

MODERN SERVICES EXPORT PERFORMANCES AMONG EMERGING AND DEVELOPED ASIAN ECONOMIES

Shahbaz Nasir and Kaliappa Kalirajan

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Modern Services Export Performances among Emerging and Developed Asian Economies*

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Abstract

Advancements in information and communications technologies (ICTs) have expanded the possibilities for trade in modern services and many Asian emerging and developed economies are increasingly participating in these new trade activities. This study examines the export performances of emerging and developed Asian economies in selected modern services—computer and information, business and professional, and telecommunications—using a stochastic frontier gravity model. Estimation results show that the performances of emerging economies in South Asia and the Association of Southeast Asian Nations (ASEAN), in terms of realization of export potential, are considerably weaker than those of developed economies in North America and Europe. The results also show that the number of graduates and the quality of ICT infrastructure in emerging countries are among the key factors in realizing services export potential. These findings suggest that emerging economies need to remove “behind-the-border” constraints and adopt advanced technologies in order to catch up with high-performing developed countries.

Keywords: Service exports, stochastic frontier gravity model, Asia, North America, and Europe.

JEL Classification: F14, C24

1. Introduction

Over the past 2 decades, technological developments, the liberalization of the services trade, and rising shares of services in most economies have resulted in the increasing globalization of services. In terms of world gross domestic product (GDP), the share of services has increased from 59% in 1985 to 71% in 2011, underlying the tremendous scope for trade in services. Also, unprecedented advancements in information and communications technologies (ICTs) have made it possible to provide many services across borders without the physical movement of persons. In the literature, modern services are broadly defined as commercial services excluding the traditional services of transport and travel (Ghani 2010 and Ghani and Anand 2009). ICT advances have revolutionized trade possibilities in modern services, especially telecommunications, computer and information, banking, insurance, and other business services. Given these developments, modern services exports are growing more rapidly than traditional services exports, such as transport and travel services, reaching \$2.3 trillion in 2011. In 2011, the share of modern services was 54% of the total services trade, an increase from 35% in 1990. Overall, the modern services trade is growing even faster than the goods trade. Since 1990, modern services trade has increased 7.7-fold compared with a 5.1-fold increase in the goods trade.¹

The regions of South Asia, East Asia, and the Association of Southeast Asian Nations (ASEAN) are increasingly participating in the growing market of modern services exports. In particular, the world share of South Asia in the export of computer and information services has increased from 10% in 2000 to over 25% in 2011. However, there are differences in export growth across countries and within countries across different modern services exports. For example, in 2000–11, India and Pakistan experienced significant growth in the export of business and professional services (BPS), while there was slow growth in these exports from Indonesia and Malaysia over the same period. In this context, in particular, Malaysia has invested heavily in infrastructure, including the creation of “Cyberjaya” to promote IT-related production and exports.² Important questions are: To what extent have countries involved in the export of computer and information services and BPS reached their potential? How are countries in South Asia and ASEAN performing with respect to their peers and the developed world in terms of utilization of export potential in modern services? This analysis is important for emerging countries that are experiencing an increase in the share of services exports as a part of their overall economic growth. The efficient utilization of a country’s export potential increases its exports and overall economic growth. The analysis of export potential has useful policy implications for export growth: countries with less utilization of their potential bilateral services exports first need to remove “behind-the-border” constraints before following the advanced technologies and trade practices of high-performing countries. Furthermore, countries that are close to their potential should exert more effort in research and development (R&D) and the development of new technologies to shift their potential frontiers.

¹ Figures are based on data from the World Bank (2012).

² “Cyberjaya” is an IT-themed city in Malaysia with state-of-the-art infrastructure and IT systems.

The exciting developments and growth in modern services have attracted much research, in particular, on the issue of job losses in the developed world due to the outsourcing of services to emerging economies. To our knowledge, no study has analyzed the export potential in modern services from emerging countries, although there are a limited number of studies on the estimation of gravity models for modern services. Most studies use aggregate levels of services trade and have less coverage of exports from emerging countries. Grünfeld and Moxnes (2003), Mirza and Nicoletti (2004), and Kimura and Lee (2006) find gravity estimates only for aggregate services and goods using an Organization for Economic Co-operation and Development (OECD) dataset for up to 20 OECD reporting countries. Another study by Head et al. (2009) calculates the gravity estimates for “other commercial services,” IT, and miscellaneous business services, using Eurostat data for the period 1992–2006.³ However, bilateral coverage of data for most countries before 2000 is small and may influence estimations.

Services are different from goods in terms of restrictions on trade. Due to the specific nature of various services and the different modes of supply, domestic regulations are mostly the only restrictions on services trade (World Trade Organization [WTO] 2012). Specific discriminatory regulations in services sectors can have negative effects on trade flows. For example, licensing requirements, quotas on foreign providers, and cumbersome procedures are some of the regulations that can reduce potential trade in professional services. One of the limitations with aggregate services analysis is that we cannot analyze the impact of sector-specific services trade restrictions on services exports. For example, Grünfeld and Moxnes (2003) use the Services Trade Restrictiveness Index (STRI) developed by Findlay and Warren (2000), but their analysis was inherently biased because these STRIs only cover 35% of total services. Kimura and Lee (2006), using 1999–2000 data for 10 OECD countries, apply the Economic Freedom of the World (EFW) Index as a crude proxy for barriers to trade in services.⁴ A recent study by Nordas (2008) uses sector-specific STRIs and estimates a gravity type model at a disaggregated level for computer and information services and business services, using sector-specific STRIs. On the other hand, Head et al. (2009) do not include services trade restrictions in their gravity model specification.

The characteristics of services vary between categories. For example, the nature of BPS is very different from that of transport services. Therefore, aggregate analysis used in earlier studies, with due acknowledgement, is of limited help for policymakers. The quality and coverage of services data has improved only recently. In earlier studies, the limited number of observations at the disaggregated level might have compromised the estimations. Therefore, the current study is expected to contribute in three ways. First, it provides a systematic analysis of the performances of emerging countries in modern services exports in terms of utilization of their potential, using the stochastic gravity frontier approach. Second, it uses a larger and more complete dataset than those in earlier studies. Finally, it explains the potential and determinants of modern services exports at a disaggregated level.

