Comparative advantages in U.S. bilateral services trade with China and India

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A B S T R A C T

Using bilateral trade data for 16 service categories, this paper examines the patterns, evolution, and determinants of comparative advantage (CA) in U.S. services trade with China and India from 1992 to 2010. The results indicate that the U.S. has a CA in most services, except in more traditional ones, such as travel and transportation. However, India, and more recently China, gained a CA in modern services, such as computer and information services during the period considered in this paper. An examination of the distributional dynamics indicates that the likelihood of U.S. gaining CA over an initial position of comparative disadvantage (CDA) in its trade of a particular service with India is higher than the probability of losing its initial dominance. In contrast, the U.S. CA or CDA vis-à-vis China exhibits high levels of persistence over time. The regression results suggest that relative abundance of sector-specific labor, human capital, and FDI inflows have been significant sources of CA for the U.S. over both China and India.

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1. Introduction

International trade in services has become increasingly important in today's world. With a total value of USD 367 billion, commercial services trade accounted for about 3.3% of world GDP in 1980.[1] In 2012, this value increased to USD 4350 billion and it was about 6% of world GDP. The recognition of the importance and viability of services trade brought it into the realm of multilateral trade negotiations through the establishment of the General Agreement on Trade in Services (GATS) that came into effect on January 1, 1995.[2] Although services trade has largely been confined to developed nations, some fast growing emerging market economies (EME) have become prominent players in recent years.[3] The fact that China and India appear in

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[1] The trade and GDP figures are obtained from online databases maintained by the World Trade Organization (WTO) and the World Bank, respectively, downloaded from http://stat.wto.org/StatisticalProgram/WSDBViewData.aspx?Language=E and http://data.worldbank.org/region/WLD on March 8, 2014. For a discussion on the growth of services trade, see, for example, Apte and Nath (2013).

[2] The GATS definition of trade in services includes four categories of transactions: (a) Cross-border trade: services supplied across borders (e.g., electricity, telecommunications, and transportation). (b) Consumption abroad: services supplied in a country to the foreigners (e.g., tourism, education abroad). (c) Commercial presence: services supplied in a country by foreign firms (e.g., restaurant chains, hotel chains). (d) Presence of natural persons: services supplied in a country by foreign nationals (e.g., services by visiting entertainers). Recently, the statistical agencies in the U.S. and other countries have tried to be consistent with this definition while collecting data on services trade.

[3] Although services trade for developing countries is much smaller than for developed countries in absolute terms, it may still be important in terms of its share in individual country's GDP, more so than in developed countries. In particular, services trade is very important for some relatively smaller developing countries such as Liberia, Maldives, Timor-Leste, Aruba, Lebanon, and Malta.

the list of top ten countries in services trade is an indicator of this growing trend.[4] For both countries, the U.S. is the largest trading partner in services trade. However, there is an important difference between these two countries: China is a net importer of services from the U.S. whereas India is a net exporter. In fact, this disparity between the two countries has widened over time. Between 2010 and 2011, the U.S. services trade surplus with China rose by 20% while the deficit with India grew by almost 60%.[5]

In general, the patterns of services trade of China and India with the U.S. reflect the relative importance of services in their respective overall trade. Due to China's specialization in manufacturing, the share of services in its total trade was merely 11% in 2012. In contrast, services accounted for more than 25% of India's overall trade in the same year and have been a major contributor to its economic growth. In addition, although services trade accounted for only about 21% of its total trade in 2012, the U.S. is the leading trader of services in the world. The U.S. services trade with China and India has intensified in recent years, reaching a value of USD 36 billion and 28 billion, respectively, in 2011.[6] The major services export and import items between the U.S. and China or India along with their importance in total services trade are listed in Table 1.

The direction and composition of U.S. bilateral services trade with China and India are particularly important because of the economic restructuring unleashed by the market-oriented reforms that were initiated and intensified in both countries during the 1990s. Due to the trade liberalization measures and consequent competitive pressure, these economies were expected to move toward specialization on the basis of their respective comparative advantages (CAs). It is in this context that this paper presents a comparative analysis of the evolution and determinants of CAs in U.S. bilateral trade in various services with China and India over the period 1992–2010. In particular, we use bilateral trade data for 16 service categories to calculate two measures of CA and employ kernel densities to study the shape of the distribution of CA and its changes over time. Furthermore, we employ transition matrices to estimate the likelihood of the U.S. gaining, maintaining, or losing its CA vis-à-vis China and India over different time horizons. Finally, we also conduct regression analysis to shed lights on some of the determinants of CA in U.S. services trade with the two Asian countries.

There is a substantial empirical literature that presents CA measures for different countries.[7] However, the number of studies on CAs in services trade is relatively small. This is primarily due to a lack of relevant data and the peculiarities of services trade. Furthermore, there are only a limited number of previous studies that focus on the services trade of China and India, but they lack the comparative dimension as each country is examined separately.[8,9] Further, these studies do not focus on bilateral trade with the U.S. He (2009) explores China's trade in services with the rest of the world and demonstrates that despite rapid growth in exports, the country had an overall comparative disadvantage (CDA) over the period 1982–2006. At disaggregate levels, however, China exhibited CA only in a few services over the same period, including other business services, travel, and construction. These results are further supported by Yang (2009). For India, Burange, Chaddha, and Kapoor (2010) show that the country had a robust CA only in commercial services that exclude traditional services like transportation and travel over the period 1980–2007. The main component responsible for this pattern is identified as trades in computer and information services. Pailwar and Shah (2009) confirm these findings using the same data and sample period but employing a more sophisticated methodology. In addition, Dash and Parida (2012, 2013) show that services exports have made a significant contribution to India's economic growth over the period 1996–2010.[10]

Using bilateral trade data for 16 service categories, we examine the patterns, evolution, and determinants of CA in U.S. services trade with China and India from 1992 to 2010. Our results indicate that the U.S. has CA in most services over China and India, except in more traditional services, such as travel and transportation. However, India, and more recently China, have gained CA in modern services, such as computer and information services. The analysis of distributional dynamics suggests that the U.S. is more likely to gain CA over India than to lose its initial dominance in services trade. In contrast, the U.S. CA/CDA in services trade with China exhibits high levels of persistence over time, resulting in less pronounced distributional dynamics. The regression analysis suggests that relative abundance of sector-specific labor, human capital,

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[4] Mexico is another EME that appears in this list. But as the next-door neighbor to the U.S., this is not surprising.

[5] Note that China has recorded an overall trade surplus every year since the early 1990s, while India has had sustained trade deficit. Furthermore, China's trade surplus increased tenfold in the past decade, while India's deficit worsened almost thirtyfold over the same period.

[6] The U.S. imports of private services from India have increased by almost 800% between 2000 and 2011, while U.S. exports to China and India have risen by more than 350% over the same period. Note that the significant growth of services trade in India and China has been accompanied by the rapid expansion of the tertiary (service) sector in both countries.

[7] Examples of this literature include Balassa (1965, 1986); Bender and Li (2002); and Carolan et al. (1998).

[8] Studies that conduct a comparative analysis of the service sector in China and India are limited as well. They either do not discuss trade at all or explore other aspects related to trade and, therefore, do not focus on services trade per se. For example, Wu (2007) examines the growth of service industries in both countries over the period 1993–2003 and concludes that rising per-capita income, accelerated urbanization, and external demand are the driving forces behind the rapid development of the tertiary sector.

[9] Batra and Khan (2005) and Veeramani (2008) conduct comparative analyses of CAs in merchandize trade in China and India. The current paper shares the same spirit but focuses on services trade.

[10] In a related study, Liu and Trefler (2008) investigate the impact of services imports from China and India on employment and earnings in the U.S. over the period 1996–2006 and report a small negative effect. They also show that U.S. services exports to these two Asian countries have a small positive effect, rendering the overall net effect either slightly positive or zero. They, however, do not differentiate between the impact of China and India. Freund (2009) analyzes the competition of Latin America with China and India in the services trade with the U.S. and notes that despite higher levels of exports to and imports from the U.S., Latin America lags behind the two Asian countries in terms of trade growth. Moreover, Indian exports are found to have displaced Latin American exports to the U.S., especially in research, development, and testing services; legal services; industrial engineering; and other business, professional, and technical services.

