

# ASSESSING THE IMPACT OF GREAT RECESSION ON INDIA'S TRADE IN GRAVITY MODEL FRAMEWORK

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## *Abstract*

This study examines the efficacy of trade channel in the transmission of recent Great Recession impulses to the Indian economy. To investigate the impact of Great Recession on India's trade, gravity model of trade was estimated by regressing trade flows on size of economies, level of economic development, geographical distance, and dummies for common border, landlocked country, islands, colonial history, common language, etc. For the same, quarterly data in respect of eleven advanced nations (*viz.*, Austria, Australia, Canada, Denmark, Japan, Korea, New Zealand, Sweden, Switzerland, United Kingdom and USA) and nine EMEs, including the BRICS nations (*viz.*, Brazil, Russia, Indian, China, South Africa), Indonesia, Mexico, Saudi Arabia, and Turkey) for the period from 2001q1 to 2013q4 was considered. Estimations suggest that Great Recession had an adverse impact on India's bilateral import volume and total trade volume after a lag of three quarters. Findings validate that trade channel acted as a conduit for transmission of Great Recession impulses to the Indian economy. This suggests that as the Indian economy becomes progressively more integrated with the global economy, containment of potential adverse shocks emanating from trade sector would call for more pro-active policies. Lessons from the Indian economy could be useful for other similar EMEs.

**Keywords:** Trade, Gravity Model, Great Recession, Panel data, India.

**JEL Code:** F14, G01.

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## I. Introduction

The world has become more globalised than ever. A series of economic crises that occurred since the 1990s [such as the Mexican crisis (1994); East Asian crisis (1997-98); Brazilian crisis (1999) and the Great Recession] have evidenced that crisis can get transmitted from a country (where it originated) to other countries through designated transmission channels. Main channels for transmission of crisis impulses across borders include finance channel, trade channel, and confidence channel [RBI (2010); Mohanty (2010)]. Finance channel operates through the financial markets wherein a country's equity, foreign exchange, and money markets get affected in the aftermath of a crisis event elsewhere. Trade channel adversely impacts the merchandise sector and decline in imports and exports moderates or slows down domestic economic activity as production and investment activities get hampered on account of sluggish external demand. The confidence channel operates through the financial markets, wherein across the board decline in business and consumer confidences undermines resource mobilisation activities of firms through the financial market and thereby adversely affect production and investment activities.

During the Great Recession, all these transmission channels operated in India; albeit their strength varied and that finance channel was more dominant as compared to trade channel (RBI, *op. cit.*). In the present analysis, however, only the trade channel has been analysed for understanding the adverse impact of the Great Recession on the Indian economy. This has been done for the sake of making it a study focused only on trade.

Though there is an abundant literature on trade and growth linkages, little attention has been paid to the issue as to whether, and to what extent, crisis shocks influence bilateral trade flows of a country. This matter has significant policy implications as trade flows affect growth and thereby economic welfare of an economy. Furthermore, a broader understanding of how the shocks affect trade flows could help policy makers in designing counter-cyclical policies in a better way. Against this premise, this Study examines whether the trade channel acted as a conduit for transmission of Great Recession impulses to the Indian economy by analysing bilateral trade flows of the Indian economy with select economies, both the advanced economies (AEs) and the emerging market economies (EMEs).

The present analysis has a number of distinctive features differentiating it from earlier studies. First, this study is based on high frequency (quarterly) data, which presents a more realistic assessment of impact of crisis. Second, the analysis is undertaken in a panel gravity model framework, covering bilateral trade flows, which has theoretical foundations. Third, none of the studies, so far have examined how the Great recession had affected trade, export and import of the Indian economy using bilateral level trade flows data.

The remainder of study is organised as follows: Section II discusses select literature on this area. Section III analyses recent trend in India's trade. Section IV covers data sources and empirical estimation. Concluding observations of the Study are set in section V.

## **II. Literature survey**

Trade openness could possibly cause the business cycle of an open economy co-move with its trading partners either in the same or opposite direction depending upon the nature of trading relations. This suggests that trade sector could act as a conduit for transmission of international crisis from one country to another, if there are trade linkages between them. However, given the ambiguous impact of trade openness on business cycles correlation, there is a clear divide amongst the experts on the issue whether trade linkages act as a conduit for transmission of crisis impulses. Some consider that international trade linkages do act as a conduit for transmission of crisis from one country to another (Eichengreen, 1999). Akin (2006) attached importance to trade linkages as medium of transmission of crises, but contended that trade channel gets overshadowed by other transmission mechanisms. On the contrary, Mason (1998) and Harrigan (2000) contended that trade linkages do not play any role in the transmission of international crisis, citing the fact that in the past crises, *viz.* Mexican crisis, Asian crisis, and Russian crisis, trade sector did not act as a conduit for international transmission of crisis.

A few studies relating to the Indian economy have also dwelt on the issue whether trade sector acted as a conduit for transmission of international crises to the Indian economy. These studies have covered the role of trade in transmission of crisis in

respect of the Great Recession [Fidrmuc and Korhonen (2010); RBI, *op. cit.*; and Mohanty, *op. cit.*].

Fidrmuc and Korhonen (2010) analysed the transmission of global financial crisis to business cycles in China and India using quarterly GDP data from 1993 to 2008. They reported that trade intensity between the OECD economies and India had a significant effect on the correlation of their GDP cycles at business cycle frequencies.

Mohanty, *op. cit.* undertook analysis of the impact of the Great Recession on the Indian economy since the second half of 2008-09 over three distinct phases. He found that despite sound fundamentals and no direct exposure to the sub-prime assets, Indian economy got affected by global financial crisis through all the channels – trade, finance and confidence channels – reflecting increasing globalisation of the Indian economy than what is apparent in terms of traditional indicators.

