1
54	Accounting, tax preparation, bookkeeping, and payroll services	1
54	Architectural, engineering, and related services	2
54	Other professional, scientific, and technical services	2
54	Legal services	2
54	Specialized design services	2

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Table 2.2 Locational Gini classes for individual service industries *(continued)*

Two-digit NAICS code	Industry	Locational Gini class (1 = least tradable)
	Professional, scientific, and technical services *(continued)*	
54	Computer systems design and related services	2
54	Advertising and related services	2
54	Management, scientific, and technical consulting services	2
54	Scientific research and development services	3
	Management	
55	Management of companies and enterprises	2
	Administrative support	
56	Waste management and remediation services	1
56	Business support services	1
56	Services to buildings and dwellings	1
56	Landscaping services	1
56	Employment services	2
56	Other administrative and other support services	2
56	Investigation and security services	2
56	Travel arrangement and reservation services	2
	Education	
61	Elementary and secondary schools	1
61	Colleges and universities, including junior colleges	1
61	Other schools, instruction, and educational services	1
61	Business, technical, and trade schools and training	2
	Health care and social services	
62	Hospitals	1
62	Nursing care facilities	1
62	Vocational rehabilitation services	1
62	Offices of physicians	1
62	Outpatient care centers	1
62	Offices of dentists	1
62	Offices of optometrists	1
62	Residential care facilities, without nursing	1
62	Child day care services	1
62	Home health care services	1
62	Other health care services	1
62	Office of chiropractors	1

(continued on next page)

Table 2.2 Locational Gini classes for individual service industries *(continued)*

Two-digit NAICS code	Industry	Locational Gini class (1 = least tradable)
	Health care and social services *(continued)*	
62	Individual and family services	1
62	Community food and housing, and emergency services	2
62	Offices of other health practitioners	2
	Arts, entertainment, and recreation	
71	Bowling centers	1
71	Other amusement, gambling, and recreation industries	1
71	Museums, art galleries, historical sites, and similar institutions	2
71	Independent artists, performing arts, spectator sports, and related	2
	Accommodation	
72	Drinking places, alcoholic beverages	1
72	Restaurants and other food services	1
72	Recreational vehicle parks and camps, and rooming and boarding houses	1
72	Traveler accommodation	2
	Other services	
81	Beauty salons	1
81	Funeral homes, cemeteries, and crematories	1
81	Personal and household goods repair and maintenance	1
81	Automotive repair and maintenance	1
81	Barber shops	1
81	Religious organizations	1
81	Commercial and industrial machinery and equipment repair and maintenance	1
81	Drycleaning and laundry services	1
81	Car washes	1
81	Electronic and precision equipment repair and maintenance	1
81	Civic, social, advocacy organizations, and grantmaking and giving	1
81	Nail salons and other personal care services	2
81	Other personal services	2
81	Business, professional, political, and similar organizations	2

(continued on next page)

Table 2.2 Locational Gini classes for individual service industries *(continued)*

Two-digit NAICS code	Industry	Locational Gini class (1 = least tradable)
	Other services *(continued)*	
81	Labor unions	3
81	Footwear and leather goods repair	3
	Public administration	
92	Justice, public order, and safety activities	1
92	Administration of human resource programs	1
92	Other general government and support	1
92	Executive offices and legislative bodies	1
92	Military Reserves or National Guard	1
92	Administration of economic programs and space research	1
92	Administration of environmental quality and housing programs	1
92	Public finance activities	2
92	National security and international affairs	3
92	US Armed Forces, branch not specified	3
92	US Coast Guard	3
92	US Air Force	3
92	US Army	3
92	US Navy	3
92	US Marines	3

NAICS = North American Industry Classification System

Source: Jensen and Kletzer (2006).

tion of employment, sufficient to suggest that these services are traded within the United States. In addition, the industries within both services and manufacturing that have high Ginis conform to expectations about which service activities are likely to be tradable and which manufacturing industries are less likely to be tradable, again because they have high ratios of trade costs to value. For example, the five manufacturing industries with the lowest Ginis are "other" concrete product manufacturing, fabricated structural metal manufacturing, concrete block and brick manufacturing, wood container and pallet manufacturing, and ready-mix concrete manufacturing. All of these are characterized by low value-to-weight ratios and thus are less likely to be traded.