³ “Other commercial services” are calculated by subtracting transport, travel, and government services from total services.

⁴ These countries report services trade data for most of their partner countries.

The remainder of the paper is structured as follows. The following two sections provide information about the size and structure of services trade, and details on the data availability of bilateral services trade flows. In the next section, we briefly discuss the analytical framework for the estimation of services trade. The discussion concerns the application of the stochastic frontier approach to gravity modeling along with details of explanatory variables included in the empirical model. The results of the maximum likelihood estimation and export performances are also discussed in this section. A final section presents the overall conclusions of this study.

2. Trends in Services Trade

The services sector has been the most dynamic segment of the global economy in the last decade. In the domestic economy, services share of the GDP of middle and high-income countries has been rising and the services sector accounted for 72% of global GDP growth between 2001 and 2011. In the external economy, services have been dominating the landscape of both trade and FDI; most FDI in the last decade has been in the services sector and growth of modern services trade has surpassed growth in the goods trade. At the aggregate level, total world trade in commercial services has increased from \$0.82 trillion in 1990 to \$4.3 trillion in 2011, representing growth of 424%. Modern services are the main source of this growth with their current volume of over \$2.3 trillion, which covers more than 54% of total global services trade. High-income countries are the dominant players in commercial services with a share of 80% of world trade in 2011, although this is down from 87% in 1990.

Modern services have also shown smaller contractions compared to goods exports as a result of the global financial crisis in 2008. In order to understand Asia's sustained services export growth rates and rapid recovery during the recent global financial crisis, it is important to analyze the sectoral composition of the contraction in global trade and final demand during the crisis (Bems et al. 2010, and Borchert and Mattoo 2009). First, contraction in world final demand has been far less in services compared to durables. The economies of the US and the EU15 experienced a contraction of only 1 to 3 percent in demand for services against a 20 to 30 percent fall in demand for durables (Bems et al. 2010). One of the primary reasons for this slight drop in services is that most modern services, such as back office services, are unrelated to the volume of goods production. Therefore, even if goods production declines, the demand for these services will be less affected. Second, the negligible fall in final demand for services is also reflected in a slight contraction in services trade compared to goods trade.

The outsourcing of services to developing countries has been raised as a concern by some policy makers in the developed world. However, only 8% of world exports of modern services are from lower middle-income countries. It is only with respect to ICT services that lower middle-income countries have a share of 23%, most of which is contributed by India. Lower middle income countries, excluding India, have not experienced a significant change in their share of world

modern services exports, showing that the benefits of the increase in modern services is still limited to a few emerging countries.⁵

Telecommunications services, computer and information services, and business and professional services (BPS) collectively account for more than 60% of modern services exports. These are the fastest growing segments of the services trade among emerging economies engaged in outsourcing activities. The increase in IT and BPS exports from these countries has been largely due to the increasing trend of outsourcing activities. Total world estimates for the trade in computer and information services exceeded \$287 billion in 2011, increasing from \$18.5 billion in 1997 on an average annual growth rate of 24%. India, Ireland, the UK, Germany, the US, the Netherlands, Sweden, Canada, and the PRC are among the top exporters of computer and information services. Currently, in the world market for BPS exports, the US, the UK, Germany, and Japan are the main players. In South Asia and ASEAN, India, the PRC, and the Philippines are the lead BPS exporters.

While other emerging countries can also exploit their potential and benefit from expanding markets,⁶ the emerging countries of Asia (excluding India) have not experienced a significant change in the global share of modern services exports, demonstrating that the benefits of the increase in modern services trade is limited to a few Asian countries. In terms of world shares of modern services exports, East Asia and ASEAN did not show an increase in their total share between 2000 and 2010 (Table 1). During this period, the growth rate in modern services exports from South Asia was almost double the growth rate of these exports from East Asia, ASEAN, and the global average (Table 2). South Asia has increased its world share of modern services exports from 1.7% in 2000 to 4.9% in 2010, an almost 3-fold increase, mainly possible due to India's huge export volumes of computer and business services (Table 1). ASEAN countries have also improved their world shares in computer, business, and insurance services exports. In particular, the Philippines and Singapore are the major exporters of business and computer services, whereas other ASEAN countries have yet to realize their full potential.

India and the Philippines have emerged as the major Asian countries for the export of IT and business process services. India is an established player and its edge in IT services is due to a

⁵ Figures in this paragraph are based on data reported in the *World Bank's World Development Indicators* and the International Monetary Fund's (IMF) balance of payments statistics, and cover cross-border mode of services trade.

⁶ Trade in ICT and BPS services can take place through all four modes of trade in services. In our analysis, we have used balance of payments (BOP) data on services exports that cover Mode 1 (cross-border trade between residents and non-residents). According to the WTO (2005), BOP data on services exports can be seen as the upper limit of outsourcing of these services because outsourcing of ICT and BPS services is a sub-component of overall activities covered in the export of these services. Therefore, data reported for outsourcing would differ from that of cross-border trade. For example, the United Nations Conference on Trade and Development (UNCTAD 2009) estimates that the total world market for the offshoring of ICT and business processes was \$93 billion in 2008, which represents less than half the ICT cross-border trade of over \$224 billion. India, Canada, the Philippines, Ireland, and the PRC comprise the bulk (80%) of this offshoring market, although this share is declining over time as new countries enter the market.

