

India's comparative advantages in services trade

Hiranya K. Nath¹ · Binoy Goswami²

Received: 14 March 2017 / Revised: 19 January 2018 / Accepted: 29 January 2018 /
Published online: 12 February 2018
© Eurasia Business and Economics Society 2018

Abstract In the recent decades, India has not only experienced substantial growth in its services trade with the rest of the world but has also become a net exporter of services. Using the annual exports and imports data of 10 disaggregated service items from 2000 to 2013, this paper computes and analyzes various comparative advantage (CA) measures. The analysis reveals that India has had a CA in computer and information services and other business services (that include a wide range of information-intensive services) for the entire sample period. These two service categories together accounted for more than two-thirds of the total commercial services export from India. Furthermore, according to an alternative CA measure that considers intra-industry trade, India seems to have CA over the rest of the world in different services such as travel, communication services, and personal, cultural, and related services as well. This paper further explores the shape and dynamics of the distribution of the CA measures by employing a non-parametric method. The distributional dynamics analysis indicates that India is more likely to lose CA over the rest of the world than to gain dominance from a comparative disadvantage (CDA) position in services trade.

Keywords Services trade · Comparative advantage (CA) · Comparative disadvantage (CDA) · Revealed comparative advantage (RCA) · Revealed symmetric comparative advantage (RSCA) · Trade Balance Index (TBI) · India

JEL classifications F14 · O57

✉ Hiranya K. Nath
eco_hkn@shsu.edu

Binoy Goswami
binoygoswami@sau.ac.in

¹ Department of Economics and International Business, Sam Houston State University, Huntsville, TX 77341-2118, USA

² Department of Economics, South Asian University, New Delhi 110021, India

1 Introduction

With the growth of India's international trade, some interesting patterns have emerged. Since the introduction of the market oriented reforms and trade liberalization in 1991, trade as a percentage of GDP has grown about three-folds from 13.64% in 1991–1992 to 40.69% in 2013–2014.¹ India has been a net importer and has therefore been experiencing overall trade deficits. The rank of India is low among the exporters and importers of goods. However, India's rank is 6th among the exporters of services, and 9th among the services importers in the world.² The share of services in India's total trade (exports *plus* imports of both goods and services) increased from about 20% in 1995 to about 31% in 2006, which further declined to about 27% in 2013.³ Furthermore, India has been earning trade surpluses in services trade since 1998 with the only exception of 2001. Thus, services trade may have important influence on future economic growth and macroeconomic management. Therefore, this paper intends to examine the patterns and evolution of India's comparative advantage (CA) and comparative disadvantage (CDA) in various disaggregated services trade items.

The empirical literature on CA measures for different countries is large.⁴ However, a relatively small number of studies focus on CA measures in services trade. A paucity of relevant data and the peculiarities of services trade are primarily responsible for this state of the literature. Furthermore, only a limited number of previous studies focus on the services trade of India.^{5,6} According to Burange et al. (2010), the country had a robust CA only in commercial services over the period from 1980 to 2007. However, traditional services like transportation and travel are excluded from this service category. The study identifies trades in computer and information services as the primary driver of India's robust CA in commercial services. Using the same data and sample period but employing a more sophisticated methodology, Pailwar and Shah (2009) validate these findings. In contrast, Nath et al. (2015) use the data available for bilateral trade under 16 categories of different services for investigating the patterns, evolution, and determinants of CA in bilateral services trade between the U.S. and China and between the U.S. and India from 1992 to 2010. According to the results reported in that study, India and more recently China have acquired CA in modern services like computer and information services. Furthermore, the relative abundance of sector-specific labor, human capital, and FDI inflows are identified as significant sources of

¹ These figures are based on authors' calculations using the data obtained from the Handbook of Statistics on the Indian Economy published by the Reserve Bank of India (2016).

² See Mandal and Nath (2016).

³ Authors' calculation based on data collected from United Nations Conference on Trade and Development (UNCTAD) website (<http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx>).

⁴ Examples of this literature include Balassa (1965, 1986), Carolan et al. (1998), Bender and Li (2002), Fertö and Hubbard (2003), and Benedictis (2005).

⁵ In a study on the growth of service industries in China and India over the period 1993–2003, Wu (2007) identifies rising per-capita income, accelerated urbanization, and external demand as the primary drivers of the rapid expansion of the tertiary sector.

⁶ For comparative analyses of CAs in merchandise trade in China and India, please see Batra and Khan (2005) and Veeramani (2008).

CA for the U.S. over India (as well as China). Furthermore, Dash and Parida (2012, 2013) demonstrate that services export has contributed significantly to India's economic growth over the period 1996–2010.

Using the data of total export and import for 10 services under different categories, we examine the patterns and evolution of CA in India's services trade with the rest of the world from 2000 to 2013. Our results indicate that India has CA in computer and information services and other business services throughout the sample period. Furthermore, according to an alternative CA measure that considers intra-industry trade, it seems that India is in a comparatively advantageous position over the rest of the world in travel, communication services, and personal, cultural and related services as well. However, India has recently lost its advantageous position in communication services with regard to the rest of the world. The analysis of distributional dynamics suggests that in services trade it is more likely that India will lose CA vis-à-vis the rest of the world than to gain dominance from a position of CDA. To the best of our knowledge, this is the first study that examines the dynamics of India's CA over the rest of the world for various disaggregated service items.

The remainder of the paper is structured as follows. Section 2 discusses the methodology and data. The main empirical results are presented in Sect. 3. Section 4 includes a discussion of the results. Finally, our concluding remarks are presented in Sect. 5.

