Information and Communication Technology-Enabled Modern Services Export Performances of Asian Economies

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Advancements in information and communication technology (ICT) have expanded the possibilities for trade in modern services. Many emerging and developed Asian 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 show that the number of graduates and the quality of ICT infrastructure in emerging economies 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 to catch up with high-performing developed economies.

Keywords: Asia, Europe, North America, service exports, stochastic frontier gravity model
JEL codes: C24, F14

I. Introduction

Over the past 2 decades, technological developments, the liberalization of the services trade, and the rising share 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 increased from 59% in 1985 to 71% in 2011, underlying the tremendous scope for trade in services. Also, unprecedented advancements in information and communication technology (ICT) have made it possible to provide many services across borders without the physical movement of persons. In the

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literature, modern services are broadly defined as commercial services excluding the traditional services of transport and travel (Ghani 2010, 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, 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, the modern services trade has increased nearly eightfold compared with a fivefold increase in the goods trade.[1]

The economies of South Asia, East Asia, and the Association of Southeast Asian Nations (ASEAN) are increasingly participating in the growing market for modern services exports. South's Asia share of global exports of computer and information services increased from 10% in 2000 to over 25% in 2011. However, there are differences in export growth across economies and within economies across different modern services exports. For example, in 2000–2011, 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. Meanwhile, Malaysia has invested heavily in infrastructure, including the creation of an entire city, Cyberjaya, to promote ICT-related production and exports.[2]

To what extent have economies involved in the export of computer and information services and BPS reached their potential? How are economies 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 economies that are experiencing an increase in services exports as a share of their overall economic growth. The efficient utilization of an economy's export potential increases its exports and overall economic growth. The analysis of export potential also has useful policy implications for export growth: economies with lower rates of utilization of their potential bilateral services exports first need to remove behind-the-border constraints before adopting the advanced technologies and trade practices of high-performing economies. Furthermore, economies 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.

Developments in modern services have attracted much research, particularly 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 modern services export potential of emerging economies, although there are a limited number of studies on the estimation of gravity models for modern services. Most studies

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

[2] Cyberjaya is an ICT-themed city in Malaysia with state-of-the-art infrastructure and ICT systems.

use aggregate levels of the services trade and have less coverage of exports from emerging economies. Grünfeld and Moxnes (2003), Mirza and Nicoletti (2004), and Kimura and Lee (2006) find gravity estimates only for aggregate services and goods using an Organisation for Economic Co-operation and Development (OECD) dataset for up to 20 OECD reporting economies. Another study by Head, Mayer, and Ries (2009) calculates the gravity estimates for other commercial services, ICT, and miscellaneous business services using Eurostat data for the period 1992–2006.[3] However, bilateral coverage of data for most economies before 2000 is small, which 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 the primary restrictions on services trade (World Trade Organization [WTO] 2012). Specific discriminatory regulations in services sectors can have negative effects on trade flows. 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 economies, apply the Economic Freedom of the World 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. On the other hand, Head, Mayer, and Ries (2009) do not include services trade restrictions in their gravity model specification. With regard to the impacts of outsourcing on the labor markets of those economies demanding the services provided through outsourcing, most of the theoretical models discussed in Francois and Hoekman (2010) have predicted positive gains for high-skilled wages in the United States (US) market and a marginal impact on low-skilled jobs.

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 use for policy makers. 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 economies in modern services exports in terms of utilization of their

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

[4] These economies report services trade data for most of their partner economies.

potential, using the stochastic gravity frontier approach. Second, it uses a larger and more complete dataset than those used in earlier studies. Finally, it explains the potential and determinants of modern services exports at a disaggregated level.

Developments in ICT have made it possible for emerging economies to exploit their comparative advantage in some modern services. The driving force for this comparative advantage is the large pool of semiskilled and skilled graduates in emerging economies who can deliver their services across borders using advanced communication technologies. Trade in services can take different forms. Services can be an intermediate or a final product, and services can be delivered through a foreign presence or via cross-border trade using communication networks. This study focuses on modern services that are delivered largely through cross-border trade; outsourcing has contributed to the increase in these exports from emerging economies (Bhagwati, Panagariya, and Srinivasan 2004). Feenstra (2008) notes that developing economies also outsource services to developed economies for high value-added and high-end tasks. For example, the software industries in India and Pakistan import the services of US professionals for tasks for which domestic expertise is scarce. In this context, tight restrictions on other modes of supply drive businesses to pursue cross-border transactions to the point that the possibility of measured flows being higher than they would be otherwise may not be completely ruled out. However, it is not an issue in this paper because what is discussed here concerns the export potential of the modern services trade of selected economies for given levels of determinants including technical knowledge and capacity. The objective of this study is to gauge, for those given determinants of the modern services trade, maximum possible trade and the gap between such a maximum and actual trade. Thus, in a way, this is a demand-side analysis.