Table 1: Shares of World Services Exports (%)

	2000				2010				Absolute Change in Shares			
	World	ASEAN	East Asia	South Asia	World	ASEAN	East Asia	South Asia	World	ASEAN	East Asia	South Asia
Commercial Services	100	4.5	11.3	1.3	100	5.3	12.6	3.4	0	0.8	1.3	2.1
Modern Services	100	3.8	12.7	1.7	100	4.0	12.5	4.9	1	0.2	-0.2	3.1
Computer and information	100	1.3	6.4	24.0	100	3.3	5.3	27.2	10	2.0	-1.1	3.2
Telecommunications	100	1.1	1.8	1.1	100	1.5	1.6	1.6	22	0.4	-0.2	0.5
Business and professional	100	4.7	16.8	0.3	100	4.9	16.4	2.6	1	0.2	-0.3	2.3
Insurance and financial	100	2.9	8.9	0.7	100	5.3	6.9	2.5	4	2.4	-1.9	1.8
Others	100	3.7	10.7	0.8	100	2.5	13.3	1.8	2	-1.2	2.6	0.9
Traditional Services	100	5.1	10.2	0.9	100	6.8	12.8	1.8	0	1.7	2.5	0.8
Transportation	100	4.9	14.9	0.9	100	6.6	16.8	1.9	1	1.4	1.2	2.0
Travel	100	5.2	6.7	0.9	100	6.9	9.3	1.6	1	1.1	1.1	1.4

ASEAN = Association of Southeast Asian Nations.

Note: These are regional shares of world exports of services by type of service.

Source: Authors' calculations using UN Services Trade Database and the World Bank's *World Development Indicators*.

Table 2: Exports of Modern Services

	Value in 2000 (\$ billion)				Value in 2010 (\$ billion)				CAGR (%)			
	World	ASEAN	East Asia	South Asia	World	ASEAN	East Asia	South Asia	World	ASEAN	East Asia	South Asia
Commercial Services	1,501	68	169	19	3,862	206	488	131	10	12	11	21
Modern Services	641	25	81	11	2,047	83	256	99	12	13	12	25
Computer and information	31	0.4	2.0	7.5	211	7	11	57	21	33	19	23
Telecommunications	17	0.2	0.3	0.2	60	0.9	0.9	1	13	17	12	18
Business and professional	289	14	48	1	890	44	146	23	12	12	12	38
Insurance and financial	99	3	9	1	318	17	22	8	12	19	10	28
Others	204	8	22	2	568	14	75	10	11	6	13	19
Traditional Services	860	44	88	8	1,815	123	232	32	8	11	10	15
Transportation	374	18	56	3	840	55	141	16	8	12	10	17
Travel	486	25	32	4	976	68	91	16	7	10	11	14

ASEAN = Association of Southeast Asian Nations; CAGR = Compound Annual Growth Rate.
Source: Authors' calculations using UN Service Trade Database and the World Bank's World Development Indicators.

large pool of skilled IT professionals and entrepreneurs, and India has also gradually expanded its business process outsourcing (BPO) industry. Comparatively, the Philippines has been successful primarily in its BPO industry concentrating in voice-based services e.g. call centres, which are considered as low end services. The Philippines has a comparative advantage in BPO due to the availability of sufficient manpower with good English language proficiency and basic skills required for BPO industry.

In the year 2012, India's exports of IT related and business and professional services (BPS) crossed US\$ 90 billion, in which BPS exports were US\$ 24.6 billion. India's BPS exports grew by compound average growth rate (CAGR) of 24.8 percent during 2002 to 2012. On the other hand, the Philippines increased its BPS exports to US\$ 9.6 billion in the year 2012 with CAGR of 43.3 percent during the last ten years. With respect to small economy size of the Philippines compared to India i.e. only one-seventh of India's GDP, the Philippines has been a star performer in BPO service exports. A realistic analysis of the share of services sector output in India and the Philippines that is exported in terms of BPS exports shows a stark difference – BPS exports of the Philippines are now 7 percent of its services sector output (value added), which was only 0.62 percent in 2002. In comparison, India's BPS exports are only 2.5 percent of its services sector output.

Labor productivity in services sector of the Philippines showed low annual growth rate (1.84%) during 2000-2010 and the sector needs a shift towards high end segments of services exports (Donghyun and Shin 2013). In India, the growth rates in labor productivity during 2000-2005 were relatively higher at 5.41 percent, which was also more than double the labor productivity in industrial sector of India. India has competitive edge in IT related services and knowledge based services gained by leveraging on high value added IT and business processes services. National Association of Software and Services Companies (NASSCOM) of India is providing necessary strategic direction for the industry's sustainable growth. Similarly, IT and Business Process Association of Philippines (IBAP) is also helping investors in the Philippines to set up their businesses in IT and BPO industry. IBAP in its roadmap 2012-2016 aims to double the current level of exports of IT and BPO services to a US\$ 25 billion by 2016. Going forward, IBAP will need to lead the industry for new business ventures of high end services.

3. Data on Bilateral Services Trade

Unlike the systematic and sufficiently disaggregated data on bilateral goods trade, services trade data are insufficient both in terms of disaggregation and coverage. The three primary sources for bilateral services trade data are Eurostat, the OECD, and the UN. Eurostat provides bilateral services trade data for 27 European Union (EU) countries and 66 possible partners. Although Eurostat provides bilateral services data going back to 1985, there are very few observations for earlier years and only a small portion of the early data is disaggregated. The OECD database provides data for 30 reporter countries and more than 200 possible partner countries. However, most OECD data are reported for the same 66 partner countries as Eurostat. The UN's disaggregation of bilateral services trade data has improved over time; however, there are few

observations for disaggregated categories of services. The UN database includes the entire UN classified list of countries as partner countries. However, again, the number of partner countries with data availability varies for each reporter country. None of the reporter countries report the data for all partner countries in any of the datasets.⁷

The reporting for services trade is not free from country bias, concealed data, and over- and under-estimation. For example, in 2003, the US reported \$420 million in imports of business, professional, and technical (BPT) services from India, while India reported \$8.7 billion for BPT exports to the US (GAO 2005). These differences in data reporting are due to several reasons, including weak reporting on the import of services, intentional under- or over-reporting, use of different definitions of cross-border services trade, and sensitivity of data. Further, sample surveys of the firms exporting services are more representative compared to surveys for firms importing services. Exporting firms can easily be covered in surveys, while importing firms are usually more numerous due to the nature of the use of imported services by domestic firms.

