Towards a New Framework for Analyzing Trade Growth Dynamics

Highlights

- A new trade growth decomposition model.
- Trade growth decomposition components: input, technological, efficiency and random effects.
- Testable hypotheses for checking model consistency. Findings confirmatory.
- Potential applications: New Structural Economics and World Bank's Trade Strategy.

Abstract

Open trade policies are needed to ensure economic growth for all countries. This requires an understanding of the interaction between trade growth dynamics, trade costs and reforms.

Existing literature has decomposed total exports growth into the sum of changes in demand and changes in trade costs arising out of 'explicit beyond the border barriers', 'implicit beyond the border barriers' and 'behind the border barriers'. Reforms promote trade growth by reducing 'implicit beyond the border barriers'.

However, this method decomposes trade growth for a specific country. This method is extended to analysing world trade flows in this paper.

Trade growth is decomposed into *input, technological, efficiency effects* and *random effects.* The first three are similar to output growth while the fourth, a new term, captures the impact of random shocks. Hypotheses are also formulated on trade growth patterns and on reforms and trade growth components.

Model results are confirmatory and recommend its use as a supporting tool for ongoing researches in trade and development. Few of these are the New Structural Economics and World Bank's Trade Strategy.

(178 words)

Keywords

Trade dynamics; reforms; stochastic frontier; gravity models.

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C51; F19; O10.

1 Introduction

Strong open trade policies are essential for promoting economic growth of all countries (World Bank (2018)).

This requires a crucial understanding of the interaction between trade growth dynamics, trade costs and reforms.

Kalirajan (2009) has addressed this issue by developing a new trade decomposition framework that decomposes total exports growth into the sum of changes in demand and changes in trade costs arising out of 'explicit beyond the border barriers', 'implicit beyond the border barriers' and 'behind the border barriers'. Reforms are expected to induce trade growth by reducing 'implicit beyond the border barriers'. This method was first applied to analysing sources of Pakistan's export growth between 1999 and 2004 by Khan and Kalirajan (2011).

This model is however developed for a single country setting.

The aim of the present research is to extend this method to analyse trade growth of countries participating in world trade using the concepts from productivity analysis. The role of reforms in promoting trade growth is also analysed. It will also enable a comparison with output growth dynamics, which can facilitate a deeper understanding of trade and development.

The paper is structured as follows: Section 2 explains the trade growth decomposition model and hypotheses on trade growth dynamics. Section 3 explains the reform evaluation framework and hypotheses on impact of reforms on stages of trade growth. Frontier model, data and descriptive statistics are dealt in Section 4. Empirical results and discussions on trade dynamics and reform implementation are presented in Section 5. Section 6 presents the conclusions and recommendations.

2 Trade Growth Decomposition Framework: Concept and Hypotheses

2.1 CONCEPT

2.1.1 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 as follows:

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

$$LnY^1_{ij} = \alpha^1 + Lnf^1(X^1_{ij}; \beta^1) + V^1_{ij} - U^1_{ij},\ i,j = 1,\ldots, n. \quad \textbf{(1)}$$

$$LnY^2_{ij} = \alpha^2 + Lnf^2(X^2_{ij}; \beta^2) + V^2_{ij} - U^2_{ij},\ i,j = 1,\ldots, n. \quad \textbf{(2)}$$

($(Lnf^1(X^1_{ij}; \beta^1) = \beta^1 LnX^1_{ij}$ and so on is the general form of the export frontier and αs and βs are estimated coefficients).

Difference between the log of trade flows, or trade growth, over the two periods is:

$$LnY^2_{ij} - LnY^1_{ij} = (\alpha^2 - \alpha^1) + Lnf^2(X^2_{ij}; \beta^2) - Lnf^1(X^1_{ij}; \beta^1) + V^2_{ij} - V^1_{ij} + U^2_{ij} - U^1_{ij},\ i,j = 1,\ldots, n.$$

$$= \beta^2(LnX^2_{ij} - Ln\,X^1_{ij}) + [(\alpha^2 - \alpha^1) + (\beta^2 - \beta^1)\,Ln\,X^1_{ij}] - (U^2_{ij} - U^1_{ij}) + (V^2_{ij} - V^1_{ij}),$$

$$i,j = 1,\ldots, n. \qquad \textbf{(3)}$$

Taking the mean of the above equation, one gets:

$$Ln\bar{Y}^2_{ij} - Ln\bar{Y}^1_{ij} = \beta^2(Ln\bar{X}^2_{ij} - Ln\bar{X}^1_{ij}) + [(\alpha^2 - \alpha^1) + (\beta^2 - \beta^1)\,Ln\bar{X}^1_{ij}] - (\bar{U}^2_{ij} - \bar{U}^1_{ij}),\ i,j = 1,\ldots, n. \qquad \textbf{(4)}$$

where, the bar denotes the sample mean of the respective variable. The last bracketed term in (3) vanishes as V_{ij} is distributed $N(0, \sigma_v^2)$.

The first three bracketed terms on the right-hand sides of Equations 3 and 4 correspond to the notions of "input effect", "technological effect" and "efficiency effect" developed in Kumbhakar and Bhaumik (2010). The fourth term in Equation 3 is defined as "random effect" to capture the role of random shocks on trade growth.

2.1.2 Interpretation of model terms (Equation 3):

(i) Input effect: Contribution of change in inputs to trade growth (Kumbhakar and Bhaumik (2010))

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.

(ii) Technological effect: Contribution of change in export productivity to trade growth (Kumbhakar and Bhaumik (2010) and Berkowitz et al (2006), who apply the Trade Facilitation-Export Competitiveness Framework[i] (World Bank) to explaining trade growth dynamics)

Technological effect in output growth decomposition derives its concept from production theory. However, in trade growth decomposition, it is posited to derive its links from both trade as well as 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 (decrease) export productivity.

(iii) Efficiency effect or catch-up effect: Contribution of change in technical inefficiency to trade growth (Kalirajan (2010)).

Efficiency effect is posited to be a movement from a position within the export frontier towards the export frontier.

(iv) 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.

Note that these terms have similar meanings for Equation 4 except that it explains growth of average trade values. The random effect component is zero in Equation 4 as the random error term has a zero mean.

2.1.3 Trade growth dynamics

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

1. 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.

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

3. 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.

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

2.2 HYPOTHESES ON TRADE GROWTH PATTERNS

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

H1: Input effect is expected to be larger for developing countries than developed countries.

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.

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:

(1) Poor trade performance of developed countries as compared to the developing countries during 2001-2007 (WTO (2008)), which is the period of analysis.

(2) 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, Weiss and Zhang (2005) and so on).

(3) Sampling considerations and aggregation issues.
Countries like Singapore and Hong Kong, which are usually found to determine the trade frontier (Kalirajan, Drysdale and Armstrong (2008)) are not included in the sample due to data constraints.

Also, the data is at an aggregate level, masking technological differences across sectors.

H3: Efficiency effect is expected to be higher (could also be 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 would possibly indicate 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.*

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.