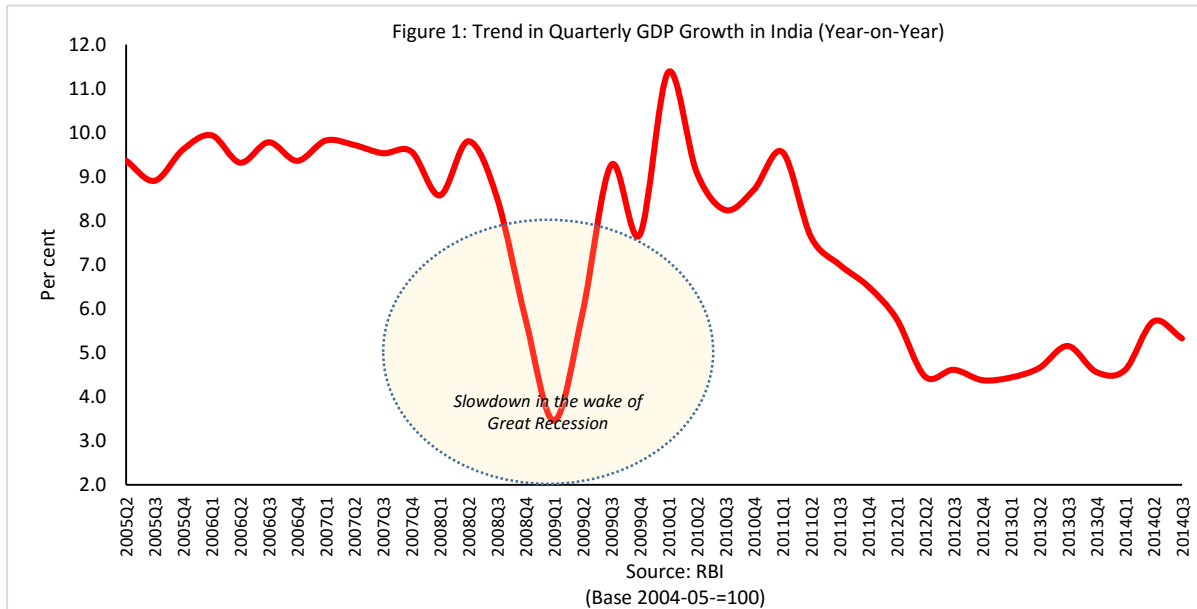
RBI (2010) observed that global financial crisis got transmitted to the Indian economy through three channels, *viz.*, finance, trade, and confidence channels. Using VAR framework, it found that finance channel had a more dominant role in transmitting the effects of global developments to Indian economy. Analysing the quarterly data from 1996 to 2009 in VAR framework, it reported that about 50 per cent of variation in GDP in India was explained by financial variables, while exports of goods and services explained only about 9 per cent of output variation.

Notwithstanding the above-mentioned studies, none of the studies, so far, have examined the impact of Great Recession on trade, export and import of the Indian economy using bilateral level trade data in gravity model framework (which is premised on theory). Against this premise, this Study seeks to bridge this gap in literature.

### **III. Great Recession and its Impact on the Components of Aggregate Demand in India**

The advanced economies got affected severely by the sub-prime crisis in 2007. However, this did not have an immediate impact on the Indian economy. The collapse of Lehman Brothers, a big global investment firm, in September 2008, nevertheless, brought a major meltdown in the global financial markets. Indian economy could not remain insulated to such a development as the crisis took a toll on the financial markets and the external trade. These external shocks caused India's GDP growth to moderate to 3.5 per cent in the first quarter of 2009 (Figure 1). Nevertheless, the Indian economy

rebounded from the mid of 2009. Mohanty, *op. cit.* contended that as compared to many other economies, India was among the first to exhibit strong rebound from the global downturn.



For an open economy, like India, external sector influences growth impulses through, *inter alia*, better technology and productivity, economies of scale, optimal allocation of resources, research & development, augmentation of demand, *etc.* RBI (2010) observed that the impact of exports on GDP growth depends upon the share of exports in domestic demand, and the income (global) elasticity of exports. In a similar vein, any shock to the external sector might affect growth prospects of an economy. The Great Recession caused dislocations in the external sector, which had an adverse impact on economic activity. The Great Recession could have affected the Indian economy through the trade channel in the following scheme. Recessionary conditions in the global economy caused a decline in both exports and imports. This, in turn, led to contraction in investment demand, which thereby impacted production adversely. Incidences of joblessness rose across a number of sectors, which caused further compression in demand conditions. This, in turn, affected the economy adversely.

The impact of Great Recession on the Indian economy was examined by analysing the effect on individual components of GDP from the expenditure side. It is observed that in the period prior to the Great Recession, domestic consumption and capital formation were the main drivers of growth. In the aftermath of Great Recession,

investment demand, however, declined sharply on account of subdued investment climate and economic uncertainties (Figure 2). Consumption activity, on the contrary, being primarily domestic-oriented was not found to have been affected much by the crisis (Figure 3).