The remainder of the paper is structured as follows. The next two sections provide information about the size and structure of the services trade and details on the data availability of bilateral services trade flows. Section IV briefly discusses the analytical framework for the estimation of the 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.

II. Trends in Services Trade

The services sector has been the most dynamic segment of the global economy over the last decade. In the domestic economy, services' share of the GDP of middle- and high-income economies has been rising. The sector accounted for 72% of global GDP growth in 2001–2011. In the external economy, services have been dominating the landscape of both trade and foreign direct investment. Most foreign

direct investment in the last decade has been in the services sector as growth of the modern services trade has surpassed growth in the goods trade. At the aggregate level, total world trade in commercial services increased from $0.82 trillion in 1990 to $4.3 trillion in 2011, representing growth of about 424%. The modern services trade is the main source of this growth with a current volume of over $2.3 trillion, which covers more than 54% of the total global services trade. High-income economies remain the dominant players in commercial services with a share of about 80% of world trade in 2011, down from about 87% in 1990.

Modern services exports also showed smaller contractions compared with goods exports during the global financial crisis in 2007–2009. In order to understand Asia's sustained services export growth rates and rapid recovery from the global financial crisis, it is important to analyze the sectoral composition of the contraction in global trade and final demand during this period (Bems, Johnson, and Yi 2010; Borchert and Mattoo 2009). First, contraction in world final demand was far less for services than for durables during the period Q1 2008–Q2 2009: the US and 15 members of the European Union (EU) experienced a contraction of only 1%–3% in demand for services against a 20%–30% fall in demand for durables (Bems, Johnson, and Yi 2010). One of the primary reasons for this relatively smaller 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 smaller contraction in the services trade compared with the goods trade.

The outsourcing of services to developing economies is of concern to some policy makers in the developed world, though both the theoretical and empirical studies reviewed by Francois and Hoekman (2010) show that the impact of services outsourcing on OECD labor markets has been insignificant. Only about 8% of world exports of modern services are from lower-middle-income economies. It is only with respect to ICT-enabled services that lower-middle-income economies have a larger share of the world total (about 23%), most of which is contributed by India. Lower-middle-income economies, 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 exports is still limited to a few emerging economies.[5]

Telecommunications services, computer and information services, and 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 ICT-enabled services and BPS exports from these economies has been largely due to the increasing trend of outsourcing activities. Total world estimates for the trade in computer and information services exceeded

[5] Figures in this paragraph are based on data reported in the World Bank's *World Development Indicators* and the International Monetary Fund's Balance of Payments Statistics, and cover cross-border services trade.

$287 billion in 2011, increasing from $18.5 billion in 1997 on an average annual growth rate of about 24%. India, Ireland, the United Kingdom (UK), Germany, the US, the Netherlands, Sweden, Canada, and the People's Republic of China (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 economies can exploit their potential and benefit from expanding markets, the emerging economies of Asia (excluding India) have not experienced a significant change in their global share of modern services exports, demonstrating that the benefits of growth in the modern services trade have thus far been limited to a few Asian economies.[6] In terms of world share of modern services exports, East Asia and ASEAN did not show an increase in their respective shares 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 increased its world share of modern services exports from 1.7% in 2000 to 4.9% in 2010, an almost threefold increase, mainly due to India's huge export volumes of computer and business services (Table 1). ASEAN economies have also improved their world shares in computer, BPS, and insurance services exports. In particular, the Philippines and Singapore are major exporters of business and computer services, while other ASEAN economies have yet to realize their full potential.

India (within South Asia) and the Philippines (within ASEAN) have emerged as the major Asian economies for the export of ICT-enabled services and BPS. India is an established player and its edge in ICT-enabled services is due to a large pool of skilled ICT professionals and entrepreneurs. India has also gradually expanded its business process outsourcing (BPO) industry. The Philippines has been successful primarily in the segment of its BPO industry concentrating in voice-based services, such as call centers, which are considered low-end services. The Philippines has a comparative advantage in BPO due to the availability of sufficient manpower with good English language proficiency and the basic skills required for the BPO industry.

In 2012, India's exports of ICT-related and BPS crossed $90 billion, in which BPS exports were $24.6 billion. India's BPS exports grew by a compound average growth rate of 24.8% in 2002–2012. Over the same period, the Philippines increased

[6]Trade in ICT-enabled services and BPS 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 nonresidents). 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-enabled services and BPS is a subcomponent 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 estimates that the total world market for the offshoring of ICT-enabled services and BPS was $93 billion in 2008, which represents less than half the ICT cross-border trade of over $224 billion (UNCTAD 2009). India, Canada, the Philippines, Ireland, and the PRC comprise the bulk (80%) of this offshoring market, although their cumulative share is declining over time as new economies 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: Figures are regional shares of world exports of services by type of service.
Sources: Authors' calculations based on United Nations (UN). 2010. *Manual on Statistics of International Trade in Services.* Washington, DC; World Bank. 2012. *World Development Indicators.* Washington, DC.