2 Methodology and data

2.1 Methodology

Although CA is a key concept in the international trade theory, its measurement involves formidable challenges. In theory, it is defined in terms of relative autarkic prices. However, once trade takes place these autarkic prices cannot be observed. Therefore, using relative export performance as a proxy for CA has been a standard practice in the empirical literature. Note that such a measure reflects both relative costs and differences in factor intensities. The revealed comparative advantage (RCA) index proposed by Balassa (1965) is one such widely-used measure. It is a ratio that represents the share of a given product in a country's total exports relative to the share of that product in the total world exports. If the share of a particular product or service in a country's total exports is relatively larger than its share in total world exports, the country is said to have CA in that product or service.⁷ Since this measure is based on *ex-post* export performance, some authors (e.g. Laursen 2015) would term it as a measure of international specialization rather than of international competitiveness.

The RCA index for India's trade in services is constructed as follows:

⁷ Since the RCA measures are not strictly based on the concept of comparative advantage as explained in the international trade theories, they are often criticized. Costinot et al. (2012) propose an empirical strategy for measuring Ricardian comparative advantage. It is based on the theoretical foundations and focuses on revealed productivity measures.

$$RCA_{India,j} = \frac{\left(\frac{X_{India,j}}{\sum_{j=1}^n X_{India,j}} \right)}{\left(\frac{X_{World,j}}{\sum_{j=1}^n X_{World,j}} \right)}, \quad (1)$$

where, $X_{India,j}$ denotes the value of India's exports of service j ($j = 1, \dots, n$) and $X_{World,j}$ is the value of world exports of service j . RCA index expresses the share of a given service in total Indian exports relative to the share of world exports in this service. The possible values of this index range from 0 to infinity. A value greater than 1 indicates that service j is more important in Indian service exports than in the total world exports and therefore India has CA in that service. In contrast, values between 0 and 1 suggest that India has CDA vis-à-vis the rest of the world.

There are two major problems with Balassa's RCA index. *First*, since the values on one side of unity cannot be compared with those on the other side, the measure is asymmetric.^{8,9} To deal with this issue, Dalum et al. (1998) suggested the transformation of the RCA index into:

$$RSCA_{India,j} = \frac{RCA_{India,j} - 1}{RCA_{India,j} + 1}. \quad (2)$$

RSCA represents the revealed symmetric comparative advantage. The values of RSCA index range between -1 and $+1$. While a positive value indicates that India has a CA, a negative value is an indication of India's CDA over the rest of the world in service j .

The other problem lies in its exclusive focus on relative export performance and utter neglect of the net trade flows and intra-industry trade. In order to address this issue, we employ the following modification of Lafay's (1992) trade balance index (TBI) as proposed by Bugamelli (2001):

$$TBI_{India,j} = \left[\frac{X_{India,j} - M_{India,j}}{X_{India,j} + M_{India,j}} - \frac{\sum_j X_{India,j} - \sum_j M_{India,j}}{\sum_j X_{India,j} + \sum_j M_{India,j}} \right] \times \frac{X_{India,j} + M_{India,j}}{\sum_j X_{India,j} + \sum_j M_{India,j}} \times 100. \quad (3)$$

The TBI index reflects service j 's contribution to India's overall balances in services trade with the rest of the world and its value varies from -50 to $+50$. A positive (negative) value implies that India is a net exporter (net importer) of service j to the rest of the world and therefore has CA (CDA) in providing service j relative to all other services.

One advantage of RSCA or TBI being symmetric is that it is possible to use a nonparametric methodology for investigating the shape and dynamics of the cross-

⁸ If we were simply interested in knowing the service items for which India has CA over the rest of the world, this would not be a serious problem. Symmetry is important because we also investigate the distributional dynamics of the CA measure in order to shed lights on the evolution of CA.

⁹ Laursen (2015) also shows how using asymmetric RCA in econometric analysis (e.g. regression analysis) leads to biases by assigning larger weights to values above 1 compared to those below.

sectional distribution of these indices. In particular, we use a kernel function to estimate the probability densities for this index. Let, X_1, \dots, X_n be a sample of n independent and identically distributed observations on a random variable X (RSCA in our case).¹⁰ The following kernel density estimator is used to estimate the density value, $f(x)$, at a given point x :

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

where, h is the bandwidth of the interval around x and K is the kernel function.¹¹ The Kernel estimator assigns a weight to each observation in the interval around x . This weight is inversely proportional to the distance between the observation and x . The density estimate is the vertical sum of frequencies at each observation. The smooth curve that results from this exercise helps us visualize the shape of the CA distribution across service items and study its evolution over time.

Furthermore, we estimate the eventual probability of India's losing or gaining its CA in services trade against the rest of the world to explore the distributional dynamics. To that end, we estimate a transition probability matrix. Let Q_t denote the distribution of the RSCA index across services at time t , then the distribution at time $t + \tau$ evolves as follows:

$$Q_{t+\tau} = M \times Q_t, \quad (5)$$

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

$$M = \begin{pmatrix} p_{11} & \dots & p_{1N} \\ \vdots & \ddots & \vdots \\ p_{N1} & \dots & p_{NN} \end{pmatrix}, \quad (6)$$

where p_{kl} with $k, l = 1, \dots, N$ is the probability that an initial state k in year t will make a transition to a state l in year $t + \tau$. The diagonal elements of the matrix represent the probabilities that an observation stays in the same state in t and $t + \tau$ and therefore are measures of persistence. Note that N , the number of states, is two and they correspond to CA and CDA respectively. We consider three different time horizons ($\tau = 3, 5, 10$) to study the transition dynamics.