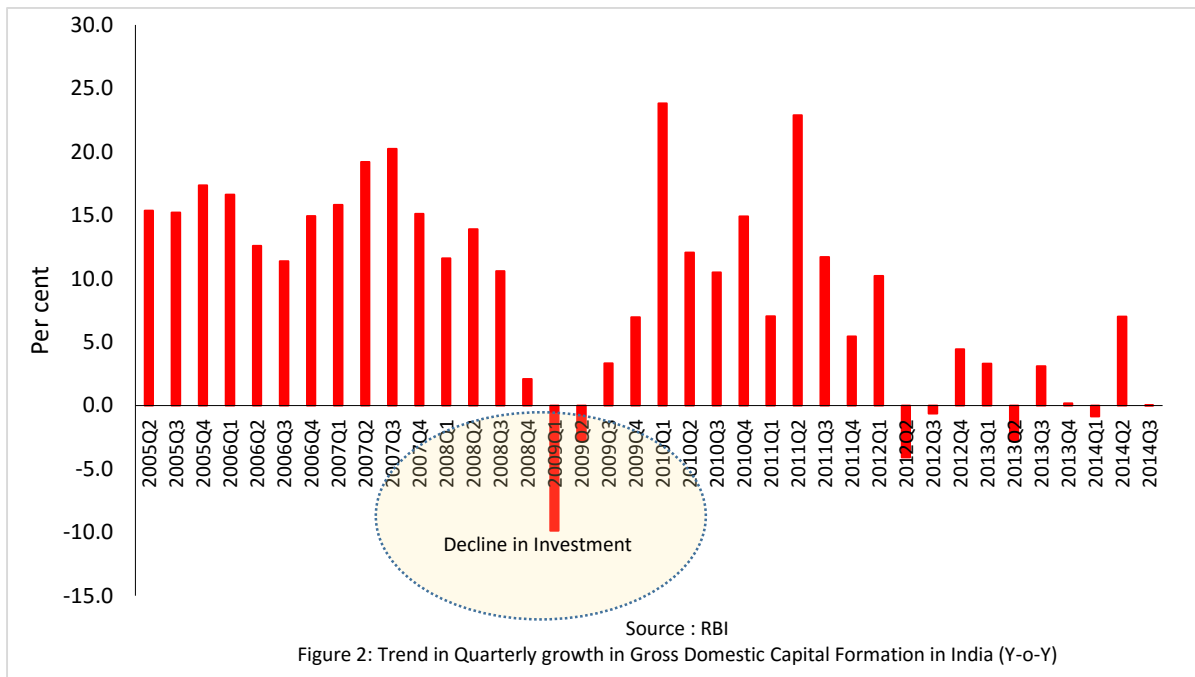


Figure 2: Trend in Quarterly growth in Gross Domestic Capital Formation in India (Y-o-Y)

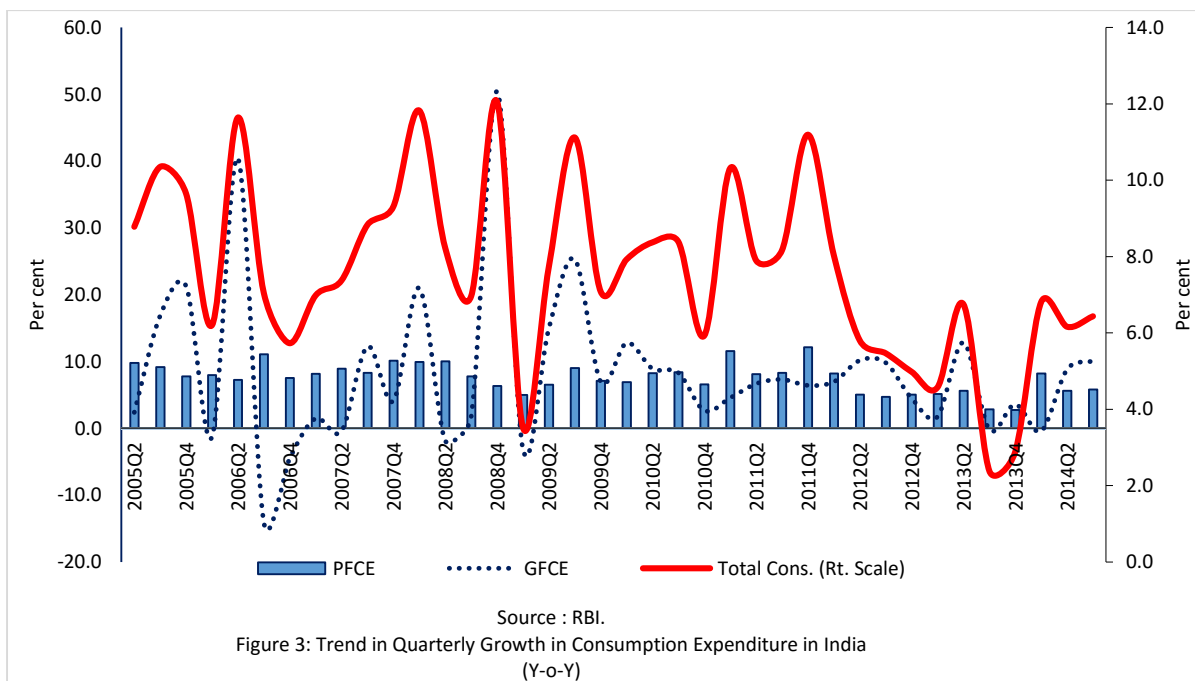


Figure 3: Trend in Quarterly Growth in Consumption Expenditure in India (Y-o-Y)

The external sector remained the most adversely affected sector on account of unfavourable global demand conditions. Both exports and imports declined with the intensification of the global financial crisis in mid-September 2008 (Figure 4). As the recession in the advanced economies deepened, external demand conditions became subdued and India's trade volume slumped. Decline in commodity prices such as that of crude oil and other agricultural primary commodities also pulled down the trading activity. Imports also declined following slump in exports (which reduced imports of gems and jewellery and crude oil<sup>1</sup>) and softening of commodities prices.