Table 1
Major services trade items between the U.S. and China/India, 2011.

U. S. export items	% share in total service exports	U. S. imports items	% share in total service imports
Panel A: Services trade between the U.S. and China			
Education	19	Travel	28
Travel	17	Transportation of goods	26
Royalties and license fees	14	Computer and data processing services	10
Transportation of goods	11	Research, development, and testing services	9
Panel B: Services trade between the U.S. and India			
Education	32	Computer and data processing services	44
Travel	26	Travel	19
Other business, professional, and technical services	13	Research, development, and testing services	12
		Management, consulting, and public relations services	10

Source: Authors' calculation from the Bureau of Economic Analysis (BEA) international trade data.

and FDI inflows have been significant sources of CA for the U.S. in its services trade with both China and India. Furthermore, the U.S. has a CA over China in information-intensive services while it has a CDA over India in the same services.

The rest of the paper is organized as follows: the methodology and data are discussed in Section 2, while the main empirical results and analysis are presented in Section 3. In Section 4, we explore some of the potential factors that affect CA of the U.S. in its bilateral services trade with China and India. The last section includes our concluding remarks.

2. Methodology and data

2.1. Methodology

Although CA is one of the key concepts in the theory of international trade, its measurement has been fraught with difficulties. The main reason is that it is defined in terms of relative autarkic prices, which are not observable once the trade takes place. Therefore, empirical studies have proxied CA by relative export performance, which reflects both relative costs and differences in factor intensities. One of the most widely used measures in this context has been Balassa's (1965) revealed comparative advantage (RCA) index, which measures the share of a given product in a country's total exports relative to the share of that product in total world exports. A country is said to have a CA in a particular product if its share in the country's total exports is relatively larger than the share of the product in total world exports.[11]

We modify this index to the case of bilateral trade in services. In this case, the world consists of two countries that trade services. Thus, RCA for U.S. bilateral trade in services with China or India is expressed as:

$$\text{RCA}_{ij} = \frac{\left((X_{ij}) / \left(\sum_{j=1}^{n} X_{ij} \right) \right)}{\left((X_{ij} + M_{ij}) / \left(\sum_{j=1}^{n} X_{ij} + \sum_{j=1}^{n} M_{ij} \right) \right)} \tag{1}$$

where X_{ij} denotes the value of U.S. exports of service j ($j = 1, \ldots, n$) to country i (i = China, India). M_{ij} is the value of country i's exports of service j to the U.S. (i.e., U.S. imports of service j from country i). In other words, the bilateral RCA index expresses the share of a given service in total U.S. exports to China/India relative to the share of U.S. trade (exports as well as imports) in this service with China/India in total U.S. services trade with China/India. This index may take values that range from 0 to infinity. Values exceeding 1 indicate that the U.S. has CA in service j as it is more important in U.S. service exports to China/India than U.S. trade in service j is in total U.S. services trade with China/India. Values between 0 and 1 mean that the U.S. has a CDA in a given service vis-à-vis China or India.

Balassa's RCA index suffers from two major problems. First, it is asymmetric and, therefore, values on one side of unity are not comparable with those on the other side.[12] To address this issue of asymmetry, Dalum, Laursen, and Villumsen (1998)

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[11] Note that one of the main criticisms of the RCA measures is that they are not strictly based on the concept of comparative advantage as expounded in the theories of international trade. Recently, Costinot et al. (2012) has proposed an empirical strategy for measuring Ricardian comparative advantage that is strictly based on theoretical foundations and focuses on revealed productivity measures.

[12] This would not be a serious problem if we simply want to know which service items the U.S. has CA over China/India. Since we also examine the distributional dynamics of the CA measure with an objective of shedding lights on the evolution of CA, symmetry is important.

suggest transforming the RCA index into:

$$RSCA_{ij} = \frac{RCA_{ij} - 1}{RCA_{ij} + 1} \tag{2}$$

In contrast to the RCA, the revealed symmetric comparative advantage (RSCA) index ranges in values between -1 and $+1$. Positive (negative) values indicate that the U.S. has a CA (CDA) vis-à-vis China/India in service j.

The second issue with the RCA index is that it focuses on relative export performance, thereby neglecting net trade flows and intra-industry trade. Accordingly, we employ an additional measure, which is a modification of Lafay's (1992) trade balance index (TBI) and suggested by Bugamelli (2001) as follows:

$$TBI_{ij} = \left[\frac{X_{ij} - M_{ij}}{X_{ij} + M_{ij}} - \frac{\sum_j X_{ij} - \sum_j M_{ij}}{\sum_j X_{ij} + \sum_j M_{ij}} \right] \times \frac{X_{ij} + M_{ij}}{\sum_j X_{ij} + \sum_j M_{ij}} \times 100 \tag{3}$$

The TBI index measures the contribution of service j to the overall U.S. services trade balance with China/India and ranges from -50 to $+50$. Positive (negative) values imply that the U.S. is a net exporter (net importer) of service j to China/India and, therefore, has a CA (CDA) in j relative to all other services.

The symmetric nature of RSCA and TBI allows us to explore the shape and dynamics of the distribution of these indices across services by employing a nonparametric methodology. In particular, we estimate probability densities for each index using a kernel function. Let $X_1, \ldots, X_n$ be a sample of n independent and identically distributed observations on a random variable X (RSCA or TBI in our case). The density value $f(x)$ at a given point x is estimated by the following kernel density estimator:

$$\hat{f}(x) = \frac{1}{nh} \sum_{i=1}^{n} K\left(\frac{x - X_i}{h}\right) \tag{4}$$

where h denotes the bandwidth of the interval around x and K is the kernel function.[13] The kernel estimator assigns a weight to each observation in the interval around x with the weight being inversely proportional to the distance between the observation and x. The density estimate consists of the vertical sum of frequencies at each observation. The resulting smooth curve enables us to visualize the shape of the distribution of the CA index and study its evolution over time.

Furthermore, we explore the distributional dynamics by estimating the probability that the U.S. gains or loses its CA in services trade against China/India over time. For this purpose, we estimate a transition probability matrix. Let Q_t denote the distribution of the RSCA (or TBI) index across services at time t. The distribution at time $t + \tau$ is then described by:

$$Q_{t+\tau} = M \times Q_t \tag{5}$$

where M is a finite discrete Markov transition matrix that contains a complete description of the distributional dynamics as it maps Q_t into $Q_{t+\tau}$. The transition matrix is given by

$$M = \begin{pmatrix} p_{11} & \cdots & p_{1N} \\ \vdots & \ddots & \vdots \\ p_{N1} & \cdots & p_{NN} \end{pmatrix} \tag{6}$$

where p_{kl} with $k, l = 1, \ldots, N$ is the probability of a transition from an initial state k in year t to a state l in year $t + \tau$. The main diagonal of the matrix is an indicator of persistence because it consists of the probabilities that an observation remains in the same state in t and $t + \tau$. Note that N is the number of states. In our analysis, we define two states that correspond to CA and CDA respectively, and study the transition dynamics over three different time horizons ($\tau = 3, 5, 10$).

2.2. Data

The data for our analysis are primarily collected from the International Accounts of the Bureau of Economic Analysis (BEA) and cover the period 1992–2010. Trade liberalization and the expansion of the service sector in China and India gained momentum only in the 1990s. Therefore, the U.S. services trade with these two Asian countries was either nonexistent or too insignificant in most service categories before 1992. We obtain detailed annual bilateral trade data between the U.S. and China as well as between the U.S. and India for 16 disaggregated service categories. The categories include travel; passenger fares; freight transportation; port services; royalties and license fees; education; financial services; insurance services; telecommunications; computer and information services; management and consulting services; research and development and testing services; advertising; construction; installation, maintenance and repair of equipment; and legal services.[14] The definitions and coverage of each of these 16 services are included in Appendix 2. These categories cover all main industries in

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[13] We use data-driven bandwidth selection (likelihood cross validation) and a Gaussian kernel.