2.2 Data

We obtain the data on India's trade in 10 different service items from the World Trade Organization (WTO)—Trade in Commercial Services Dataset during 2000–2013. The data are collected from the WTO website. WTO provides information on exports and imports of the following items, viz., overall commercial services, transport, travel, and other commercial services for the period 1980–2013

¹⁰ Nath et al. (2015) use a similar methodology for investigating the US bilateral CA/CDA over India and China.

¹¹ Data-driven bandwidth selection (likelihood cross validation) and a Gaussian kernel are used.

as per the fifth edition of the balance of payments manual. However, the disaggregated level data on other commercial services (i.e., data on items under other commercial services) are available only since 2000. The service items we consider in this study include transportation, travel, communications services, construction, insurance services, financial services, computer and information services, royalty and license fees, other business services, personal, cultural, and related services.¹² The availability of data primarily dictates the choices of the disaggregated service categories and the sample period.

Table 1 presents the summary statistics of the services trade items considered here. As the table indicates, computer and information services and other business services are the two largest services export items from India and they together account for about 70% of the total services exports. Among the import items, transportation has the largest portion with an average share of 46% followed by other business services with 24%.

3 Empirical results

3.1 Comparative advantage measures

The RCA and RSCA measures for India's trade in 10 service items are presented in Tables 2 and 3, respectively. Both the RCA and RSCA index take values for six items, namely, transportation, travel, insurance services, financial services, royalty and license fees, and personal, cultural, and related services, for the entire sample period, which indicate that India has CDA over the rest of the world in these services. For these six items, the RCA index takes values between 0 and 1, and the RSCA index takes negative values. Similarly, in the construction industry, the RCA values are between 0 and 1 and the RSCA values are negative for most of the sample period, except for the year 2000. In contrast, India is in a comparatively advantageous position in computer and information services and other business services for the entire sample period. However, in communications services, India was in a comparatively advantageous position until 2007 and then India lost her advantage to the rest of the world. This also happens to be the period of global financial and economic crisis. Nevertheless, further investigation is needed to establish whether there is a connection between India's loss of advantageous position in communication services and global financial and economic crisis.

To examine the robustness of our results, we calculate TBI. By taking into account not only the relative performance of exports but also of imports, this alternative CA measure is concerned about the biases that could arise due to the presence of intra-industry trade. Table 4 presents the TBI measures. A comparison

¹² Appendix table provides a list of the 10 items with their corresponding definitions according to WTO. Note that the services trade items that we study here do not necessarily represent services producing industries. They are services items as recorded in the balance of payments (BoP) transactions. The BoP methodology focuses on the products and services and not the industries. For example, as we discuss in the introduction, trade in computer services may include services provided either by computer services industry or by other industries (e.g., construction or finance).

Table 1 Summary statistics: 2000–2013

Services category	Export to world			Import from world		
	% share in total services exports	Mean (Millions of USD)	Coefficient of Variation (%)	% share in total services imports	Mean (Millions of USD)	Coefficient of Variation (%)
	(1)	(2)	(3)	(4)	(5)	(6)
Transportation	10.7	8863.51	66.21	46.1	30327.09	65.28
Travel	11.9	9912.94	56.57	11.4	7525.11	49.99
Communications services	1.9	1580.53	38.19	1.2	816.66	47.60
Construction	0.7	604.55	51.97	1.3	839.87	40.00
Insurance services	1.5	1251.58	62.14	4.9	3251.21	63.81
Financial services	3.4	2844.81	82.68	4.8	3184.68	76.12
Computer and information services	30.2	25111.16	65.86	2.9	1887.53	55.77
Royalties and license fees	0.2	155.92	81.93	2.3	1523.18	85.14
Other business services	38.9	32406.81	37.55	24.6	16161.89	56.12
Personal, cultural and recreational services	0.6	478.16	73.06	0.5	314.39	68.45
Total Commercial services		76561.65	65.22		68038.54	61.85

Source: Authors' calculation from WTO data

of TBI with RSCA suggests that from these two measures, it is possible to conclude that India's CA/CDA is identical for seven service items. However, for travel, TBI indicates that India is a net exporter, and therefore has a CA over the rest of the world. Similarly, according to TBI, India has been a net exporter of communications services (and therefore has CA) for almost the entire sample period except for 2002. Furthermore, in case of personal, cultural, and related services, India seems to have CA for most of the years, although it lost its advantageous position in 2004–2005 and again in 2010–2011. Thus, taking into consideration the inputs, i.e., intra-industry trade, India seems to have CA over the rest of the world in travel, communication services, and personal, cultural, and related services.

The following general conclusions can be drawn from our results. *First*, India has always had CA over the rest of the world in computer and information services and other business services. *Second*, with the correction of the biases induced by intra-industry trade, India seemed to have CA vis-a-vis the rest of the world in travel, communication services, and personal, cultural, and related services as well. The

