Chapter 1
Towards a New Framework for Analysing Trade Growth Dynamics

Pragya Shankar

1.1 Introduction

Global development experience shows that no sizable country has sustained rapid economic growth (seven plus and above) without sustained export growth backed by appropriate trade policies (Acharya 2019; Roy 2019). According to World Bank (2018), strong open trade policies promote economic growth by accelerating innovation, productivity, income, opportunities and provision of affordable goods and services to low-income households. They also play a direct role in reducing global poverty. UN-DESA (2015) sums this as the relation between trade and structural transformation that is observed as the graduation of many countries out of LDC (Least Developed Countries) status.

Existing literature has analysed several aspects of trade dynamics and growth. Few of these are constant market share analysis (Jepma 1986), rank ordering of commodities and countries based on product cycle approach (Feenstra and Rose 1997), intensive and extensive margin approach (Evenett and Venables 2002; Hummels and Klenow 2005), decomposition using gravity model (Novy 2009) and decomposition based on stochastic frontier gravity models (Kalirajan 2010).

Kalirajan (2010) in his decomposition stresses on the interactions between trade growth dynamics, trade costs and reforms. He decomposes total exports growth of a country with its various trade partners into the sum of changes in demand and trade costs, with the latter being composed of 'explicit beyond the border barriers', 'implicit beyond the border barriers' and 'behind the border barriers'. Reforms are found to promote trade growth by reducing 'implicit beyond the border barriers'. This method is formulated for assessing trade growth of a particular country with all

P. Shankar (✉)
Ram Lal Anand College, Delhi University, New Delhi, India

A. K. Mishra et al. (eds.), *Advances in Innovation, Trade and Business*,
Contributions to Management Science,
https://doi.org/10.1007/978-3-030-60354-0_1

its trade partners. Kalirajan and Khan (2011) apply it to analyse Pakistan's export growth between 1999 and 2004.

The above literature survey reveals one area of potential research, viz., of developing a trade growth decomposition framework based on the concepts of productivity analysis. Productivity analysis decomposes output growth into input effect, technological effect and efficiency effect. Both frontier and data envelopment analysis techniques have been used for this decomposition. This paper tries to develop a trade decomposition framework using the concepts from productivity analysis.

The relevance for such an exercise can be justified from the following observations: (i) Trade facilitation polices are found to increase trade by reducing trade costs (Wilson et al. 2004, Duval and Utoktham 2009, 2011a, 2011b and so on). This corresponds to the concept of 'input effect' in productivity analysis; (ii) Berkowitz et al. (2006) have applied the Trade Facilitation and Export Competitiveness framework outlined in Spence and Karingi (2011) to develop the concepts of production and transaction effects. These effects measure the impact of change in export productivity on trade growth. The sum of these two effects, technological effect, is related to the technological effect used in output growth decomposition (Kumbhakar and Bhaumik 2010); and (iii) The efficiency effect documented in Stochastic Frontier Gravity Models (Armstrong et al. 2008; Kalirajan and Khan 2011) is the counterpart of efficiency effect in productivity analysis.

Thus, existing literature reveals a close correspondence between aspects of trade and output growth dynamics. The next step in this direction would be to develop a quantitative model that can represent all aspects of trade growth, as found for output growth.

The starting point for this proposed model is Kumbhakar and Bhaumik (2010). The authors develop an output growth decomposition framework by taking the difference of two cross-sectional stochastic frontier production models (estimated for a point in time). Analogous to Kumbhakar and Bhaumik (2010), the proposed model is obtained by taking the difference of two cross-sectional stochastic frontier gravity models. Four terms are identified in this trade growth decomposition: input effect, technological effect, efficiency effect and random effect. While the first three are analogous to components found in output growth decomposition (Kumbhakar and Bhaumik 2010), the fourth, a new term, captures the effect of random shocks on trade growth. Interpretation of model terms is as based on the above-mentioned literature.

Next step in this modelling is hypotheses on trade growth patterns. UNIDO (2005) and Kumbhakar and Bhaumik (2010) discuss expected patterns of output dynamics for developed and developing countries. This literature is used to develop hypotheses on expected trade growth patterns of developing and developed countries.

Finally, keeping up with Kalirajan (2010), a new method for assessing the role of reforms in influencing trade dynamics is proposed.

The model contributes to the existing literature in the following ways: (i) it provides a new method for analysing trade growth dynamics and of reforms in

influencing trade growth; and (ii) provides for comparison with output growth. This can provide a deeper understanding of processes involved in structural transformation and development, as discussed by World Bank (2018) and UN-DESA (2015) above.

The paper is structured as follows: Sect. 1.2 lists the objectives of this paper. Section 1.3 discusses the data description and methodology. Section 1.4 presents the results, while Sect. 1.5 concludes.

1.2 Objectives

1. Develop a trade growth decomposition model based on concepts of productivity analysis for analysing trade growth of countries/regions. Trade growth decomposed into input effect, technological effect, efficiency effect and random effect.
2. Develop a reforms evaluation framework for assessing role of reforms in influencing trade growth.

1.3 Data and Methodology

1.3.1 Data Description

This paper builds a trade growth decomposition model using stochastic frontier inverse gravity model and uses it to describe trade growth patterns of developing and developed countries. It also investigates the role of reforms in this process. Data for undertaking these analyses are taken from the following sources.

A total of 34 countries constituting a sample of 1097 bilateral merchandize trade flows are used for estimating frontier models for the years 2001 and 2007. These countries featured in the list of top 50 exporters for the years 2001 and 2007 (WTO 2008) and accounted for about 75% of world merchandize trade in these years.

The Global Competitiveness Report, GCR, released by World Economic Form and Harvard University (2010) divides these 34 countries into five categories according to their level of development:

Stage 1: Low developed, factor driven countries (Bangladesh (**Bgd**), India (**Ind**);

Transition from Stage 1 to Stage 2: (Philippines **(Phl)**, Vietnam **(Vnm)**);

Stage 2: Efficiency driven economies (China (**Chn**), Colombia **(Col)**, Indonesia **(Idn)**, South Africa **(Zaf)**, Sri Lanka (**Lka**) and Thailand **(Tha)**);

Transition from Stage 2 to Stage 3: (Argentina **(Arg)**, Brazil **(Bra)**, Chile **(Chl)**, Malaysia **(Mys)**, Mexico **(Mex)**, Romania **(Rom)**, Russia **(Rus)** and Turkey **(Tur)**);

Stage 3: Innovation driven economies or frontier countries (Australia **(Aus)**, Austria **(Aut)**, Belgium **(Bel)**, Canada **(Can)**, France **(Fra)**, Germany **(Deu)**, Israel

(Isr), Italy **(Ita)**, Japan **(Jpn)**, Korea **(Kor)**, Netherland **(Nld)**, Spain **(Esp)**, Sweden **(Swe)** , Switzerland **(Che)**, GBR **(UK)**, USA (**US)**).

Trade frontier countries like Singapore and Hong Kong have been excluded due to data limitations.

Data for the dependent variable of the inverse gravity equation has been collected from the earlier version of **TRADE COSTS DATABASE.**

Data on gravity covariates, viz. bilateral distance, common border and common language, has been taken from **CEPII**. Membership in Free trade areas has been constructed using the list of FTA agreements given on the **WTO** Website. Domestic trade costs are represented using unadjusted (not chain linked) overall country scores from Annual Report of Economic Freedom Network (**EFN**), released by the Heritage Foundation.

Reform areas: Information and Communication Technology Expenditure is sourced from World Development Indicators. Reform areas measuring Tariff and Non-Tariff Barriers, Government's Business Start-Up Regulations, Import and Export Costs, Protection of Property Rights and Efficiency of Legal Framework for Settling Disputes and Challenging Legality of Government Actions are sourced from Economic Freedom Network (**EFN**).

Variables need not be adjusted for price changes as the dependent variable is in the form of a ratio (Novy and Chen 2009) and the independent variables are in the form of indices. No cases of multicollinearity are reported in the data set as the highest magnitude of variance inflation factor is found to be 3.19 (Model 3, Year 2001, Appendix 1 Table 1.11).

The estimation of the Frontier Models has been done using Stata 13 Software. Results provide observation-wise magnitudes of one-sided error term and predicted values, from which magnitudes of the two-sided error terms are obtained.

1.3.2 Methodology

The methodology in this analysis is explained under two parts. The first part explains the construction of the trade growth decomposition model and the reforms evaluation framework. Hypotheses on trade growth patterns and role of reforms on influencing trade growth are also reported. The second part reports the econometric model, the specification of the inverse frontier model, for this paper. Descriptive statistics of some key variables are also presented.

1.3.2.1 Trade Growth Decomposition and Reforms Evaluation: Concepts and Hypotheses

Trade Growth Decomposition: Concept and Hypotheses

Model Structure

Kumbhakar and Bhaumik (2010) apply stochastic frontier method in a cross-sectional framework to decompose output growth into input, technological and efficiency effects. This method is utilized to build a trade growth decomposition framework using stochastic frontier gravity models as follows:

Consider two *estimated* stochastic frontier 'inverse' gravity models for world trade for periods 1 and 2:

$$\mathrm{Ln}Y_{ij}^{1} = \alpha^{1} + \mathrm{Ln}f^{1}\left(X_{ij}^{1};\beta^{1}\right) + V_{ij}^{1} - U_{ij}^{1}, \qquad i,j = 1, \ldots, n. \tag{1.1}$$

$$\mathrm{Ln}Y_{ij}^{2} = \alpha^{2} + \mathrm{Ln}f^{2}\left(X_{ij}^{2};\beta^{2}\right) + V_{ij}^{2} - U_{ij}^{2}, \qquad i,j = 1, \ldots, n \tag{1.2}$$

where $\mathrm{Ln}f^{1}\left(X_{ij}^{1};\beta^{1}\right) = \beta^{1}\mathrm{Ln}X_{ij}^{1}$ and so on.

Taking the difference of the above equations and using $\mathrm{Ln}f^{1}\left(X_{ij}^{1};\beta^{1}\right) = \beta^{1}\mathrm{Ln}X_{ij}^{1}$ and so on, one gets

$$\begin{aligned}\mathrm{Ln}Y_{ij}^{2} - \mathrm{Ln}Y_{ij}^{1} = {} & \beta^{2}\left(\mathrm{Ln}X_{ij}^{2} - \mathrm{Ln}X_{ij}^{1}\right) + \left[\left(\alpha^{2} - \alpha^{1}\right) + \left(\beta^{2} - \beta^{1}\right)\mathrm{Ln}X_{ij}^{1}\right] \\ & + \left(V_{ij}^{2} - V_{ij}^{1}\right) - \left(U_{ij}^{2} - U_{ij}^{1}\right), \qquad i,j \\ & = 1, \ldots, n\end{aligned} \tag{1.3}$$

Taking the mean of the above equation, one gets

$$\begin{aligned}\left(\overline{\mathrm{Ln}Y_{ij}^{2}} - \overline{\mathrm{Ln}Y_{ij}^{1}}\right) = {} & \beta^{2}\left(\overline{\mathrm{Ln}X_{ij}^{2}} - \overline{\mathrm{Ln}X_{ij}^{1}}\right) + \left[\left(\alpha^{2} - \alpha^{1}\right) + \left(\beta^{2} - \beta^{1}\right)\overline{\mathrm{Ln}X_{ij}^{1}}\right] \\ & - \left(\overline{U_{ij}^{2}} - \overline{U_{ij}^{1}}\right), \qquad i,j \\ & = 1, \ldots, n\end{aligned} \tag{1.4}$$

where the bar denotes the sample mean of the respective variable. The third bracketed term of Eq. (1.3) vanishes in Eq. (1.4) as V_{ij} is distributed $N(0, \sigma_{v}^{2})$.