[14] There are well-known problems in measuring services. For example, what is a good measure of output for financial services? These problems are even more acute in measuring services trade. Furthermore, there are variations in the quality of services trade measures across different items. However, with the adoption of uniform standards under the aegis of GATS and conscientious efforts by the statistical agencies, the quality of data has presumably improved.

services trade at the most disaggregated level. The trade data cover both affiliated and unaffiliated transactions between U.S. residents and Chinese or Indian residents.[15] Affiliated transactions consist of intra-firm trade within multinational companies – specifically, trade between U.S. parent companies and their foreign affiliates and trade between U.S. affiliates and their foreign parent groups. Unaffiliated transactions are with foreigners (Chinese or Indian) that neither own, nor are owned by, the U.S. party to the transaction.

We also obtain data on some additional variables for our analysis in Section 4. Thus, we gather data on output, employment, and gross fixed capital formation for the U.S. from the BEA national accounts. The corresponding data for China are collected from the 1993 through 2011 issues of the *China Statistical Yearbook* published by China's National Bureau of Statistics. The data for India are obtained from the National Accounts Statistics published by the Ministry of Statistics and Program Implementation. Indian data are reported for fiscal years and were converted into calendar years by adding three-quarters of the value in the current fiscal year and one-quarter of the value from the previous year. The output and capital values are converted into dollars using the purchasing power parity (PPP) exchange rates obtained from the World Bank's *World Development Indicators* (WDI). In addition, data on FDI inflows and average schooling for the U.S., China, and India are obtained from WDI.

It is worth noting that data on these variables are not available for all the services categories, particularly for India, and for all years. Furthermore, there is an important issue of appropriate mapping between the services trade categories and the corresponding service industries, which limits the scope of our investigation and the implications of the empirical results from our regression analysis. The summary statistics of services trade data are included in Appendix 1.

Before we calculate the CA measures for the U.S. services trade with China and India, a few comments on the conceptual issues associated with certain services that we consider in this study are in order. For example, 'trade in royalties and license fees' are the transactions with foreign countries in rights to various types of intellectual property. Although these transactions are recorded as a service item in international trade statistics, the underlying intellectual property rights can be in any sector. Thus, interpreting the CA measures for royalties and license fees requires some careful deliberation. These measures do not necessarily reflect CA in a particular sector in the conventional sense. Despite this caveat, we believe that CA measures for royalties and license fees are useful in that a value indicating a country's CA over another reveals its superiority in technological knowledge.

Furthermore, trade in 'freight transportation' and 'port services' is closely related to merchandize trade. Similarly, 'trade in telecommunications' is also, to some extent, related to trade in goods and other services. Thus, bilateral trade in these services is likely to be explained more by bilateral trade in goods than by comparative advantages. However, receipts (exports) and payments (imports) for these services are recorded in international trade statistics according to whether domestic or foreign carriers are involved. Thus, there are at least some CAs and CDAs associated with these carriers and, therefore, we believe, that the CA measures capture comparative (dis)advantages to some extent.[16] Furthermore, because of the ad hoc nature of its relationship with the theories of international trade, RSCA measures reflect more than the differences in supply side factors such as factor endowments and technology. For example, as it would be true for above service items, these measures can be influenced by demand side factors as well.

3. Empirical results

3.1. Comparative advantage measures

The RSCA measures for bilateral trade between the U.S. and China are presented in Panel A of Table 2. The indices for travel, passenger fares, freight transportation, and advertising are negative for almost the entire sample period, indicating that China has a CA over the U.S. in these services. In contrast, the U.S. has a CA in 8 service categories including port services; royalties and license fees; education; financial services; insurance services; construction; installation, maintenance, and repair of equipment; and legal services. Although the U.S. had a CA in computer and information services, management and consulting services, and research and development and testing services until the mid-2000s, China seized it since then and has experienced a rise in its value in recent years. In telecommunications, the U.S. was at a disadvantage until the turn of the century when it was able to gain a CA over China, but it lasted only until 2006.

The corresponding RSCA measures for the U.S. bilateral trade with India are shown in Panel B of Table 2. India's CA in travel, passenger fares, port services, and legal services deteriorated since the early 2000s and eventually disappeared during the period 2003–2007.[17] The evolution of CA in telecommunications is quite similar, with the U.S. taking over in 2009, despite the fact that India's CA in this service had been one of the strongest in magnitude across all categories. The U.S. had a

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[15] Since our data combine services trade that takes place under different categories or modes of transactions (as listed in footnote 2), there are certain issues that need to be recognized. For example, trade under Category (b) or/and (c) ('Consumption abroad' and 'Commercial presence', respectively) is a substitute mode of supply for cross border transactions. Since we do not consider the variables that affect the choice of those modes, the analysis of cross border transactions may be biased. However, if data become available by different categories of transactions in services trade, we will be able to address this issue in future work.

[16] For exact definitions of trade in these services, please see the descriptions in Appendix 2.

[17] This largely concurs with the findings of Burange et al. (2010), who showed that India lost its global comparative advantage over the rest of the world in travel in the aftermath of the 1997 East Asian financial crisis.

Table 2
Bilateral revealed symmetric comparative advantage (RSCA) in U.S. services trade with China (Panel A) and India (Panel B).