Within the information sector, the industries with the lowest Ginis are newspaper publishers, motion picture theaters except drive-ins, television broadcasting, radio stations, and wired telecommunication carriers. These all tend to rely heavily on local inputs or require a physical presence to provide the service. The information industries with the highest Ginis are record produc-

Table 2.3 Employment in NAICS sectors by degree of tradability
(percent)

NAICS code	Sector	Locational Gini class (1 = least tradable) 1	2	3
11	Agriculture	0	88	12.1
21	Mining	0	24.2	75.8
22	Utilities	80.9	15.3	3.8
23	Construction	100	0	0
31	Manufacturing	0	40.4	59.6
32	Manufacturing	22	44.9	33.1
33	Manufacturing	14.4	65.4	20.2
3M	Manufacturing	0	100	0
42	Wholesale trade	45.8	50.6	3.6
44	Retail trade	81.7	18.3	0
45	Retail trade	88.7	11.4	0
4M	Retail trade	100	0	0
48	Transportation and warehousing	42.8	22	35.2
49	Transportation and warehousing	0	100	0
51	Information	33.3	50.4	16.4
52	Finance and insurance	32.1	51	17
53	Real estate and rental and leasing	9.1	90.9	0
54	Professional, scientific, and technical services	14	79.9	6.2
55	Management of companies and enterprises	0	100	0
56	Administrative support and waste management and remediation	59.5	40.5	0
61	Education	99	1.1	0
62	Health care and social assistance	97.8	2.2	0
71	Arts, entertainment, and recreation	67.4	32.7	0
72	Accommodation and food services	81.9	18.1	0
81	Other services (except public administration)	79.8	9.9	10.4
92	Public administration	71.7	4.6	23.7
	All industries	60.8	29.8	9.4

NAICS = North American Industry Classification System; M = miscellaneous

Source: Jensen and Kletzer (2006).

Table 2.4 Correlations between geographic concentration and export measures for manufacturing and business services

Sector	Number of industries	Correlation between locational Gini coefficient and: Exports-to-sales ratio	Correlation between locational Gini coefficient and: Share of establishments that export
Manufacturing	473	0.255	0.440
Business services	125	0.436	0.523

Note: All correlations are statistically significant at $p < 0.0001$.

Source: Author's calculations using data from the 2002 Census of Manufactures and the 2002 Census of Service Industries.

tion, music publishers, cable and other subscription programming, integrated record production and distribution, and "other motion picture and video industries."

Within professional, scientific, and technical services, some of the low-Gini industries are portrait photography studios and veterinary services. High-Gini industries in this group include payroll services and R&D in the social sciences and humanities. These results are also consistent with our expectations about the ability to provide these services over distances. Industries within the educational, health service, and "other services (except public administration)" sectors tend to have low Gini coefficients, suggesting low tradability.

As another check on the usefulness of geographic concentration in identifying tradable activities, table 2.4 reports, for 473 six-digit NAICS manufacturing industries, the correlations between the locational Gini coefficient and the exports-to-sales ratio and between the Gini and the share of establishments that export. The correlations are strong, providing further evidence that geographic concentration is a useful proxy for tradability.

For a subset of business service industries, those in NAICS sectors 51, 54, and 56, similar export information is available. Table 2.3 reports the same correlations for these industries as for the manufacturing industries above. Again the correlations are very strong.

Again, these results suggest that a number of service industries are tradable within the United States. For at least some of these, international trade seems technologically feasible.