The first three bracketed terms on the right-hand side of Eq. (1.4) (and the first, second and fourth term of Eq. (1.3)) correspond to the notions of 'input effect', 'technological effect' and 'efficiency effect' developed in Kumbhakar and Bhaumik (2010). The third term in Eq. (1.3) is defined as 'random effect' to capture the role of random shocks on trade growth.

Interpretation of Model Terms (Eqs. (1.3) and (1.4))

The interpretation of the terms in Eq. (1.3) are derived from the literature (relevant references stated in brackets). They have similar meaning for Eq. (1.4), except that they explain growth of average trade. Random effect component vanishes in Eq. (1.4) as the random error term has a zero mean.

Input effect (Kumbhakar and Bhaumik 2010)*: Contribution of change in inputs to trade growth*. Input effect is posited to be captured by a movement along the trade frontier or by exploitation of the curvature of the trade (export) frontier.

Technological effect (Kumbhakar and Bhaumik 2010; Berkowitz et al. 2006)*: Contribution of change in export productivity to trade growth***.** Technological effect in output growth decomposition derives its concept from production theory. However, in trade growth decomposition, it is posited to arise from both trade and production theory as the exporting decision is an offshoot of the production activity. Technological effect is defined to arise from two components:

Transaction effect: Increased export productivity caused by reduction in transaction costs of exporting firms. Reforms reduce transaction (trade) costs by reducing *fixed costs of exporting* such as those related to gathering information about demand conditions in foreign markets, searching for new partners, monitoring trade alliances, trade procedures and so on. This promotes trade by allowing existing firms to produce more of existing as well as new products to old and new markets. It also encourages new firms to enter export markets. This concept is related to 'intensive' and 'extensive' growth margins, which has its roots in the heterogeneous models of international trade (Melitz 2008).

Production effect: Increased export productivity caused by changes to production structures. Production effect is created through scale economies, learning-by-exporting skills, in-house technical innovation and adoption, intra-industry trade, promotion of sophisticated growth boosting products and so on.

No association is made between these two concepts and the two components of technological effect. As changing production structures takes time, reforms are likely to enhance export productivity through higher transaction effect than production effect in the short run.

Technological effect is posited to be captured by shift in the trade (export) frontier. An outward (inward) shift is purported to represent increased (decreased) export productivity.

Efficiency effect or catch-up effect (Kalirajan 2010; Kumbhakar and Bhaumik 2010)*: Contribution of change in technical efficiency to trade growth*. Efficiency effect is posited to be a movement from a position within the export frontier towards the export frontier.

Random effect: Effect of random shocks on trade growth. Sources of such shocks could be financial crises, exchange rate fluctuations, socio-political and environmental issues and innovations.

Expected Pattern of Trade Dynamics

Trade growth dynamics is expected to follow similar trends as reported for output growth in UNIDO (2005).

In general, in the initial stages, trade growth occurs via enhanced resource utilization or higher input effect (due to trade reforms). However, corresponding to the growth literature, where this stage continues till dictated by the law of diminishing returns, no such analysis has been undertaken in the present study.

In the next stage, trade growth becomes dependent on increase in export productivity or technological effect.

Finally, as countries try to reach the trade frontier by improving their trade performance and trade technologies, the efficiency effect, which generally stays negative in the initial stages of growth, becomes positive.

The above pattern gets affected by both positive and negative random shocks existing in the global economic environment.

Hypotheses on Trade Growth Patterns of Developing and Developed Countries

Based on UNIDO (2005), which presents stylized facts on productivity decomposition for output growth, following hypotheses are proposed for trade growth.

First Hypothesis (H1)

Input effect is expected to be larger for developing countries than developed countries.

Explanation: Akin to output growth, trade is expected to be governed by input effect in developing countries. In addition, as developing countries have higher trade costs than developed countries, reforms are expected to add to input effect by releasing inputs blocked in the supply chain.

Second Hypothesis (H2)

Technological effect, on average, is expected to be larger for developed countries than developing countries, as the former are the innovators of technology.

However, a reverse trend, if found, is attributed to the following reasons: (i) Poor trade performance of developed countries as compared to the developing countries during 2001–2007 (WTO 2008), which is the period of analysis; (ii) Increased fragmentation of production and trade networks in technologically sophisticated goods (the embodiments of innovation). This leads to a situation where developed countries export semi-finished technologically intensive goods to developing countries, which in turn, re-export them in finished form to developed countries. This may impute a lower production effect to developed countries (Lall et al. 2005 and so on); (iii) Sampling considerations and aggregation issues: Countries like Singapore and Hong Kong, which are usually found to determine the trade frontier (Armstrong, Drysdale and Kalirajan 2008) are not included in the sample due to data constraints. Also, the data is at an aggregate level, masking technological differences across sectors.

Third Hypothesis (H3)

Efficiency effect is expected to be higher (or positive) for developed countries and lower (or even negative) for developing countries.

Technological progress in developing countries occurs by adoption of techniques (for domestic and export) that are new in their environment and at the beginning of the learning curve but mature in developed countries. Thus, the transfer of techniques to developing countries by the developed countries leads, *ipso facto*, to a regress in inefficiency.

In contrast, the attraction effect of technological innovation carried out by frontier countries is powerful in countries in the technological neighbourhood of the innovative segment, as they have similar infrastructure to undertake such activity. Hence efficiency effect for developed countries is expected to be positive.

Note*: A combination of negative technological effect and positive efficiency effect for developed countries possibly indicates presence of a large negative transaction effect in these countries. This is because a positive efficiency effect is likely to be the outcome of a strong production effect as these countries are the innovators of technology.*

Fourth Hypothesis (H4)

The random effect is expected, in general, to be higher for developed countries than for developing countries.

Developed countries have strong interlinkages with world trade and production networks that allows easier access to inputs, investment opportunities, credit, transport facilities and the like. However, a converse pattern, if found, is attributed to the global financial crisis and the poor trade and production performance of developed countries during 2001–2007.

Reforms Evaluation Framework: Concept and Hypotheses

Concept

Reforms act like inputs in accelerating the growth process. In this paper, reforms are represented by pillars of the Global Competitiveness Index (GCI) (Global Competitiveness Report (GCR) (World Economic Forum and Harvard University (2010, p. 8))))—basic requirements, efficiency enhancers and innovation and sophistication factors—which help in transition of factor driven economies (least developed countries) to innovation driven economies (advanced economies). A low level of development is equated with a factor driven economy (in which 70% of exports are primary commodities) where competitiveness is derived from certain basic requirements. Thereafter efficiency enhancers dominate before innovation and sophistication factors come to the fore (Table 1.1 gives details on these pillars).

Reforms influence trade by affecting trade growth components. The ‘stage’ of a reform area, measured by its depth and period of implementation, is posited to be directly related to the stage of trade growth dynamics. Thus, for instance, mature areas are expected to influence latter stages of trade growth in advanced countries.

Table 1.1 Coverage of various reform areas

GCR(x) (Reform area or index for measuring the area)	ICT (Source: WDI)	IMPCOU (Source: EFN)	PROP (Source: EFN)	NTB (Source: EFN)	IMEX (Source: EFN)	STABUS (Source: EFN)
Basic requirements						
Institutions		B	A			Burden of Government Regulations
Infrastructure	Telephone lines				Ports	
Macroeconomic stability						
Health and primary education						
Efficiency enhancers						
Higher education and training	Internet access in schools					
Goods market efficiency				Prevalence of trade barriers	Burden of customs procedures	Number of procedures and time required to start a business
Labour market efficiency						
Financial market sophistication						
Technological readiness	Except laws relating to ICT					
Market size						
Innovation and sophistication factors						
Business sophistication	X					
Innovation	X					

Source: Author

A: Property rights, including over financial assets, are poorly defined and not protected by law (=1) or are clearly defined and well protected by law (=10); B: The legal framework in your country for private businesses to settle disputes and challenge the legality of government actions and/or regulations is inefficient (min = 1) and subject to manipulation or is efficient and follows a clear neutral process (max = 10).

ICT: Correspondence with GCR established based on Global Trade Enabling Report (World Economic Forum 2008), which is like GCR. 'X' denotes the indirect coverage of these areas by ICT.

IMPCOU, PROP, NTB: The EFN values for these three variables (IMPCOU, PROP and NTB) are sourced from GCR.

IMEX, STABUS: These two variables have partial correspondences with GCR as they are part of Doing Business Report. The common areas between the EFN and GCR are indicated in Table 1.1.

Six reform areas are included in the paper: **ICT (**Information and Communication Technology Expenditure)**, IMEX** (Import and Export Costs)**, NTB (**Tariffs and non-tariff barriers)**, PROP** (Protection of property rights)**, IMPCOU** (Functioning of courts) and **STABUS** (Regulations for starting a business). Table 1.1 reports the correspondences of these areas with GCI.

The stage of a reform area is determined by worldwide trends, relation with GCI pillars (higher level pillars associated with higher level of development) and other factors. Trends in elasticities of frontier estimation between 2001 and 2007 (Appendix Tables 1.11 and 1.12) are not considered due to poor trade performance of developed countries in this period and other reasons like the inverse gravity methodology (dependent variable is international trade divided by intranational trade of both partners). Classification of these areas is explained below:

$ICT_{ij,}$ intermediate/matured area: Increased usage by countries over time across the globe (ITU 2010) and usage amongst leaders of ongoing Industrial Revolution 4.0 (which is based on ICT)—Canada, Japan, Germany, Australia, Austria and Switzerland) (Clarke-Potter 2019).[1] ICT plays roles of '*infrastructure*', '*technological readiness*' and '*innovation* and *sophistication*' pillars of GCI, depending upon various stages of trade growth.

$IMEX_{ij}$ and $NTB_{ij,}$ intermediate/mature areas: $IMEX_{ij}$ covers issues relating to border related trade facilitation, inland infrastructure and logistics services and has a profound impact on trade (Francois and Manchin 2007; UNESCAP 2009). Border related trade facilitation costs are in a comparable range across developing and developed countries (Duval and Utoktham 2009, 2011a) due to the implementation of worldwide reforms (Doing Business 2006, 2008, 2009, 2010, World Bank). However, work is required in the other two areas (India's logistics costs are amongst the highest in the world at around 13% of GDP that impose an annual loss of around $20 billion to its GDP (Banik 2014). Moreover, logistics are expected to play an important role in fostering regional cooperation (UNCTAD 2007b).