Year	Travel	Passenger fares	Freight transportation	Port services	Royalties and license fees	Education	Financial services	Insurance services	Telecomm-unications	Computer and information services	Management and consulting	Research and development and testing services	Advertising	Construction	Installation, maintenance, and repair services	Legal services
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Panel A																
1992	−0.30	−0.31	−0.62	0.22	0.24	0.25	0.23	−0.06	−0.25	0.13	−0.41	0.13		0.22	0.25	0.11
1993	−0.26	−0.61	−0.62	0.22	0.09	0.25	0.23	−0.70	−0.31	0.15		0.20		0.25	0.25	−0.09
1994	−0.22	−0.63	−0.47	0.23	0.22	0.26	0.20	−0.54	−0.37	0.21	0.00	0.07	−0.40	0.24	0.26	0.02
1995	−0.22	−0.47	−0.39	0.20	0.25	0.25	0.19	0.04	−0.45	0.20	0.07	0.05		0.24	0.25	0.07
1996	−0.08	−0.12	−0.53	0.18		0.23	0.18	0.18	−0.29	0.15	0.19	0.04	−0.30	0.23	0.22	0.08
1997	−0.06	−0.12	−0.36	0.09		0.23	0.22	0.24	−0.45	0.17	0.00	0.07	−0.37	0.23	0.22	0.06
1998	−0.07	−0.10	−0.37	−0.04	0.11	0.22	0.22		−0.41	0.13	−0.19	0.05	−0.38	0.22	0.22	0.01
1999	−0.17	−0.07	−0.44	−0.01	0.22	0.24	0.25	0.14	−0.44	0.11	0.07	−0.54	−0.23	0.25	0.22	0.11
2000	−0.11	0.04	−0.54	0.08	0.23	0.23	0.23	0.24	−0.11	0.11	0.10	−0.36	−0.36	0.24	0.19	0.09
2001	−0.14	0.02	−0.52	0.09	0.24	0.24	0.23	0.21	0.01	0.14	0.18	−0.03	−0.29	0.24	0.21	0.12
2002	−0.12	−0.15	−0.52	0.10	0.25	0.25	0.24	0.23	−0.01	0.20	0.12	0.11	−0.37	0.25	0.16	0.10
2003	−0.19	−0.08	−0.48	0.10	0.21	0.24	0.21	0.22	0.03	0.19	0.00	0.08	−0.20	0.24	0.18	0.06
2004	−0.23	−0.22	−0.52	0.16	0.26	0.25	0.25	0.26	0.04	0.22	0.21	−0.14	−0.34	0.27	0.21	0.13
2005	−0.23	−0.16	−0.48	0.06	0.25	0.24	0.23	0.26	0.04	0.22	0.14	−0.27	−0.25	0.26	0.17	0.17
2006	−0.10	−0.12	−0.58	0.18	0.28	0.27	0.28	0.27	−0.11	−0.31	0.02	−0.35	−0.19	0.26	0.21	0.22
2007	−0.09	−0.08	−0.55	0.16	0.26	0.25	0.25	0.22	−0.16	−0.42	−0.04	−0.74	−0.24	0.27	0.20	0.20
2008	−0.07	−0.05	−0.34	0.07	0.21	0.20	0.16	−0.06	−0.17	−0.52	−0.08	−0.75	−0.35	0.21	0.15	0.13
2009	−0.09	−0.01	−0.30	0.00	0.18	0.17	0.16	0.10	−0.24	−0.52	−0.12	−0.79	−0.46	0.19	0.14	0.09
2010	−0.07	0.01	−0.35	0.02	0.17	0.16	0.15	0.06	−0.27	−0.54	−0.12	−0.78	−0.59	0.18	0.08	0.07
Panel B																
1992	−0.11		0.09	−0.32	0.23	0.22	0.19	−0.27	−0.24	0.14	0.16	−0.67		0.23	0.23	0.23
1993	−0.13		0.08	−0.18	0.23	0.23	0.18	−0.24	−0.27	0.15	0.16	−0.43		0.23	0.23	
1994	−0.12	−0.62	−0.15	0.14	0.22	0.24	0.19	−0.46	−0.36	−0.05	0.04	0.24	0.24	0.24	0.24	−0.10
1995	−0.08	−0.69	0.09	−0.05	0.23	0.24	0.14	−0.08	−0.41	0.08	−0.02	0.05		0.24	0.24	−0.10
1996	−0.05	−0.38	0.12	−0.24	0.22	0.27	0.08	0.06	−0.59	0.23	0.16	−0.07	−0.27	0.27	0.27	−0.21
1997	−0.05	−0.35	0.21	−0.19	0.20	0.27	0.09	0.08	−0.57	0.16	0.14	0.00	−0.48	0.28	0.23	−0.06
1998	−0.06	−0.29	0.20	−0.12	0.25	0.29	0.13	0.15	−0.58	−0.33	0.13	0.12	−0.47	0.27	0.27	−0.24
1999	−0.03	−0.43	0.17	−0.19	0.26	0.27	0.16	0.13	−0.48	−0.37	−0.24	−0.13	−0.27	0.22	0.24	−0.07
2000	−0.01	−0.40	0.18	−0.29	0.27	0.27	0.11	0.27	−0.65	−0.19	−0.38	−0.10	−0.27	0.24	0.25	−0.03
2001	−0.03	−0.10	−0.04	−0.01	0.21	0.23	0.11	0.09	−0.58	−0.32	−0.19	−0.30	0.03	0.06	0.20	0.03
2002	−0.03	−0.45	0.01	−0.03	0.17	0.22	0.03	0.12	−0.50	−0.52	−0.11	−0.51	−0.32	−0.05	0.17	−0.02
2003	−0.03	−0.66	0.02	−0.17	0.16	0.21	0.05	−0.13	−0.34	−0.38	−0.28	−0.45	−0.13	0.05	0.15	0.07
2004	−0.05	−0.64	0.00	−0.02	0.21	0.24	0.06	0.07	−0.35	−0.54	−0.16	−0.41	0.01	0.14	0.22	0.04
2005	0.00	−0.19	−0.05	−0.03	0.30	0.32	0.19	0.03	−0.21	−0.47	−0.21	−0.28	−0.05	0.30	0.27	0.11
2006	−0.01	0.25	0.24	0.17	0.33	0.36	0.23	−0.03	−0.34	−0.82	−0.57	−0.77	−0.04	0.26	0.31	0.14
2007	0.09	0.30	0.26	0.13	0.30	0.35	0.15	0.24	−0.22	−0.86	−0.64	−0.92	−0.46	0.29	0.33	0.19
2008	0.10	0.28	0.24	0.17	0.33	0.37	0.12	0.23	−0.22	−0.87	−0.63	−0.95	−0.54	0.25	0.24	0.12
2009	0.08	0.30	0.29	0.15	0.32	0.38	0.14	0.19	0.07	−0.83	−0.58	−0.90	−0.47	0.20	0.32	0.17
2010	0.14	0.33	0.25	0.19	0.32	0.39	0.17	0.10	0.03	−0.84	−0.62	−0.92	−0.51	0.20	0.36	0.16

Source: Authors' calculation from the Bureau of Economic Analysis (BEA) international trade data.

CA over India in freight transportation; royalties and license fees; education; financial services; insurance services; construction; and installation, maintenance and repair of equipment over the entire sample period. Two service items in which the U.S. lost its CA to India in the late 1990s are computer and information services, and management and consulting services.[18] In recent years, India has consolidated its advantage in these two services as reflected in the large RSCA values (in absolute terms).

As a robustness check, we calculate TBI. As discussed in the previous section, it is an alternative CA measure that takes into account not only relative export performance but also imports, and thus corrects for biases that could result from the presence of intra-industry trade. The TBI measures are reported in Panel A for China and Panel B for India of Table 3. A comparison between TBI and RSCA shows that the direction of CA and its change over time are almost identical for these two measures. Given the robustness of our estimates, we choose to focus on the RSCA index for the rest of our analysis.

Based on our results, we can draw the following general conclusions. First, the U.S. has always had a CA over both China and India in royalties and license fees; education; financial services; construction; and installation, maintenance, and repair of equipment. Second, although China continues to maintain its CA in travel, passenger fares, freight transportation, and advertising, India has lost its dominance in travel, passenger fares, port services, and legal services. Third, India managed to gain a CA over the U.S. in computer and information services, as well as in management and consulting services in the late 1990s, while China was able to achieve this only in 2006–2007. India benefited immensely from the information technology (IT) boom in the U.S. in the 1990s by employing a large number of relatively cheap, skilled, English-speaking engineers and other IT professionals who could satisfy the rising demand for such services in developed countries. However, while the cost of skilled labor in India was rising due to the rapid growth of the IT sector, China was able to gain ground as the quantity and global competitiveness of its engineering graduates increased over time. As a result, China gained a CA in IT-related services in the late 2000s.

3.2. Distribution dynamics

The kernel density distributions of the RSCA index across various service categories are presented in Fig. 1. The RSCA distributions for the U.S. trade with China and India in 1992 are very similar in that most of the probability mass is concentrated between the values of 0 and 0.5. This implies that the U.S. had a CA over China and India in most service categories in the early 1990s. However, the concentrations of probability mass over the negative values are much smaller. While there is one smaller mode for China on the negative side, there are two such modes for India although they are less prominent. They are indicative of U.S. CDA vis-à-vis China and India in only a few services.

Almost a decade later, although the multimodal shape of the distributions remained intact, some important differences emerged. In the case of U.S. vis-a-vis China, the variance of the RSCA index has decreased significantly, leading to an even stronger concentration of density around the value of 0.25. Thus, the U.S. dominance in services trade with China was further consolidated with the U.S. maintaining and gaining CA over a larger number of service items than before. While a similar tendency can be detected for CA of the U.S. over India, its extent is much less dramatic. More importantly, there is a marked shift of the large mode to the left indicating a loss in CA for the U.S. vis-à-vis India in a number of services. This contrast in U.S. services trade with China and India in 2001 is particularly significant as China set forth to join of the WTO.

By 2010, there has been a significant reversal. The density distribution of the RSCA index for U.S. trade with China returned to its original bimodal shape as in 1992. However, the larger mode made a clear shift to the left, while the smaller mode moved toward values below −0.5. These tendencies suggest that the CA of the U.S. over China eroded during the 2000s. As for the service trade with India, a large increase in dispersion produced a bimodal distribution that is very different from the ones in 1992 and 2001. The largest share of the probability mass is now concentrated in the positive range of values indicating a significant improvement of U.S. CA over India in the 2000s. At the same time, a smaller but distinctive mode between the values of −0.5 and −1.0 shows that the CDA of the U.S. vis-à-vis India in computer and information services, and management and consulting services has worsened.