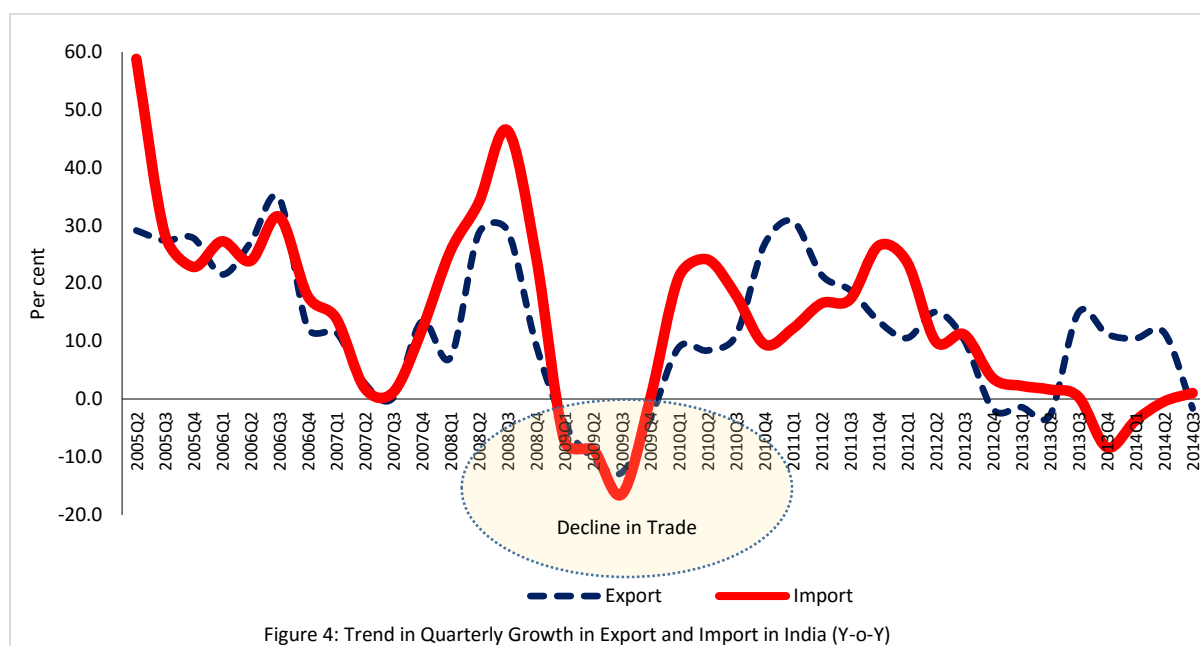
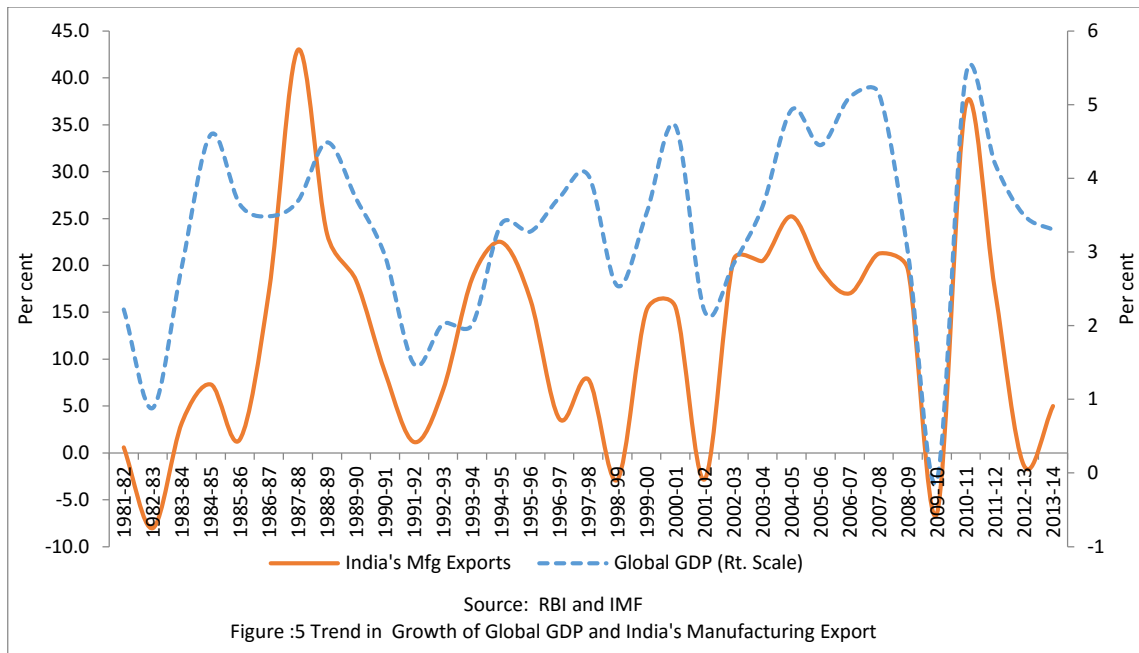