3 Reforms Evaluation Framework

Reforms influence trade by impacting the trade growth components.

In this paper, reforms are approximated by the pillars of the Global Competitiveness Index (GCI). These pillars indicate the various inputs – institutions, policies and factors- needed by a country at various stages of its growth process (GCR (2010), p.8).

Six reform area are discussed in the paper. Table 1 presents their correspondences with GCI and are discussed below:

Table 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		a	B			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						
Innovation						

Source: Author.

(1) 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).

(2) ICT: Correspondence with GCR established based on Global Trade Enabling Report (2008), which is like GCR.

Shaded areas corresponding to the last two pillars under ICT indicate indirect capturing of these pillars by this variable.

(3) The EFN chain indexed values for Institutional variables (IMPCOU, PROP and NTB) are comparable to GCR values as they are sourced from this report. However, EFN values are chain weighted, to facilitate comparison across time, while GCR values are not. Hence magnitudes differ.

(4) IMEX and STABUS have partial correspondences with GCR. The common areas between the EFN and GCR are indicated in the Table above.

1. A matured reform area, **ICT_{ij}**: ICT usage has increased over time across the globe (ITU (2010)). It is also used as a **technological readiness** pillar by developing countries through their participation in globalized manufactured chains in electronics (Lall, Weiss and Zhang (2005)).

2. Reforms with intermediate coverage, $IMEX_{ij}$ and NTB_{ij}:

$IMEX_{ij}$: This area 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)). Owing to border related reforms, Import and export costs have declined due to the implementation of border related reforms ((Doing Business (2006, 2008, 2009, 2010), World Bank) and are now in a comparable range in both developing and developed countries (Duval and Utoktham (2009, 2011a)). However more work is required in the remaining two areas. For instance, India's logistics costs are among the highest in the world at around 13 percent of GDP that impose an annual loss of about $20 billion to its GDP (Banik (2010)).

NTB_{ij}: This area captures the coverage of trade policy barriers- tarif and non-tariffs (NTB). Though tariff liberalization has already been undertaken at an intensive level under successive rounds at WTO, there still exists scope for pursuing further attempts in this in field and they must be continued (Duval and Utoktham (2011a, 2011b), Kowalseki and Dihel (2009)). Further, reduction of NTBs now forms a crucial component of international trade policy (UNESCAP (2009), Das (2012))

3. Reforms undertaken recently, $IMPCOU_{ij}$, $PROP_{ij}$ and $STABUS_{ij}$: These reforms are still in early stages as several developed countries are trying to improve in these areas.

Following hypotheses are proposed for the above six reform areas:

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 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.

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.

4 The Frontier Model, Data and Descriptive Statistics

4.1 The Frontier Model

Following specification of Equation (1) is adopted:

$$\mathbf{LnY_{ij} = Const + \beta 1\ Ldist_{ij} + \beta 2\ Lang_{ij} + \beta 3\ Contig_{ij} + \beta 4\ FTA_{ij} + \beta 5\ ReformArea_{ij} + \beta 6\ LnDomt_{ii} + \beta 7\ LnDomt_{jj} + V_{ij} - U_{ij}.} \qquad \mathbf{i, j = 1...n, i \neq j.} \quad \mathbf{(5)}$$

Table 2: Variable Definition

Note: FTAs are listed at the end of the paper[ii].

Source: Author

Variables used in Equation 5 are listed in Table 2 above. Six forms of Equation (5)), corresponding to each of the six reform areas, are estimated for the years 2001 and 2007.

Model results are also subject to robustness checks based on the method in Duval and Utoktham (2011a). Results of frontier estimation are given in Appendix Tables A1 and A2.

4.2 Data

VARIABLE	DEFINITION	SOURCE	PURPOSE	REFERENCE
1.$LDIST_{ij}$(-)	Ln(Distance)	CEPII	Transportation costs.	Armstrong etal (2008), Armstrong and Drysdale (2009).
2.$CONTIG_{ij}$(+)	Dummy for contiguity.	CEPII	Transport and communication advantage.	Armstrong etal (2008), Armstrong and Drysdale (2009).
3.$COMLANG_{ij}$(+)	Dummy for common language.	CEPII	Communication advantage.	Armstrong etal (2008), Armstrong and Drysdale (2009).
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 etal (2008), Armstrong and Drysdale (2009)
6.ICT_{ij}(+)	Log(ICT expenditure as a ratio of GDP of Exp*Imp)	WDI	Information availability, automation of customs procedures, technological readiness.	Wilson etal (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 Kowalski and Dihel (2009).
11.$LDOMT_{ii}$ $LDOMT_{jj}$	Log(EFN country score) (+) Log(EFN country rank)(-)	EFN EFN	Domestic Trade costs. 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)

The frontier model (Equation 5) is estimated using a sample of 1097 bilateral merchandize trade flows from 34 countries. These countries featured in the list of top 50 exporters for the

years 2001 and 2007 (WTO (2008)), accounting for about 75 percent of world merchandize trade.

GCR (2010) divides countries into five categories according to their level of development. The 34 sampled countries are classified below as follows:

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 could not be included due to data limitations.

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. Note EFN Indices are chain linked, enabling comparison across different years. No cases of multicollinearity are reported in the data set.

4.3 Descriptive Statistics of Key Variables.

Some important trends of the dependent variable, **Ltrade$_{ij}$**, **TradeGrowth$_{ij}$** and the six reform areas are discussed below:

1. Ltrade$_{ij}$: Mean increases from (-12.42) to (-11.74).

High: 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: 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 and Chile (not each other's key trade partners).

2. TradeGrowth$_{ij}$: Mean value in the sample is 0.68.

High: China, Turkey, Romania, Chile, Vietnam, India, Russia and Brazil, South Africa, and Netherlands (in that order).

Low: Philippines, Sri Lanka, Canada, US, UK, Japan, Mexico, France, Israel and Indonesia (in that order).

3. ICT$_{ij}$: Mean increases from 3.40 to 3.48.

Top 10 2001: Malaysia, South Korea, South Africa, China, US, Vietnam, Switzerland, Canada, Netherlands and Japan.	**Top 10 2007:** Malaysia, South Africa, Korea, Bangladesh, Switzerland, US, Japan, Netherlands, Canada and China.
Bottom 10 2001: Bangladesh, Sri Lanka, Indonesia, India, Colombia, Russia, Argentina, Turkey, Mexico and Chile.	**Bottom 10 2007:** Indonesia, India, Russia, Turkey, Sri Lanka, Mexico, Colombia, Chile, Spain and Romania.
Key Changes: **Top 10:** Bangladesh moves from bottom 10 in 2001 to top 5 in 2007. **Bottom 10:** Spain in bottom 10 in 2007.	

4. IMPCOU$_{ij}$: Mean increases from 3.25 to 3.31.

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.

5. $PROP_{ij}$: Mean increases from 3.23 to 3.81.

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 while France and Japan 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.