Occupations

So far I have been seeking to identify service industries that are potentially tradable. I am also interested in identifying tradable occupations within service industries because, at least according to anecdotal reports in the press, some inputs into service production might be tradable even though the service industry to which those inputs contribute is not. For example, retail banking is classified as a nontradable industry because it has low geographic concentra-

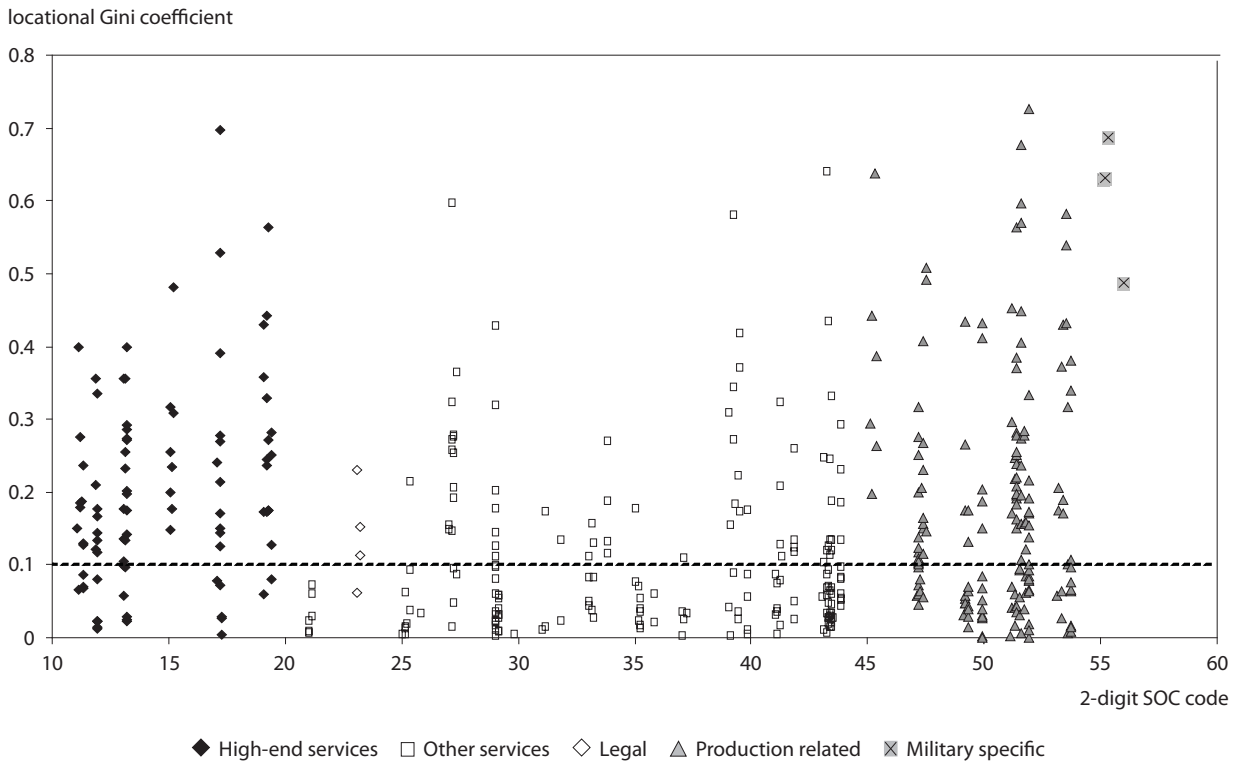
tion. Yet one might think of some of the activities at a typical retail bank—especially back-office operations like accounting but also customer support—as at least potentially tradable. Thus, looking at occupations as well as industries yields a different perspective on economic activity and tradability—another piece of the mosaic.

To classify occupations into tradable and nontradable categories, Kletzer and I (2006) used a methodology similar to that for industries. We constructed a demand-weighted Gini coefficient for each occupation as described in appendix D and used the same threshold (a Gini of 0.1) to distinguish between tradable and nontradable occupations. Figure 2.2 shows the results by major occupational group. Examples of occupations that are highly geographically concentrated include marine engineers and naval architects, actors, economists, actuaries, brokerage clerks, medical scientists, and financial analysts. Occupations with low geographic concentration include retail salespeople, dental hygienists, secondary school teachers, bartenders, child care workers, and pharmacists.