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.

Sources: Authors' calculations based on United Nations (UN). 2010. *Manual on Statistics of International Trade in Services*. Washington, DC; World Bank. 2012. *World Development Indicators*. Washington, DC.

its BPS exports to $9.6 billion on a compound annual growth rate of 43.3%. Considering that its GDP is only one-seventh the size of India's, the Philippines has been Asia's star performer in terms of BPO services exports. Analysis of the composition of services sector exports in India and the Philippines reveals a stark difference. BPS exports from the Philippines comprised 7% of the services sector total output (value-added) in 2012, up from only 0.6% in 2002. In comparison, India's BPS exports accounted for 2.5% of the services sector output in 2012.

Labor productivity in the services sector in the Philippines posted an annual growth rate of only 1.8% in 2000–2010, suggesting that a shift toward high-end services exports is needed (Park and Shin 2013). In India, the average annual growth rates in labor productivity in 2000–2005 was 5.4%, which was more than double the labor productivity of the industry sector in India over the same period. India has a competitive edge in ICT-enabled and knowledge-based services that has been gained by leveraging high value-added ICT-enabled and business processes services. The National Association of Software and Services Companies of India is providing strategic direction for the industry's sustainable growth. Similarly, the ICT and Business Process Association of the Philippines (IBAP) is helping investors set up businesses in the Philippine ICT and BPO industries. IBAP aims to double ICT-enabled and BPO services exports to $25 billion between 2012 and 2016. Going forward, IBAP will need to support the establishment of new business ventures offering high-end services.

III. 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 United Nations (UN). Eurostat provides bilateral services trade data for 27 EU economies 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 reporting economies and more than 200 possible partner economies. However, most OECD data are reported for the same 66 partner economies 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 economies as partner economies. Again, the number of partner economies with data availability varies for each reporting economy. None of the reporting economies provide data for all partner economies in any of the datasets.[7]

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

The reporting for services trade is not free from economy bias, concealed data, and overestimation and underestimation. For example, in 2003, the US reported $420 million in imports of business, professional, and technical services from India, while India reported $8.7 billion in business, professional, and technical exports to the US (GAO 2005). Such differences in data reporting are due to several reasons, including weak reporting on the import of services, intentional underreporting or overreporting, 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 with surveys of 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 a major trading partner of many economies 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 nonreporting of certain bilateral trade figures by individual economies 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 economies from three data sources: the OECD, Eurostat, and the UN.[8] For our analysis, we selected the main modern services subcategories: BPS, computer and information services, and telecommunications services. We merged bilateral data flows for these subcategories from three databases and compiled a single dataset. We used this basic dataset to extract bilateral services exports of developing economies from the import data of importing OECD economies using mirror flows. Using three different datasets from Eurostat, OECD, and UN services trade data, 30 reporting economies were selected for which relatively consistent data with respect to same partner economies were available (Table 6). However, none of the reporting economies provide data for all of its partner economies in any of the datasets.

IV. 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

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

flows between two trading partners can be explained by the economic size of the trading partners, the distance between them, and other factors that 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] Given basic assumptions of homothetic preferences for traded goods across economies and using the constant elasticity of substitution preferences, Anderson (1979) derived the following specification of a gravity-type equation:

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

where,

X_{ij} = exports of economy i to economy j
Y_i = income in economy i
d_j = distance between economy i and economy j
$Ø_i$ = share of expenditure on all traded goods and services in total expenditure of economy $i = F(Y_{ij}, N_i)$, where N is the population in economy i

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

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

According to Anderson (1979), with the log-linear function of Ø and *m,* Equation (1) resembles Equation (2) with an important difference. This difference is the square bracket term in Equation (1) $[\sum_j \frac{\phi j Y j}{\sum_j \phi_j Y_j} \cdot \frac{1}{f(d_{ij})}]^{-1}$. This is missing in the generally used empirical specification of the gravity model presented in Equation (2). Anderson (1979, 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

[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.

moments of its distribution" (Kalirajan 2007, 92). Therefore, the OLS estimation for such gravity equations will be biased.

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 nonlinear in terms of 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, y is GDP, and the whole term represents the weighted average distance of economy i from all its trading partners except 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 nonnormality of the error term, as previously discussed.

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

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

where

X_{ij} = actual exports from economy i to economy j
Z_{ij} = potential exports from economy i to economy 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 economy with respect to the particular importing economy, creating the difference between actual and potential bilateral trade; normally assumed to have a truncated normal distribution

[10] Aigner, Lovell, and Schmidt (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.

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; normally assumed to follow a normal distribution with mean 0 and constant variance.