Table 2 Revealed comparative advantage (RCA): 2000–2013

Years/ items	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Transportation	Travel	Communications service	Construction	Insurance services	Financial services	Computer & information services	Royalties & license fees	Other business services	Personal, cultural, and recreational services
2000	0.53	0.68	1.62	1.55	0.86	0.26	8.25	0.08		
2001	0.54	0.61	2.70	0.18	0.84	0.29	9.94	0.04		
2002	0.58	0.53	1.74	0.55	0.62	0.5	9.31	0.02		
2003	0.59	0.64	1.69	0.55	0.59	0.24	8.95	0.02		
2004	0.52	0.56	1.21	0.66	0.88	0.13	7.71	0.02	1.39	0.12
2005	0.49	0.51	1.27	0.3	0.92	0.31	7.47	0.06	1.47	0.23
2006	0.49	0.46	1.25	0.37	0.73	0.43	6.97	0.01	1.49	0.53
2007	0.47	0.48	1.12	0.34	0.78	0.45	6.95	0.03	1.44	0.75
2008	0.47	0.44	0.91	0.27	0.67	0.52	6.62	0.02	1.43	0.87
2009	0.60	0.48	0.79	0.28	0.6	0.52	6.44	0.03	1.15	0.59
2010	0.54	0.5	0.52	0.17	0.61	0.68	5.99	0.02	1.15	0.33
2011	0.62	0.52	0.49	0.24	0.76	0.61	5.67	0.03	1.07	0.28
2012	0.59	0.49	0.45	0.26	0.65	0.5	5.45	0.03	1.24	0.59
2013	0.57	0.48	0.56	0.36	0.64	0.55	5.31	0.04	1.26	0.89
Average	0.54	0.53	1.17	0.43	0.73	0.43	7.22	0.03	1.31	0.52
SD	0.05	0.07	0.63	0.35	0.11	0.16	1.47	0.02	0.15	0.27

Source: Authors' calculation from WTO data

Table 3 Revealed Symmetric Comparative Advantage (RSCA): 2000 - 2013

Years/ items	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Transportation	Travel	Communications service	Construction	Insurance services	Financial services	Computer and information services	Royalties and license fees	Other business services	Personal, cultural, and recreational services
2000	- 0.31	- 0.19	0.24	0.21	- 0.07	- 0.58	0.78	- 0.85		
2001	- 0.30	- 0.24	0.46	- 0.69	- 0.09	- 0.55	0.82	- 0.93		
2002	- 0.26	- 0.31	0.27	- 0.29	- 0.23	- 0.33	0.81	- 0.97		
2003	- 0.26	- 0.22	0.26	- 0.29	- 0.26	- 0.61	0.80	- 0.97		
2004	- 0.32	- 0.28	0.09	- 0.20	- 0.06	- 0.77	0.77	- 0.96	0.16	- 0.79
2005	- 0.34	- 0.32	0.12	- 0.54	- 0.04	- 0.53	0.76	- 0.88	0.19	- 0.63
2006	- 0.34	- 0.37	0.11	- 0.46	- 0.15	- 0.40	0.75	- 0.97	0.20	- 0.31
2007	- 0.36	- 0.35	0.06	- 0.49	- 0.13	- 0.38	0.75	- 0.94	0.18	- 0.14
2008	- 0.36	- 0.39	- 0.04	- 0.57	- 0.19	- 0.32	0.74	- 0.95	0.18	- 0.07
2009	- 0.25	- 0.35	- 0.12	- 0.56	- 0.25	- 0.32	0.73	- 0.94	0.07	- 0.26
2010	- 0.30	- 0.33	- 0.31	- 0.70	- 0.25	- 0.19	0.71	- 0.97	0.07	- 0.51
2011	- 0.23	- 0.32	- 0.35	- 0.61	- 0.13	- 0.24	0.70	- 0.94	0.03	- 0.57
2012	- 0.25	- 0.34	- 0.38	- 0.59	- 0.21	- 0.33	0.69	- 0.94	0.11	- 0.26
2013	- 0.27	- 0.35	- 0.28	- 0.47	- 0.22	- 0.29	0.68	- 0.92	0.11	- 0.06
Average	- 0.30	- 0.31	0.01	- 0.45	- 0.16	- 0.42	0.75	- 0.94	0.13	- 0.36
SD	0.04	0.06	0.26	0.24	0.08	0.16	0.04	0.04	0.06	0.25

Source: Authors' calculation from WTO data

Table 4 Trade Balance Index (TBI): 2000–2013

Years/ items	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Transportation	Travel	Communications service	Construction	Insurance services	Financial services	Computer and information services	Royalties and license fees	Other business services	Personal, cultural, and recreational services
2000	-16.74	3.65	1.58	1.22	-1.34	-2.50	11.02	-0.49		
2001	-15.26	1.91	2.59	-0.99	-1.20	-3.56	15.30	-0.69		
2002	-14.02	0.92	-0.37	-0.84	-1.28	-1.88	15.00	-0.78		
2003	-12.47	2.18	0.81	-1.86	-1.50	-0.21	16.72	-1.06		
2004	-12.97	1.31	0.62	-0.49	-1.36	-0.67	14.65	-0.80	-0.27	-0.03
2005	-16.52	0.57	1.05	-0.31	-1.58	0.17	14.01	-0.52	3.14	-0.01
2006	-15.78	0.33	1.04	-0.23	-1.48	0.02	13.59	-0.68	3.05	0.13
2007	-16.51	0.35	0.73	-0.08	-1.38	-0.34	13.17	-0.72	4.61	0.17
2008	-18.69	0.07	0.56	-0.01	-1.72	-0.01	14.51	-0.79	5.93	0.14
2009	-16.27	0.18	0.30	-0.24	-1.70	-0.40	16.03	-1.06	4.19	0.04
2010	-14.73	1.61	0.15	-0.21	-1.44	-0.48	15.63	-1.02	3.61	-0.06
2011	-16.90	0.88	0.03	-0.15	-1.56	-1.08	15.66	-1.03	3.92	-0.01
2012	-17.50	1.35	0.16	-0.11	-1.72	-0.13	15.15	-1.44	4.81	0.05
2013	-17.15	1.44	0.27	-0.15	-1.66	-0.25	15.20	-1.41	5.60	0.12
Average	-15.82	1.20	0.68	-0.32	-1.49	-0.81	14.69	-0.89	3.86	0.05
SD	1.76	0.96	0.74	0.67	0.17	1.09	1.42	0.29	1.74	0.08

Source: Authors' calculation from WTO data

information technology (IT) boom in the U.S. benefitted India since the 1990s as a large number of relatively cheap, skilled, English-speaking engineers and other IT professionals got employment and they could satisfy the growing demand for such services in the developed countries.