6. NTB_{ij}: Mean increases from 3.62 to 3.69.

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 replaced by Israel and France in 2007.
Bottom 10: Romania, Indonesia, Turkey and Japan replaced by Argentina, Brazil, Thailand and Switzerland in 2007.

7. $IMEX_{ij}$: Mean decreases from 4.22 to 4.12.

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.

8. STABUS$_{ij}$: Mean increases from 3.21 to 4.37.

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, Vietnam, Belgium and Italy.	**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, Philippines, China, Spain, India and Sri Lanka move here in 2007.	

5 Trade Decomposition and Reforms Analysis: Findings and Discussion

5.1 Model Details

Equation (3) is calculated for each of the 1097 trade pairs for all the six models. For Model 1, for instance, this takes the following form:

$$\begin{aligned}
&LnY^2_{ij} - LnY^1_{ij} \\
&= \beta^2(LnX^2_{ij} - Ln\,X^1_{ij}) + [(\alpha^2 - \alpha^1) + (\beta^2 - \beta^1)\,Ln\,X^1_{ij}] - (U^2_{ij} - U^1_{ij}) + (V^2_{ij} - V^1_{ij}). \\
&= [(-1.51)*(\mathbf{Ldist}_{ij}2007 - \mathbf{Ldist}_{ij}2001) + (0.13)*(\mathbf{Comlang}_{ij}2007 - \mathbf{Comlang}_{ij}2001) + \\
&\quad (1.38)*(\mathbf{Contig}_{ij}2007 - \mathbf{Contig}_{ij}2001) + (1.4)*(\mathbf{FTA}_{ij}2007 - \mathbf{FTA}_{ij}2001) + (2.18)*(\mathbf{ICT}_{ij}2007 - \mathbf{ICT}_{ij}2001) + \\
&\quad (3.93)*(\mathbf{LDomt}_{ii}2007 - \mathbf{LDomt}_{ii}2001) + (3.99)*(\mathbf{LDomt}_{jj}2007 - \mathbf{LDomt}_{jj}2001)] + \\
&\qquad [\{(-19.81) - (-21.05)\}] \\
&+ [\{(-1.51) - (-1.57)\}*\mathbf{Ldist}_{ij}2001 + \{(0.13) - (0.03)\}*\mathbf{Comlang}_{ij}2001 + \{(1.38) - (0.88)\}*\mathbf{Contig}_{ij}2001 + \\
&\{(2.18) - (2.23)\}*\mathbf{ICT}_{ij}2001 + \{(3.93) - (4.40)\}*\mathbf{LDomt}_{ii}2001 + \{(3.99) - (4.16)\}*\mathbf{LDomt}_{jj}2001] \\
&\qquad - (U^2_{ij} - U^1_{ij}) + (V^2_{ij} - V^1_{ij}). \\
&\qquad\qquad i,j = 1,\ldots, 1097. \qquad (7)
\end{aligned}$$

Values of the error terms in the above equation (Equation (7)) are obtained from the LIMDEP Frontier estimation. Also note that the first three terms in the input effect are zero as the variables **$Ldist_{ij}$**, **$Comlang_{ij}$** and **$Contig_{ij}$** do not change over time.

Equation (7) is calculated for each of the 1097 trade pairs and averaged across different regions.

There are four regions: (1) Full sample, corresponding to world trade; (2) Trade between developed countries; (3) Trade between developing countries (China and Korea excluded); Trade between developing countries (China and Korea excluded) and all their trading partners. Findings are also reported for Indian and Chinese trade. These trade decomposition patterns are presented through Tables 3 to 6 below.

5.2 Trade Growth Patterns: Findings and Discussions

Table 3: Trade Growth Decomposition- Full Sample.

(Figures in numbers (in brackets, percentages)

Reform Area	Input Effect	Technological Effect	Efficiency Effect	Total
ICT_{ij}	0.458 **(67.20)**	0.485 **(71.17)**	-0.26 **(-38.15)**	0.683 (100)
$IMPCOU_{ij}$	0.166 **(24.06)**	0.544 **(79.24)**	-0.019 **(-2.79)**	0.685 (100)
$PROP_{ij}$	1.513 **(222.01)**	-0.736 **(-108.44)**	-0.094 **(-13.79)**	0.681 (100)
NTB_{ij}	0.059 **(8.51)**	0.745 **(109.32)**	-0.118 **(-17.31)**	0.686 (100)
$IMEX_{ij}$	-0.229 **(-33.90)**	1.0459 **(153.34)**	-0.139 **(-20.40)**	0.68 (100)
$STABUS_{ij}$	3.035 **(445.34)**	-2.104 **(-308.73)**	-0.251 **(-36.83)**	0.68 (100)
Average	0.833 **(122.20)**	-0.004 **(-0.01)**	-0.147 **(-22)**	0.682 (100)

Average increase in trade of the full sample = 0.6815 (100).

Source: Author

Table 4: Trade Growth Decomposition- Developed Countries

(Figures in numbers (in brackets, percentages)

Reform Area	Input Effect	Technological Effect	Efficiency Effect	Random Effect	Total
ICT_{ij}	-0.208 **(-42.17)**	0.476 **(96.51)**	-0.012 **(-2.43)**	0.241 **(48.86)**	**0.496 (100)**
$IMPCOU_{ij}$	-0.172 **(-34.87)**	0.311 **(63.06)**	0.126 **(25.55)**	0.237 **(48.05)**	**0.501 (100)**
$PROP_{ij}$	0.578 **(117.19)**	-0.306 **(-62.04)**	0.042 **(8.52)**	0.182 **(36.90)**	**0.496 (100)**
NTB_{ij}	-0.196 **(-39.74)**	0.108 **(21.90)**	0.163 **(33.05)**	0.423 **(85.77)**	**0.498 (100)**
$IMEX_{ij}$	-0.346 **(-70.15)**	0.306 **(62.04)**	0.111 **(22.51)**	0.421 **(85.36)**	**0.492 (100)**

$STABUS_{ij}$	2.573 **(521.70)**	-2.45 **(-496.76)**	0.045 **(9.12)**	0.324 **(65.69)**	**0.492 (100)**
Average	0.372 **(75.43)**	-0.259 **(-52.51)**	0.079 **(16.02)**	0.305 **(61.84)**	**0.497 (100)**

Average Trade Growth Between Industrialized Countries = 0 .4932 (100). Note calculations are made using sample means.

Source: Author

Table 5: Trade Growth Decomposition- Developing Countries (excluding China and Korea).