NTB_{ij} captures the coverage of trade policy barriers-tariff and non-tariffs (NTB). Tariff liberalization is already extensive worldwide due to WTO, however, scope for more reduction has been identified (Duval and Utoktham 2011a, 2011b; Kowaleski and Dihel 2009). Moreover, reduction in NTBs is now the crucial component in international trade policy (UNESCAP 2009; Das 2012).

$IMEX_{ij}$ and NTB_{ij} are associated with *'infrastructure'* and *'goods market efficiency'* and '*goods market efficiency*', respectively, in Table 1.1. They also indirectly impact the last stage pillar.

$IMPCOU_{ij}$, $PROP_{ij}$ and $STABUS_{ij}$ (domestic business investment), indeterminate areas: These variables are possibly associated with ongoing reforms, as many developed countries feature in bottom ranks. These variables are directly associated with *'institutions'* and *'goods market efficiency'* pillars (STABUS with both).

[1] https://blockheadtechnologies.com/these-are-the-six-countries-leading-the-fourth-industrial-revolution/

However, they also indirectly impact the later stage pillar related to innovation and sophistication.

Hypotheses

Two more hypotheses are tested for examining the role of reforms in influencing trade growth dynamics.

Fifth Hypothesis (H5)

The stage of a reform area, in terms of years and coverage of implementation, is directly related to the stage of trade growth dynamics.

Examples: **ICT** is expected to influence early stages of trade growth in developing countries (as many of them still feature in lower ranks of this variable) and later stages of growth in developed countries. Further, reforms, in general, are expected to influence the later (earlier) stages of trade growth in developed (developing) countries.

Sixth Hypothesis (H6)

Random effect is expected to be higher for all reform areas with trade orientation ($IMEX_{ij}$, NTB_{ij}) than those aimed at building domestic capacity ($PROP_{ij}$, $IMPCOU_{ij}$, $STARBUS_{ij}$). It is also expected to be higher for developed countries as compared to developing countries.

1.3.2.2 Econometric (Frontier) Model and Descriptive Statistics of Key Variables

Frontier Model

The trade decomposition equations in Sect. 1.3.2.1 (Eqs. (1.3) and (1.4)) are obtained by taking the difference of two cross-sectional stochastic frontier inverse gravity models between 2001 and 2007.

Inverse gravity model does away with the multilateral resistance terms that simplifies estimation. However, a consequence of this model is that model parameters represent combined performance of both trade partners. Thus, the trade growth decomposition components represent combined performance of both trade partners. However, variations in trade performances of developed and developing countries do exist (Shankar 2015).

Following specification of stochastic frontier inverse gravity model (Eq. (1.1)) is adopted (the inverse gravity model does away with the multilateral resistance terms):

$$\mathrm{Ln}Y_{ij} = \mathrm{Ln}\left[\left(\frac{X_{ij}}{X_{ii}}\right) \times \left(\frac{X_{ji}}{X_{jj}}\right)\right]$$

$$= \text{Const} + \beta 1\text{Ldist}_{ij} + \beta 2\text{Lang}_{ij} + \beta 3\text{Contig}_{ij} + \beta 4\text{FTA}_{ij} + \beta 5\text{ReformArea}_{ij} + \beta 6\text{LnDomt}_{ii} + \beta 7\text{LnDomt}_{jj} + V_{ij} - U_{ij}, \quad i.j = 1, \ldots, n. \; i \neq j. \tag{1.5}$$

Variables used in Eq. (1.5) are listed in Table 1.2.[2] Six forms of Eq. (1.5), corresponding to each of the six reform areas, are estimated for 2001 and 2007. Model results are subject to robustness checks based on Duval and Utoktham (2011a). Results of the frontier estimation are provided in Appendix Tables 1.11 and 1.12.

Variables and Descriptive Statistics

Table 1.2 shows the variables used in the frontier estimation (Eq. (1.5)) along with their references. Some important trends of the dependent variable, **Ltrade$_{ij}$** and other variables—**TradeGrowth$_{ij}$** and the six reform areas (bilateral trade pair values)—are discussed below. Correlations between dependent variable and independent variables are also reported. These will be used for explaining results of trade growth decomposition in Sect. 1.4.

1. **Ltrade$_{ij}$:** Mean increases from (−12.42) to (−11.74). (Dvd: (−9.77), (−9.44); Dvg. (−14.13), (−13.06)—Increase)

   High (2007): Belgium, Netherlands, Malaysia and Austria (high trade to GDP ratio); Germany, China, US, Japan, France, UK and Canada (leading merchandize traders in 2007) (WTO 2008) and Vietnam (high trade/GDP ratio, high trade growth and amongst top merchandize 50 traders in 2007).

   Low (2007): Colombia and Bangladesh (low trade to GDP ratio); Philippines and Sri Lanka (least export growth amongst sample countries and a decline in trade/GDP ratio during 2000–2007); Romania-Philippines, Bangladesh and Chile (negligible trade (WITS, export share, 2007)).

   Similar pattern of Ltrade for 2001 (not reported).
2. **TradeGrowth$_{ij}$:** Mean value in the sample is 0.68. (Dvd: 0.33; Dvg: 1.08)

   High:

   Country pairs: Colombia-Bangladesh (max), Turkey, China, India; Vietnam-Argentina, Chile, Brazil, Mexico; Romania-Japan.

[2]FTAs (along with the year they came into force): APEC, APEC-China (2001), ASEAN, ASEAN-China (Goods-2005, Services-2007), Canada-Chile (1997), Canada-Israel (1997), Chile-China (2006), Chile-India (2007), Chile-Japan (2007), Chile-Mexico (1995), EU, EU-Chile (Goods-2003, Services-2005), EU-Israel (2000), EU-Mexico (2000), EU-Turkey (1996), SAFTA (2006), India-Sri Lanka (2001), Israel-Mexico (2000), Japan-Malaysia (2006), Japan-Mexico (2005), Japan-Thailand (2007), Korea-Chile (2004), MERCOSUR (1994), NAFTA (1993), Thailand-Australia (2005), Turkey-Israel (1997), US-Australia (2005), US-Chile (2004) and US-Israel (1985).

Table 1.2 Variable definition

Variable	Definition	Source	Purpose	Reference
1. $LDIST_{ij}(-)$	Ln(Distance)	CEPII	Transportation costs.	Armstrong et al. (2008), Armstrong and Drysdale (2010).
2. $CONTIG_{ij}(+)$	Dummy for contiguity.	CEPII	Transport and communication advantage.	Armstrong et al. (2008), Armstrong and Drysdale (2010).
3. $COMLANG_{ij}(+)$	Dummy for common language.	CEPII	Communication advantage.	Armstrong et al. (2008), Armstrong and Drysdale (2010).
4. $STABUS_{ij}(+)$	Log(Index of Govt. Reglns in Starting a Bus. of Exp*Imp)	EFN	Government's Business Start-up Regulations (Reglns).	Duval and Utoktham (2009, 2011a, 2011b).
5. $FTA_{ij}(+)$	Dummy for membership in Regional Trade Agreements	WTO	Foreign Policy.	Armstrong et al. (2008), Armstrong and Drysdale (2010)
6. $ICT_{ij}(+)$	Log(ICT expenditure as a ratio of GDP of Exp*Imp)	WDI	Information availability, automation of customs procedures, technological readiness.	Wilson et al. (2004) and Duval and Utoktham (2009, 2011a).
7. $PROP_{ij}(+)$	Log(Protection of property rights index of Exp*Imp)	EFN	Property rights protection.	Anderson and Marcouiller (2002) and Duval and Utoktham (2009, 2011a).
8. $IMPCOU_{ij}(+)$	Log(Index of improper courts of Exp*Imp)	EFN	Contract enforcement mechanism.	Anderson and Marcouiller (2002) and Duval and Utoktham (2009, 2011a).
9. $IMEX_{ij}$ (+)	Log(Cost of export and import index of Exp*imp)	EFN	Import and Export Costs.	Duval and Utoktham (2011a, 2011b), Francois and Manchin (2007), UNESCAP (2009).
10. NTB_{ij} (+)	Log(Index of Tariffs and Non-Tariff Barrier of Exp*Imp)	EFN	Foreign policy.	UNESCAP (2009), Das (2012), Duval and Utoktham (2011a, 2011b) and Kowaleski and Dihel (2009).
11. $LDOMT_{ii}$ (+) $LDOMT_{jj}$	Log (EFN country score)	EFN	Domestic Trade costs.	Shankar (2015)
12. $LTRADE_{ij}$	Log[(Bilateral exports/internal trade) of Exp*Imp]	TRADE COST DATABASE	Internal trade adjusted bilateral exports.	Shankar (2015)

FTAs are listed as a footnote
Source: Author

Low:

Country pairs: Philippines-Romania (min), Israel; Chile-Bangladesh; UK-Philippines; Korea-Sri-Lanka; Thailand-Romania; Sri-Lanka-Israel; UK-Indonesia; Philippines-Sri Lanka; UK-Chile.

Countries (Sample average trade growth):

High: Vietnam (highest), China, India, Argentina, Belgium, Bangladesh, Colombia, Turkey, Netherlands, Switzerland.

Low: Philippines (lowest), UK, Israel, Sri Lanka, France, Indonesia, US, Sweden, Italy, Australia.

3. **Correlations**-Dependent and independent variables.

Variables	Full Sample		Developed Countries		Developing Countries	
	2001	2007	2001	2007	2001	2007
Reforms: ICT, Impcou, Prop, Ntb, Imex, Stabus	0.51, 0.45, 0.51, 0.46, 0.56, 0.39	0.27, 0.41 0.42, 0.28, 0.29, 0.25	−0.26, −0.07, 0.21, 0.28 0.43, −0.34	−0.13, −0.01, 0.07, 0.12, 0.14, 0.15	0.53, 0.31, 0.33, 0.31, 0.42, 0.54	0.29, 0.38, 0.30, 0.11, 0.13, −0.03
Gravity: Contig, Comlang, Ldist, FTA	0.33, 0.18, −0.57, 0.41	0.34, 0.15, −0.57, 0.40	0.58, 0.22 −0.81, 0.49	0.56, 0.24 −0.78, 0.43	0.28, 0.14, −0.57, 0.48	0.32, 0.12, −0.55, 0.49
Domestic Trade Costs: Exp and Imp EFN Scores	0.33, 0.32	0.28, 0.28	0.08, 0.04	0.01, −0.05	0.23, 0.24	0.18, 0.21

Correlations report a decline in value from 2001 to 2007 for most variables. Increase: (i) Full sample: **Contig**; (ii) Developed countries: **ICT, IMPCOU, STABUS, Comlang** and **Ldist**.; (iii) Developing countries: **IMPCOU, Contig**, **Ldist** and **FTA.** Possible reasons for these observations could be the inverse gravity model methodology, where dependent variable is different from normal gravity equations, and an increase in negative shocks to world trade in this period (Shankar 2015). Such shocks (not reported) also show up in frontier results in this paper in Appendix Tables 1.11 and 1.12.

4. **ICT_{ij}:** Mean increases from 3.40 to 3.48. (Dvd: 3.66, 3.57—Decrease; Dvg: 3.19, 3.41—Increase).