In our dataset for bilateral services, we find significant differences in the reporting of bilateral trade flows. For example, the US, despite being the major trading partner for many countries in the world, reports few bilateral trade flows. Vast differences in the reporting highlight underlying weaknesses in the compilation and coverage of bilateral services trade flows. As a result of these issues and the non-reporting of certain bilateral trade figures by individual countries in the reported data, we used data extracted from OECD, Eurostat, and UN data sources to arrive at bilateral services trade figures.

Initially, we extracted bilateral services import and export data between 2002 and 2011 for all possible reporting and partner countries from three data sources: the OECD, Eurostat, and the UN.⁸ For our analysis, we selected the main modern services sub-categories: BPS, computer and information services, and telecommunications services. We merged bilateral data flows for these sub-categories from three databases and compiled a single dataset. We used this basic dataset to extract bilateral services exports of emerging and developing countries.

4. Analytical Framework

In the international trade literature, the gravity model has been widely used to examine trade flows between trading partners. The basic gravity model was introduced by Tinbergen (1962) and its log-linear form specifies that the trade flows between two trading partners can be explained by the economic size of the trading partners, the distance between them, and other factors that

⁷ These three data sources broadly follow the BOP classification for services trade.

⁸ Recently, Francois and Pindyuk (2013) compiled comprehensive data on the services trade using Eurostat, OECD, and UN data sources. The time period covered extends until 2010. However, there are fewer values for 2010. We prefer to create our own database because we had additional data for 2010–2011 and better coverage for some of the developing countries.

can affect trade. The empirical application of this model has been very successful in economics (Anderson and Wincoop 2003).

Anderson (1979) provided a basic theoretical framework for a gravity model of trade flows that later was extended by others.⁹ With the basic assumptions of homothetic preferences for traded goods across countries and using the constant elasticity of substitution (CES) preferences, Anderson (1979) derived the following specification of a gravity type equation:

$$X_{ij} = \frac{m_i \phi_i Y_i \phi_j Y_j}{\sum_j \phi_j Y_j} \cdot \frac{1}{f(d_{ij})} \left[\sum_j \frac{\phi_j Y_j}{\sum_j \phi_j Y_j} \cdot \frac{1}{f(d_{ij})} \right]^{-1} u_{ij} \quad (1)$$

where,

X_{ij} = Exports of country i to country j

Y_i = Income in country i

d_{ij} = Distance between country i and country j

\emptyset_i = The share of expenditure on all traded goods and services in total expenditure of country $i = F(Y_i, N_i)$, where N_i is the population in country i

The standard form of the gravity equation used in empirical studies can be given as

$$X_{ij} = \alpha Y_i^{\beta_1} Y_j^{\beta_2} N_i^{\beta_3} N_j^{\beta_4} d_{ij}^{\beta_5} U_{ij} \quad (2)$$

According to Anderson (1979), with the log-linear function of \emptyset and m , Eq. (1) resembles Eq. (2), with an important difference. This difference is the square bracket term in Eq. (1)

$\left[\sum_j \frac{\phi_j Y_j}{\sum_j \phi_j Y_j} \cdot \frac{1}{f(d_{ij})} \right]^{-1}$. This is missing in the generally used empirical specification of the gravity model presented in Eq. (2). Anderson (1979, p. 113) describes this term as follows: “the flow from i to j depends on economic distance from i to j relative to a trade weighted average of economic distance from i to all points in the system.”

Omission of this important relative economic distance term in the empirical specification of the gravity model leads to biased estimates. This is because the error term is affected by the relative economic distance term, therefore, $E(U_{ij}) \neq 0$ and the normality assumption of ordinary least squares (OLS) is violated. This problem leads to “heteroskedastic error terms and the log-linearization of the empirical model in the presence of heteroskedasticity leads to inconsistent estimates because the expected value of the logarithm of a random variable depends on higher-order moments of its distribution,” (Kalirajan 2007, p. 92). Therefore, the OLS estimation for such gravity equations will be biased.

⁹ For example, Bergstrand (1985, 1989) and Deardorff (1995) derived the gravity equation from the Heckscher-Ohlin model, while Eaton and Kortum (2002) developed a theoretical justification of the gravity equation from the Ricardian model.

Measuring the correct specification of the relative economic distance term is difficult because researchers do not know all the factors affecting this term. The economic distance can be affected by many factors—institutional, regulatory, cultural and political—that are difficult to measure completely. These factors are referred to as behind-the-border constraints. The correct empirical specification of the gravity equation is still a challenge despite many proposals to partly solve the inherent bias in the standard gravity model. For example, some suggest using fixed effects models (e.g. Bayoumi and Eichengreen 1997), while Egger (2008) suggests the use of panel data models, which are non-linear in trade costs. Feenstra (2002) uses price differences between trading partners in his specification of the gravity model. Since McCallum (1995), many empirical papers have used “remoteness” variables, generally defined by $\sum_{m \neq j} d_{im}/y_m$, where d is distance and y is GDP and the whole term represents the weighted average distance of country i from all its trading partners, except for partner j . Anderson and Wincoop (2003) criticize these remoteness variables and suggest another multilateral resistance term. However, these solutions are either not based on the basic theory of the gravity model or cannot fully capture the inherent bias in the empirical estimation. These also give biased results by not addressing the heteroskedasticity and non-normality of the error term, as previously discussed.