3.2 Consistency of CA measures

Although there are agreements among the three indices on the general patterns of RCA for most cases, specific results may have been sensitive to the index used. Therefore, we would like to conduct the formal tests of consistency among these three measures.¹³ Since we have used the indices to identify whether India has CA or CDA over the rest of the world, the test for consistency of the indices as dichotomous measures is the most relevant.¹⁴ This test involves using the share of product or service groups in which both of the paired indices suggest CA or CDA. For the test, the criterion for consistency is “ ≥ 70 ”. In Table 5, the results are reported and they suggest that all three CA measures (RCA, RSCA, and TBI) are consistent with each other.

3.3 Distribution dynamics

In this subsection, we entirely focus on RSCA index. As mentioned earlier, the RSCA index being a symmetric measure of CA, the nonparametric methodology can be conveniently applied for examining the shape and dynamics of its distribution over various services. Besides, as Laursen (2015) shows RSCA “is the best measure of comparative advantage” (p. 113) among several alternatives used in the literature. The kernel density distributions of the RSCA index are presented in Fig. 1. There is a concentration of the probability mass around the value of -0.5 in 2000, which indicates that India had CDA in most services during the sample period. In the subsequent years, the mode shifted slightly to the right but remained below 0.

The distribution in 2000 and 2005 also indicates the presence of large variance in the RSCA index. However, the variance decreased significantly, which led to an even stronger concentration of density around -0.25 . The appearance of a smaller mode on the right tail of the distribution further indicates that by 2010, India consolidated its CA, albeit over only a few (two to be more specific) service items. In 2013, another smaller mode can be detected on the left tail of the distribution along with the one on the right. This suggests that India’s CDA over a few service items also became consolidated at the lower end (stronger CDA), while major

¹³ Following suggestions of Balance et al. (1987), Fertő and Hubbard (2003) conducted simple statistical tests to examine the consistency of various measures in identifying CA in Hungarian data.

¹⁴ There are other tests used in the literature. For example, depending on whether the CA measures are interpreted as cardinal measures (extent of CA/CDA in a product or a service) or ordinal measures (ranking of products or services by degree of CA/CDA), the literature suggests two different consistency tests. The consistency test of the indices as cardinal measures is based on pairwise correlation coefficients for each year during the sample period. Likewise, the pairwise rank correlation coefficients are used to test consistency of the indices as ordinal measures.

Table 5 Consistency test results

Correlation	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
RCA vs. TBI	100	100	100	100	100	100	100	100	100	100	100	100	100	100
RSCA vs. TBI	88.89	88.89	87.5	88.89	80	80	70	80	70	70	80	80	70	70
RCA vs. RSCA	88.89	88.89	87.5	88.89	80	80	70	80	70	70	80	80	70	70

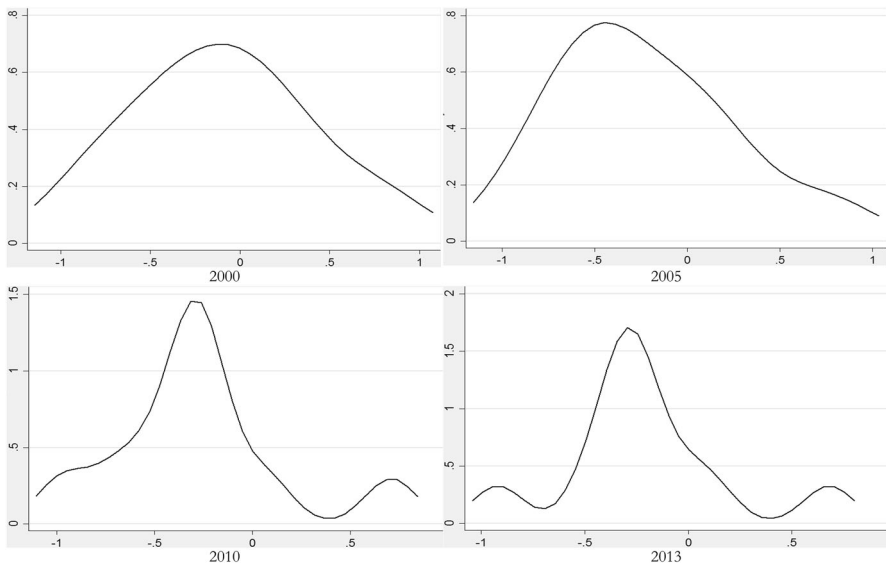


Fig. 1 Kernel density distributions of the RSCA index for India's services trade with the rest of the world

clusters were formed just below the threshold. The evolution of a multimodal distribution from one with a prominent single mode may indicate resource mobilization around a few specialized services at the cost of some others.

Furthermore, we estimate the probability of India in maintaining, gaining or losing its CA over three different time horizons in order to examine the distribution dynamics. Table 6 presents the corresponding transition matrices. The probability of India's maintaining the initial CDA or CA in trade over the rest of the world (presented along the diagonals in the matrices in Table 6) varies between 100 and 44%. While there is no change in CDA persistence (i.e., the probability of CDA is 100% in all the three time horizons considered), there is significant decrease in the probability of maintaining CA. It decreased from 83.33% at 3-year transition to about 44% at 10-year transition horizon. This further suggests that the probability of India's losing its CA is relatively higher than the probability of switching from CDA to CA. This result accords well with the findings reported by Nath et al. (2015), wherein bilateral services trade is considered between the US and India.