(Figures in numbers (in brackets, percentages)

Reform Area	Input Effect	Technological Effect	Efficiency Effect	Random Effect	Total
ICT_{ij}	1.08 **(111.33)**	0.55 **(56.41)**	-0.45 **(-46)**	-0.21 **(-21.37)**	**0.98 (100)**
$IMPCOU_{ij}$	0.46 **(47.22)**	0.78 **(80.61)**	-0.06 **(-6.4)**	-0.20 **(-20.54)**	**0.98 (100)**
$PROP_{ij}$	2.40 **(246.96)**	-1.16 **(-119.04)**	-0.15 **(-15.37)**	-0.12 **(-12.39)**	**0.97 (100)**
NTB_{ij}	0.27 **(27.87)**	1.43 **(147.19)**	-0.337 **(-34.66)**	0.39 **(39.72)**	**0.97 (100)**
$IMEX_{ij}$	-0.16 **(-16.69)**	1.88 **(193.12)**	-0.32 **(-32.63)**	-0.43 **(-43.74)**	**0.98 (100)**
$STABUS_{ij}$	3.44 **(353.54)**	-1.75 **(-180.14)**	-0.43 **(-43.74)**	-0.23 **(-23.49)**	**0.97 (100)**
Average	1.25 **(128.36)**	0.29 **(29.69)**	-0.3**0 (-31.87)**	-0.32 **(-32.00)**	

Average Trade Growth Between Developing Countries = 0.9723 (100).

Source: Author

Table 6: Trade Growth Decomposition: Developing Countries and All Partners

(Figures in numbers (in brackets, percentages)

Reform Area	Input Effect	Technological Effect	Efficiency Effect	Random Effect	Total
ICT_{ij}	0.80 **(101.20)**	0.49 **(62.19)**	-0.369 **(-46.36)**	-0.12 **(-14.82)**	**0.79 (100)**
$IMPCOU_{ij}$	0.32 **(40.73)**	0.67 **(84.87)**	-0.067 **(-8.42)**	-0.12 **(-14.75)**	**0.81 (100)**
$PROP_{ij}$	1.96 **(248.48)**	-0.94 **(-118.79)**	-0.14 **(-17.59)**	-0.08 **(-10.31)**	**0.80 (100)**
NTB_{ij}	0.19 **(23.75)**	1.06 **(134.49)**	-0.24 **(-30.15)**	-0.21 **(-24.63)**	**0.81 (100)**
$IMEX_{ij}$	-0.18 **(-23.27)**	1.43 **(180.29)**	-0.24 **(-30.15)**	-0.21 **(-26.04)**	**0.80 (100)**
$STABUS_{ij}$	3.23 **(409.12)**	-1.94 **(-244.96)**	-0.38 **(-47.74)**	-0.13 **(-16.22)**	**0.79 (100)**
Average	1.05 **(133.34)**	0.13 **(16.32)**	-0.24 **(-30.00)**	-0.14 **(-18.00)**	

Average Trade Growth Between Developing Countries and all countries = 0.7959 (100).

Source: Author

Trade growth patterns conform to those described earlier in Section II, based on UNIDO (2005) for output growth, and provide some support for the hypotheses outlined therein. Details:

Overall trade growth (Log points): Highest growth for developing countries (0.97213, Table 5) followed for Developing-All (0.7959, Table 6), Full sample (0.6816, Table 3) and Developed countries (0.4932, Table 3). At Country level, Minimum value for Romania-Philippines (-4.05) and maximum for Colombia-Bangladesh (8.90).

This conforms to actual trade growth patterns (in percent) in the literature during 2000-2007 (WTO (2008)) (World -5.5, North Americas- 4, Europe- 4, Latin America and Asia- 9, India and China- 13 and 22).

It is also consistent with Besedes and Prusa (2007). Using the concepts of intensive and extensive margins, the authors found the highest gains in extensive margins for East Asia followed for Africa, India and Central and South American countries respectively. US and EU registered 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).

Trade growth components as a percentage of trade growth:

Input effect: Highest for Developing-All (133, Table 6) followed for Developing (125, Table 5), Full sample (122, Table 3) and Developed countries (75, Table 4) respectively.

The trend supports the hypothesis **H1** as 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 (30, Table 5) followed for Developing-All (11.25, Table 6), Full sample (-0.01, Table 3) and Developed countries (-52, Table 4) respectively.

The trend is contrary to the hypothesis **H2**. Sampling issues, level of aggregation over goods and the presence of Asian countries in globalized production networks (Lall, Weiss and Zhang (2005)).

In addition, it also possibly indicates the presence of a 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 (16, Table 4) followed for Full sample (-0.01, Table 3), Developing ((-30, Table 5) and Developing-All (-30, Table 6) respectively.

These observations support the hypothesis **H3**. This probably indicates that developed countries, being the innovators of technology, have strong production effects that leads to positive and a higher 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 (3) and China (8) have positive effects.

Random effect: Highest for Developed countries (16, Table 4) followed for Full sample (-0.01, Table 3), Developing countries (-30, Table 5) and Developing-All (-30, Table 6) respectively. India and China: 3 and 8.

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, and depreciation of the US Dollar against major currencies during this period (UNCTAD (Trade Development Report 2008)). This retarded their exports and hence trade growth.

The next section analyses the impact of four reform areas (for brevity) on trade growth.

5.3 Reforms Implementation: Findings and Discussions

5.3.1 Country and regional patterns (Figures are averages, in numbers)

1. ICT_{ij} (Table 7)

Input effect: **Maximum**: Bgd-Lka (4.45); **Minimum**: Bel-Esp (-0.80)

This possibly reflects the role of ICT as an **infrastructure pillar** in fostering trade as Bangladesh moves from bottom 10 in 2001 to top 5 in 2007.

Developing countries score more than developed countries.

Technological effect: **Maximum**: Chn-Rus (1.31); **Minimum**: Nld-Che (0.05).
(China moved in top 10 in 2007 while Netherlands and Switzerland stayed in top 10 in both the years).

This possibly reflects that developing countries are participating in globalized manufactured chains in electronics (Lall, Weiss and Zhang (2005)) and possibly reflects the role of ICT as a **technological readiness pillar** in fostering trade.

For instance, in Table 7 below, Rus-Chn (1.31) and Ind-Bgd (1.3) score higher than US-Can (1.16).

Overall, developed countries score more than developing countries.

Efficiency effect: **Maximum**: Chl-Bgd (4.45); **Minimum**: Col-Tur (-3.54).
(Bangladesh moved in top 5 in 2007. Chile, Colombia and Turkey were in bottom 10 in both years).

Here, ICT is again a **technological readiness pillar** in developing countries. For instance, Phl-Rom (4.09), Bgd(2.8) is higher than US-Can (1.3). Philippines had switched over from apparel and other low technology items to electronics and automotive components during 1990 and 2000 (Lall, Weiss and Zhang (2005)).
Developed countries score more than developing countries.