Drawing on Kalirajan (2007), this study uses a stochastic frontier approach (SFA) to estimate the gravity model,¹⁰ taking into account heteroskedasticity and non-normality because we do not know the structure of heteroskedasticity in a gravity equation. With a stochastic frontier approach, the gravity equation can be written as

$$X_{ij} = f(Z_{ij}; \beta) \exp (v_{ij} - u_{ij}) \quad (3)$$

where,

- X_{ij} = actual exports from country i to country j
- Z_{ij} = potential exports from country i to country j
- β = a vector of unknown parameters
- u_{ij} = single-sided error term for the combined effects of inherent economic distance bias or behind-the-border constraints, which is specific to the exporting country with respect to the particular importing country, creating the difference between actual and potential bilateral trade. u_{ij} is normally assumed to have a truncated normal distribution
- v_{ij} = double-sided error term that captures the impact of inadvertently omitted variables and measurement errors that are randomly distributed across observations in the sample, and is assumed to follow a normal distribution with mean zero and constant variance.

If u_{ij} is zero, then the economic distance bias and behind-the-border constraints are not important. If u_{ij} is close to 1, then these constraints are important and prevent trade from reaching

¹⁰ Aigner et al. (1977) and Meeusen and van den Broeck (1977) were the first to introduce stochastic production frontier models, which have been used extensively in the production economics literature. Kalirajan (2000) formally introduced this approach in trade to address the inherent bias in the conventional gravity model of trade and to estimate potential trade flows.

its potential (Kalirajan 2007). Thus, unlike the conventional method of the gravity estimation, the stochastic frontier approach does not exclude the effect of economic distance on bilateral trade in the gravity estimation. Eq. (3) can be re-written as

$$\ln X_{ij} = \alpha + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln d_{ij} + \varphi R - u_{ij} + v_{ij} \tag{4}$$

R is a vector of other variables normally used in augmented gravity models. In Eq. (4), it is assumed that the one-sided error term, u , which concerns the economic distance bias or behind-the-border constraints, follows a half normal distribution as follows

$$f_u(u) = \frac{1}{\sigma_u \sqrt{\pi/2}} e^{-\frac{1}{2} \frac{u^2}{\sigma_u^2}} \text{ if } u \geq 0$$

$$= 0 \text{ otherwise.}$$

The statistical error term v follows a full normal distribution. Thus, with these combined error terms, neither OLS nor any variant of OLS can be used to estimate Eq. (4). Instead, the maximum likelihood estimation (MLE) technique can be used. Given these density functions of half normal and full normal distributions for u and v respectively, the density function of $\ln X$ in Eq. (4) can be derived using the density functions of $u+v$ as follows

$$f_x(\ln X) = \frac{1}{\sigma \sqrt{\pi/2}} \left\{ 1 - F \left[\frac{u+v}{\sigma} \left(\sqrt{\frac{\gamma}{1-\lambda}} \right) \right] \right\} e^{-\frac{1}{2} \left(\frac{u+v}{\sigma} \right)^2}$$

$$-\infty < \ln X < +\infty$$

Where $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \frac{\sigma_u^2}{\sigma^2}$. is an indicator of the relative importance of v , which is the impact of behind-the-border constraints on potential exports. The likelihood function, which is the probability density of obtaining the sample $(\ln X_1, \ln X_2, \dots, \ln X_n)$ may be written as follows

$$L^*(\mathbf{h} X; \theta) = \prod_{i=1}^n f_x(\mathbf{h} X)$$

where Θ is the parameter to be estimated and it is equal to β, σ^2 , and γ .

The MLE method aims to find an estimate of Θ , which maximizes the value of the likelihood function, and this means that the probability of the same drawn is large (Theil 1971, p.89). The MLE estimators of Θ , maximizing the above likelihood function, are obtained by setting its first order partial derivatives with respect to β, σ^2 , and γ equal to zero. MLEs of Eq. (4) can be obtained through popular software such as STATA.

There are two advantages of SFA as described by Kalirajan (2007). First, it estimates the complete impact of the economic distance term, separating it from the statistical error term. This enables us to see the trade impact of behind-the-border constraints, when researchers do not have full information on the behind-the-border constraints. Second, it provides potential trade estimates by using the upper limit of data that comes from countries that have the least behind-the-border resistances.

4.1 Data on Explanatory Variables

The empirical specification of our gravity model includes the basic explanatory variables suggested by the analytical framework discussed in the previous section. These include the combined GDP of the trading partners, distance between them, and language and colony variables.¹¹ We focus on IT and IT-enabled services exports that are greatly affected by the availability of a tertiary-educated population and the use of IT infrastructure. Therefore, in our empirical specification, we included a stock of tertiary graduates and Internet subscribers per 100 persons. Data for the variables on GDP and the Internet were from the World Bank's on-line database, *World Development Indicators*. The country stocks of tertiary graduates were estimated using the base stocks of graduates from Barro (2010) and tertiary enrollment, obtained from the online database of the United Nations Educational, Scientific, and Cultural Organization (UNESCO).¹² Distance, common language, and colony variables were downloaded from the French Research Center in International Economics (CEPII). We also compiled a variable for the time difference between trading partners using information on time zones. Due to strong collinearity between the distance variable and the time difference, we dropped this variable from the main regressions.

The model also specifies the variables that are either expected to augment or diminish trade between trading partners. These include a services trade agreement between the trading partners and the STRIs of importing countries. To create a dummy variable for a services trade agreement between trading partners, we used the information on the WTO website for the effective bilateral and regional trade agreements for goods and services. The dummy variable takes a value of 1 if the trading partners belong to an effective trade agreement that also includes services. For our analysis, we excluded trade agreements that only impact the goods trade and do not cover services. Finally, we used STRIs to include barriers to the services trade in our model. An explanation of STRIs is provided below.

Barriers to trade in services are difficult to measure, compared to tariffs and non-tariff barriers to trade in goods. Most barriers to the services trade are in the form of regulations. Construction of an STRI first requires the careful selection of policies and regulations potentially restricting trade

¹¹ GDP is in constant 2005 prices and the GDP deflator for the base year 2005 has been used to deflate services exports.