In addition, we examine the distribution dynamics by estimating the probability of the U.S. maintaining, gaining or losing its CA over 3 different time horizons. The corresponding transition matrices in Table 4 reveal major differences between U.S.–China and U.S.–India trade. The probability that the U.S. maintains its initial CA or CDA in trade with China (presented along the diagonals in left-hand matrices in Table 4) is very similar and varies between 80% and 88%. This relatively high level of persistence is robust to changes in the length of the transition period. For example, the likelihood of the U.S. maintaining its CDA with China is 81.7%, 80.8%, and 80% over a 3-year, 5-year, and 10-year period, respectively. Correspondingly, there is only 18.3–20% chance that U.S. will make a transition from a CDA position to a CA position over these time horizons. In its trade with India, the U.S. has a higher probability of maintaining its initial CA than its disadvantage. As the length of the transition period increases, the probability of persistence declines, but this tendency is more pronounced for the CDA. Accordingly, the likelihood of the U.S. keeping its initial CA over a 10-year period is about 74%, whereas the corresponding probability for CDA is only 50%. These results also suggest that it is relatively easier for the U.S. to move from a position of CDA to that of CA vis-à-vis India than vis-à-vis China.

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[18] Burange et al. (2010) and Pailwar and Shah (2009) also identify computer and information services as India's industry with the strongest CA over the rest of the world.

Table 3
Trade balance index (TBI) in U.S. services trade with China (Panel A) and India (Panel B).

Year	Travel	Passenger fares	Freight transportation	Port services	Royalties and license fees	Education	Financial services	Insurance services	Telecomm-unications	Computer and information services	Management and consulting	Research and development and testing services	Advertising	Construction	Installation, maintenance, and repair services	Legal services
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Panel A																
1992	−17.09	−1.17	−13.24	9.64	2.30	15.53	0.20	−0.03	−2.19	0.12	−0.21	0.12	−0.05	1.33	1.78	0.05
1993	−13.73	−2.55	−13.36	8.70	0.05	14.07	0.30	−0.17	−3.50	0.13		0.16	−0.04	4.10	1.57	−0.02
1994	−11.55	−1.76	−12.00	9.64	1.44	13.50	0.13	−0.14	−5.10	0.34	0.00	0.03	−0.08	2.97	1.44	0.01
1995	−10.62	−1.54	−12.98	8.54	2.13	9.96	0.35	0.02	−5.63	0.39	0.06	0.01	−0.06	4.75	2.03	0.07
1996	−5.82	−1.11	−11.58	5.60		8.06	0.46	0.03	−5.93	0.23	0.12	0.01	−0.07	2.38	2.01	0.11
1997	−5.08	−1.30	−8.21	2.11		7.99	0.87	0.05	−5.59	0.29	0.00	0.02	−0.08	2.20	1.02	0.08
1998	−5.27	−1.03	−7.39	−0.90	1.98	8.19	0.57		−4.70	0.22	−0.15	0.02	−0.08	2.47	1.04	0.01
1999	−9.50	−0.78	−10.73	−0.09	4.83	9.75	0.77	0.06	−3.29	0.15	0.04	−0.36	−0.05	4.14	1.20	0.22
2000	−6.91	0.61	−15.87	1.82	4.65	8.33	1.14	0.09	−0.54	0.13	0.04	−0.28	−0.06	3.14	1.09	0.14
2001	−7.65	0.32	−17.38	2.40	5.08	9.26	1.06	0.11	0.06	0.18	0.09	−0.02	−0.04	1.37	1.31	0.19
2002	−5.48	−1.61	−18.73	2.93	6.21	9.52	1.03	0.25	−0.02	0.27	0.05	0.06	−0.07	0.81	0.97	0.16
2003	−6.80	−0.63	−18.94	2.45	5.95	10.34	1.08	0.13	0.09	0.24	0.00	0.04	−0.06	1.56	1.01	0.10
2004	−8.38	−1.93	−18.28	4.15	6.96	8.08	1.76	0.24	0.09	0.33	0.29	−0.07	−0.11	2.06	1.03	0.23
2005	−9.85	−1.82	−14.25	1.09	6.49	8.12	1.69	0.21	0.10	0.40	0.21	−0.11	−0.06	3.08	0.95	0.36
2006	−3.75	−1.19	−20.23	3.91	6.89	6.95	2.97	0.21	−0.30	−0.91	0.10	−0.34	−0.06	1.01	0.99	0.61
2007	−3.49	−0.87	−17.34	3.57	6.86	6.34	3.16	0.16	−0.46	−2.02	−0.30	−2.03	−0.12	1.46	1.11	0.71
2008	−3.14	−0.73	−9.52	1.34	6.50	6.39	1.88	−0.07	−0.42	−3.55	−0.75	−2.79	−0.18	1.57	0.96	0.51
2009	−4.69	−0.15	−6.46	0.07	5.45	7.40	2.97	0.10	−0.50	−4.06	−1.16	−4.00	−0.26	2.05	1.15	0.32
2010	−3.42	0.19	−8.19	0.25	6.10	7.09	3.36	0.05	−0.39	−3.78	−1.07	−3.96	−0.22	1.65	0.69	0.19
Panel B																
1992	−11.52		1.60	−1.83	1.79	16.41	0.29	−0.05	−4.17	0.14	0.23	−0.47	−0.07	1.19	0.60	0.04
1993	−12.36	−4.69	1.24	−1.24	0.12	18.47	0.32	−0.04	−5.06	0.14	0.18	−0.16	−0.07	0.54	0.87	
1994	−9.55	−5.35	−2.32	2.43	1.85	17.31	1.05	−0.05	−6.64	−0.09	0.06	0.08	0.04	0.81	0.50	−0.02
1995	−7.02	−6.87	1.54	−0.43	1.92	16.23	0.66	−0.02	−7.70	0.22	−0.05	0.02		1.05	0.47	−0.02
1996	−4.60	−3.97	2.15	−1.43	1.84	14.42	0.34	0.02	−11.67	0.63	0.31	−0.04	−0.06	0.98	0.42	−0.12
1997	−4.63	−3.88	3.43	−0.89	1.82	13.76	0.40	0.02	−10.81	0.59	0.26	0.00	−0.13	0.06	0.24	−0.02
1998	−5.56	−2.77	2.08	−0.40	1.47	13.49	0.45	0.05	−9.26	−2.21	0.13	0.09	−0.10	0.68	0.47	−0.08
1999	−3.40	−2.88	2.18	−0.57	1.70	14.08	0.77	0.04	−8.33	−3.20	−0.25	−0.07	−0.04	0.20	0.39	−0.04
2000	−0.94	−2.19	2.23	−0.73	1.75	13.33	0.65	0.02	−11.69	−1.86	−0.44	−0.09	−0.03	0.26	0.37	−0.02
2001	−2.41	−1.23	−0.46	−0.05	1.45	15.13	0.61	0.02	−9.67	−2.30	−0.22	−0.29	0.01	0.06	0.39	0.03
2002	−2.43	−3.45	0.06	−0.15	1.14	17.42	0.12	0.17	−7.75	−4.39	−0.12	−0.33	−0.07	−0.03	0.31	−0.01
2003	−2.37	−3.53	0.30	−0.64	1.15	17.39	0.18	−0.08	−3.31	−6.12	−0.35	−0.34	−0.03	0.03	0.21	0.05
2004	−4.04	−2.34	−0.02	−0.08	1.90	17.62	0.30	0.02	−2.51	−5.03	−0.24	−0.66	0.00	0.90	0.53	0.03
2005	−0.09	−0.92	−0.32	−0.06	2.07	19.34	0.84	0.01	−0.98	−3.45	−0.34	−0.30	−0.01	0.46	0.27	0.07
2006	−0.37	4.01	0.98	0.53	2.88	15.17	1.59	−0.01	−1.76	−17.68	−4.53	−2.65	−0.01	0.73	0.34	0.08
2007	4.60	5.28	1.13	0.31	3.56	12.88	1.18	0.12	−0.97	−20.42	−4.92	−4.57	−0.19	0.93	0.59	0.12
2008	5.06	4.84	1.03	0.31	3.97	12.98	0.92	0.07	−0.64	−19.23	−4.66	−5.84	−0.27	0.62	0.41	0.11
2009	3.34	4.15	0.89	0.21	3.59	15.49	1.19	0.06	0.25	−21.08	−4.29	−5.20	−0.19	0.33	0.59	0.15
2010	6.02	4.63	0.84	0.27	2.81	15.62	1.23	0.03	0.10	−23.55	−3.66	−5.76	−0.21	0.29	0.58	0.14