If u_{ij} is 0, then the economic distance bias and behind-the-border constraints are not important. If u_{ij} is close to 1, then these constraints prevent trade from reaching 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. Equation (3) can be rewritten 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 Equation (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:

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

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 Equation (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 Equation (4) can be derived using the density functions of $u + v$:

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

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 $(\ln X_1, \ln X_2, \ldots \ln X_n)$ may be written as

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

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 sample drawn is large (Theil 1971, 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 0. The MLEs of Equation (4) can be obtained through popular software such as STATA.

There are two advantages of the stochastic frontier approach 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 economies that have the least behind-the-border resistance.

A. 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 (Appendix). These include the combined GDP of the trading partners, distance between them, and language and colony variables.[11] We focus on ICT-enabled services exports that are greatly affected by the availability of a tertiary-educated population and the use of ICT infrastructure. Therefore, in our empirical specification, we include the stock of tertiary graduates and Internet subscribers per 100 persons. Data for the variables on GDP and Internet subscribers were taken from the World Bank's *World Development Indicators*. The 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.[12] Distance, common language, and colony variables were downloaded from the French Research Center in International Economics. 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 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 economies. To create a dummy variable for a services trade agreement between trading partners, we used the

[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 enrollment of tertiary education. We fill missing observations for an economy using available information on the economy and regional averages.

information on the WTO website for 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 nontariff 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 in services (Grosso et al. 2015). Applied regulations and policies are quantified and 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 services subsectors and 34 economies. Grünfeld and Moxnes (2003) use this STRI in their gravity model for total services trade, but they have been criticized by Kimura and Lee (2006) because the use of six services industry STRIs for the 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 subcategories 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 Grosso et al. 2015) and the World Bank (Borchert, Gootiiz, and Mattoo 2012). The STRIs derived by the OECD are only for OECD economies, while the World Bank covers 79 developing and transition economies, and 24 OECD economies. 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 economy coverage than the OECD project. However, sector-specific STRIs for computer services and BPS are not available in the World Bank database. Therefore, we used STRIs compiled by the OECD for our estimations as OECD economies are the trading partners considered for the gravity models used in this paper. The OECD STRIs cover restrictions on foreign ownership, market entry, and the movement of people; discriminatory measures; public ownership; barriers to competition; and regulatory transparency and licensing (OECD 2009). In order to construct the index, each measure has been allocated a weight according to importance of that measure in terms of trade restrictiveness. Further, these policy measures are categorized by the modes of supply. In our

analysis, we used the STRIs that pertain to cross-border trade. Overall, STRI value is scaled from 0 to 1, where 0 reflects minimum trade restrictions.[13]

B. 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 2002–2011. We provide estimation results for the regions of South Asia, East Asia, ASEAN, Europe, and the Americas. As the STRI variable is available only for OECD economies, each exporting economy's trading partners are limited to OECD economies.[14] The stochastic frontier model was estimated using STATA software (version 11).

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 significant and close to 1, which is the upper limit for a gamma coefficient. 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 economy-specific, behind-the-border constraints that are not captured by other explanatory variables. In developing economies, 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 industries, such as Chennai, regularly experience power shortages and interruptions. Thus, state and central governments urgently need to rectify the power supply situation in their respective economies. Though the economy-specific, behind-the-border constraints could not be identified in this study due to a lack of comparable data across the sample economies, some conjectures can be made. For example, exports of modern services from developing economies may be constrained by weak regulations, lack of modern infrastructure, and domestic political interests. These factors prevent developing economies 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

[13] STRI data by service classification, type of restriction, and mode of service was made available during the OECD experts meeting on the STRI held in Paris on 2–3 July 2009. See http://www.oecd.org/tad/services-trade/oecdexpertsmeetingsontradeinservices.htm. For more information on STRI data, see http://www.oecd.org/tad/services-trade/services-trade-restrictiveness-index.htm.