Top 10 2001	Top 10 2007
Malaysia (best), Korea, South Africa, China, US, Vietnam, Switzerland, Canada, Netherlands and Japan.	Malaysia (best), South Africa, Korea, Bangladesh, Switzerland, US, Japan, Netherlands, Canada and China.
Bottom 10 2001	Bottom 10 2007
Bangladesh (worst), Sri Lanka, Indonesia, India, Colombia, Russia, Argentina, Turkey, Mexico and Chile.	Indonesia (worst), India, Russia, Turkey, Sri Lanka, Mexico, Colombia, Chile, Spain and Romania.

(continued)

Key Changes Top 10: Bangladesh moves from bottom 10 in 2001 to top 5 in 2007. Vietnam moves out of top 10 in 2007. Bottom 10: Romania and Spain in bottom 10 in 2007. Argentina (with Bangladesh) not in bottom 10 in 2007.

Note: Dvd. and Dvg. stand for groups of developed and developing defined in Tables 1.4 and 1.5, respectively.

5. **$IMPCOU_{ij}$:** Mean increases from 3.25 to 3.31. (Dvd.: 3.94, 3.83—Decrease; Dvg: 2.71, 2.90—Increase)

Top 10 2001 Australia, Israel, UK, Switzerland, Germany, Netherlands, US, Canada, Sweden and Austria.	Top 10 2007 Switzerland, Germany, Sweden, Austria, Netherlands, Australia, Canada, France, Japan and UK.
Bottom 10 2001 Argentina, Indonesia, Russia, Romania, Bangladesh, Turkey, Philippines, Mexico, Colombia and Vietnam.	Bottom 10 2007 Argentina, Bangladesh, Italy, Mexico, Russia, Philippines, Brazil, Romania, Turkey and Indonesia.
Key Changes Top 10: Israel and US out of top 10 in 2007; Switzerland, Germany, Sweden move up in rankings in 2007; France and Japan in top 10 in 2007. Bottom 10: Italy in bottom 10 in 2007; Colombia and Vietnam out of bottom 10 in 2007; Bangladesh and Mexico further down.	

6. **$PROP_{ij}$:** Mean increases from 3.24 to 3.81. (Dvd.: 4.07, 4.23—Increase; Dvg: 2.58, 3.47—Increase)

Top 10 2001 US, UK, Netherlands, Austria, Australia, Switzerland, Sweden, Germany, Canada and Belgium.	Top 10 2007 Switzerland, Austria, Germany, Sweden, Canada, Australia, Netherlands, Japan, France and Belgium.
Bottom 10 2001 Bangladesh, Indonesia, Vietnam, Russia, Argentina, Romania, Philippines, Turkey, Mexico and India.	Bottom 10 2007 Argentina, Russia, Indonesia, Bangladesh, Philippines, Mexico, Romania, Turkey, Vietnam and Colombia.
Key changes Top 10: US and UK out of top 10 while France and Japan move here in 2007; Switzerland, Austria and Germany improve further in 2007. Bottom 10: India out in 2007; Argentina and Russia slide back in rankings in 2007; Colombia joins in 2007; Vietnam improves its rank in 2007.	

7. **NTB_{ij}:** Mean increases from 3.62 to 3.69. (Dvd.: 4.04, 3.91—Decrease; Dvg: 3.29, 3.51—Increase)

Top 10 2001 Chile, Netherlands, Sweden, Austria, Belgium, UK, Australia, Germany, Spain and US.	Top 10 2007 Sweden, Chile, Austria, Belgium, Netherlands, Australia, Israel, France, Germany and UK.
Bottom 10 2001 Vietnam, Romania, Russia, Philippines, Indonesia, Bangladesh, Turkey, Sri Lanka, Colombia and Japan.	Bottom 10 2007 Argentina, Russia, Colombia, Vietnam, Brazil, Thailand, Sri Lanka, Philippines, Bangladesh and Switzerland.
Key changes Top 10: Spain and US move out. Replaced by Israel and France in 2007. Bottom 10: Romania, Indonesia, Turkey and Japan move out. Replaced by Argentina, Brazil, Thailand and Switzerland in 2007.	

8. **$IMEX_{ij}$:** Mean decreases from 4.22 to 4.12. (Dvd.: 4.46, 4.34—Decrease; Dvg: 4.04, 3.95—Decrease)

Top 10 2001 UK, Belgium, Spain, Sweden, Italy, Australia, US, France, Germany and Switzerland.	Top 10 2007 US, Netherlands, Germany, Sweden, Austria, South Korea, Belgium, Switzerland, Canada and Spain.
Bottom 10 2001 Sri Lanka, Russia, Brazil, Argentina, India, Romania, Turkey, Bangladesh, Colombia and Philippines.	Bottom 10 2007 Russia, South Africa, Bangladesh, Vietnam, Indonesia, China, Chile, Sri Lanka, Mexico and Italy.
Key changes Top 10: Italy from top 10 in 2001 to bottom 10 in 2007. UK, Italy, Australia and France replaced by Netherlands, Austria, South Korea and Canada in top rankings. Bottom 10: Most of the countries in 2007 replaced over those in 2001 except Sri Lanka, Russia and Bangladesh.	

9. **$STABUS_{ij}$:** Mean increases from 3.23 to 4.37. (Dvd.: 3.45, 4.47—Increase; Dvg: 3.06, 4.28—Increase)

Top 10 2001 US, UK, Canada, Australia, Malaysia, Israel, Thailand, Switzerland, Sri Lanka and Netherlands.	Top 10 2007 Australia, Canada, US, France, Belgium, Romania, Turkey, UK, Italy and Netherlands.
Bottom 10 2001 Romania, Argentina, Mexico, Colombia, France, Russia, Bangladesh, Belgium, Italy and Philippines.	Bottom 10 2007 Indonesia, Brazil, Bangladesh, Philippines, China, Vietnam, Spain, India, Colombia and Sri Lanka.
Key changes Top 10: Malaysia, Israel, Thailand, Switzerland and Sri Lanka replaced by France, Belgium, Romania, Turkey and Italy in 2007. Bottom 10: Romania, France, Belgium and Italy move away to top 10 in 2007. Indonesia, Brazil, China, Vietnam, Spain, India and Sri Lanka move here in 2007.	

1.4 Trade Decomposition and Reforms Analysis: Results

Equation (1.3) is calculated for each of the 1097 trade pairs for all the six models. Results for Eq. (1.4) are obtained by aggregating across four regions: (1) Full sample or world trade; (2) Trade between developed countries; (3) Trade between developing countries; (4) Trade between developing countries and all their trading partners.

1.4.1 Trade Growth Components

Trade growth patterns are presented in Tables 1.3, 1.4, 1.5, 1.6.

Trade decomposition modelling has been built around the concepts of growth accounting in this paper, as trade and output growth are related. A comparison with growth accounting estimates from a similar period would therefore provide a preliminary assessment of the methodology adopted in this paper.

APO (2012) reports contribution of total factor productivity growth (TFPG) to economic growth (goods and services) for a sample of 32 OECD and Asian countries for the period 2000–2010. Most of these countries are covered in this analysis. The report finds the TFPG share to be more than 40% on average for Asian countries and 50% or more for OECD countries. TFP in growth accounting is the sum technical progress, scale efficiency change, allocative efficiency change and technical efficiency change (Kim and Saravanakumar 2012). TFP is the sum of technological and efficiency effects in this paper.

The sums of technological and efficiency effects for developed and developing countries (for goods only) in Tables 1.4 and 1.6 (Average excluding $\mathbf{PROP_{ij}}$) come to about 40% and 26%, respectively. Accounting for sampling and methodological differences, these estimates probably provide preliminary support to the methodology adopted in the paper. The patterns of trade growth components, derived from

Table 1.3 Trade growth decomposition—full sample (Figures in percentages)

Reform area	Input effect	Technological effect	Efficiency effect
ICT_{ij}	86.42	61.67	−48.09
$IMPCOU_{ij}$	43.67	56.69	−0.36
$PROP_{ij}$	219.13	−112.57	−6.56
NTB_{ij}	110.68	−16.45	5.78
$IMEX_{ij}$	72.83	32.23	−5.06
$STABUS_{ij}$	65.55	33.13	1.32
Average	99.71	9.11	−8.83
Average without $PROP_{ij}$	75.83	33.45	−9.28
Average growth	0.682 (log points)		

Source: Author

Table 1.4 Trade growth decomposition—developed countries (Figures in percentages)

Reform area	Input effect	Technological effect	Efficiency effect	Random effect
ICT_{ij}	−15.69	100.59	−34.20	49.30
$IMPCOU_{ij}$	−31.64	60.95	31.37	39.32
$PROP_{ij}$	126.58	−82.22	22.38	33.26
NTB_{ij}	112.40	−127.68	59.99	55.29
$IMEX_{ij}$	15.87	−2.49	35.12	51.51
$STABUS_{ij}$	−8.97	47.55	38.15	23.26
Average	33.09	−0.55	25.47	41.99
Average without $PROP_{ij}$	14.39	15.78	26.09	43.74
Average growth	0.326 (log points)			

Source: Author

Table 1.5 Trade growth decomposition—developing countries (Figures in percentages)

Reform area	Input effect	Technological effect	Efficiency effect	Random effect
ICT_{ij}	98.01	52.27	−44.14	−6.14
$IMPCOU_{ij}$	53.15	49.62	0.99	−3.76
$PROP_{ij}$	213.60	−107.01	−4.70	−1.89
NTB_{ij}	94.82	12.54	2.08	−9.44
$IMEX_{ij}$	75.12	41.68	−5.58	−11.22
$STABUS_{ij}$	72.98	23.43	4.05	−0.46
Average	101.28	12.09	−7.88	−5.49
Average without $PROP_{ij}$	78.82	35.91	−8.52	−6.21
Average growth	1.075 (log points)			

Source: Author

UNIDO (2005) for output growth, also conform to hypotheses outlined in Sect. 1.3.2.1 and are discussed below.

1.4.1.1 Overall Trade Growth (Log Points)

Highest average trade growth for Developing countries (1.075, Table 1.5) followed for Developing-All (0.846, Table 1.6), Full sample (0.682, Table 1.3) and Developed countries (0.326, Table 1.4). India: 1.464, China: 1.982. (Country pairs: Min: Romania-Philippines (−4.05), Max: Colombia-Bangladesh (8.90)).

Table 1.6 Trade growth decomposition: developing countries and all partners (Figures in percentages)

Reform area	Input effect	Technological effect	Efficiency effect	Random effect
ICT_{ij}	96.66	56.59	−47.81	−5.44
$IMPCOU_{ij}$	52.23	53.65	−1.85	−4.03
$PROP_{ij}$	223.53	−112.84	−7.71	−2.98
NTB_{ij}	105.54	0.43	1.14	−7.12
$IMEX_{ij}$	77.69	37.60	−7.78	−7.51
$STABUS_{ij}$	73.30	28.83	−0.11	−2.02
Average	104.83	10.71	−10.69	−4.85
Average without $PROP_{ij}$	81.09	35.42	−11.28	−5.22
Average Growth	0.846 (log points)			

Source: Author

This conforms to actual trade growth patterns (in percent) in the literature during 2000–2007 (WTO 2008, Table I.2, p. 7) (World—5.5, North Americas—4, Europe—4, Latin America and Asia—9, India and China—13 and 22.5).