Table 7: ICT_{ij}- Trade Growth Decomposition

(Figures in numbers)

Input effect:	**Technological effect:**
Developed (-0.21):	**Developed (0.48):**
Maximum: Can-Aut, Isr, Fra, Jpn, Che (1.10)	**Maximum: US-Can; Deu-Aus; Fra-Ita, Bel, Esp (1.09)**
Minimum: Bel- Esp, Swe, US, Nld, GBR (-0.76).	**Minimum: Che-Nld, GBR, Esp, Swe, Bel (0.10).**
Developing-All (0.80):	**Developing-All (0.49):**

Maximum: Bgd.- Lka, Can, Rom, Col, Rus (4.19).	**Maximum: Rus-Chn; Ind-Bgd; Vnm-Chn; Arg-Bra; Mys-Idn (1.23).**
Minimum: Mys-Bel, Esp, Swe, US; Arg-Esp (-0.69).	**Minimum: Che-Tur, Rom, Mys, Rus, Zaf (0.21).**
Developing (1.08):	**Developing (0.55):**
Maximum: Bgd-Lka, Rom, Col, Rus, Ind (4.08).	**Maximum: Ind-Bgd; Arg-Bra; Mys-Idn, Tha; Bra-Col (1.13).**
Minimum: Mys- Arg, Vnm; Arg-Vnm; Bra- Mys, Arg (-0.36).	**Minimum: Bra-Chl; Mys-Zaf, Lka; Zaf-Chl, Arg (0.31).**
Efficiency effect:	**Random effect:**
Developed (-0.01):	**Developed (0.24):**
Maximum: Can- US, Isr, Fra, Jpn, Aut (1.07).	**Maximum: Bel-US, Aus, Can, Jpn, Swe (1.57).**
Minimum: Che-Can, Aus, Bel; Can-Nld; Esp- Che (-1.09).	**Minimum: Can- US, Jpn, Fra, Isr, Ita (-0.70)**
Developing-All (-0.37).	**Developing-All (-0.12):**
Maximum: Chl-Bgd; Phl-Rom, Bgd; Tha-Bgd; Lka-Kor (3.42).	**Maximum: Arg-Chn; Vnm-Bel, Arg, Mys, Nld (2.10).**
Min: Col-Tur, Bgd; Arg-Che; Vnm-Bra, Mex (-2.65).	**Minimum: Chl-Bgd; Rus-Lka, Ind; Phl-Rom; Lka-Isr (-1.78)**
Developing (-0.45):	**Developing (-0.21):**
Maximum: Bgd-Chl; Phl-Rom, Bgd; Tha-Bgd, Rom (3.39).	**Maximum: Vnm-Arg, Mys; Mys, Rus-Arg; Vnm-Bra (1.64)**
Minimum: Col- Tur, Bgd; Vnm- Bra, Mex, Chl (-2.6)	**Minimum: Chl-Bgd; Rus-Lka, Ind; Phl-Rom; Tha-Bgd (-1.76)**

Source: Author

Random effect: **Maximum**: Chn-Arg (2.33); **Minimum**: Bgd-Chl (-1.94).

(China moved in top 10 in ICT rankings in 2007. It featured amongst the top exporters and export growth countries; Bangladesh moved to top 10 ICT rankings in 2007 but has a very trade to GDP ratio.

Several developing countries with high trade/GDP ratios and high trade growth also do well here. For instance, Vnm-Arg (2.1) is higher than US-Bel (1.9).

Developed countries score more than developing countries.

Other details:

Amongst developed countries, Switzerland has the least technological effect and a negative efficiency effect. Switzerland being a frontier country (GCR 2009), this possibly reflects its country's move into more innovative products that have not been directly considered in the analysis.

2. IMPCOU$_{ij}$. (Table 8)

Input effect: **Maximum**: Chl-Fra (2.28); **Minimum**: Ita-Isr (-1.54).
France moved in top 10 sampled countries in 2007. Chile's rank for this variable in GCR (2008) is 30, reflecting improved performance. Italy features in bottom 10 countries in 2007 and Israel moved out of top 10 sampled countries in 2007.

Developed countries have a lower input effect than developing countries.

Technological effect: **Maximum**: Can-Isr (2.23); **Minimum**: Arg-Bgd (-1.57).
Canada's rank in GCR (2008) is 14 and it still has a competitive disadvantage[iii] in this variable. So, a high technological effect **probably** reflects ongoing reforms.
(Switzerland and Netherlands, which feature in the top rankings, report negative magnitudes here. This probably reflecting considerable improvements already made in this area).

Argentina (Rank 126) and Bangladesh (Rank 122) are the lowest rank holders amongst the sample countries in this variable.

Developing countries score higher than developing countries. This could possibly be because several developed countries in the sample- USA, Belgium, Spain, Israel and Italy- do not feature in the top 20 ranks in GCR (2008).

Table 8: $IMPCOU_{ij}$- Trade Growth Decomposition

(Figures in numbers)

Input effect:	**Technological effect:**
Developed (-0.17)	**Developed (0.31)**
Maximum: Aus-Nld; Jpn-Fra, Can, Esp, Aut (0.83).	**Maximum: Can-Isr, Fra, US, Aut, Swe (1.64).**
Minimum: Isr- Ita, US; Ita- US; GBR-Isr, Ita (-1.20)	**Minimum: Aus-Nld; Che-US, GBR; Bel-GBR; Nld-Che (-0.58).**
Developing-All (0.32)	**Developing-All (0.67)**
Maximum: Chl-Fra, Esp, Aut, Swe; Rom-Idn (2.01).	**Maximum: Bra-Col; Can-Ind, Col; Chn- Vnm, Rus (2.13).**
Minimum: Isr-Bra, Lka; Ita-Bra, Lka; Lka-Bra (-1.19) .	**Minimum: Arg-Bgd, US, Che, Phl, GBR (-1.32).**

Developing (0.46)	**Developing (0.78)**
Maximum: Rom-Idn; Chl-Ind; Idn- Arg, Tur, Rus (1.80).	**Maximum: Col- Bra, Rom, Lka, Vnm; Lka-Rom (1.94).**
Minimum: Bra- Lka, Mex, Zaf; Lka-Mex, Zaf (-0.66).	**Minimum: Arg-Bgd, Phl, Idn, Tha, Zaf (-1.02).**
Efficiency effect:	**Random effect:**
Developed (0.13)	**Developed (0.24)**
Maximum: Can-Fra, Esp, Swe, Jpn, Aut (0.78)	**Maximum: Bel-US, Ita, Aus, Isr, Can (1.71).**
Minimum: Che-Can, Aus; Can-Nld; Che-GBR, Nld (-1.04)	**Minimum: Can-Fra, Jpn, US, Esp, Swe (-0.85).**
Developing-All (-0.07)	**Developing-All (-0.12)**
Maximum: Rom- Phl, Tha, Idn; Chl- Bgd, Rom (2.19).	**Maximum: Arg- Vnm, Chn, Bel; Vnm-US; Arg- Che (2.0).**
Minimum: Col-Bgd,Tur; Arg-Che; Vnm-Mex, Chl (-2.86).	**Minimum: Rom-Phl, Tha; Rus-Ind; Idn-Fra, Kor (-1.83).**
Developing (-0.06)	**Developing (-0.20)**
Maximum: Rom- Phl, Tha, Idn; Chl-Bgd, Rom (2.19).	**Maximum: Arg- Vnm, Rus, Mex, Phl, Mys (1.70).**
Minimum: Col-Bgd, Tur; Vnm-Mex, Chl; Col-Ind (-2.78).	**Minimum: Rom- Phl, Tha; Ind, Mys-Rus; Chl-Bgd (-1.77).**

Source: Author

Efficiency effect: **Maximum:** Rom-Phl (3.50); **Minimum**: Bgd-Col (-5.50).