Source: Authors' calculation from the Bureau of Economic Analysis (BEA) international trade data.
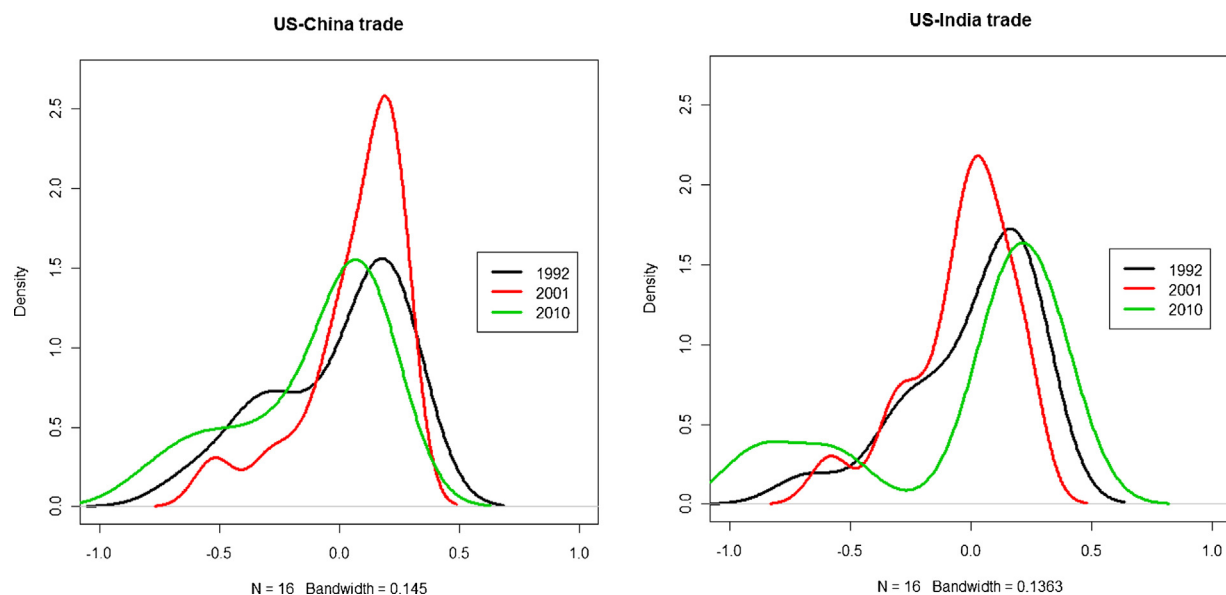
Fig. 1. Kernel density distributions of the RSCA index for U.S. services trade with China and India.
Source: Authors' plot based on RSCA measures calculated from the Bureau of Economic Analysis (BEA) international trade data.

Thus, the U.S. is more likely to gain a CA over India than to lose its initial dominance. If the U.S. initially lacked a CA, it had a 22% chance of obtaining it over a 3-year period and a 50% chance over a 10-year period. In contrast, if the initial situation favored the U.S. over India, the probability of a reversal was only between 14% and 26%, depending on the length of the transition horizons. The high and robust persistence of CA and CDA in trade with China produces less pronounced dynamics. In particular, the likelihood of the U.S. losing its CA to China was only between 12% and 16%, while China had an 18–20% chance of relinquishing its dominance.

Pailwar and Shah (2009) estimate transition probability matrices for India's services trade with the rest of the world rather than just with the U.S. Although they use annual transitions and a shorter sample period, their results for at least some industries, such as transportation, are in line with our findings. However, they also show that India is four times more likely to gain a CA in other business services than to lose it. These results might be biased because annual transitions are prone to the effects of short-run fluctuations.

The economic theories of international trade emphasize the differences in factor endowments and technology as the sources of CA. Since these structural features do not change frequently, any theory-consistent CA measure has to be stable over time. In this context, the distribution dynamics analysis can be considered a tool for assessing to what extent the RSCA

Table 4
Transition matrices for U.S. comparative advantage over different time horizons.

	U.S. RSCA over China		U.S. RSCA over India	
	CDA	CA	CDA	CA
3-year transitions				
CDA	81.7	18.3	77.6	22.4
CA	12.3	87.7	13.9	86.1
5-year transitions				
CDA	80.8	19.2	68.9	31.1
CA	15.8	84.3	15.8	82.5
10-year transitions				
CDA	80.0	20.0	50.0	50.0
CA	15.7	84.3	26.3	73.7

Source: Authors' estimation using the RSCA measures calculated from the Bureau of Economic Analysis (BEA) international trade data.
Note: CDA: comparative disadvantage; CA: comparative advantage. Each number represents the probability (in %) that the U.S. moves from an initial state (far left column) to a final state (top row) of comparative advantage over a given time horizons (3, 5, or 10 years). For example, the value of 81.7 in the first transition matrix indicates that if the U.S. has CDA over China in a particular service trade, on an average, there is 81.7% probability that it will still have CDA over China after 3 years. Similarly, the value of 18.3 indicates that there is an 18.3% probability that the U.S. will move from a position of CDA to a position of CA over China.

measures satisfy this criterion. As we see above, the RSCA measures for the U.S. vis-a-vis China are quite persistent which implies that if the U.S. has CA (or CDA) over China, it is unlikely to change quickly. Thus, in case of bilateral services trade between the U.S. and China, RSCA measures seem to reflect CA that is driven by the underlying differences in technology and factor endowments. In contrast, while the RSCA measures reflecting the U.S. CA over India are quite persistent even at 10-year interval, it is relatively less persistent in the case of U.S. CDA over India. This is not surprising given the fact that India's exports, particularly of information-intensive services in the late 1990s and the early 2000s, were driven primarily by the demand created in the U.S. Overall, the RSCA measures reported here seem to reflect the underlying CAs reasonably well.

4. Determinants of CA in U.S. bilateral services trade with China and India

It is pertinent to explore some of the intuitively plausible determinants of CA in the U.S. bilateral trade in services with China and India. The existing theories of international trade imply that differences in factor (labor, physical, and human capital) endowments, economies of scale, and technology could be major sources of comparative advantage. There are several issues that constrain our efforts in obtaining the appropriate data for examining all potential factors. First, there is no one-to-one mapping between the services trade items and the industrial classifications that BEA uses for collecting data on output, labor, and capital. This is further complicated by the fact that the industrial classifications used in China and India are different from those in the U.S. For the U.S., we use an unpublished mapping scheme obtained from BEA, while, for China and India, we try to match the industries based on our reading of the industry descriptions. Because of this imperfect matching, we could obtain data on some of the potential explanatory variables for only 11 industries in the case of India.[19] Second, the data on these variables for China and India are not available for the entire sample period. In particular, industry-level data in China are publicly available only for the late 2000s.

Furthermore, due to a lack of appropriate data, we use number of employees as the labor variable and gross fixed capital formation as the capital variable. Ideally, we would like to include the total number of hours worked and the stock of capital as the labor and capital variable, respectively. However, the data on the number of hours worked are available for neither China nor India. Furthermore, in general, it is difficult to measure capital stock primarily due to differences in prices of different capital goods over the period of their accumulation and a lack of appropriate depreciation measures for different types of capital goods. Although perpetual inventory method is used to calculate capital stock in the literature, adequate data are not available at the disaggregated level to carry out such an exercise for China and India. The proxies that we use are likely to introduce some biases in our estimation, particularly if their variations over time and across industries are not proportional to the variations in the actual variables they represent. However, the directions of these biases are hard to speculate on in the absence of relevant information on, for example, whether workers over-(under-)work in China or India relative to U.S. workers. Because of the issues discussed above, caution should be exercised in assessing the regression results that are suggestive at best.