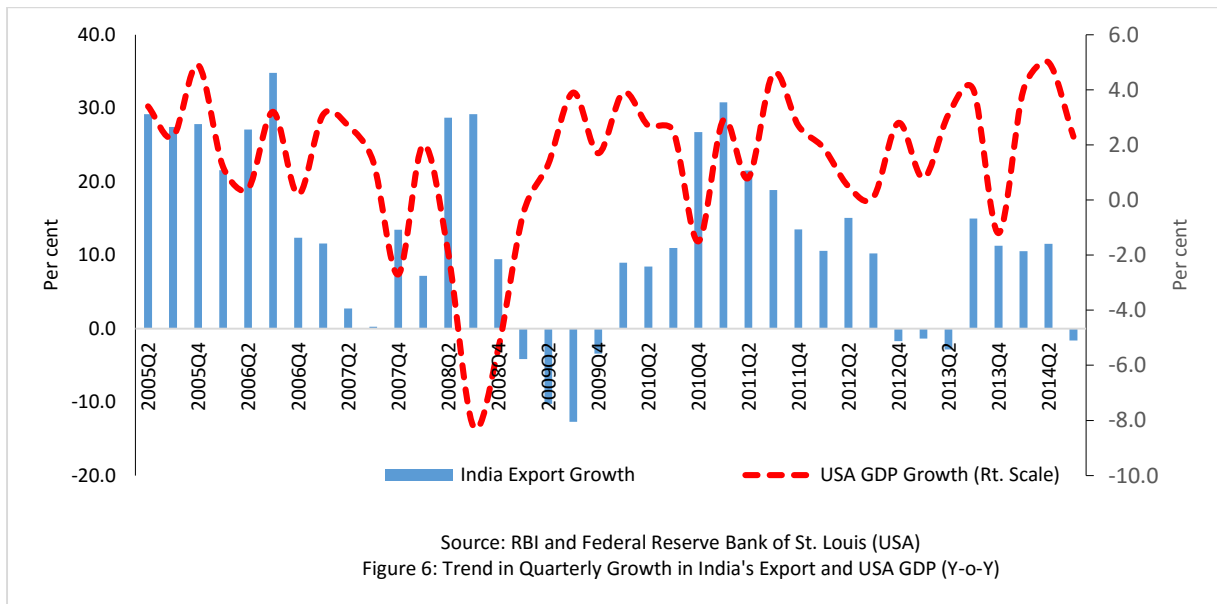
Figure 4: Trend in Quarterly Growth in Export and Import in India (Y-o-Y)

Decline in India's exports was in line with the deepening of recession in the developed countries as India's manufacturing exports are significantly correlated with global economic activity. For most of the period since 1980s, growth in India's manufacturing exports has co-moved with that of global GDP (Figure 5).

<sup>1</sup> Due to sharp decline in international crude oil prices, oil imports declined by 29.0 per cent during November 2008-March 2009.



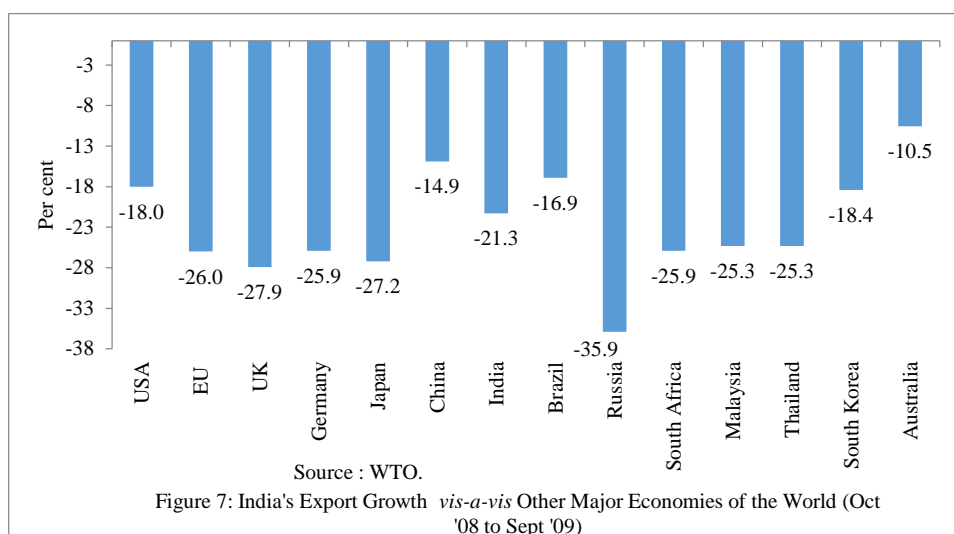
The US economy, which accounts for almost a quarter of global GDP, is one of the major trading partners of the Indian economy. Slowdown in the US economy following the global financial turmoil, *inter alia*, had severely impacted India's exports. Quarterly growth in the US economy and India's export from 2005 to 2014 were, by and large, found to show co-movement (Figure 6).



Global financial turmoil adversely affected the export growth of a number of countries, including India. A comparison of India's export performance with other economies



suggests that reduction in India's exports was relatively lower than that of many of the advanced economies as well as some of the EMEs (Figure 7).



From the foregoing analysis, it can be deduced that while investment activity and external trade declined in the aftermath of economic crisis, domestic consumption expenditure, which alone accounted for about 70 per cent of India's GDP, maintained its momentum and shielded growth from skidding down substantially. Thus, it could be argued that preponderance of domestic consumption, fiscal stimulus programme of the Government and the easy monetary policy pursued by the Reserve Bank provided the necessary cushion to the Indian economy to absorb the adverse effects of global crisis to some extent.