Romania, though still in bottom 10 in 2007, has made considerable changes in this variable (magnitude of 1.0). Bangladesh has gone further down in the rankings. Philippines features in bottom 10 in both years.

Amongst developed countries, lowest value is for Switzerland's (GCR Rank 3) trade with Canada and Australia (Table 8). This probably reflects the advanced states of these countries with respect to this reform area.

Overall, developed countries score higher than developing countries.

Random effect: **Maximum**: Vnm-Arg (2.28); **Minimum:** Phl-Rom (-2.09).

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 also trade growth in this period). Vietnam also moved out of bottom 10 in 2007.

Overall, developed countries score higher than developing countries.

3. NTB_{ij} (Table 9)

Input effect: **Maximum:** Chl-Ind (4.43); **Minimum:** Arg-Nld (-0.75).

As per GCR (2008), the top 5 sampled developing countries in this reform area are: Chile (5), South Africa (43), Turkey (44), Mexico (55) and India (69). Chile, South Africa and Turkey have a competitive advantage in this area while India and Mexico have a competitive disadvantage. Further, India had a Preferential Trade Pact with Chile (2007) and is likely to benefit from it (an agreement on expansion of this PTA was signed on 6th September 2016, which is likely to benefit India[iv]). These observations can possibly explain the entry against the maximum value.

Argentina moves into the bottom 10 in 2007 (Netherland was in top 10 in both years).

Overall, developing countries score higher than developed countries.

Technological effect: **Maximum:** Rom-Rus (2.26); **Minimum:** Che-US (-0.92).
Romania moves out of bottom 10 in 2007 (Russia was in bottom 10 in both the years).
Switzerland moved into bottom 10 in 2007.

On the whole, technological effect is *higher* for developing countries than developed countries (Minimum for US and GBR). This is probably because many of them, viz., Australia, Israel, France, Germany, Canada, Spain, Italy, Japan and Switzerland featured out of top 20 rankings in GCR (2008).

Table 9: NTB_{ij} - Trade Growth Decomposition

(Figures in numbers)

Input effect:	**Technological effect:**
Developed (-0.20)	**Developed (0.11)**
Maximum: Can- Aut, Fra, Jpn, Isr; Aus-Nld (0.45).	**Maximum: Fra-Can, Bel; Isr-Can; Fra-Che, Ita (0.99)**
Minimum: Bel-Che, Nld, Esp; Nld-Che, Esp (-0.59).	**Minimum: US-Che, Nld, Bel; GBR-Nld; US-Aus (-0.77)**
Developing-All (0.19)	**Developing-All (1.06)**

Maximum: Chl- Ind, Aut, Fra, Swe, Deu (1.89).	**Maximum: Rom-Rus, Vnm; Bgd-Vnm; Rom-Tur; Vnm-Chn (2.19)**
Minimum: Arg- Nld, Che, Esp, US, Ita (-0.71).	**Minimum: Chl- US, Che, UK, Aus; Mys-US (-0.52).**
Developing (0.27)	**Developing (1.43)**
Maximum: Chl-Ind; Rom-Idn, Vnm, Tur; Vnm-Idn (1.15).	**Maximum: Rom-Rus, Vnm; Bgd-Vnm; Tur-Rom; Bra-Col (2.18).**
Minimum: Arg-Zaf, Mys, Bgd, Bra, Tha (-0.58).	**Minimum: Chl-Mys, Tha, Zaf, Phl, Ind (0.37).**
Efficiency effect:	**Random effect:**
Developed (0.16)	**Developed (0.42)**
Maximum: Can-Fra, US, Isr, Ita; Isr-Aus (0.61).	**Maximum: Bel- US, Aus; Che-Aus; Nld-US; Can-Bel (1.87).**
Minimum: Che-Can, Aus; Nld-Can; Nld, GBR-Che (-1.06).	**Minimum: Can-Fra, US, Isr; Isr-Swe; Ita-Can (-0.65).**
Developing-All (-0.24)	**Developing-All (-0.21)**
Maximum: Phl- Rom, Isr; Chl-Bgd; Tha, Idn-Rom (2.62)	**Maximum: Chn-Arg, Col; Vnm-US; Arg- Bel, Vnm (1.84).**
Minimum: Col- Bgd, Tur; Arg-Che; Col-Ind; Vnm-Chl (-2.79).	**Minimum: Phl-Rom, Isr; Ind-Rus; Tha-Rom; Lka-Kor (-2.02).**
Developing (-0.34)	**Developing (0.39)**
Maximum: Rom-Phl; Chl-Bgd; Tha, Idn-Rom; Phl-Lka (2.53).	**Maximum: Vnm-Arg; Col-Bgd; Arg-Mys, Rus; Vnm-Mys (1.26).**
Minimum: Col-Bgd, Tur, Ind; Vnm-Chl, Mex (-2.60).	**Minimum: Phl-Rom; Ind-Rus; Tha-Rom; Chl-Bgd; Lka-Rus (-1.86).**

Source: Author

Efficiency effect: **Maximum:** Rom-Phl (4.24); **Minimum:** Col-Bgd (-5.24).
Romania moves out of bottom ten in 2001 while Columbia and Bangladesh remain there.

Canada (GCR (2008) Rank 34) has a competitive disadvantage while Austria (Rank 5) has a competitive advantage. Switzerland and Britain have the least magnitudes (similar to technological effect). So, the model seems to be picking up the performance of countries.

Overall, efficiency effect is higher for developed countries than developed countries.

Random effect: **Maximum:** Bel-US (2.41); **Minimum:** Phl-Rom (-2.38).
Belgium has a high trade/GDP ratio and features in top 10 countries in both 2001 and 2007. Philippines indicates a decline in trade/GDP ratio and is amongst the bottom 10 countries in both the years.
Overall, developed countries score higher than developing countries.

4. STABUS$_{ij}$ (Table 10)

Input effect: **Maximum:** Rom-Arg (6.48); **Minimum:** Idn-US (0.69).
Romania moves into top 10 in 2007 whereas Indonesia was ranked lowest in 2007.

Overall, developed countries score higher than developing countries in this area, as they feature in lower ranks in this indicator.

Technological effect: **Maximum:** Can-Isr (-0.56); **Minimum:** Che-Nld (-3.59).
Canada improves its position whereas Switzerland moves out of top 10 amongst the sampled countries.