¹² There are missing observations in the data for graduates and enrolment of tertiary education. We fill missing observations for a country using available information on the respective country or regional averages.

in services. Applied regulations and policies are quantified and are then converted into an index by assigning appropriate weights to each policy. To obtain more specific STRIs, we also need to separate policy measures affecting different modes of services trade. The first comprehensive effort to construct sector-specific STRIs was made by the Australian Productivity Commission (Findlay and Warren 2000) and has been widely quoted in the services trade literature. The index covers six service sub-sectors and 34 countries. Grünfeld and Moxnes (2003) use this STRI in their gravity model for total services trade but have been criticized by Kimura and Lee (2006) because the use of six service industry STRIs for overall services trade can produce misleading results. With the availability of more disaggregated bilateral services trade data, it is possible to test the index for individual sub-categories of services. However, the index is based on information for the latter years of the 1990s and is not suitable for the more recently available bilateral services trade data that includes expanded coverage.

Recent attempts involving the construction of STRIs include projects by the OECD (OECD 2009) and the World Bank (Borchert et al. 2012). The STRIs derived by the OECD are only for OECD countries, while the World Bank covers 79 developing and transition countries, and 24 OECD countries. The World Bank survey covers financial services, telecommunications, retail distribution, transportation, and professional services. The OECD provides STRIs for telecommunications, construction, BPS, and computer-related services. The World Bank project has greater country coverage than the OECD project, however, sector-specific STRIs for computer-related and business services are not available in the World Bank database. Therefore, we used STRIs compiled by the OECD for our estimations as OECD countries are the trading partners considered for the gravity models used in this paper. The OECD STRIs cover restrictions on foreign ownership and market entry, restrictions on the movement of people, discriminatory measures, public ownership, barriers to competition, and regulatory transparency and licensing (OECD 2009). Further, these policy measures are categorized by the modes of supply. In our analysis, we used the STRIs that pertain to cross-border trade.

4.2 Maximum Likelihood Estimates

The gravity type stochastic frontier model discussed above was estimated using the maximum likelihood method. Separate stochastic frontier models were estimated for the export of computer and information services, BPS, and telecommunications services (Tables 3, 4, 5). The estimations were performed on annual bilateral services exports for the period 2002–11. We provide estimation results for the regions of South Asia, East Asia and ASEAN, and Europe and the Americas. As the STRI variable is available only for OECD countries, each exporting country's trading partners are limited to OECD countries.¹³ The stochastic frontier model was estimated, using the STATA software version 11.

¹³ Among OECD countries, we excluded the Czech Republic, Slovakia, and Slovenia due to a lack of comparable data.

Table 3: Maximum Likelihood Estimation Results of Stochastic Frontier Model
(Exports of Business and Professional Services)

	All Countries	South Asia	East Asia and ASEAN	Europe and the Americas
Log of exporters' real GDP	0.683*** (0.028)	1.221*** (0.119)	0.535*** (0.066)	0.684*** (0.024)
Log of importers' real GDP	0.896*** (0.032)	0.787*** (0.111)	1.127*** (0.069)	0.767*** (0.031)
Colony	0.222 (0.227)	1.270 (0.755)	-0.352 (0.537)	0.277 (0.219)
Common language	0.649*** (0.148)	-0.306 (0.486)	0.794** (0.309)	0.726*** (0.157)
Log of distance	-0.981*** (0.042)	0.038 (0.731)	-0.690*** (0.236)	-0.889*** (0.041)
Services Trade Restrictiveness Index (STRI)	-12.045*** (1.540)	-10.414* (4.703)	-19.146*** (3.252)	-9.031*** (1.542)
FTA_services	0.020 (0.079)	-0.019 (0.087)	-0.106 (0.111)	0.150 (0.123)
Log of internet users per 100 persons_i	0.237*** (0.031)	0.376*** (0.133)	0.155*** (0.053)	0.230*** (0.059)
Log of internet users per 100 persons_i	0.154*** (0.053)	1.048*** (0.234)	0.282** (0.124)	0.089 (0.056)
Log of tertiary graduates_i	0.398*** (0.024)	1.171*** (0.150)	0.125** (0.045)	0.597*** (0.025)
Constant	-6.253*** (0.727)	-25.928*** (6.155)	-9.939*** (2.498)	-6.242*** (0.622)
Gamma	0.86***	0.830***	0.850***	0.830***
Log likelihood	-4,083.1	-196.9	-1,353.3	-2,259
Wald Chi2	2,533.5	259	610.7	1,881
No. of Obs.	4,940	258	1,375	3,307

ASEAN = Association of Southeast Asian Nations; FTA = free trade agreement; GDP = gross domestic product.

Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% significance levels, respectively. Figures in parentheses are standard errors.

Source: Authors' calculations.

Table 4: Maximum Likelihood Estimation Results of Stochastic Frontier Model
(Exports of Computer and Information Services)

	All Countries	South Asia	East Asia and ASEAN	Europe and Americas
Log of exporters' real GDP	0.520*** (0.044)	1.575*** (0.157)	0.339*** (0.075)	0.458*** (0.042)
Log of importers' real GDP	0.818*** (0.054)	1.521*** (0.163)	0.963*** (0.101)	0.630*** (0.049)
Colony	0.263 (0.335)	-0.829 (1.342)	0.021 (0.608)	0.324 (0.300)
Common language	0.862*** (0.224)	1.208 (0.969)	1.105** (0.380)	0.484** (0.215)
Log of distance	-0.795*** (0.063)	0.333 (1.222)	-0.671** (0.304)	-0.565*** (0.064)
Services Trade Restrictiveness Index (STR)	-7.106** (3.048)	-21.294*** (5.137)	-17.285** (6.950)	-6.788** (2.832)
FTA_services	0.053 (0.123)	0.021 (0.131)	-0.063 (0.178)	-0.028 (0.186)
Log of internet users per 100 persons_i	0.424*** (0.048)	0.598** (0.270)	0.225*** (0.084)	0.547*** (0.068)
Log of internet users per 100 persons_j	0.511*** (0.073)	1.408** (0.590)	0.180 (0.237)	0.643*** (0.068)
Log of tertiary graduates_i	0.315*** (0.038)	1.592*** (0.157)	0.181** (0.073)	0.366*** (0.040)
Constant	-6.171*** (1.130)	-39.553*** (9.067)	-8.190* (3.256)	-7.336*** (0.857)
Gamma	0.86***	0.88***	0.82***	0.88***
Log likelihood	-4,114.9	-469.4	-1,082	-1,970.8
Wald Chi2	1,611.1	529.29	266.4	1,416.9
No. of Obs.	3,532	277	841	2,414

ASEAN = Association of Southeast Asian Nations; FTA = free trade agreement; GDP = gross domestic product.
Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% significance levels, respectively. Figures in parentheses are standard errors.
Source: Authors' calculations.