[14] Among OECD economies, 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 Economies		South Asia		East Asia and ASEAN		Europe and the Americas	
Log of exporters' real GDP	0.683***		1.221***		0.535***		0.684***	
	(0.028)		(0.119)		(0.066)		(0.024)	
Log of importers' real GDP	0.896***	0.952***	0.787***	0.762***	1.127***	1.096***	0.767***	0.832***
	(0.032)	(0.035)	(0.111)	(0.108)	(0.069)	(0.057)	(0.031)	(0.038)
Colony	0.222	0.540*	1.270	1.836*	−0.352	−0.288	0.277	0.534
	(0.227)	(0.290)	(0.755)	(0.833)	(0.537)	(0.605)	(0.219)	(0.273)
Common language	0.649***	0.510***	−0.306	−0.208	0.794**	0.274	0.726***	0.737***
	(0.148)	(0.194)	(0.486)	(0.549)	(0.309)	(0.361)	(0.157)	(0.194)
Log of distance	−0.981***	−0.998***	0.038	0.073	−0.690***	−0.743***	−0.889***	−0.862***
	(0.042)	(0.054)	(0.731)	(0.817)	(0.236)	(0.266)	(0.041)	(0.048)
Services Trade Restrictiveness Index (STRI)	−12.045***	−12.405***	−10.414*	−10.582*	−19.146***	−18.534***	−9.031***	−8.874***
	(1.540)	(1.951)	(4.703)	(4.879)	(3.252)	(2.901)	(1.542)	(1.698)
FTA_services	0.020	−0.019			−0.106	−0.098	0.150	−0.037
	(0.079)	(0.087)			(0.111)	(0.116)	(0.123)	(0.153)
Log of internet users per 100 persons_i	0.237***	0.394***	0.376***	0.634***	0.155***	0.317***	0.230***	0.256***
	(0.031)	(0.031)	(0.133)	(0.175)	(0.053)	(0.046)	(0.059)	(0.060)
Log of internet users per 100 persons_j	0.154***	0.162***	1.048***	1.033***	0.282**	0.480***	0.089	0.020
	(0.053)	(0.055)	(0.234)	(0.228)	(0.124)	(0.113)	(0.056)	(0.060)
Log of tertiary graduates_i		0.398***		1.171***		0.125**		0.597***
		(0.024)		(0.150)		(0.045)		(0.025)
Constant	−6.253***	−2.311***	−25.928***	−19.276*	−9.939***	−5.370**	−6.242***	−3.086***
	(0.727)	(0.689)	(6.155)	(7.529)	(2.498)	(2.617)	(0.622)	(0.690)
Gamma	0.86***	0.900***	0.830***	0.880***	0.850***	0.880***	0.830***	0.880***
Log likelihood	−4,083.1	−3,933.100	−196.9	−198.070	−1,353.3	−1,370.5	−2,259	−2,057.4
Wald Chi^2	2,533.5	1,816.1	259	181.3	610.7	685.5	1,881	1,056.8
No. of Obs.	4,940	4,489	258	258	1,375	1,362	3,307	2,869

ASEAN = Association of Southeast Asian Nations, FTA = free trade agreement, GDP = gross domestic product.
Notes: *** = 10% level of statistical significance, ** = 5% level of statistical significance, * = 1% level of statistical significance. 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 Economies		South Asia		East Asia and ASEAN		Europe and Americas	
Log of exporters' real GDP	0.520***		1.575***		0.339***		0.458***	
	(0.044)		(0.157)		(0.075)		(0.042)	
Log of importers' real GDP	0.818***	0.821***	1.521***	1.480***	0.963***	0.922***	0.630***	0.625***
	(0.054)	(0.058)	(0.163)	(0.173)	(0.101)	(0.111)	(0.049)	(0.054)
Colony	0.263	0.491	−0.829	−0.224	0.021	0.020	0.324	0.544
	(0.335)	(0.394)	(1.342)	(1.409)	(0.608)	(0.634)	(0.300)	(0.345)
Common language	0.862***	1.004***	1.208	1.119	1.105**	0.982**	0.484**	0.590**
	(0.224)	(0.234)	(0.969)	(1.123)	(0.380)	(0.393)	(0.215)	(0.249)
Log of distance	−0.795***	−0.823***	0.333	0.210	−0.671**	−0.703**	−0.565***	−0.521***
	(0.063)	(0.074)	(1.222)	(1.364)	(0.304)	(0.324)	(0.064)	(0.073)
Services Trade Restrictiveness Index (STRI)	−7.106**	−7.560**	−21.294***	−18.295**	−17.285**	−14.712**	−6.788**	−9.141**
	(3.048)	(3.508)	(5.137)	(6.039)	(6.950)	(7.459)	(2.832)	(3.111)
FTA_services	0.053	0.021			−0.063	−0.040	−0.028	−0.349
	(0.123)	(0.131)			(0.178)	(0.181)	(0.186)	(0.208)
Log of internet users per 100 persons_i	0.424***	0.484***	0.598**	0.620***	0.225***	0.323***	0.547***	0.421***
	(0.048)	(0.050)	(0.270)	(0.261)	(0.084)	(0.084)	(0.068)	(0.077)
Log of internet users per 100 persons_j	0.511***	0.292***	1.408**	1.197**	0.180	0.200	0.643***	0.464***
	(0.073)	(0.092)	(0.590)	(0.561)	(0.237)	(0.241)	(0.068)	(0.083)
Log of tertiary graduates_i		0.315***		1.592***		0.181**		0.366***
		(0.038)		(0.157)		(0.073)		(0.040)
Constant	−6.171***	−1.162	−39.553***	−35.559***	−8.190*	−4.972	−7.336***	−3.308***
	(1.130)	(0.861)	(9.067)	(10.483)	(3.256)	(3.406)	(0.857)	(0.863)
Gamma	0.86***	0.88***	0.88***	0.85***	0.82***	0.84***	0.88***	0.88***
Log likelihood	−4,114.9	−3,850.7	−469.4	−464.6	−1,082	−1,078	−1,970.8	−1,763.5
Wald Chi^2	1,611.1	1,249.6	529.29	456.3	266.4	225.8	1,416.9	1,085.8
No. of Obs.	3,532	3,196	277	277	841	835	2,414	2,084