#### IV. Data and Estimation

##### IV.1. Data at a Glance

In the present analysis, quarterly data in respect of eleven advanced nations and nine EMEs (including India) for the period from 2001q1 to 2013q4 was considered. For the sake of consistency of data availability for all the countries, sample was confined till 2013q4. Choice of countries in the present analysis was governed by the criterion of trade flows such that India's major trading partners, both from developed and the developing world economies were considered (**Annex 1**). Data for trade, exports and imports (in value or nominal terms) were sourced from the IMF. Data for exports, imports, and trade were converted to real terms (in terms of volume) by deflating them

by unit value of exports and imports (sourced from UNCTAD - annual data was converted into quarterly data), respectively and then deseasonalised. Data on area of nations [square Kilometers (KMs) converted to million square KMs) were sourced from the World Development Indicators (WDI). GDP data for countries were taken from the OECD database. Seaport distance (distance between major ports of countries) was used as a measure of distance of countries from India. Based on historical legacy, colonial ties could also influence trade flows between countries, hence another dummy, DUMCOL, to control for colonisation effect was introduced. Amongst the countries considered for the present study, UK and Denmark had colonized India, and for them DUMCOL takes the value equal to 1 and is set zero for other countries. Access to seaports also fosters trading ties and hence, to control for the same, dummy for access to seaport for ease of trade from the country was created. Countries with seaport were assigned a value equal to 1, while for other countries with no seaport were assigned a value equal to zero. Amongst the nations considered for study, two countries, viz., Austria and Switzerland, did not have seaports and hence were assigned a value equal to zero. Firms in adjacent countries having a common language or other relevant cultural features are more likely to understand each other's business practices and trade intensively. The Commonwealth of Nations are unified by historical legacy; culture; common language; and respect for democratic norms, human rights and rule of law. Dummy for commonwealth members (Australia, Canada, New Zealand, South Africa, India, and UK) assumes value equal to 1 and is zero for non-members. Commonality of languages also bolsters trade relations between countries, hence dummy for common language was also introduced. Since English was the common language, those countries, which have English as one of the main languages are assigned a value equal to one; for others it is set zero.

To capture the impact of Great Recession, a dummy (DUMGFC) was introduced. DUMGFC assumes a value equal to 1 for the period from 2008q1 to 2009q4; and is zero for rest of the quarters. Upto four quarters lag of crisis dummies were incorporated in the analysis as higher lags were found to be insignificant.

## **IV.2. Scatter Plot**

Before proceeding for estimation, scatter plot analysis was undertaken. On the expected lines, geographical distance and trade flows shared an inverse relationship

as the scatter plot was found to be downward sloping (Figure 8). Furthermore, trade flows, as expected, were found to share positive relationship with area, economic size and the level of development (Figures 9 to 11). For the pre-crisis (prior to the Great Recession) period (2000q1 to 2007q4), scatter plots suggest that India's bilateral trade, export, and import volumes exhibit a clear uptrend suggesting rising trend over time (Figure 12, Figure 15 and Figure 18). During the crisis (Great Recession) phase (2008q1 to 2009q4), India's bilateral export to the designated economies is found to be sloping downward, clearly highlighting the adverse impact of Great Recession (Figure 13). Furthermore, during the Great Recession phase, scatter plots of both bilateral import and total trade flows of the Indian economy were found to have become flatter as compared to relatively steeper slopes for the pre-crisis phase (Figures 16 and 19). This also suggests the adverse impact of Great Recession on India's bilateral import and trade flows. For the post-crisis period (2010q1 to 2013q4), scatter plot of bilateral export, import and trade flows were found to have a relatively flatter slope as against the pre-crisis phase (Figures 14, 17, and 20).