Since our objective is to examine the effects of different factors on whether a country is likely to have a CA or not, we create a binary dependent variable that takes the value of 1 if the country has CA, and 0 otherwise. We use a pooled Probit model that has the following form:

$$P(y_{jt} = 1|\mathbf{x}_{jt}) = G(\mathbf{x}_{jt}\boldsymbol{\beta}) \tag{7}$$

where G is the standard normal cumulative distribution function.[20] $j = 1, 2, 3, \ldots, n$ indexes service categories and $t = 1, 2, \ldots, T$ indexes time. $\mathbf{x}$ is a vector of explanatory variables that include relative output (defined as natural logarithm of the ratio between industry j's output in the U.S. and that in China/India), relative capital per unit of output (measured by natural logarithm of the ratio between industry j's capital per unit in the U.S. and that in China/India) and relative labor per unit of output (measured by natural logarithm of the ratio between the number of workers per unit of output in industry j in the U.S. and that in China/India).[21] The first variable in this list measures the relative size of specific industries in the U.S. vis-a-vis China/India and is expected to reflect the difference in scale as a source of CA or CDA. If relative industry size reflects underlying relative scale of operations at the firm level and there are economies (diseconomies) of scale, the larger relative size should be a source of CA (CDA). The second and third variables are expected to reflect the relative abundance of capital and labor per unit of output in each industry as sources of CA or CDA in the U.S.[22] According to the traditional international trade theory, a country's relative abundance in a productive resource should be positively associated with its CA.

Note that the basic Heckscher–Ohlin model predicts that countries will have CA in (and will export) products (services) that use their respective abundant and cheap factors of production. However, the underlying assumption is that the productive resources (capital and labor) are perfectly mobile across different industries. In reality, this assumption does not hold when production of different goods requires different types of capital (specific to respective industries) and labor

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[19] The excluded industries are advertising, construction services, installation services, passenger services, and port services.

[20] For a discussion, see Wooldridge (2002), pp. 608–635.

[21] Since output is measured in U.S. dollars (USD), relative capital (labor) per unit of output refers to the relative amount of capital (in USD) or relative number of workers per USD worth of output in the U.S. vis-à-vis China or India.

[22] Since we use gross fixed capital formation to proxy capital, it represents new capital per unit of output.

Table 5
Probit estimates of comparative advantage in U.S. services trade with China and India.

| | U.S.–China | | U.S.–India | |
	(1)	(2)	(1)	(2)
Relative output	−0.839*** (0.191)	−1.157*** (0.235)	−0.001 (0.0003)	0.00007 (0.0004)
Relative capital per unit of output	−0.147 (0.091)	−0.306*** (0.115)	−0.0001 (0.003)	0.0002 (0.0003)
Relative labor per unit of output	0.143 (0.091)	0.302*** (0.115)	0.908*** (0.209)	1.418*** (0.248)
Relative FDI per unit of output		0.001*** (0.0004)		0.0002 (0.0003)
Relative schooling		11.523** (5.199)		8.076*** (1.753)
Information services dummy	0.821* (0.433)	0.712* (0.431)	−0.785*** (0.304)	−0.399 (0.348)
Log likelihood value	−63.977	−57.377	−111.01	−96.757
McFadden Pseudo R-squared	0.252	0.329	0.199	0.302
No. of service categories	16	16	11	11
No. of observations	131	131	209	209
Partial effects				
Relative output	−0.229***	−0.283***	−0.0002*	0.00002
Relative capital per unit of output	−0.040*	−0.075***	−0.00002	0.00005
Relative labor per unit of output	0.039	0.074***	0.273***	0.378***
Relative FDI per unit of output		0.0003***		0.00005
Relative schooling		2.822**		2.153***
Information services dummy	0.183**	0.151**	−0.268**	−0.114

Source: Authors' estimation.
Note: Dependent variable is a dummy variable that takes the value of 1 if U.S. has CA over China or India and 0 otherwise. All independent variables are expressed as the logarithm of the ratio of the U.S. level to that of its Asian trading partner. Standard errors are in parenthesis.
* $p < .10$.
** $p < .05$.
*** $p < .01$.

(with industry-specific skills). This is particularly the case in service industries. Thus, while labor, in general, is relatively abundant in both China and India than in the U.S., this is not necessarily true for labor employed by, say, education or management and consulting services. Therefore, instead of considering relative abundance in economy-wide capital and labor, we are considering industry-specific factor abundance between the U.S. and China or India.

Furthermore, we divide the service industries into two categories: information and physical services. Information services primarily involve creating, processing and communicating of information, such as royalties and license fees, education, finance, insurance, telecom, computer and information services, consulting, research and development, advertising, and legal services. Physical services, on the other hand, involve mostly physical tasks, such as transportation and passenger travel. To examine if such categorization would affect CA in U.S. bilateral services trade with China/India, we include a dummy variable that takes the value 1 for information services, and 0 otherwise.[23]

In addition to the baseline (parsimonious) specification outlined above, we further add other variables in an alternative specification, including relative FDI inflows per unit of output (measured by natural logarithm of the ratio between FDI per unit of output in industry j in the U.S. and that in China/India) and relative mean years of schooling (measured by natural logarithm of the ratio between mean years of schooling in the U.S. and that in China/India). Since FDI not only brings foreign capital but also technology with it, difference in FDI per unit of output can be a source of CA. Finally, relative schooling captures differences in human capital, which can also be a basis for CA.

The estimation results are presented in Table 5. We report the results for China in the first two columns and for India in the last two columns. Cols. (1) and (3) show the results for our baseline specification and Cols. (2) and (4) show the results for the alternative extended specification. While the signs and statistical significance of the coefficient estimates provide us with a sense about the direction and importance of the effects of the explanatory variables on the response probability, we cannot use their values to measure the partial effects of each of these variables. We, therefore, report the partial effects calculated at the sample mean in the bottom panel of Table 5. Each of these values represents change in the probability of the U.S. having CA as a result of one unit change in the corresponding explanatory variable, holding all other variables constant.

For the U.S.–China trade, the larger the size of the industry in the U.S., the lower is the probability of the U.S. having a CA in the corresponding service item. Drawing on the theoretical intuition of scale economies as a source of CA, it may seem counterintuitive. However, industry level data may not be reflective of scale economies that are usually determined at the firm level. Thus, with no additional information on industry structure in both countries, it is difficult to

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[23] Ideally, we would like to estimate the models with industry fixed effects and time fixed effects. However, formal tests suggest that time fixed effects are redundant. Although industry fixed effects together are not redundant, not all industry-specific factors are individually significant. Therefore, instead of using individual dummy for each industry, we use only one dummy based on information/physical categorization of the industries.

draw a conclusion. Relatively larger quantity of capital per unit of output also has a negative effect on the probability of the U.S. having a CA. This result is reminiscent of the Leontief paradox.[24] While it is difficult to speculate on any particular explanation, the higher capital cost per unit of output in the U.S. may be a potential source. Since the U.S. industries presumably already have had a larger stock of capital, adding more capital does not increase output as much as it does in China or India due to diminishing returns. Therefore, the capital cost per unit of output is higher in the U.S. than in China or India. Also, the coverage of data (types of capital assets) may not be exactly comparable between the U.S. and China. According to our results, relatively larger number of workers per unit of output has a positive and, in the case of the extended model, significant effect on the probability of the U.S. having CA. It seems to suggest that labor abundance at the level of industry may be a source of CA for the U.S. over China. Although China and India are abundant in labor, the U.S. has a large pool of skilled workers and, at the industry level, the relative abundance of skilled workers (which also indicates abundance of human capital) seem to be the source of CA. Receiving more FDI per unit of output and having relatively more schooling increase the chance of CA for the U.S. Finally, it is more likely to have CA over China in information intensive services.