The GCR (2008) provides additional information on these two countries on the three subcomponents of this indicator:

Burden of Government Regulations	**No of procedures**	**Time to start a business**
Che (11, disadv), Can (40, disadv).	Che (19, disadv), Can (1, adv).	Che (42, disadv), Can (2, adv)

On the whole, developing countries score more than developed countries in this area due to considerable heterogeneity in the performance of these countries (GCR (2008)) as listed below:

Countries	**No of procedures**	**Time to start a business**	**Burden of government regulations**
Developing	Sri Lanka and Turkey (9), Romania (19), Bangladesh (44); Korea (75), China (108);	Turkey (6), Romania (27), Malaysia (51), Chile (61), China (83).	Malaysia (13), China (23), Korea (24), Chile (34), Sri Lanka (44).
Developed	Netherlands, U.K USA , Switzerland (19); Austria, Japan (44); Germany, Italy (58); Spain (75).	Australia (2), Canada (3), Belgium (4), USA (6); Italy, UK (24); Germany (38); Switzerland (42); Japan (48); Austria (64).	Japan (9), Switzerland (11), USA (50), Germany (77), U.K. (82), Australia (85).

Table 10: STABUS$_{ij}$- Trade Growth Decomposition

(Figures in numbers)

Input effect:	**Technological effect:**
Developed (2.57):	**Developed (-2.45)**
Maximum: Fra- Bel, Ita, Jpn, Aut, Deu (4.44).	**Maximum: Can-Isr, Fra, Jpn, Ita, US (-1.36).**
Minimum: US-GBR, Isr, Can, Aus; GBR-Isr (1.11).	**Minimum: Che-Nld, GBR, US, Bel; US-Bel (-3.52).**

Developing-All (3.23)	**Developing-All (-1.94)**
Maximum: Rom-Arg, Mex; Fra-Chl; Rom-Fra, Col (6.23).	**Maximum: Can-Idn, Tha, Mys; Mys-Chn; Can-Ind (-0.85).**
Minimum: Idn-US, GBR, Mys, Tha; Mys-US (0.88).	**Minimum: Arg-Che, US; Rom-Che; Arg-GBR; Mex-Che (-3.20).**
Developing (3.44)	**Developing (-1.75)**
Maximum: Rom- Arg, Mex, Col; Mex-Arg; Rus-Rom (6.13).	**Maximum: Mys-Idn, Tha; Idn-Tha, Rus, Vnm (-1.21).**
Minimum: Idn-Mys, Tha, Lka, Bra; Mys-Tha (1.10).	**Minimum: Arg-Bgd, Rom, Phl, Mex, Zaf (-2.64).**
Efficiency effect:	**Random effect:**
Developed (0.05)	**Developed (0.32):**
Maximum: Fra- Can, Ita, Isr, Aut, Esp (1.12).	**Maximum: US-Bel, Nld; Che-Aus, US, Bel (1.72).**
Minimum: Che-Can, Aus, GBR, Nld; Can-Nld (-1.46).	**Minimum: Fra-Can, Ita, Esp, Jpn; Ita-Can (-1).**
Developing-All (-0.38)	**Developing-All (-0.13):**
Maximum: Rom-Phl, Chl; Bgd-Chl; Rom-Tha, Col (3.20).	**Maximum: Vnm-US; Zaf-Chn; Vnm-Mys; Bra-Chn; Vnm-Nld (1.59)**
Minimum: Col- Bgd, Tur; Arg-Che; Vnm-US; Col-Ind (-2.31).	**Minimum: Rom-Ita; Chl-Fra; Rom-Fra, Phl; Ind-Rus (-2.07).**
Developing (-0.43)	**Developing (-0.23):**
Maximum: Phl-Rom; Chl-Rom, Bgd; Rom-Tha, Col (3.20).	**Maximum: Vnm-Mys; Bra-Tha; Col-Bgd; Bra-Vnm, Mys (1.31).**
Minimum: Col-Bgd, Tur, Ind; Vnm-Bra, Chl (-2.21).	**Minimum: Phl-Rom; Rus-Ind, Rom; Tha-Rom; Rus-Vnm (-1.70).**

Source: Author

Efficiency effect: **Maximum:** Rom-Phl (4.82); **Minimum:** Bgd-Col (-4.61).

Romania moves into top 10 in 2007 whereas Bangladesh slides back from 7th lowest to 3rd lowest in 2007.

Overall, developed countries score higher than developing countries.

Random effect: **Maximum:** Bel-US (2.13); **Minimum:** Ita-Rom (-2.35).

A high trade/GDP ratio for Belgium and low trade/GDP ratio for Italy can possibly explain this observation. Note that both Belgium and Italy move into top 10 countries in 2007.

Overall, developed countries score more than for developing countries.

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 Sections 3:

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

(ii) ICT_{ij}: On average, frontier countries are found at top rankings. Thus, factor driven economies have higher input effect than frontier countries.

Further, the aggregate technological and efficiency effects also show the right related trend: they are lesser (even negative) for frontier countries as compared to the factor countries or other intermediate stage countries.

For instance, **Switzerland** has a low technological effect and a negative efficiency effect under **ICT_{ij}**. This reflects its forays into more technologically advanced products other than those captured by the **ICT_{ij}** variable. Lower stage countries are found to have high magnitudes of both components. For instance, Philippines reports high magnitudes of both technology and efficiency effect reflecting the role of ICT as a **technological readiness** pillar.

(ii) $IMEX_{ij}$ and NTB_{ij}: Here frontier countries do not depict a clear pattern. Many of them are out of top ranks in GCR (2008).

For instance, **US, Switzerland** and **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 **$IMEX_{ij}$**.

On the aggregate, frontier countries still have lower input effects as compared to the other stage countries.

However, these countries have lower aggregate technological effect as compared other countries as the latter have made strides in this area. However, frontier countries dominate in aggregate efficiency effect, though country variations remain. For instance, **Romania** scores higher than **Switzerland** under both these components under **NTB_{ij}**.

(iii) **IMPCOU$_{ij}$**, **PROP$_{ij}$** and **STABUS$_{ij}$**. Here, countries depict no clear pattern. Frontier countries like **Italy** feature in the bottom ten in reform areas like **IMPCOU$_{ij}$** and **IMEX$_{ij}$** 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, reflects this heterogeneity.

Thus, **STABUS$_{ij}$** depicts a higher aggregate input effect for frontier countries than others. Aggregate technological effect is higher for other countries under **IMPCOU$_{ij}$**, and **STABUS$_{ij}$**. However, **PROP$_{ij}$** shows all the right comparative trends for frontier countries. Efficiency effect is highest for frontier countries under all three areas.

(iv) 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 also trade growth) have benefitted from positive random factors (Belgium, Vietnam, China and so on) while those with the reverse (Philippines, Sri Lanka and so on) have suffered. The model can, therefore, capture trade related shocks.

6 Conclusions

The results of the previous section indicate that the model outlined in this paper captures the dynamics of trade growth and reforms both at the aggregate as well as at the country level respectively.

These findings make the model suitable as a quantitative tool for current researches in trade and development such as New Structural Economics and World Bank Trade Strategy. The New Structural Economics (Lin (2011), Lin and Monga (2011)), which deals with structural transformation, is closely related to the concepts of this paper.