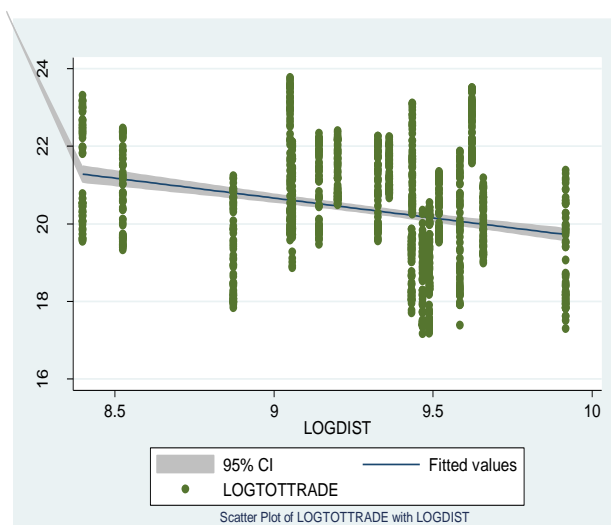


Figure 8. Scatter Plot of Trade and Distance

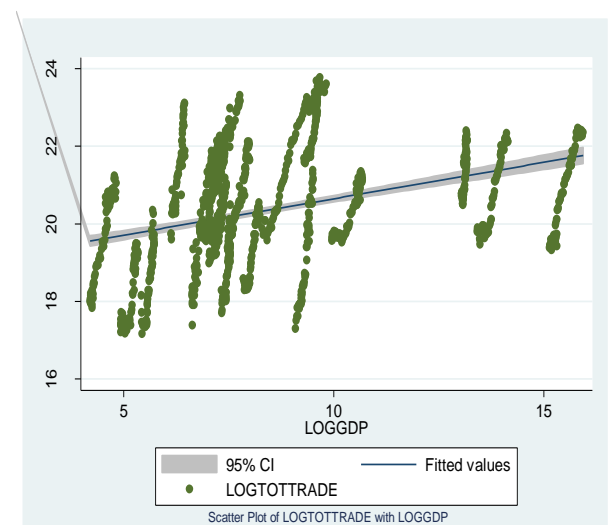


Figure 9. Scatter Plot of Trade and GDP

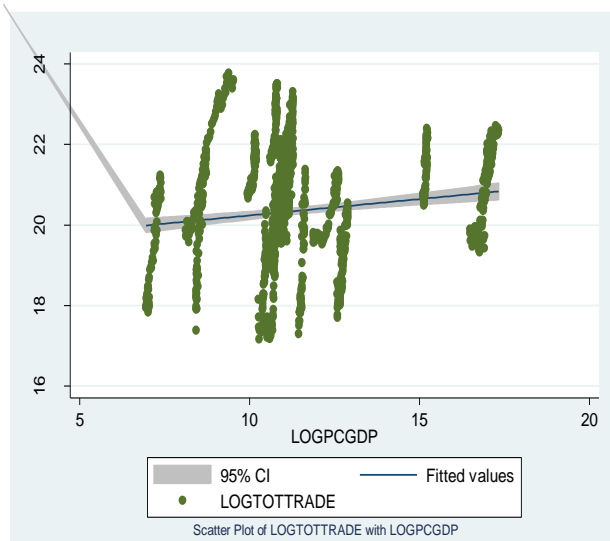


Figure 10. Scatter Plot of Trade and Per Capita Income

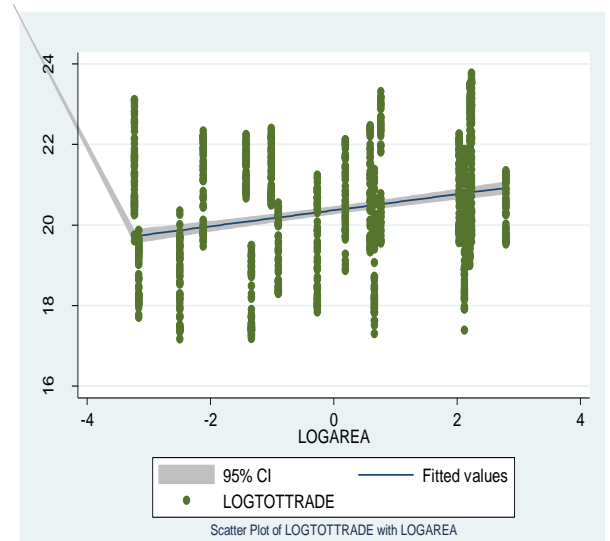


Figure 11. Scatter Plot of Trade and Area

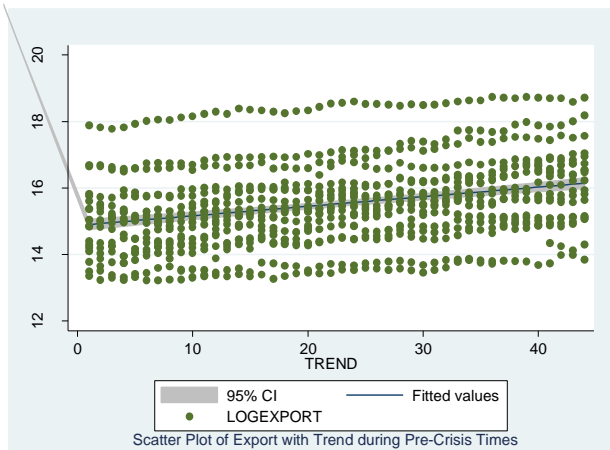


Figure 12. Scatter Plot of Export and Trend for the period prior to the Great Recession

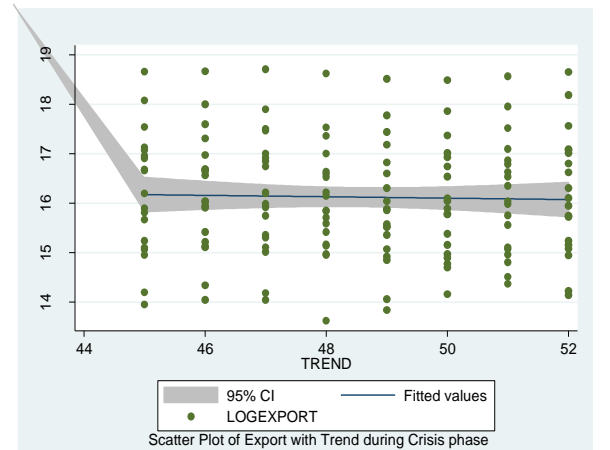


Figure 13. Scatter Plot of Export and Trend during Great Recession

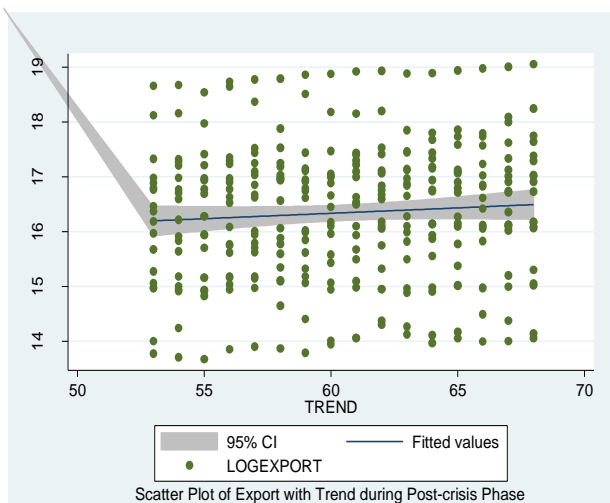


Figure 14. Scatter Plot of Export and Trend during the post Great Recession period.

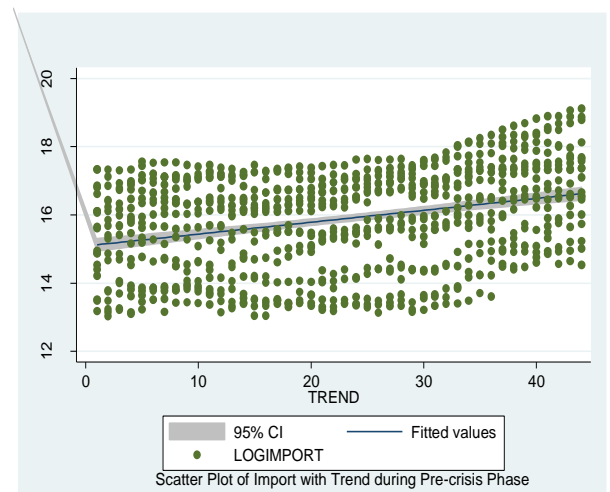


Figure 15. Scatter Plot of Import with Trend for the period prior to the Great Recession.