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

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

	All Economies	South Asia	East Asia and ASEAN	Europe and Americas
Log of exporters' real GDP	0.505***	0.766***	0.230***	0.530***
	(0.031)	(0.249)	(0.069)	(0.031)
Log of importers' real GDP	0.698***	0.367**	0.832***	0.586***
	(0.037)	(0.172)	(0.095)	(0.035)
Colony	0.353*	1.026	1.485*	0.124
	(0.212)	(1.534)	(0.882)	(0.186)
Common language	0.590***	−0.010	0.772	0.331*
	(0.165)	(0.997)	(0.492)	(0.151)
Log of distance	−0.730***	2.776	−0.504	−0.704***
	(0.047)	(2.216)	(0.892)	(0.045)
Services Trade Restrictiveness Index (STRI)	−0.959	−2.067	1.302	−1.682
	(1.277)	(10.607)	(2.834)	(1.321)
FTA_services	0.514***		0.137	0.283*
	(0.133)		(0.333)	(0.134)
Log of internet users per 100 persons_i	0.249***	0.215*	0.056	0.463***
	(0.044)	(0.103)	(0.068)	(0.081)
Log of internet users per 100 persons_j	0.487***	1.155**	0.830***	0.412***
	(0.077)	(0.473)	(0.232)	(0.077)
Constant	−6.349***	−42.006**	−9.511	−8.216***
	(0.697)	(16.174)	(8.573)	(0.676)
Gamma	0.78***	0.79***	0.78***	0.77***
Log likelihood	−2,366.1	−232.5	−543	−1,617.2
Wald Chi^2	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: *** = 10% level of statistical significance, ** = 5% level of statistical significance, * = 1% level of statistical significance. Figures in parentheses are standard errors.
Source: Authors' calculations.

of exporters and importers, 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 services, ICT-enabled services, and BPO exports from South Asia are generated by offshore service providers based in India and delivered online.[15] 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 economies in different time zones.[16] Compared with South Asia, the distance

[15] 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.

[16] 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.

coefficient for East Asia and ASEAN 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 economies are more dependent on personal interactions 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 an economy. The coefficients for Internet use are positive for both exporting and importing economies; however, they are more significant for exporting economies. The results show that Internet use in both trading partners is essential to augment the trade of modern services between them.

Other explanatory variables included in the empirical model exhibit theoretically correct signs for 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 seems little affected by the STRIs. Trade agreements that include services generally do not have significant 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 was found to be significant and to 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 or ASEAN.

C. Export Performance

This section describes the performance of the economies in our sample in terms of realizing their bilateral export potential, using economy-specific stochastic frontier estimates. As described by O'Donnell, Rao, and Battese (2008), economies 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 economies, under the assumption that each economy has different levels of trade technology, is reasonable for our analysis.

Economy-wise realization of export potential is provided in Table 6 for BPS, computer and information services, and telecommunications services. The realization of export potential is plotted against per capita GDP in Figure 1. The plot shows that lower-middle-income economies seem to have realized greater export potential in telecommunications services, while high-income economies appear to have realized greater export potential in BPS. It is interesting to know whether there are any specific reasons for such a pattern of realization between lower-middle-income and high-income economies. The plot of the realization of export potential against per capita R&D expenditure shown in Figure 2 indicates