It is also consistent with Besedes and Prusa (2007). Using the concepts of intensive and extensive margins, the authors find the highest gains in extensive margins for East Asia followed for Africa, India and Central and South American countries, respectively. US and EU register small gains. The authors propose that developed countries need to increase their trade potential by reorganizing their trade and production structures to keep up their trade potential vis-à-vis developing countries (where trade potential is still at an evolutionary stage and high).

1.4.1.2 Trade Growth Components as a Percentage of Average Trade Growth

Input effect. Highest for Developing-All (81.09, Table 1.6) followed for Developing (78.82, Table 1.5), Full sample (75.83, Table 1.3) and Developed countries (14.39, Table 1.4), respectively.

The trend supports Hypothesis **H1** that growth takes place by using inputs in the initial stages. Further, developing countries have substantial inputs blocked in the supply chain due to trade costs. Reforms, which release such inputs, also add to the input effect in developing countries.

Technological effect. Highest for Developing countries (35.91, Table 1.5) and Developing-All (35.42, Table 1.6), Full sample (33.45, Table 1.3) and Developed countries (15.78, Table 1.4), respectively.

The trend is contrary to Hypothesis **H2**. Sampling issues, level of aggregation over goods, presence of Asian countries in globalized production networks (Lall et al. 2005) and poor trade and production performance of developed countries vis-à-vis developing countries during 2000–2007 are provided as possible causes.

It also possibly confirms large negative transaction effect for developed countries due to falling market shares (WTO 2008) and low extensive and intensive margins (Besedes and Prusa 2007) in this period.

Efficiency effect. Highest for Developed Countries (26.09, Table 1.4). After that followed by Developing Countries (−8.52, Table 1.5), Full sample (−9.28, Table 1.3), and Developing-All group (−11.28, Table 1.6) respectively.

These observations support Hypothesis **H3**. This probably indicates that developed countries, being the innovators of technology, have strong production effect, which in turn gives rise to a positive and a higher magnitude of efficiency effect as compared to developing countries.

However, due to falling of trade potential in developed countries (Besedes and Prusa 2007) and the emergence of multipolar world (Lin 2011) developing countries also seem to be catching up. For instance, India and China have positive values.

Random effect. Highest for Developed countries (43.74, Table 1.4) followed for Developing-All (−5.22, Table 1.6) and Developing countries (−6.21, Table 1.5), respectively.

Random effect component supports Hypothesis **H4**. Thus, random factors, captured via interlinkages with world trade, investment and production networks promoted trade growth of developed countries. Developing countries suffered negative shocks, in the form of the Global Financial Crisis that had set in by 2008, depreciation of the US Dollar against major currencies during this period (UNCTAD Trade Development Report 2008) and other factors. This retarded their exports and hence trade growth.

The next section presents country level analysis for four reform areas—**ICT, IMPCOU, NTB** and **STABUS** (the other two not reported for space issues) through Tables 1.7, 1.8, 1.9, 1.10. This analysis is based on magnitudes (not percentages) as many trade pairs have negative growth. Also, for ease of reporting, these tables record maximum values of a trade pair for each component when the difference between them is insignificant (e.g. max of **Bgd-Lka** and **Lka-Bgd** in Table 1.7).

1.4.2 Reforms Implementation

1.4.2.1 Country and Regional Patterns

ICT_{ij}

Input effect: **Maximum**: Bgd-Lka (4.33); **Minimum**: UK-Vnm (−0.37)

Bangladesh posted the highest increases of 6.1 (316 %) (Sri Lanka was second at 2.2 (90%)) for ICT variable during 2001–2007 and moved from bottom 10 in 2001

Table 1.7 ICT—Trade growth decomposition (Figures in numbers (percentages in square brackets))

Input effect	**Technological effect**
Developed (−0.05) [−16]	*Developed (0.33) [101]*
Max: Fra-Jpn (0.55), Aut; Aut-Jpn; Fra-Che, Deu (0.33)	Max: Aut-Deu (0.92); Fra-Ita, Esp, Bel; Ita-Aut (0.83)
Min: UK-Swe (−0.35), Bel; Bel-Swe; US-UK, Swe (−0.33)	Min: Che-Nld (−0.25), UK, Swe, Esp, Bel (−0.08)
Developing-All (0.82) [97]	*Developing-All (0.48) [57]*
Bgd-Lka (4.33), Rom, Rus, Ind, Col, Idn, Zaf, Tur, Mex, Chl, Phl (3.38)	Bgd-Ind (1.38); Rus-Chn; Bra-Arg; Rus-Idn; Bgd-Lka; Idn-Mex; Chn-Vnm; Rus-Mex; Idn-Mys; Mex-US (0.98)
Vnm-UK (−0.37), Swe, Bel, US, Esp, Can , Aus, Nld, Bra, Mys (−0.22)	Mys (0.02), Kor-Che; Mys-UK; Zaf-Che; Mys-Nld; Kor-UK, Nld; Mys-Zaf; Mys, Kor (0.10)-Swe.
Efficiency effect	**Random effect**
Developed (−0.11) [−34]	*Developed (0.16) [49]*
Che-Can (1.17), Aus, Bel; Can-Nld; Che-Nld (0.60)	Bel-US (1.63), Aus, Can, Jpn, Swe (1.11)
Isr-Swe (−0.92); Fra-Isr, UK, Ita, Esp (−0.71)	Fra-Esp (−0.51), Ita, Isr; Isr-Swe; Fra-Deu (−0.28)
Developing-All (−0.41) [−48]	*Developing-All (−0.05) [−5]*
Col-Tur (3.54), Bgd; Vnm-Bra, Chl, Mex; Arg-Che; Vnm-Col, Tur; Can; Chn-Col (1.56).	Chn-Bel (2.13); Vnm-Mys, Arg, Bel; Chn-Col, Arg; Nld-Vnm, Chn; Chn-Bra; Vnm-US (1.64)
Chl-Bgd (−4.90); Rom-Phl; Bgd-Phl, Lka, Tha, Aus; Kor-Lka; Rom-Tha; Phl-Lka, Isr (−2.54)	Rus-Ind (−1.85), Lka; Bgd-Fra, Nld, Chl, Ita; Lka-Isr; Bgd-US; Lka-UK; Rom-Phl (−1.50)

Source: Author

to top 5 in 2007. Vietnam posted the greatest decrease of −1.8 (24%). ICT possibly reflects the role of **infrastructure pillar** in fostering trade in Bangladesh.

Region: Developing countries score more than developed countries (percentage).

Technological effect: **Maximum**: Bgd-Ind (1.38); **Minimum**: Che-Nld (−0.25).

Bangladesh's merchandize trade with India increased nearly 2.5 times between 2000–2001 and 2006–2007 from $1 to 2.5 billion, with trade being tilted in favour of India (Bangladesh's trade deficit with India increased from $1 to 2 billion). However, exports from Bangladesh to India nearly doubled between 2004–2005 and 2006–2007. Its import-export ratio declined from 20 in 2001–02 to 8 in 2006–07.[3] ICT reforms in Bangladesh, which helped in increasing jobs and productivity, are likely to have played some role here (UNCTAD (2007a)).

Second highest-Chn-Rus (1.28): China-Russia bilateral trade increased due to sanctions imposed on Russia's exports by European Union post the Crimean war in 2014 and China's growing energy needs, which are met by Russia. Share of Chinese

[3] https://www.financialexpress.com/archive/india-bangladesh-keen-on-joint-ventures-across-sectors/350826/

Table 1.8 IMPCOU—Trade growth decomposition (Figures in numbers (percentages in square brackets))

Input effect	Technological effect
Developed (−0.10) [−32]	*Developed (0.20) [61]*
Jpn-Fra (1.07), Aut, Esp; Fra-Aut, Esp (0.69)	Isr-Aus (1.03); Deu-Aut; Isr-Can, Swe, US (0.73)
Isr-Ita (−1.32), US; Ita-US; UK-Isr, Ita (−0.92)	UK-Che (−0.35), Bel, Nld, Ita; Nld-Che (−0.26)
Developing-All (0.44) [52]	*Developing-All (0.45) [54]*
Chl-Fra (2.37); Rom-Idn; Chl-Aut, Esp; Tur-Idn; Chl-Swe, Ind, Deu; Rus-Idn; Chl-Nld (1.76)	Chn-Ind (1.51), Rus, Vnm; Bra-Col; Ind-Isr; Chn-Mys, Col, Isr, Bra, Rom (1.18)
Lka (−1.10), Bra-Isr; Lka, Bra-Ita; Lka, Bra -US; Bra-US; Zaf-Isr; Lka-UK; Chn-Isr (−0.69)	Arg-Phl (−0.83), US, Can, Che, UK, Ita, Bel, Nld, Idn, Jpn (−0.55)
Efficiency effect	**Random effect**
Developed (0.10) [31]	*Developed (0.13) [39]*
Che-Can (1.07), Aus; Nld-Can; Che-UK, Bel (0.61).	Bel-US (1.85), Ita, Isr, Can, Aus (1.23)
Jpn-Swe (−0.64); Fra- Esp, Che, Jpn, Can (−0.50)	Jpn-Swe (−0.76); Fra-Jpn, Esp; Swe-Isr; Fra-Che (−0.60)
Developing-All (−0.02) [−2]	*Developing-All (−0.03) [−4]*
Col-Bgd (5.65), Tur, Ind; Vnm-Chl, Mex; Arg-Che; Bgd-Ind, Lka; Bra-Vnm; Rom-Jpn (1.32)	Arg-Vnm (2.29), Chn; Col-Chn; Vnm-US; Chn, Arg-Bel; Arg-Rus, Che; Bgd-Col; Rus-Arg (1.62)
Rom-Phl (−3.36), Tha, Idn; Chl-Bgd, Rom; Phl-Isr; Chl-UK; Idn-Aut, Col; Rom-Vnm (−1.34)	Rom-Phl (−2.15); Fra-Idn; Rom-Tha; Rus-Ind, Mys; Phl-Isr; Idn-Swe; Chl-Fra; Idn-Kor, Esp (−1.49).

Source: Author

imports into Russia increased from less than 5% in 2000 to around 15% in 2007 and China became Russia's second largest importer in 2007 (WITS Trade Summary 2001 and 2007). In addition, Chinese exports to Russia began to shift from labour intensive to high technology level goods during 2001–2007 (Garcia-Herrero and Xu 2016, 2019).

These observations possibly reflect the role of ICT as both **infrastructure** and **technological readiness** pillars in fostering trade**.** Netherlands and Switzerland, being at the top 10 in both the years, possibly reflect low unrealized gains, amongst other factors.

Region: Developed countries score more than developing countries (percentage). **ICT** probably captures the role of technological readiness and to some extent 'business sophistication and innovation pillars' of GCI in developed countries in this period both through general impact (Spiezia 2011) and through trade in network products (Veeramani and Dhir (2019b)). The latter role of **ICT** is also reflected in ongoing fourth industrial revolution in these countries (Clarke-Potter 2019).