Table 2.5 reports the share of employment in each two-digit Standard Occupational Classification (SOC) group by Gini class. Once again the groupings are largely consistent with expectations. For example, 68 percent of employment in business and financial operations is in detailed occupation categories classified as tradable (66 percent in Gini class 2 and 2 percent in Gini class 3). Computer and mathematical occupations are all classified as tradable. The architecture and engineering category has 64 percent of its employment in tradable occupations. Almost all employment—96 percent—in legal occupations is classified as tradable.

Notable occupational groups that are nontradable include education and library occupations, where 99 percent of employment is in occupations classified as nontradable; health care practitioners, where 87 percent of employment is so classified; health care support, 97 percent nontradable; and food preparation and serving, 96 percent nontradable. Among blue-collar occupations, 90 percent of employment in installation, maintenance, and repair occupations is classified as nontradable, as is 80 percent of employment in production occupations and 89 percent in transportation and material moving occupations. The result for production occupations may at first seem counterintuitive, given the manufacturing industry results. However, production occupations are typically not industry specific but instead are functional activities and are thus distributed more broadly. For example, production occupations include occupations like "extruding and drawing machine setters, operators, and tenders, metal and plastic" or "cutting, punching, and press machine setters, operators, and tenders, metal and plastic" and "tool and die makers"—all of which could be found in a number of manufacturing industries. Thus, even though the aircraft industry or the automobile industry might be concentrated in a particular region, the production occupations of many of their workers are not, because many other manufacturing industries also employ workers in these occupations. This shows why it is important to look at tradability from both an industry perspective and an occupation perspective.

Figure 2.2 Geographic concentration of occupations in the United States



SOC = Standard Occupational Classification

Note: "Other services" includes SOC major categories 21 and 25-43 (see appendix C for a list of major categories).

Source: Author's calculations using 2000 Decennial Census of Population.

Table 2.5 Employment in SOC occupations by degree of tradability (percent)

		Locational Gini class (1 = least tradable)		
SOC code	**Occupation**	**1**	**2**	**3**
11	Management	34.5	61.2	4.4
13	Business and financial operations	31.7	66	2.3
15	Computer and mathematical	0	73.1	26.9
17	Architecture and engineering	36	58.3	5.7
19	Life, physical, and social sciences	16.3	58.6	25.1
21	Community and social services	100	0	0
23	Legal	3.8	96.2	0
25	Education and library	99.5	0.5	0
27	Arts, design, and entertainment	17.1	75	7.9
29	Health care practitioners and technologists	86.6	13.1	0.3
31	Health care support	96.7	3.3	0
33	Protective service	59.8	40.2	0
35	Food preparation and serving	95.7	4.3	0
37	Building maintenance	98.5	1.5	0
39	Personal care services	82.6	7.2	10.1
41	Sales and related	75.4	21.8	2.8
43	Office and administrative support	93.1	6.7	0.2
45	Farming, fishing, and forestry	0	81	19
47	Construction and extraction	61.4	36.2	2.5
49	Installation, maintenance, and repair	90	8.9	1.1
51	Production	80.3	17.2	2.6
53	Transportation and material moving	89.2	5.9	5
55	Military specific	0	0	100
	All occupations	71.7	24.9	3.5

SOC = Standard Occupational Classification

Source: Jensen and Kletzer (2006).

Summary

This chapter began by bemoaning the fact that data for service trade are nowhere as detailed as for the manufacturing sector. The rest of the chapter has shown, however, that this obstacle need not be insurmountable. The chapter presented a methodology for identifying, at a detailed level, indus-

tries and occupations whose outputs appear to be traded within the United States and thus, at least in principle, are tradable internationally. The intuition behind this methodology relies on a long-standing measurement tradition in economic geography and produces results very much in line with what one would expect given the nature of the different service activities examined. In addition, to the extent possible with existing data, the chapter reported results of validity checks on the relationship between geographic concentration and trade, which further suggest that the method is useful. Chapter 3 examines the next piece of the mosaic on trade in services, exploring the characteristics of workers in tradable activities.