In an earlier study, Pailwar and Shah (2009) report the transition probability matrices for India's services trade with the rest of the world. Although annual transitions and a shorter sample period were employed, the results obtained in this study are in line with our findings for at least some industries, such as transportation. Furthermore, according to their study, India is four times more likely to acquire CA in other business services than to lose it. Since the annual transitions are prone to the effects of short-run fluctuations, these results may have been biased.

The international trade theories underscore the importance of differences in factor endowments and technology for CA. Since changes in these structural

Table 6 Transition matrices for India's comparative advantage over different time horizons

	CDA	CA
3-year transitions		
CDA	100.00	0.00
CA	16.67	83.33
5-year transitions		
CDA	100.00	0.00
CA	26.09	73.91
10-year transitions		
CDA	100.00	0.00
CA	55.55	44.45

CDA: Comparative Disadvantage. CA: Comparative Advantage. Each number represents the probability (in %) that India moves from an initial state (as indicated in the far left column) to a final state (as indicated in the top row) of CA or CDA over a given time horizon (3, 5, or 10 years). For example, the value of 100.00 in the first transition matrix indicates that if India has CDA vis-a-vis the world in a particular service trade, on an average, there is 100.00% probability that it will still have CDA after 3 years. Similarly, the value of 16.67 indicates that there is a 16.67% probability that India will move from a position of CA to a position of CDA over the rest of the world

Source: Authors' estimation using the RSCA measures calculated from the WTO trade in commercial services data

features do not take place frequently, any CA measure consistent with the theory has to be stable over time. Interestingly, the analysis of distribution dynamics could be a tool for assessing the extent to which the RSCA measures satisfy this stability condition. As indicated by our results, the RSCA measures for India are quite persistent (at least up to 5 years) and they are unlikely to change quickly. Accordingly, the RSCA measures in the current study seem to be consistent with the theoretical concept of CA that is driven by the underlying differences in factor endowments.

4 Discussion

Since it is difficult to map the BoP transactions to specific industries, it is indeed challenging to conduct a formal analysis of the factors determining India's comparative advantages in the service items as indicated by our results using appropriate data. Therefore, we resort to a discussion of the results based on the existing studies that have identified several factors for the growth of exports in various services.

First, low cost physical infrastructure like telecom, transport, and power contributes to the exports of computer and information, business, and travel services by developing human capital that leads to an increase in the productivity of the labor force and boost entrepreneurship (see Sahoo and Dash 2014; Bhattacharjee and Chakrabarti 2015). Telecom infrastructure is the primary vehicle of information and

communication technology (ICT) and communication services. The telecom revolution that started in the mid-1990s with the assistance of low cost and widespread telecommunication network led to India's success in software and communication services. The reform measures adopted in telecommunication and software sector (that include lower tax and tariff obligations) have facilitated India's integration into the global economy.

Second, in spite of wage inflation in India, the Indian information technology (IT) industry continues to have cost advantage over its counterparts in the US and Europe as low cost skilled labor is available in the country. With a favorable demographic profile, India's large pool of technically trained labor force with English language proficiency and exposure to frontier technology have complemented this cost advantage (Arora and Athreye 2002 and Joshi and Mudigonda 2008). The higher wages offered by the Indian software industry relative to the wages in the manufacturing sector attracts a large pool of youths to acquire required education and skills for this sector that ensures a sustained supply of workforce. Consequently, India has been able to sustain its cost advantage for a long period of time (Balasubramanyam and Balasubramanyam 1997). Additionally, the Indian software industry has also moved higher up the value chain for maintaining the competitive edge through standardization and automation of business processes, process innovation, delivery excellence, and so on (Bhattacharjee and Chakrabarti 2015, NASSCOM 2013). Burange et al. (2010) further emphasize that India's CA in computer and information services and other business services can be possibly maintained depending on the role of low cost but high quality human capital. Innovations in areas like organizational structure, value based pricing models, domain expertise and so on are shifting business to tier 2 and tier 3 cities. This has been enabled by improvement in the required infrastructure, which involves less cost, incorporation of the global delivery model, and adoption of international quality certification; all these further contributed to the cost advantage and expansion of the industry in India (Bhattacharjee and Chakrabarti, 2015).¹⁵

Third, after the economic reforms and liberalization of the 1990s, the inflow of foreign direct investment (FDI) increased significantly. In particular, the IT industry received substantial foreign capital. The availability of highly educated and English speaking work force and a favorable policy environment attracted FDI. This has had an impact on providing India a comparatively advantageous position in the computer and information, and business services by augmenting skills of the work force and by improving market penetration potential.

Fourth, Burange et al. (2010) and Bhattacharjee and Chakrabarti (2015) further highlighted the role that the time zone plays to India's advantage. The gap between Indian and overseas markets (like the USA) time zone is about 8–12 h, which allows India to provide round-the-clock services like business process outsourcing services to its clients. Further, it allows the Indian companies to work in shifts and make better utilization of their resources.

¹⁵ This enables firms to estimate time and resources required for a project and thereby allow them to bid for challenging projects.

Fifth, Sahoo and Dash (2014) discuss about the economic freedom index, which is a proxy for better institutional quality and positively influences the computer and information services. Better institution improves the confidence of the importers of services. Regional trade agreements have also favorable impacts on these services. Note that the National Association of Software and Services Companies (NASSCOM) has represented Indian IT and ITeS companies as a strong unified force and played a pivotal role in the industry's policy-making process (Goswami et al. 2009). In order to diversify Indian software exports beyond Japan, Western Europe, and North America, NASSCOM has signed several trade contracts with such countries as Ireland, Israel, Mexico, Morocco, and Singapore.