Similarly, World Bank Trade Strategy (WBGT) (2011) rests on four pillars for promoting trade. Three of them are related to the GCI (2008), while the fourth is concerned with random shocks. The model developed in this paper can serve as a quantitative tool for capturing the performances of these four pillars.

APPENDICES

Table A1: Frontier Estimation, World Trade Flows, 2001

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6

Const	-21.05 (-15.60)	-19.03 (-11.86)	-15.7 (-8.69)	-1.72* (-1.09)	-17.75 (-7.35)	-0.14* (-0.13)
$Ldist_{ij}$	-1.57 (-19.96)	-1.41 (-16.29)	-1.40 (-15.90)	-1.38 (-14.26)	-1.37 (-14.98)	-1.49 (-16.52)
$Comlang_{ij}$	0.03* (0.09)	-0.14* (-0.46)	-0.08* (-0.27)	-0.05* (-0.16)	0.10* (0.32)	-0.03* (-0.11)
$Contig_{ij}$	0.88 (2.39)	1.13 (3.08)	1.05 (2.95)	1.01 (2.59)	1.20 (3.21)	1.32 (2.97)
FTA_{ij}	1.04 (7.67)	1.57 (10.70)	1.65 (11.11)	1.71 (11.01)	1.24 (8.03)	1.39 (8.41)
ICT_{ij}	2.23 (18.93)					
$IMPCOU_{ij}$		0.90 (6.73)				
$PROP_{ij}$			1.19 (7.62)			
NTB_{ij}				1.76 (6.94)		
$IMEX_{ij}$					4.99 (10.87)	
$STABUS_{ij}$						1.93 (10.04)
$LDomt_{ii}$	4.40 (10.19)	4.74 (8.46)	3.58 (5.64)	-0.51 (-5.70)	-0.34 (--3.98)	-0.56 (-7.27)
$LDomt_{jj}$	4.16 (9.69)	4.47 (7.97)	3.27 (5.17)	-0.48 (-5.27)	-0.31 (-3.63)	-0.51 (-6.55)
Log-Likelihood	-2256.92	-2385.22	-2379.43	-2414.49	-2376.97	-2382.31
σ^2_u	5.74	6.46	6.04	6.64	5.94	6.57
σ^2_v	1.62	2.30	2.38	2.48	2.40	2.24
Λ	1.88	1.68	1.59	1.64	1.57	1.71
Σ	2.71	2.96	2.90	3.02	2.89	2.97
Γ	0.88	0.86	0.85	0.85	0.84	0.86
Log-Likelihood Statistic	41.67	33.56	30.83	34.45	34.27	35.35
N	1097	1097	1097	1097	1097	1097

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Table A2: Frontier Estimation, World Trade Flows, 2007.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Const	-19.81 (-7.44)	-6.28 (-2.00)	-8.58 (-2.95)	0.51 (0.21)	-7.15 (-3.13)	-8.38 (-2.48)

$Ldist_{ij}$	-1.51 (-15.22)	-1.35 (-13.15)	-1.34 (-13.20)	-1.45 (-11.76)	-1.4 (-12.07)	-1.38 (-11.16)
$Comlang_{ij}$	0.13* (0.41)	0.16* (0.48)	0.12* (0.38)	0.28* (0.79)	0.37* (1.10)	0.22* (0.61)
$Contig_{ij}$	1.38 (2.69)	1.56 (3.18)	1.47 (3.29)	1.49 (2.66)	1.41 (2.63)	1.55 (2.73)
FTA_{ij}	1.4 (7.97)	1.55 (8.82)	1.65 (9.55)	1.52 (8.30)	1.66 (9.01)	1.63 (8.93)
ICT_{ij}	2.18 (12.27)					
$IMPCOU_{ij}$		1.65 (8.92)				
$PROP_{ij}$			2.59 (9.98)			
NTB_{ij}				0.94 (2.29)		
$IMEX_{ij}$					2.38 (6.11)	
$STABUS_{ij}$						2.62 (4.28)
$LDomt_{ii}$	3.93 (4.60)	0.52* (0.49)	-0.03* (-0.03)	-0.2 (-1.94)	-0.09* (-0.92)	-0.14 (-1.39)
$LDomt_{jj}$	3.99 (4.74)	0.7* (0.67)	0.12* (0.12)	-0.21 (-2.09)	-0.1* (-1.17)	-0.15 (-1.58)
Log-Likelihood	-2455.05	-2482.15	-2474.09	-2545.91	-2532.18	-2539.95
σ^2_u	7.37	6.52	6.56	7.36	6.73	8.25
σ^2_v	2.58	3.11	3.02	3.48	3.55	3.13
Λ	1.69	1.45	1.47	1.45	1.38	1.62
Σ	3.16	3.10	3.10	3.29	3.21	3.37
Γ	0.86	0.82	0.83	0.82	0.81	0.85
Log-Likelihood Statistic	24.46	12.93	13.92	15.46	13.12	20.21
N	1097	1097	1097	1097	1097	1097

Notes to Tables 1A and 2A:
(i) The critical value for the Log-Likelihood Test equals 8.273; (ii) *implies that the variable is not significant; (iii) In the first three models, domestic trade costs are measured using the EFN country scores while in the last three they are measured using EFN country ranks; (iv) Figures in parentheses are t- statistics; (v) Other comments:

(1) The inefficiency parameter,γ, which lies in the range of about 0.80-0.88 in all the models for the years 2001 and 2007 respectively. This probably reflects the observation made by Duval and Utoktham (2011b) that reform measures initiated by countries all over the globe have not been able to keep pace with the growing world trade volumes leading to an increase in advalorem trade costs.

(2) The frontier estimation for the year 2007 indicates a higher magnitude of the variance of the two-sided error term (σ^2_v) as compared to that found for the year 2001. This is probably reflective of the negative shocks to world trade that had their origins in the world financial

crisis that severely affected world trade and output performance, the dollar devaluation, which made exports from developing countries costlier, and similar other factors.

(3) Thus, frontier methodology is proficient in capturing the effects of both random and inefficiency factors influencing the actual trade process. Correlation between the actual trade flows and those predicted by the model is about 0.76 in both the years of analysis.

Source: Author Calculations

(8711 words)

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End notes:

[i] http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/TRADE/EXTEXPCOMNET/0,,contentMDK:21784205~pagePK:64168427~piPK:64168435~theSitePK:2463594,00.html

[ii] FTAs (along with the year they came into force): APEC, APEC-China(2001), ASEAN, ASEAN-China (Goods-2005, Services-2007), Canada- Chile (1997), Canada- Israel1(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).

[iii] GCR (2008) defines competitive advantage in the following way: For those economies ranked in the top 10 in the overall GCI, individual variables ranked between 1 and 10 are advantages. For those economies ranked from 11 to 50 in the overall GCI, variables ranked higher than the economy's own rank are advantages. For those economies ranked lower than 50 in the overall GCI, any individual variables ranked higher than 51 are considered as advantages.

[iv] pib.nic.in/newsite/PrintRelease(6 September 2016).