Table 5: Maximum Likelihood Estimation Results of Stochastic Frontier Model
(Exports of Telecommunications Services)

	All Countries	South Asia	East Asia and ASEAN	Europe and Americas
Log of exporters' real GDP	0.505*** (0.031)	0.766*** (0.249)	0.230*** (0.069)	0.530*** (0.031)
Log of importers' real GDP	0.698*** (0.037)	0.367** (0.172)	0.832*** (0.095)	0.586*** (0.035)
Colony	0.353* (0.212)	1.026 (1.534)	1.485* (0.882)	0.124 (0.186)
Common language	0.590*** (0.165)	-0.010 (0.997)	0.772 (0.492)	0.331* (0.151)
Log of distance	-0.730*** (0.047)	2.776 (2.216)	-0.504 (0.892)	-0.704*** (0.045)
Services Trade Restrictiveness Index (STRI)	-0.959 (1.277)	-2.067 (10.607)	1.302 (2.834)	-1.682 (1.321)
FTA_services	0.514*** (0.133)		0.137 (0.333)	0.283* (0.134)
Log of internet users per 100 persons_i	0.249*** (0.044)	0.215* (0.103)	0.056 (0.068)	0.463*** (0.081)
Log of internet users per 100 persons_j	0.487*** (0.077)	1.155** (0.473)	0.830*** (0.232)	0.412*** (0.077)
Constant	-6.349*** (0.697)	-42.006** (16.174)	-9.511 (8.573)	-8.216*** (0.676)
Gamma	0.78***	0.79***	0.78***	0.77***
Log likelihood	-2,366.1	-232.5	-543	-1,617.2
Wald Chiz	1,085.6	115.9	261.3	863.7
No. of Obs.	2,747	176	559	2,012

ASEAN = Association of Southeast Asian Nations; FTA = free trade agreement; GDP = gross domestic product.
Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% significance levels, respectively. Figures in parentheses are standard errors.

Source: Authors' calculations.

First, the gamma coefficient, which is the ratio of the variation in exports due to behind-the-border constraints to total variation in exports, in all the regressions is close to 1, which is the upper limit for a gamma coefficient, and significant. A significant gamma coefficient shows that the use of the stochastic frontier method to estimate the gravity model is appropriate for the sample data. This also shows that there are country-specific, behind-the-border constraints that are not captured by other explanatory variables. In developing countries, some of the important behind-the-border constraints in services—particularly BPS, computer and information services, and telecommunications services—are electricity supply interruptions and chaotic urban transportation. For example, India suffers severe power supply shortages. Many cities that are known for their active participation in the aforementioned services, such as Chennai, regularly experience power shortages and interruptions. Thus, state and central governments urgently need to rectify the power supply situation in the country. Though the country-specific, behind-the-border constraints could not be identified in this study due to a lack of comparable data across the sample countries, some conjectures can be made. For example, exports of modern services from developing countries may be constrained by weak regulations, lack of modern infrastructure, and domestic political interests. These factors prevent developing countries from reaching their export potential.

The coefficients of the standard gravity variables generally exhibit signs in accordance with gravity trade theory. Services exports increase with a rise in the GDP of exporters and imports, and decrease with an increase in the distance between them. The GDP coefficients for both exporters and importers are highly significant. The coefficient of distance in the regression for South Asia is positive and not significant for computer and information services, BPS, and telecommunications services. This is in line with the idea that most computer, IT, and business process outsourcing (BPO) exports from South Asia are generated by offshore service providers based in India and delivered online.¹⁴ Second, an increase in distance also provides opportunities for South Asia to provide customer support services, back office services, some data processing, and the processing of medical transcripts to countries in different time zones.¹⁵ Compared to South Asia, the distance coefficient for East Asia and the ASEAN region is negative and significant in the regression for BPS and computer and information services exports. This may be because the BPS exports of East Asian countries are more dependent on personal interaction compared to South Asia's BPS exports.

New ICTs have played a central role in the increase in trade in modern services. We included Internet use as a proxy for the availability and use of ICTs in a country. The coefficients for Internet use are positive for both exporting and importing countries; however, they are more significant for exporting countries. The results show that Internet use in both trading partners is essential to augment the trade of modern services between them.

¹⁴ BPO includes a large number of services that firms can outsource offshore. Exports of services that come from BPO operations can have entries under different BPO service classifications, including computer services, information services, other business services, and telecommunications services.

¹⁵ We also used the time difference between the bilateral trade partners in separate regressions and found that the coefficient of time difference was also positive and not significant for South Asia, while it was negative and significant for our overall sample.

Other explanatory variables included in the empirical model exhibit theoretically correct signs their coefficients. Although the significance of the results varies across different services categories, these are expected results. For example, sector-specific STRIs have negative and statistically significant coefficients in the regressions for BPS and computer services. In contrast, telecommunications seem little affected by the STRIs. Trade agreements that include services generally have insignificant effects on bilateral services trade. This ineffectiveness could be due to the trade agreement variable being general and not sector specific. The stock of tertiary graduates is found to significantly and positively contribute to the export of computer-related services and BPS. For South Asia, the coefficient is larger than in other regions, showing that an increase in graduates can result in a greater rise in exports in South Asia than in East Asia and ASEAN.