Table 1.9 NTB—Trade growth decomposition (Figures in numbers (percentages in square brackets))

Input effect	Technological effect
Developed (0.37) [112]	*Developed (−0.42) [−128]*
Fra-Aut (1.15), Esp, Jpn, Che; Aut-Esp (0.96)	Che-Jpn (0.68), Ita; US-Can; Che-Fra, Deu (0.45)
Bel-Nld (−0.20), UK, US; Nld-UK, US (−0.17)	Swe-Isr (−1.22), Aut; Isr-Aut; Swe-Bel; Isr-Esp (−1.14)
Developing-All (0.89) [106]	*Developing-All (0.00) [0]*
Rom-Rus (3.26), Tur, Chn; Chl-Fra; Rus-Tur; Chl-Aut; Rom-Fra; Chl-Esp; Rus-Chn; Rom-Chl (2.45)	Phl-Vnm (1.40), Arg, Jpn, Rom, Lka, Bgd, Ind, Idn, Che, US (1.06)
Arg (−0.45), Lka-Phl; Arg-Lka; Phl, Arg-Bel; Phl, Arg-Nld; Phl, Arg-UK; Phl-US (−0.30)	Chn-Chl (−1.14), Isr, Swe, Aut; Chl-Isr-Swe; Chn-Esp, Bel; Chl-Aut; Chn-Aus (−0.93)
Efficiency effect	**Random effect**
Developed (0.20) [60]	*Developed (0.18) [55]*
Aut-Swe (0.99), Isr, Nld; Nld-Deu; Can-Che (0.73)	Bel-Isr (2.07), Swe, US, Aus, Ita (1.65)
Fra-Che (−0.59), Jpn; Jpn-Swe; Fra-Esp, Can (−0.29)	Fra-Che (−0.90), Jpn, Esp; Jpn-Swe; Fra-Can (−0.53)
Developing-All (−0.01) [1]	*Developing-All (−0.06) [−7]*
Col-Bgd (6.00), Tur, Ind; Chl-Vnm; Ind-Bgd; Vnm-Col; Lka-Bgd; Arg-Aut, Che; Mex-Vnm (1.37)	Chn-Col (2.62), Bel, Arg; Arg-Vnm; Chn-Nld, Zaf; Col-Bgd; Chn-Chl; Arg, Lka-Bel (1.72)
Rom-Phl (−3.70), Tha; Phl-Isr; Rom-Chl; Rus-Phl; Rom-Vnm, Idn, Isr; Chl-UK, Bgd (−1.18)	Rom-Phl (−3.06), Tha; Phl-Isr; Rus-Rom, Ind; Phl-UK; Chl-Bgd; Rus-Mys; Rom-Vnm, Chl (−1.75)

Source: Author

Efficiency effect: **Maximum**: Col-Tur (3.54); **Minimum**: Chl-Bgd (−4.89)

Bangladesh moved in top 5 in 2007, however, Chile, Colombia and Turkey were in bottom 10 in both years. However, World Bank's Doing Business (2013) records some changes in ICT reform area for Colombia- online submission of documents for registration of business in 2005 and introduction of electronic payment system for tax compliance in 2002, for instance. Moreover, trade efficiency is likely to benefit from improvement in EFN country scores. Finally, growth values of **Col-Tur** pair (second highest) and **Chl-Bgd** (amongst the least) probably also add to explanation.

Region: Developed countries score more than developing countries (percentage).

Random effect: **Maximum**: Bel-Chn (2.15); **Minimum**: Rus-Ind (−1.85)

China was in top 10 ICT rankings in both 2001 and 2007 and became the second largest importer of ICT goods in 2006 after US. It was the largest exporter of ICT goods in 2005 (UNCTAD 2007a). Belgium has excellent network infrastructure (UNCTAD (2007a)) and ICT sector accounted for sixth of GDP growth between

Table 1.10 STABUS—Trade growth decomposition (Figures in numbers (percentages in square brackets))

Input effect	Technological effect
Developed (−0.03) [−9]	*Developed (0.16) [48]*
Fra-Aut (0.65), Jpn, Aus, Isr, Esp (0.51)	Fra-Bel (1.56), Ita, Esp, Jpn; Jpn-Bel (1.05)
Bel- Nld (−0.62), UK, Ita, US, Can (−0.51)	UK-Nld (−0.71); Isr-UK, Swe, Che, US (−0.63)
Developing-All (0.62) [73]	*Developing-All (0.24) [29]*
Rom-Rus (2.89), Tur, Idn, Chn; Rus-Tur; Rom-Vnm, Mys; Chl-Fra; Rom-Chl, Fra (2.04)	Arg-Mex (2.50), Rom, Fra, Bel, Col, Esp; Mex-Fra; Arg-Chl; Rom-Mex; Arg-Ita (1.82)
Arg-Bel (−1.04), Nld, UK, Italy, US, Lka, Can, Phl, Che, Swe (−0.69)	Mys-Lka (−1.27), Vnm; Tha-Idn, Lka; Mys-Idn; Tha-Isr, Mys, Vnm; Mys-Aus; Tur-Isr (−1.02)
Efficiency effect	**Random effect**
Developed (0.12) [38]	*Developed (0.08) [23]*
Che-Can (1.30), Aus, UK; Nld-Can, UK (0.81)	Bel-US (1.69), Isr, Can; Nld-US; Bel-Aus (1.22)
Fra-Esp (−0.76), Ita, Aut, Jpn, Che (−0.52)	Fra-Esp (−1.19), Jpn, Ita, Aut, Che (−0.82)
Developing-All (−0.00) [0]	*Developing-All (−0.02) [−2]*
Col-Bgd (5.82), Tur; Lka-Bgd; Col-Vnm, Ind; Bgd-Ind; Vnm-Chl, Can, Bra; Chn-Bgd (1.35)	Mys-Vnm (2.68); Col-Chn; Vnm-US, Arg, Nld; Zaf-Chn; Bra-Vnm; Chn-Nld; Tha-Vnm; Chn-Bel (1.62)
Rom-Phl (−3.79), Chl, Tha; Chl-Bgd; Rom-Col, Idn; Phl-Isr; Chl-UK; Rom-Isr, Vnm (−1.31)	Rom-Phl (−3.05), Tha, Fra; Chl-Fra; Rom-Ita, Chl; Chl-Bgd; Rus-Rom, Ind; Rom-Bra (−1.80)

Source: Author

1997 and 2007.[4] Both Belgium and China featured amongst top exporters and importers of merchandize trade in 2007 and had high trade/gdp ratios in 2007. In general, countries with high trade growth, high trade/gdp shares score high in this component. Russia witnessed a decline in trade/gdp ratio after 2004 (below the world average) and had negative trade growth with India during 2001–2007.

Region: Developed countries score more than developing countries (percentage).

$IMPCOU_{ij}$

Input effect: **Maximum**: Fra-Chl (2.38); **Minimum**: Ita-Isr (−1.32).

France moved in top 10 sampled countries in 2007. Israel and Italy recorded largest decreases of −3.3 (−39%) and 1.6 (−35%), respectively.

Region: Developed countries score lesser than developing countries (percentage).

Technological effect: **Maximum**: Ind-Chn (1.51); **Minimum**: Arg-Phl (−0.83).

[4]https://www.business.belgium.be>ict

Chn-Ind (1.51) reflects efforts of increasing trade through bettering of political and institutional ties amongst other factors. China's bilateral trade with India increased from about $0.2 billion in 1990 to $5 billion in 2002 to $13.6 billion in 2004.[5] Similarly, Chn-Rus (1.45) reflects growing mutual relation with Russia, as discussed earlier under **ICT**, and, probably, growing trade within APEC region, as it accounted for 65% of China's total trade in 2006.[6] Argentina was the lowest rank holder amongst all sample countries in both years.

Region: Developed countries score more than developing countries (percentage).

Efficiency effect: **Maximum:** Bgd-Col (5.65).**: Minimum**: Rom-Phl (−3.36);

Colombia moves out of bottom 10 in 2007. This is confirmed by World Bank's Doing Business Report (2013), which finds that Colombia improved its performance on worldwide governance indicators pertaining to rule of law (which includes IMPCOU) between 2002 and 2010. Philippines features in bottom 10 in both years and had the least trade growth in the sample. Finally, **Col-Bgd** and **Rom-Phl** had the highest and least values of trade growth in the sample.

Region: Developed countries score higher than developing countries (percentage).

Random effect: **Maximum**: Arg-Vnm (2.29); **Minimum:** Rom-Phl (−2.15)

This possibly reflects greater trade integration (high trade/GDP ratio) and higher trade growth of Vietnam and poorer performance of Philippines (decline in trade/GDP ratio and trade growth in this period and also low rank under **IMPCOU**). Vietnam also moved out of bottom 10 in 2007. Finally, **Vnm-Arg** falls amongst high trade growth performers whereas **Rom-Phl** had the least trade growth.

Region: Overall, developed countries score higher than developing countries (percentage).

NTB_{ij}

The coefficient of $\mathbf{NTB_{ij}}$ variable decreases and becomes negative in 2007 while coefficients of domestic trade costs variables increase (Model 4, Tables 1.11 and 1.12). This trend is possibly explained in World Trade Report (2008), which states that trade liberalization becomes less important for trade when administrative barriers become more significant, as they act as a substitute for lower tariffs. This observation, along with decline in value of $\mathbf{NTB_{ij}}$ variable for developed countries, poor trade performance of developed countries during 2000–2007 (WTO 2008) could explain the results below.

Input effect: **Maximum:** Rom-Rus (3.26); **Minimum:** Arg-Phl (−0.45).

2007: Romania moves out of bottom 10 while Argentina falls to this category.

[5] https://journals.openedition.org/chinaperspectives/2853#authors

[6] http://apec.org/Press/News-Releases/2007/0701_aus_iapchina

Romania (led by Indonesia) posts highest growth in this variable, whereas Argentina (followed by Switzerland) posts the least growth.

Region: Developed countries score *higher* than developing countries (percentage).

Technological effect: **Maximum:** Phl-Vnm (1.40); **Minimum:** Isr-Swe (−1.22).

Phl-Vnm has the third highest (though negative in magnitude and after **Vnm-Rom, Rus**) contributions of $\mathbf{NTB_{ij}}$ on total technological effect. Similarly, **Swe-Isr** has very low value of contributions of $\mathbf{NTB_{ij}}$ on total technological effect. Difference between magnitude of full technological effect for **Vnm-Phl** and **Swe-Isr,** in that order, is as follows:

$$\mathbf{NTB_{ij}} : 3.17; \mathbf{Expscore} : (-0.14); \mathbf{Impscore} : (-0.38); \mathbf{Ldsit} : (-0.03).$$

It is clear that **Vnm-Phl** scores lesser in all other three variables as compared to **Swe-Isr** and yet does better because of higher contribution of $\mathbf{NTB_{ij}}$ variable.

Region: Developed countries score *much lesser* than developing countries (percentage).

Efficiency effect: **Maximum:** Bgd-Col (6.00); **Minimum**: Rom-Phl (−3.70).