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

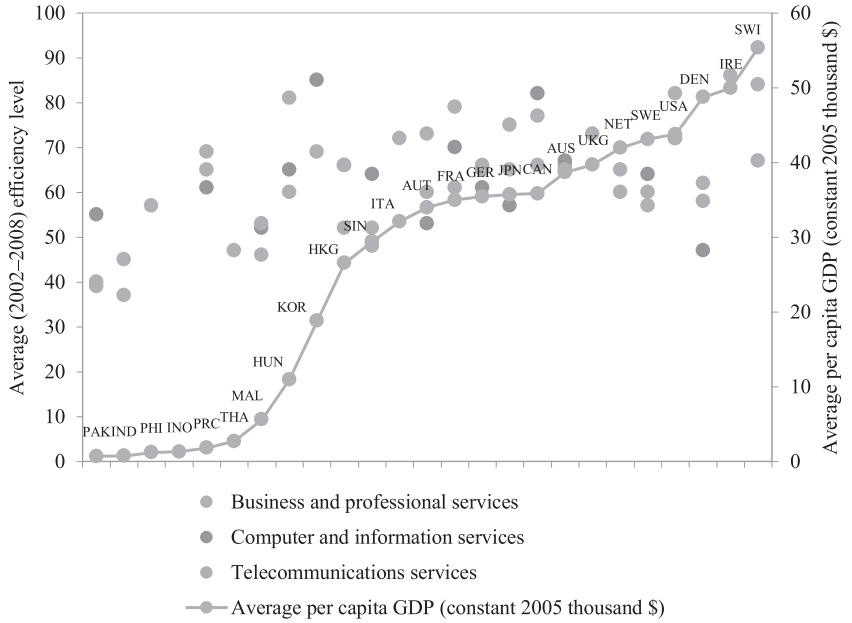
Exporter	Region	Business and Professional Services	Computer and Information Services	Telecommunications Services
India	South Asia	53	60	55
Pakistan	South Asia	39	55	40
Australia	East Asia and Pacific	66	67	65
Hong Kong, China	East Asia	52	66	66
Republic of Korea	East Asia	69	85	–
Japan	East Asia	65	57	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
United States	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	–	–
The Netherlands	Europe	65	–	60
Sweden	Europe	57	64	60
Switzerland	Europe	84	–	67
United Kingdom	Europe	73	–	–

– = data not available, ASEAN = Association of Southeast Asian Nations.
Note: Cyprus, Finland, Greece, Luxembourg, and Romania are part of the overall sample; however, they were not included in the single-economy analysis for brevity.
Source: Authors' calculations on the basis of individual economy stochastic frontier models using data for 2002–2008.

that high-income economies—such as Germany, the US, and Switzerland—spend relatively more on R&D with respect to BPS; hence, they tend to realize larger export potential in BPS. A similar argument applies for lower-middle-income economies with respect to their realization of greater export potential in telecommunications services.

In general, results reveal that emerging economies such as the Philippines and India that have seen significant growth in their modern services exports due to the outsourcing phenomenon are still not utilizing their full potential. There is also heterogeneity in individual economy performances across the three types of services under review. For BPS exports, the overall performance of ASEAN member economies is weak, with an average realization of export potential of 50% for all economies. The Philippines leads all economies in the grouping by realizing 57%

Figure 1. **Realization of Modern Services Export Potential Exports versus GDP per Capita**



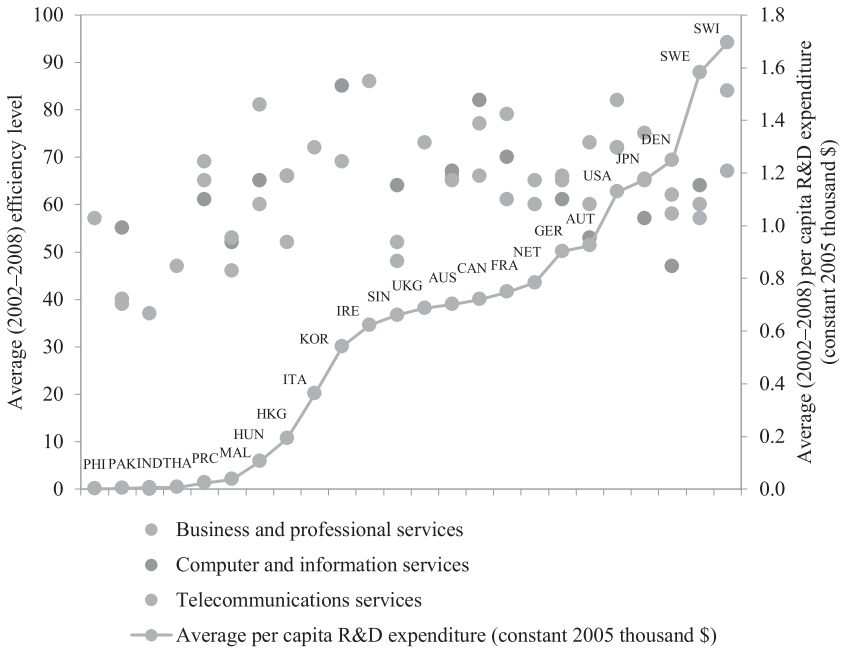
AUS = Australia; AUT = Austria; CAN = Canada; DEN = Denmark; FRA = France; GDP = gross domestic product; GER = Germany; HKG = Hong Kong, China; HUN = Hungary; IND = India; INO = Indonesia; IRE = Ireland; ITA = Italy; JPN = Japan; KOR = Republic of Korea; MAL = Malaysia; NET = the Netherlands; PAK = Pakistan; PHI = Philippines; PRC = People's Republic of China; SIN = Singapore; SWE = Sweden; SWI = Switzerland; THA = Thailand; UKG = United Kingdom; USA = United States.
Sources: Authors' calculations and World Bank. 2012. *World Development Indicators*. Washington, DC.

of its BPS export potential. The performance of India is relatively better than that of the average ASEAN economy; however, it is still considerably weaker than in East Asia, Western Europe, and North America. For example, the top performing economies—including the US, Canada, the UK, Switzerland, and Ireland—realize around 80% of their BPS export potential compared with 53% for India and an average of 50% for ASEAN.