Sixth, the large Indian diaspora in the Silicon Valley of the US has contributed positively to the Indian computer and information services. Furthermore, the presence of large Indian diaspora in the US acts as a signal of Indian workforce's credibility and brings back substantial business to India: "half of the Indian diaspora in the Silicon Valley had business contracts in India and a quarter had actually invested in an Indian start-up" (Bhattacharjee and Chakrabarti 2015). This has also contributed to the growth of the IT industry and the exports of IT-related services.

Seventh, the structure of the Indian IT industry is also a source of its comparative advantage. The industry is like a pyramid with a few major firms at the top and numerous small firms at the bottom. Contrary to the popular belief, such a structure has instilled fierce competition. "The competition is unique in the sense that while large integrated players offer bundled solutions that encompass the entire value chain of IT; small and emerging players excel in niche services/verticals so as to circumvent the competition from the industry majors. The presence of a large number of players of varying sizes, offering a plethora of services that encompass the entire value chain have made the industry internationally competitive and it remains the most favored destination for projects and contracts" (Bhattacharjee and Chakrabarti 2015, p. 25). The prevalence of fixed price contracts preferred by international contracts is also one reason behind the phenomenal increase in the exports of services by the industry (Banerjee and Dufo 2000).

Finally, among 141 economies worldwide, India's rank is 52 according to the Travel and Tourism Competitive Report 2015 prepared by the World Economic Forum. With many natural and cultural world heritage sites, relatively better environment, low cost road, and railway transport network throughout the country, India attracts large number of tourists, which in turn leads to increase in the export travel services. With increasing pace of globalization and the increase in economic activities, the number of business travellers has increased. Moreover, medical and health tourism has also shown a surge with the passage of time (Burange et al. 2010).

5 Concluding remarks

Using annual exports and imports data for 10 disaggregated service items from 2000 to 2013, this paper computes and analyzes various comparative advantage (CA) measures. The analysis reveals that India had a CA in computer and information services and other business services (that include a wide range of information-intensive services) for the entire sample period. These two categories of services accounted for more than two-thirds of total commercial services exports from India. Additionally, according to an alternative CA measure that considers intra-industry trade, India seems to have CA over the rest of the world in travel, communication services, and personal, cultural and related services as well. This paper further explores the shape and dynamics of the distribution of the CA measures by employing a nonparametric method. The distributional dynamics analysis indicates that India is more likely to lose CA over the rest of the world than to gain dominance in services trade. Several factors probably contribute to these patterns and dynamics of India's services trade.

The results presented in this paper have important policy implications. The government policy should aim at promoting computer and information services and various business services industries. Given that there are a large number of tourist destinations in the country, the promotion of tourism and travel will also help the country earn foreign exchanges. Furthermore, with the growth in business and economic activities, there will be growth in business travels.

Acknowledgements The authors are grateful to an anonymous reviewer and the Managing Editor of the journal for their comments. A major part of this research was conducted when Nath was a Visiting Professor at the Department of Humanities and Social Sciences, Indian Institute of Technology—Guwahati (IITG), India, during the 2016–17 academic year. He is grateful to IITG for its hospitality and support. An earlier version of the paper was presented at the 86th Annual Meetings of Southern Economic Association held in Washington, D.C. (USA) in November 2016 and at the School of Economics, University of Hyderabad, India, in April 2017. The authors would like to thank Zachary H. Cohle and other session participants at the conference and Phanindra Goyari and the seminar participants at the university for their valuable comments. The usual disclaimer applies.

Appendix

See Table 7.

Table 7 Services trade items and WTO definitions

Sl. no.	Trade items	WTO definition
1	Transportation	Covers sea, air and other including land, internal waterway, space and pipeline transport services that are performed by residents of one economy for those of another, and that involve the carriage of passengers, the movement of goods (freight), rentals (charters) of carriers with crew, and related supporting and auxiliary services
2	Travel	Includes goods and services acquired by personal travelers, for health, education or other purposes, and by business travelers
3	Communications services	Includes telecommunications, postal and courier services. Telecommunications services encompass the transmission of sound, images or other information by telephone, telex, telegram, radio and television cable and broadcasting, satellite, electronic mail, facsimile services etc., including business network services, teleconferencing and support services. It does not include the value of the information transported. Also included are cellular telephone services, Internet backbone services and on-line access services, including provision of access to the Internet
4	Computer services	Includes hardware and software related services and data processing services
5	Construction	Covers work performed on construction projects and installation by employees of an enterprise in locations outside the territory of the enterprise
6	Insurance services	Covers the provision of various types of insurance to non-residents by resident insurance enterprises, and vice versa, for example, freight insurance, direct insurance (e.g. life) and reinsurance
7	Financial services	Includes financial intermediation and auxiliary services provided by banks, stock exchanges, factoring enterprises, credit card enterprises, and other enterprises
8	Royalty and license fees	Covers payments and receipts for the use of intangible non-financial assets and proprietary rights, such as patents, copyrights, trademarks, industrial processes, and franchises
9	Other business services	Comprises trade-related services, operational leasing (rentals), and miscellaneous business, professional and technical services such as legal, accounting, management consulting, public relations services, advertising, market research and public opinion polling, research and development services, architectural, engineering, and other technical services, agricultural, mining and on-site processing
10	Personal, cultural, and recreational services	Is subdivided into two categories, (i) audiovisual services and (ii) other cultural and recreational services. The first component includes services and fees related to the production of motion pictures, radio and television programs, and musical recordings. Other personal, cultural, and recreational services include services such as those associated with museums, libraries, archives, and other cultural, sporting, and recreational activities