Col-Bgd and **Rom-Phl** had the highest and least values of trade growth in the sample. Moreover, as discussed above, due to increased relevance of domestic trade costs and other variables and decreased relevance of $\mathbf{NTB_{ij}}$ variable, efficiency effect is likely to be governed by other variables.

Region: Developed countries score more than developing countries (percentage).

Random effect: **Maximum:** Col-Chn (2.62); **Minimum:** Rom- Phl (−3.06).

Similar reasoning as for efficiency effect (least trade growth for **Rom-Phl**, high trade growth between **Col-Chn**) and increased value of **Efnscore** for China could be possible factors.

Region: Developed countries score higher than developing countries (percentage).

$STABUS_{ij}$

The variable $\mathbf{STABUS_{ij}}$ depicts similar trend between 2001 and 2007 as found for $\mathbf{NTB_{ij}}$. It becomes negative and insignificant during 2007 while coefficients of domestic trade costs and other variables increase in magnitude (Model 6, Tables 1.11 and 1.12). However, this variable increases in value for both developed and developing countries. These observations, along with poor trade performance of developed countries during 2000–2007 (WTO 2008) could explain the results below.

Input effect: **Maximum:** Rom-Rus (2.89); **Minimum:** Arg-Bel (−1.04).

Romania moves into top 10 in 2007 from bottom 10 in 2001. Top four countries with the highest increases for this variable are Romania (7, 268%), Argentina (6.2, 233%), Fra (6.2, 178%) and Mexico (6, 200%).

Arg-Bel suffers from a negative value of domestic trade cost for Argentina in calculation of input effect (this component is positive and of a high magnitude for **Rom-Rus**).

Region: Developed countries score lower than developing countries (percentage).

Technological effect: **Maximum:** Mex-Arg (2.50); Minimum: Mys-Lka (−1.27).

Arg-Mex has the third highest contribution of $\mathbf{STABUS_{ij}}$ (−3.99) on total technological effect (Highest for **Rom-Arg, Mex** at (−3.74) and (−3.95), respectively), whereas **Mys-Lka** has low value of this contribution. (In percentage terms, Malaysia had the fifth least increase for this variable)

The full difference between **Arg-Mex** and **Mys-Lka** in technological effect calculation is as follows:

STABUS—3.32; Expscore—0.04; Impscore—0.01; Comlang—0.23; Ldist—0.18

It is clear that the main difference is due to the **STABUS** variable.

Region: Developed countries score higher than developing countries (percentage).

Efficiency effect: **Maximum:** Bgd-Col (5.82). **Minimum:** Rom-Phl (−3.79);

Similar reasoning as for $\mathbf{NTB_{ij}}$.

Region: Developed countries score higher than developing countries (percentage).

Random effect: **Maximum:** Vnm-Mys (2.68); **Minimum:** Rom-Phl (−3.05).

Similar reasoning as in for $\mathbf{NTB_{ij}}$ (Vietnam reports high trade growth. Malaysia has a very high share of industry in value-added (Lin and Wang 2008), which probably requires good business-start up regulations- and that Malaysia was amongst the top 10 countries under this variable in 2001 possibly adds support to this assertion).

Region: Developed countries score more than developing countries (percentage).

1.4.2.2 Summary

To sum up, findings at the regional level and country level lend some confirmation to the hypotheses **H5** and **H6** formulated for reform areas under Sect. 1.3.2.1:

(i) In general, frontier countries have lower input effects than factor driven economies.

(ii) $\mathbf{ICT_{ij}}$: On average, frontier countries are found at top rankings.

Factor driven economies have higher input effect than frontier countries. However, aggregate technological effect is higher for frontier countries than factor driven economies. Efficiency effect is again higher for frontier countries.

So, model results support Hypothesis **H5**.

(iii) **$IMEX_{ij}$ and NTB_{ij}:** Here frontier countries do not depict a clear pattern. Many of them are out of top ranks in Global Competitiveness Report, GCR (World Economic Forum and Harvard University 2008).

For instance, **US, Switzerland**, **Germany** and so on are out of top 20 rankings in **NTB_{ij}**. Similarly, **UK, Italy, Australia** and **France** exited from top 10 sampled countries under **$IMEX_{ij}$**.

IMEX: On the aggregate, frontier countries have lower input effects than other stage countries. They also have higher technological and efficiency effects as compared to other stage countries. (Supports **H5**)

NTB: Frontier countries have higher input effect than factor driven economies. They also have much lower technological effect than them. However, they score more in efficiency component.

(iv) **$IMPCOU_{ij}$**, **$PROP_{ij}$** and **$STABUS_{ij}$**, indeterminate areas: Here, countries depict no clear pattern. Frontier countries like **Italy** feature in the bottom ten in reform areas like **$IMPCOU_{ij}$** and **Spain** features in the bottom ten under **$STABUS_{ij}$**. At the same time, transition countries like **Romania** and **Turkey** feature amongst the top ten under **$STABUS_{ij}$**. Model results, accordingly, reflect this heterogeneity.

$STABUS_{ij}$ and **$IMPOUC_{ij}$** depict a lower aggregate input effect as compared to other countries. Aggregate technological and efficiency effects are also higher. However, **$STABUS_{ij}$** reports a negative input effect for developed countries. **$PROP_{ij}$.** reports a similar comparative pattern but has negative magnitudes of technological effect for all regions.

(v) The model can differentiate between reform areas with a trade or domestic orientation: Random effect is higher for **NTB_{ij}** and **$IMEX_{ij}$** as compared to **$IMPCOU_{ij}$**, **$PROP_{ij}$** and **$STABUS_{ij}$**. Similarly, countries that are favourably integrated in the global production and trade chains (high trade/GDP ratio and trade growth) have benefitted from positive random factors (Belgium, Vietnam, China and so on) while those in the reverse (Philippines, Sri Lanka and so on) have suffered. Aggregate random effect is also higher for developed countries as compared to developing countries. The model can, therefore, capture trade related shocks. This supports Hypothesis **H6.**

1.5 Conclusions

The results of the previous section indicate that the model outlined in this paper captures dynamics of trade growth and reforms at the aggregate level and country level. However, a more sophisticated modelling of trade dynamics and reforms evaluation is left as an area for future research.

The findings in this paper make the model a suitable quantitative tool for researches in trade and development. Few of these examples are discussed below.

The New Structural Economics (Lin 2010, 2011; Lin and Monga 2011) (NSE) deals with structural transformation and is closely related to the concepts developed

in this paper. Further, UN-DESA (2015) cites NSE as one of the possible frameworks for promoting development by effecting structural transformation through trade. A sophisticated modelling of trade and output growth under NSE paradigm is left for further research.

The World Bank's Umbrella Facility for Trade Trust Fund (UF) was launched in 2017. As per World Bank (2018), it is expected to support four key areas of the World Bank's trade work in the coming six years: (i) trade competitiveness and diversification; (ii) trade facilitation and transport logistics; (iii) support for market access and international trade cooperation and (iv) managing shocks and promoting greater inclusion (e.g. trade and poverty; trade-gender linkages). The model developed in this paper can serve as a quantitative tool for assessing these areas.

Lastly, the Indian government recently outlined a $5 trillion vision for the Indian economy, to enable it to graduate out of its current low-income status. The Economic Survey 2019–2020 (Government of India 2020) recommends increasing exports of networked products (following China's example) to achieve this vision. Similarly, Forbes (2020) mentions India's biggest missed development opportunity to be its inability to participate in large-scale labour-intensive export manufacturing. The Flying Geese (FG) Model or East Asian Growth Model (related to NSE) explains the trade of labour-intensive and networked products and has been proposed as the model for guiding India's transition to a developed economy (Panagariya 2013; Srivastava 2016; Veeramani and Dhir 2019a; Forbes 2020). The framework developed in this paper can be used to project India's trade path to a developed economy, as guided by the FG model. However, as with NSE, more sophisticated modelling of structural transformation under Flying Geese Model is left as an area for future research.

Appendix 1

Table 1.11 Frontier estimation, world trade flows, 2001

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Const	−19.44	1.38	−17.74	1.72	−12.81	1.97	−19.60	1.66	−28.40	1.67	−19.32	1.56
$Ldist_{ij}$	−1.61	0.08	−1.46	0.09	−1.41	0.09	−1.50	0.09	−1.45	0.08	−1.61	0.08
$Comlang_{ij}$	0.00[a]	0.21	−0.16[a]	0.24	−0.07[a]	0.23	−0.15[a]	0.24	0.03[a]	0.23	−0.14[a]	0.23
$Contig_{ij}$	0.94	0.32	1.18	0.36	1.09	0.36	1.03	0.36	1.18	0.35	1.27	0.35
FTA_{ij}	1.01	0.14	1.51	0.16	1.63	0.16	1.50	0.16	1.15	0.16	1.22	0.15
ICT_{ij}	2.25	0.12										
$IMPCOU_{ij}$			0.79	0.14								
$PROP_{ij}$					1.33	0.18						
NTB_{ij}							1.19	0.30				
$IMEX_{ij}$									4.67	0.48		
$STABUS_{ij}$											1.68	0.18
$LDomt_{ii}$	4.03	0.46	4.56	0.61	2.67	0.71	4.67	0.68	2.80	0.62	4.58	0.53
$LDomt_{jj}$	3.89	0.46	4.44	0.61	2.54	0.71	4.57	0.68	2.67	0.62	4.43	0.53
Log-likelihood	−2278.81		−2406.99		−2394.98		−2414.19		−2378.08		−2382.30	
Lambda	1.75		1.57		1.55		1.47		1.45		1.54	
N	1097		1097		1097		1097		1097		1097	

Notes: Coeff is the model coefficient, while SE is the standard error; The log-likelihood test for Frontier Methodology is significant in all regressions
Source: Author calculations
[a]Implies that the variable is not significant

Appendix 2

Table 1.12 Frontier estimation, world trade flows, 2007

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Const	−17.56	2.39	−9.68	2.89	−10.74	2.74	−22.16	2.44	−22.88	2.48	−21.21	2.75
$Ldist_{ij}$	−1.51	0.09	−1.36	0.09	−1.35	0.09	−1.46	0.09	−1.41	0.09	−1.44	0.10
$Comlang_{ij}$	0.14[a]	0.24	0.12[a]	0.25	0.10[a]	0.25	0.09[a]	0.26	0.11[a]	0.26	0.09[a]	0.26
$Contig_{ij}$	1.36	0.37	1.59	0.39	1.50	0.38	1.55	0.40	1.61	0.40	1.61	0.40
FTA_{ij}	1.43	0.16	1.48	0.17	1.59	0.17	1.34	0.17	1.35	0.17	1.30	0.17
ICT_{ij}	2.06	0.20										
$IMPCOU_{ij}$			1.47	0.20								
$PROP_{ij}$					2.41	0.29						
NTB_{ij}							−0.92	0.40				
$IMEX_{ij}$									1.06	0.40		
$STABUS_{ij}$											−0.24[a]	0.65
$LDomt_{ii}$	3.50	0.79	1.74	0.97	0.86[a]	0.99	7.27	0.90	5.33	0.84	6.38	0.89
$LDomt_{jj}$	3.44	0.79	1.56[a]	0.97	0.71[a]	0.99	7.12	0.90	5.17	0.84	6.23	0.89
Log-likelihood	−2457.75		−2480.97		−2474.38		−2505.13		−2504.33		−2507.72	
Lambda	1.74		1.39		1.41		1.24		1.23		1.26	
N	1097		1097		1097		1097		1097		1097	

Notes: Coeff is the model coefficient, while SE is the standard error; The log-likelihood test for Frontier Methodology is significant in all regressions
Source: Author calculations
[a]Implies that the variable is not significant

References

Acharya, S. (2019). *Why neglect exports?* Business Standard, Retrieved from https://www.business-standard.com/article/opinion/why-neglect-exports-119121200067_1.html

Anderson, J., & Marcouiller, D. (2002). Insecurity and the pattern of trade: An empirical investigation. *Review of Economics and Statistics, 84*(2), 171–189.