4.3 Export Performance

This section describes the export performance of the countries in our sample in terms of realizing their bilateral export potential, using country-specific stochastic frontier estimates. As described by O'Donnell et al. (2008), countries exhibit different technology production opportunities due to differences in the physical, social, and economic environment in which trade or production takes place. Therefore, the estimation of separate stochastic frontiers for individual countries, under the assumption that each country has different levels of trade technology, is reasonable for our analysis.

Country-wise realization of export potential is provided in Table 6 for BPS, computer and information services, and telecommunications services. In general, results reveal that emerging countries e.g. the Philippines and India that have seen significant growth in their modern services exports due to the outsourcing phenomenon are still well behind in utilizing their full potential. There is also heterogeneity in individual country performances across the three services. For BPS exports, the performance of ASEAN member countries is weak, with the average realization of export potential below 50% and exception of the Philippines with 57% realization of potential. The performance of India is relatively better than that of the average ASEAN; however, it is still considerably weaker than East Asia, Western Europe, and North America. For example, the top performing countries—including the US, Canada, the UK, Switzerland, and Ireland—realize around 80% of their export potential in BPS compared with 53% for India and an average of 50% for ASEAN.

South and East Asian countries are performing relatively better in the export of computer and information services than in BPS. On average, countries in East Asia have realized their potential more than European countries, while ASEAN member countries seem on a par with the European average. Again, India despite being among the top offshore destinations for the outsourcing of computer-related services is lagging behind other countries in terms of its realized export potential. By making use of its unrealized potential and removing behind-the-border constraints, India could accelerate its export growth, led by computer-related and BPS services.

Table 6: Realization of Potential Bilateral Exports
(Simple Average, %)

Exporter	Region	Business and Professional Services	Computer and Information Services	Telecommunications Services
India	South Asia	53	60	55
Pakistan	South Asia	39	55	40
Australia	East Asia and Pacific	66	67	65
Hong Kong, China	East Asia	52	66	66
Rep. of Korea	East Asia	69	85	–
Japan	East Asia	65	57	75
People's Republic of China	East Asia	65	61	69
Singapore	ASEAN	52	64	48
Indonesia	ASEAN	37	–	45
Malaysia	ASEAN	46	52	53
Philippines	ASEAN	57	–	–
Thailand	ASEAN	47	–	–
Canada	North America	77	82	66
US	North America	82	72	72
Austria	Europe	73	53	60
Denmark	Europe	62	47	58
France	Europe	79	70	61
Germany	Europe	65	61	66
Hungary	Europe	60	65	81
Ireland	Europe	86	–	–
Italy	Europe	72	–	–
Netherlands	Europe	65	–	60
Sweden	Europe	57	64	60
Switzerland	Europe	84	–	67
UK	Europe	73	–	–

– = Data not available; ASEAN = Association of Southeast Asian Nations; UK = United Kingdom; US = United States.

Source: Authors' calculations on the basis of individual country stochastic frontier models using data for 2002–08.

For telecommunications services, the average export performance of East Asian economies is notably the highest among all other regions included in the study. This may be because economies in East Asia—including the Republic of Korea; Japan; Hong Kong, China; and the PRC—are active players in using advanced technologies in the provision of global transmissions of voice and data. India is also doing well compared with ASEAN member countries; however, it lags behind the performance of economies in East Asia, Europe, and North America. Furthermore, countries such as Pakistan and Indonesia that have very low efficiencies in terms of utilization of their export potential can borrow advanced technologies and learn from the experience of their high-performing neighbors.

5. Conclusion and Policy Implications

Among the three types of services included in our analysis, traditional services exporters from North America and Europe show the highest levels of performance. East Asian economies—including Hong Kong, China; the Republic of Korea; Japan; and the PRC—are also relatively efficient in their modern services exports, particularly telecommunications services. ASEAN countries that are performing well in manufacturing are less efficient in terms of realizing their export potential in modern services. India, despite its unprecedented growth rates in the export of computer, IT, and BPS services, is also not efficiently realizing its export potential. The unrealized potential of India's modern services exports reveals that the country can sustain its services-based, export-led growth if efforts are continued for venturing into high end and knowledge based services exports, and implementation of market reforms.

In order to catch up with the high-performing economies of East Asia, Europe, and North America, countries in South Asia and ASEAN should pursue best practices in their trade strategies, adopt advanced technologies, and remove behind-the-border constraints. Improvements in the business environment, regulatory reforms, and the provision of modern infrastructure are a few of the measures that can reduce behind-the-border constraints. Though modern services do not depend heavily on physical infrastructure, such as port facilities, the poor quality of infrastructure, including power shortages and chaotic urban transportation, hampers the growth of these services. Appropriate training and improved standards for graduates in IT-related disciplines are also important for the growth and sustainability of modern services exports from developing countries. Our results support the view that an increase in the stock of graduates and the adoption of ICT technologies can have a significant and positive impact on modern services exports from developing countries in general and South Asia in particular.

Exploiting the potential of Asian countries for modern services exports requires a diverse policy response and private sector initiatives. ICT infrastructure and well-trained graduates are the basic ingredients for IT-enabled modern services exports. These alone would be sufficient for countries like Bangladesh and Pakistan, as they search for their niche in a competitive global market. For established players like India on the other hand, continuous innovation will be required to move up the value chain and achieve sustainable growth beyond current dependence on labor-cost comparative advantage. Improving the urban infrastructure and development of knowledge

cities are equally important to facilitate the business models of modern services exports in Asian developing countries. Nevertheless, experience of successful countries shows the role of diverse factors in the expansion of their IT-enabled modern services, including multinationals, diaspora, partnerships, entrepreneurship and regulatory reforms related to services. In addition, there is a need for regional efforts to reduce regulatory barriers to trade in services.

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This study examines the export performance of emerging Asian economies in selected modern services. The study finds that export performance of emerging economies in South Asia and the ASEAN region, in terms of realized export potential, is considerably lower than that of the developed world. It also shows that graduates and the ICT infrastructure in emerging countries are amongst key factors for modern services exports. Policy suggestions are also provided for the emerging countries to improve their performance.

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