Source: WTO Statistical Datasets Technical Notes

References

- Arora, A., & Athreye, S. (2002). The software industry and India's economic development. *Information Economics and Policy*, 14(2), 253–273.
- Balance, R. H., Forstner, H., & Murray, T. (1987). Consistency tests of alternative measures of comparative advantage. *Review of Economics and Statistics*, 69(1), 157–161.
- Balassa, B. (1965). Trade liberalization and 'revealed' comparative advantage. *The Manchester School of Economics and Social Studies*, 33(2), 99–123.
- Balassa, B. (1986). Comparative advantage in manufactured goods: A reappraisal. *Review of Economics and Statistics*, 68(2), 315–319.
- Balasubramanyam, A., & Balasubramanyam, V. N. (1997). Singer, services and software. *World Development*, 25(11), 1857–1861.
- Banerjee, A. V., & Duflo, E. (2000). Reputation effects and the limits of contracting: a study of the Indian software industry. *The Quarterly Journal of Economics*, 115(3), 989–1017.
- Batra, A., & Khan, Z. (2005). *Revealed comparative advantage: An Analysis For India and China*. ICRIER Working Paper, 168. New Delhi: Indian Council for Research on International Economic Relations.
- Bender, S., & Li, K.W. (2002). *The changing trade and revealed comparative advantages of Asian and Latin American manufactured exports*. Center Discussion Paper, 843. New Haven: Economic Growth Center, Yale University.
- Benedictis, L. D. (2005). Three decades of Italian comparative advantages. *The World Economy*, 28(11), 1679–1709.
- Bhattacharjee, S., & Chakrabarti, D. (2015). Investigating India's competitive edge in the IT-ITeS sector. *IIMB Management Review*, 27(1), 19–34.
- Bugamelli, M. (2001). A Model of Specialization for Italy and the Main European Countries: Homogeneity and Convergence. *Bank of Italy Discussion Paper*, 402.
- Burange, L. G., Chaddha, S. J., & Kapoor, P. (2010). India's Trade in Services. *Indian Economic Journal*, 58(2), 44–62.
- Carolan, T., Singh, N., & Talati, C. (1998). The composition of U.S.-East Asia Trade and changing comparative advantage. *Journal of Development Economics*, 57(2), 361–389.
- Costinot, A., Donaldson, D., & Komunjer, I. (2012). What goods do countries trade? A quantitative exploration of Ricardo's ideas. *Review of Economic Studies*, 79(2), 581–608.
- Dalum, B., Laursen, K., & Villumsen, G. (1998). Structural change in OECD export specialisation patterns: De-specialisation and 'stickiness'. *International Review of Applied Economics*, 12(3), 423–443.
- Dash, R. K., & Parida, P. C. (2012). Services trade and economic growth in India: An analysis in the post-reform period. *International Journal of Economics and Business Research*, 4(3), 326–345.
- Dash, R. K., & Parida, P. C. (2013). FDI, services trade and economic growth in India: Empirical evidence on causal links. *Empirical Economics*, 45(1), 217–238.
- Fertő, I., & Hubbard, L. J. (2003). Revealed comparative advantage and competitiveness in Hungarian agri-food sectors. *The World Economy*, 26(2), 247–259.
- Goswami, A. G., Mattoo, A., & Sáez, S. (2009). *Exporting services: A developing country perspective*. Washington DC: World Bank.
- Joshi, K., & Mudigonda, S. (2008). An analysis of India's future attractiveness as an offshore destination for IT and IT-enabled services. *Journal of Information Technology*, 23(4), 215–227.
- Lafay, J. (1992). The measurement of revealed comparative advantage. In M. G. Dagenais & P. A. Muet (Eds.), *International trade modelling* (pp. 220–236). London: Chapman & Hall.
- Laursen, K. (2015). Revealed comparative advantage and the alternatives as measures of international specialization. *Eurasian Business Review*, 5, 99–115.
- Mandal, R., & Nath, H. K. (2016). Services trade in emerging market economies. In Rajagopal & R. Behl (Eds.) *Business Analytics and Cyber Security Management in Organizations* (pp. 64–83). Hershey: IGI Global.
- NASSCOM. (2013). *The IT-BPM sector in India: Strategic review 2013*. New Delhi: NASSCOM.
- Nath, H. K., Liu, L., & Tochkov, K. (2015). Comparative advantages in U.S. Bilateral services trade with China and India. *Journal of Asian Economics*, 38, 79–92.
- Pailwar, V. K., & Shah, N. R. (2009). Revealed comparative advantages for India in services trade. *International Journal of Trade and Global Markets*, 2(2), 109–127.

- Reserve Bank of India (2016). *Handbook of statistics on the Indian economy*. <https://dbie.rbi.org.in/DBIE/dbie.rbi?site=publications>. Accessed 30 Oct 2016.
- Sahoo, P., & Dash, R. K. (2014). India's surge in modern services exports: Empirics for policy. *Journal of Policy Modelling*, 36(6), 1082–1100.
- Veeramani, C. (2008). India and China: Changing patterns of comparative advantage? In R. Radhakrishna (Ed.), *India development report 2008* (pp. 145–156). New Delhi: Oxford University Press.
- Wu, Y. (2007). Service sector growth in China and India: A comparison. *China: An International Journal*, 5(1), 137–154.