APO. (2012). *APO productivity databook 2012, July*. Tokyo: APO.

Armstrong, S., & Drysdale, P. (2010). International and regional cooperation: Asia's role and responsibilities. *Asian Economic Policy Review, 5*(2), 157–173. Paper Prepared for Discussion at the Asian Economic Policy Review Conference, Tokyo.

Armstrong, S., Drysdale, P., & Kalirajan, K. (2008). Asian trade structures and trade potential: An initial analysis of South and East Asian Trade. EABER Working Paper, No 28. Retrieved September, 2009, from www.ncaer.org/downloads/Lectures/EABER-NCAER2008/s3p1.pdf

Banik, N. (2014). India-ASEAN free trade The untapped potential. CUTS International Briefing Paper No 3. Accessed on: January 20, 2021 from: https://www.nilanjanbanik.in/workingpaper/ASEAN_FTA_Paper.pdf

Berkowitz, D., Moenius, J., & Pistor, K. (2006). Trade, law and product complexity. *The Review of Economics and Statistics, 88*(2), 363–373.

Besedes, T., & Prusa, T. J. (2007). *The role of extensive and intensive margins and export growth. Working Paper No. 13628*. Cambridge, MA: National Bureau of Economic Research, Inc..

Clarke-Potter, K. (2019). These Are The Six Countries Leading The Fourth Industrial Revolution. Retrieved from: https://blockheadtechnologies.com/these-are-the-six-countries-leading-the-fourth-industrial-revolution/

Das, R. U. (2012). *Regional trade and integration: Analytical insights and policy options*. New York: Singapore, World Scientific. (Co-authored with Edirisuriya, P. and Swarup, A.).

Duval, Y., & Utoktham, C. (2009). *Behind the border trade facilitation in the Asia-Pacific: Costs of trade, credit information, contract enforcement and regulatory coherence*. Working Paper. No 67, Asia-Pacific Research and Training Network on Trade (ARTNeT), United Nation Economic and Social Commission for Asia-Pacific (UNESCAP), Bangkok.

Duval, Y., & Utoktham, C (2011a). *Trade facilitation in the Asia and Pacific: Which policies and measures affect trade costs the most?* Working Paper. No 94, Asia-Pacific Research and Training Network on Trade (ARTNeT), United Nation Economic and Social Commission for Asia-Pacific (UNESCAP), Bangkok.

Duval, Y., & Utoktham, C. (2011b). *Trade costs in the Asia and the Pacific: Improved and sectoral estimates*. Trade and Investment Division Staff Working Paper 05/11, Asia-Pacific Research and Training Network on Trade (ARTNeT), United Nation Economic and Social Commission for Asia-Pacific (UNESCAP), Bangkok.

Evenett, S. J., & Venables, A. J. (2002). *Export growth in developing countries: Market entry and bilateral flows*. University of Bern Working Paper, Mimeo.

Feenstra, R., & Rose, A. K. (1997). *Putting things in order: Patterns of trade dynamics and growth*. NBER Working Papers No. 5975, National Bureau of Economic Research, Cambridge, MA.

Forbes, N. (2020). *Growth matters* (p. 9). Business Standard.

Francois, J., & Manchin, M. (2007). *Institutions, infrastructure and trade*. Paper Retrieved from http://ssrn.com/abstract=964209.

Garcia-Herrero, A., & Xu, J. (2016). *The China–Russia trade relationship and its impact on Europe*. Bruegel Working Paper, No. 4. Retrieved from http://bruegel.org/wp-content/uploads/2016/07/WP-2016_04-180716.pdf

Garcia-Herrero, A., & Xu, J. (2019). How does China fare on the Russian market? Implications for the European Union. *Russian Journal of Economics, 5*, 385–399.

Hummels, D., & Klenow, P. J. (2005). The variety and quality of a nation's exports. *American Economic Review, 95*(3), 704–723.

International Telecommunication Union. (2010). *Measuring the information society: The ICT development index*. Place des Nations CH-1211, Geneva, Switzerland.

Jepma, C. J. (1986). *Extensions and application possibilities of the constant-market-shares analysis*. Groningen: Rijkusuniversiteit.

Kalirajan, K. (2010). Sources of variation in export flows over time: A suggested methodology of measurement. *International Journal of Business and Economics, 9*(2), 175–178.

Kalirajan, K., & Khan, I. U. (2011): The impact of trade costs on export growth: An empirical modelling. Foundation for Advanced Studies on International Development, Tokyo, Japan. Retrieved August, 2009, from http://www.crawford.anu.edu.au/acde/asarc/pdf/papers/2011/WP2011_07.pdf

Kim, S., & Saravanakumar, M. (2012). Economic reforms and total factor productivity growth in indian manufacturing industries. *Review of Development Economics, 16*(1), 152–166.

Kowaleski, P., & Dihel, N. (2009). *India's trade integration, realizing the potential*. OECD Trade Policy Working Paper No. 88, OECD Publishing.

Kumbhakar, S. C., & Bhaumik, S. K. (2010). Is the post-reform growth of the Indian manufacturing sector efficiency driven? Empirical evidence from plant-level data. *Journal of Asian Economics, 21*(2), 219–232.

Lall, S., Weiss, J., & Zhang, J. (2005). *The sophistication of exports: A new measure of product characteristics*. Tokyo: Asian Development Bank Institute, Discussion Paper No. 23. Retrieved from http://www.adbi.org.

Lin, J-Y. and Wang, Y. (2008). China's Integration with the world Development as a process of learning and industrial upgrading, Policy Research Working Paper No. 4799, Washington, World Bank, December.

Lin, J.-Y. (2010). *New structural economics: A framework for rethinking development*. Policy Research Working Paper No. 5197, Washington, World Bank, February.

Lin, J.-Y. (2011). *From flying geese to leading dragons: New opportunities and strategies for structural transformation in developing countries*. Policy Research working paper no. 5702, Washington, World Bank, June.

Lin, J.-Y., & Monga, C. (2011). *Growth identification and facilitation: The role of the state in the dynamics of structural change*. Policy Research working paper no. 5313, Washington, World Bank, May.

Melitz, M. (2008). International trade and heterogenous firms. in *New Palgrave dictionary of economics* (2nd ed.). Palgrave, Macmillan.

Ministry of Finance, Government of India. (2020). *Economic survey 2019–20*. Retrieved March, 4, 2020 from https://www.indiabudget.gov.in/economicsurvey/doc/echapter.pdf

Novy, D. (2009). Gravity redux: Measuring international trade costs with panel data. University of Warwick.

Novy, D. and Chen, N. (2009). International trade integration: A disaggregated approach. Retrieved from http://ssrn.com/abstract=1275688

Panagariya, A. (2013). *Indian economy: retrospect and prospect*. Canberra: Productivity Commission.

Roy, J. (2019). *Quick fixes won't solve the growth problem*. Business Standard, Retrieved from https://www.business-standard.com/article/opinion/quick-fixes-won-t-solve-growth-problem-119090800845_1.html.

Sala-i-Martin, X (Various issues). The Global Competitiveness Report. New York: Oxford University Press

Shankar, P. (2015). On the "frontier" estimation of the "inverse" gravity model: Insights and implications. *Indian Economic Journal, 63*(3), 362–384.

Spence, M. D., & Karingi, S. N. (2011). *Impact of TF mechanisms on export competitiveness in Africa*. Working Paper. No. 85, African Trade Policy Centre, United Nation Economic Commission for Africa.

Spiezia, V. (2011). Are ICT users more innovative? An analysis of ICT-enabled innovation in OECD firms. *OECD Journal: Economic Studies, 2011*, 1.

Srivastava, S. (2016). *The flying geese paradigm: "The Economics of Jugaad"*. Retrieved from https://qrius.com/flying-geese-paradigm-economics-jugaad/amp/.

UNCTAD. (2007a). *Information economy report 2007–08. Science and technology for development: The new paradigm for ICT*. New York and Geneva: United Nations Publication. Sales No. E.07.II.D.13.
UNCTAD. (2007b). *Trade and development report 2007. Regional cooperation for development*. New York and Geneva: United Nations Publication. Sales No. E.07.II.D.11.
UNCTAD. (2008). *Trade and development report 2008. Commodity prices, capital flows and the financing of investment*. New York and Geneva: United Nations Publication. Sales No. E.08.II.D.21.
UN-DESA. (2015). *Workshop on productive capacity and the use of trade-related ISMs for LDC graduation*. Retrieved frm November, 3–5, frm https://www.un.org/development/desa/dpad/2015/workshop-on-productive-capacity-and-the-use-of-trade-related-isms-for-ldc-graduation/, 3–5 November 2015, Geneva.
UNESCAP. (2009). *Designing and implementation trade facilitation in Asia and the Pacific*. November 2009. Retrieved May, 2010, from http://aric.adb.org
UNIDO. (2005). Productivity in developing countries: Trends and policies, Vienna.
Veeramani, C., & Dhir, G. (2019a). *Reaping gains from global production sharing: Domestic value addition and job creation by Indian exports*, IGIDR Working Paper No WP-2019-024, Mumbai. Retrieved from http://www.igidr.ac.in/pdf/publication/WP-2019024.pdf
Veeramani, C., & Dhir, G. (2019b). "*Dynamics and Determinants of Fragmentation Trade: Asian Countries in Comparative and Long-term Perspective*" IGIDR Working Paper No WP-2019040, Mumbai. Retrieved from http://www.igidr.ac.in/working-paper-dynamics-determinantsfragmentation-trade-asian-countriescomparative-long-term-perspective/
World Bank. (2018). *Stronger open trade policies enable economic growth for all*. Results Briefs. April 3, 2018.
World Bank. (n.d.). *Doing business report*. Various Issues.
World Economic Forum and Harvard University (2008). *The global competitiveness report*. Geneva: World Economic Forum.
World Economic Forum and Harvard University (2010). *The global competitiveness report*. Geneva: World Economic Forum.
World Economic Forum (2008). Global Trade Enabling Report 2008. Retrieved 20.01.2021 from: https://web.archive.org/web/20081206135156/http://www.weforum.org/pdf/GETR08/GETR2008_FullReport.pdf
World Trade Organization. (2008). *World trade report*. Geneva: World Trade Organization.
World Bank. Doing Business (2013) Report. Various Issues
WTO. (2008). International trade statistics.