For U.S.–India trade, the results suggest that relative size and relative capital availability do not have any significant impact on the probability of the U.S. having CA over India. In contrast, relative labor availability per unit of output has a significant positive impact on the probability. Both relative FDI and schooling have positive impact but only the effect of schooling is statistically significant. One interesting result is that the U.S. is more likely to have CDA vis-à-vis India in services that are information intensive. This is contrary to what we find for China and seems to fit well with the fact that India has been a major source of imports of information-intensive services for the U.S. in recent decades.

5. Concluding remarks

Since the 1990s, China has been accumulating overall trade surpluses while India has been running total trade deficits. However, in their services trade with the U.S., this pattern is reversed with China recording a trade deficit and India experiencing a surplus. Using bilateral trade data for 16 service categories, this paper examines the patterns, evolution, and determinants of CA in U.S. services trade with China and India over the period 1992–2010.

The results indicate that the U.S. has a CA over both Asian trading partners in most service categories. China and India have a CA in traditional services, such as travel, passenger fares, and transportation. However, India lost this advantage to the U.S. in recent years. In contrast, in the late 1990s the U.S. lost its CA to India in more modern information-intensive services, such as computer and information services, and management and consulting services. China has also gained CAs in these categories but only in the late 2000s. These findings are robust across different measures of CA.

Using kernel density distributions, we show that the distributions of CA in bilateral services trade changed significantly over the sample period. In particular, our analysis reveals a general shift of the distribution toward CA in favor of China. By comparison, the distribution for U.S. trade with India exhibits a bimodal polarization, suggesting that India, on the whole, is losing its CA, except in a few specific services. Furthermore, our findings show that the U.S. has a higher probability of maintaining its initial CA over India than its CDA. That is, the U.S. is more likely to gain a CA over India than to lose its initial dominance. In contrast, the U.S. CA (CDA) in trade with China exhibits high levels of persistence over time, resulting in less pronounced distributional dynamics.

The results from our regression analysis suggest that relative abundance of sector-specific labor, human capital, and FDI inflows have been significant sources of CA for the U.S. in its services trade with both China and India. The results also indicate that a service being information-intensive is a source of CA for the U.S. over China while it is a source of CDA for the U.S. over India. As services trade grows in China and India, these results may provide some directions for investment and trade policies in those countries. Since services have been a major driver of India's growth in the last two decades, formulating policies that promote services trade should be an area of high priority. Even for China, as manufacturing-led growth saturates and matures, the focus should be directed toward growth of services and services trade.

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[24] Leontief (1954) reported that the United States – the most capital-abundant country in the world – exported labor-intensive commodities and imported capital-intensive commodities, in contradiction with the prediction of the Heckscher–Ohlin theory.

Appendix 1

Table A1
Summary statistics of services trade data (millions of dollars).

Trade category	Export to China		Import from China		Export to India		Import from India	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Advertising	7.69	7.27	16.32	19.38	5.25	4.96	18.82	28.70
Construction	311.53	219.54	8.76	8.61	57.74	62.00	22.31	23.52
Education	1319.16	944.76	69.26	87.78	1329.05	988.37	16.16	19.07
Freight	450.95	346.50	1612.00	1257.75	159.05	64.56	67.32	42.22
Comp Info	71.84	76.71	187.32	341.04	86.58	77.21	1388.11	2281.08
Installation	221.37	186.84	41.35	49.67	45.05	44.41	8.29	12.29
Insurance	25.05	24.53	6.47	12.37	8.21	8.66	4.63	5.00
Legal	83.26	95.17	22.68	22.38	17.72	21.18	12.00	14.13
Management	137.68	218.50	123.89	202.41	46.47	58.95	314.53	525.14
Passenger	327.53	339.72	286.42	225.92	316.94	464.40	149.32	58.60
Port	708.42	362.52	245.95	162.98	61.79	38.21	48.05	15.00
RD	20.84	23.75	156.84	296.72	11.26	10.35	334.00	582.51
Royalties	931.26	935.37	57.76	55.75	253.37	297.67	35.47	49.07
Telecom	95.16	31.64	160.42	96.96	94.63	45.21	271.11	113.57
Travel	1263.95	944.00	1368.95	709.15	1301.37	885.14	1108.47	745.54

Source: Authors' calculations from the Bureau of Economic Analysis (BEA) international trade data.

Appendix 2

B.1. Definitions and coverage[25]

Travel: covers purchases of goods and services by U.S. travelers abroad and by foreign travelers in the United States. Unlike most other services categories, travel is not a specific type of service but an assortment of goods and services purchased by travelers.

Passenger fares: cover fares paid by residents of one country to airline and vessel operators (carriers) resident in other countries.

Freight transportation: charges are recorded in the U.S. international transactions accounts when shipping services are performed by the residents of one country for residents of other countries.

Port services: exports are the value of the goods and services procured by foreign carriers in U.S. ports (excluding purchases of fuel, which are included in the goods exports account); imports are the value of goods and services procured by U.S. carriers in foreign ports (excluding purchases of fuel, which are included in the goods imports account).

Royalties and license fees: cover transactions with foreign residents in rights to various types of intellectual property not included elsewhere in the accounts.

Education: exports measure foreign students' education expenditures in the United States. Foreign students are defined as individuals enrolled in institutions of higher education in the United States who are not U.S. citizens, immigrants, or refugees. Imports measure U.S. students' expenditures abroad. Students consist of U.S. residents who receive academic credit for study abroad from an accredited institution of higher education in the United States, and students who enroll directly with foreign institutions, including medical students, and receive no academic credit from U.S. institutions. The total of U.S. students' expenditures abroad is the sum of the estimates for the two groups of students.

Financial services: gross receipts (exports) and gross payments (imports) for financial services, primarily those for which an explicit commission or fee is charged; implicit fees for bond transactions are also included.

Insurance services: receipts (exports) and payments (imports) for both reinsurance and primary insurance. It consists predominantly of premiums, premium supplements in the form of investment income, and claims payable. A small amount is added to these estimates to cover auxiliary insurance services.

Telecommunications: measures gross receipts (exports) and gross payments (imports) for international telecommunications services; transactions are separated into those with unaffiliated entities and affiliated entities. Included are receipts and payments for (1) message telephone services, telex, telegram, and other jointly provided basic services; (2) private leased channel services; (3) value-added services such as (a) electronic mail, voice mail, code and protocol processing, and management and operation of data networks, (b) facsimile services and video-conferencing, (c) Internet connections, including online access services, Internet backbone services, router services, and broadband access services, (d) business communication and paging services provided by satellite connection, (e) telephony, interactive voice response, virtual private networking, remote access services, and voice over internet protocol, and (f) other value-added (enhanced) services; (4) support services related to the maintenance and repair of telecommunications equipment and ground station services; and (5) reciprocal exchanges such as transactions involving barter.

Computer and information services: includes both (a) computer and data processing services, such as data entry processing; computer systems analysis, design, and engineering; custom software and programming services; and (b) database and other

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[25] These definitions are compiled from the BEA website (www.bea.gov) and the WTO website (www.wto.org).

information systems, such as the provision of business and economic database services, including business news, stock quotation, and financial information services; medical, legal, technical, demographic, bibliographic, and similar database services; general news services, such as those purchased from a news syndicate; and reservation services and credit reporting and authorization systems.

Management and consulting services: includes management, consulting, and public relations services, and amounts received by a parent company from its affiliates for general overhead expenses related to these services.

Research, development, and testing services: includes commercial and noncommercial research, basic and applied research, and product development services.

Advertising: includes sale or leasing of advertising space or time; planning, creating and placement services of advertising; outdoor and aerial advertising and delivery of samples and other advertising materials.

Construction and related services (includes installation, maintenance, and repair services): includes construction work for buildings and civil engineering, installation and assembly work, building completion and finishing work.

Installation, maintenance, and repair series: covers maintenance and repair services by residents of one country on goods that are owned by residents of another country. The repairs may be performed at the site of the repair facility or elsewhere. Maintenance and repair of transport equipment, constructions, and computers are currently included each of the corresponding service categories.

Legal services: includes advisory and representations services for host country law, home country and/or third country law, international law, legal documentation and certification, other advisory and information services.

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