South Asian and East Asian economies are performing relatively better in the export of computer and information services than in BPS. On average, economies in East Asia have realized their potential more than European economies, while ASEAN member economies seem on 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 economies 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 services and BPS.

For telecommunications services, the average export performance of East Asian economies is the highest among all other regions included in the study. This

Figure 2. **Realization of Modern Services Export Potential and R&D Expenditure per Capita**



AUS = Australia; AUT = Austria; CAN = Canada; DEN = Denmark; FRA = France; GDP = gross domestic product; GER = Germany; HKG = Hong Kong, China; HUN = Hungary; IND = India; INO = Indonesia; IRE = Ireland; ITA = Italy; JPN = Japan; KOR = Republic of Korea; MAL = Malaysia; NET = the Netherlands; PAK = Pakistan; PHI = Philippines; PRC = People's Republic of China; R&D = research and development; SIN = Singapore; SWE = Sweden; SWI = Switzerland; THA = Thailand; UKG = United Kingdom; USA = United States.
Sources: Authors' calculations and World Bank. 2012. *World Development Indicators*. Washington, DC.

may be because some economies in East Asia—such as 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 economies; however, it lags behind the performance of economies in East Asia, Europe, and North America. Economies such as Pakistan and Indonesia that have very low efficiencies in terms of utilization of their export potential can adopt advanced technologies and learn from the experiences of their high-performing neighbors.

V. Conclusions and Policy Implications

For the three types of services included in our analysis, established 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 economies 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 BPS and computer and ICT-enabled services, is also not efficiently realizing its export potential. The unrealized potential of India's modern services exports suggests that for the economy to sustain its services-based, export-led growth, continued efforts to develop high-end and knowledge-based services exports are needed, as well as the implementation of market reforms.

In order to catch up with the high-performing economies of East Asia, Europe, and North America, economies in South Asia and ASEAN should pursue best practices in their trade strategies, adopt advanced technologies, and remove behind-the-border constraints. The importance of regional cooperation in terms of relevant services trade agreements involving technology transfer and capacity building need not be overemphasized here. Identification of particular types of behind-the-border constraints that increase the gap between the actual and potential exports of modern services is beyond the scope of this paper. Nevertheless, some conjectures can be made based on field observations. 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 ICT-related disciplines are also important for the growth and sustainability of modern services exports from developing economies. Our results support the view that an increase in the stock of graduates and the adoption of advanced technologies can have a significant positive impact on modern services exports from developing economies in general and South Asia in particular.

Exploiting the potential of Asian economies for modern services exports requires a diverse policy response and private sector initiatives. ICT infrastructure and well-trained graduates are the basic ingredients for ICT-enabled modern services exports. Improvements in these areas are needed in economies 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 is required to move up the value chain and achieve sustainable growth beyond the current dependence on labor-cost comparative advantage. Improving urban infrastructure and developing knowledge cities is also important to facilitate the business models of modern services exports in developing Asian economies. Furthermore, the experiences of successful economies point to the role of an array of diverse factors in the expansion of ICT-enabled modern services, including multinationals, diaspora, partnerships, entrepreneurship, and regulatory reforms. Finally, there is a need for regional efforts to reduce regulatory barriers to trade in services.

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APPENDIX: Simple Correlation Matrix among Explanatory Variables

	Log of importer's real GDP	Colony	Common language	Log of distance	Services Trade Restrictiveness Index (STRI)_ importer	FTA_ services	Log of tertiary graduates_ exporter	Log of internet users per 100 persons_ exporter	Log of internet users per 100 persons_ importer
Log of importers' real GDP	1								
Colony	0.051	1							
Common language	0.064	0.187	1						
Log of distance	0.119	−0.066	−0.013	1					
Services Trade Restrictiveness Index (STRI)_importer	0.045	−0.029	−0.116	−0.029	1				
FTA_services	−0.111	−0.010	−0.064	−0.750	0.105	1			
Log of tertiary graduates_exporter	−0.073	−0.008	0.001	0.309	0.017	−0.294	1		
Log of internet users per 100 persons_exporter	0.008	0.012	−0.007	−0.304	−0.038	0.316	−0.321	1	
Log of internet users per 100 persons_importer	0.065	0.015	0.097	−0.009	−0.358	−0.007	0.059	0.093	1

Note: This correlation matrix is for all the observations used in Table 3, Column 2 regression (N = 4,489).
Source: Authors' calculations.