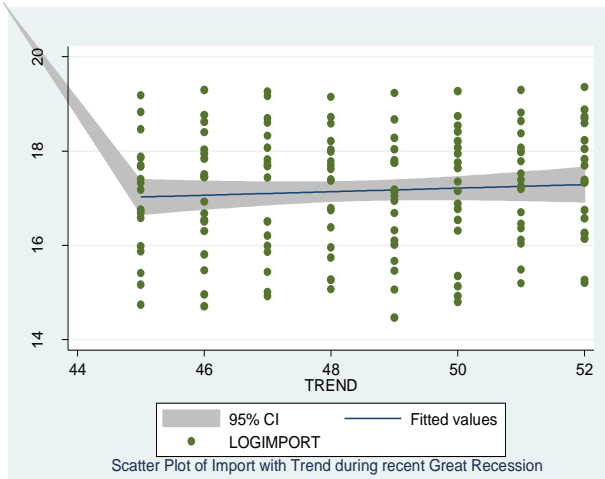


Figure 16. Scatter Plot of Import with Trend during the Great Recession

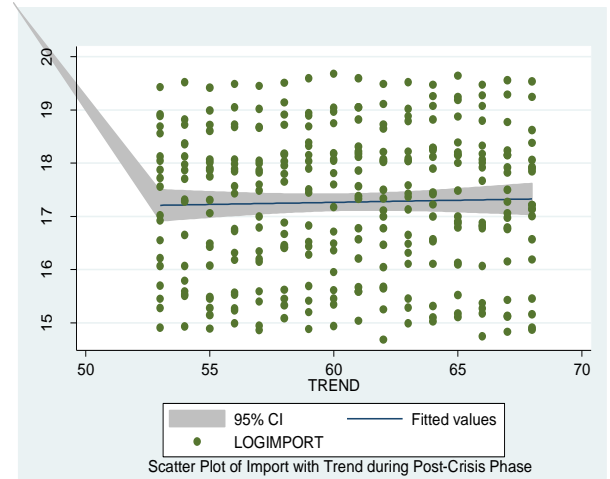


Figure 17. Scatter Plot of Import with Trend during the post Great Recession period.

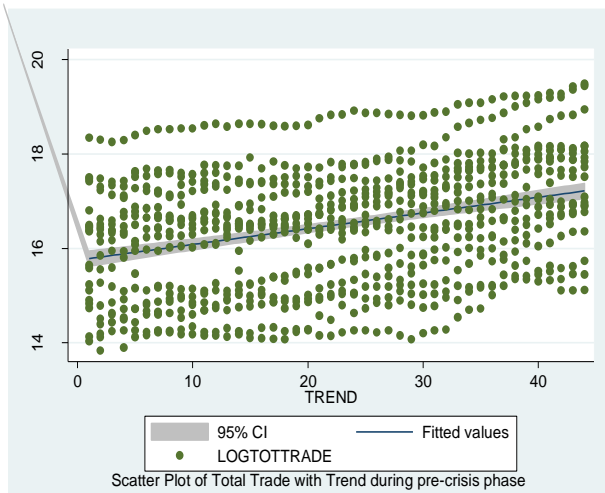


Figure 18. Scatter Plot of Trade with Trend for the period prior to the Great Recession

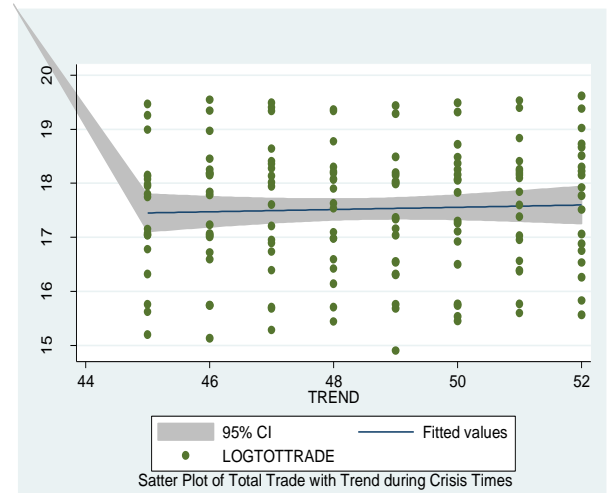


Figure 19. Scatter Plot of Trade with Trend during the Great Recession

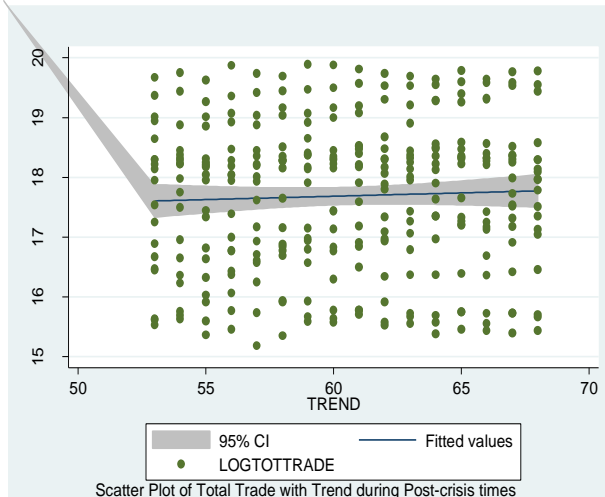


Figure 20. Scatter Plot of Trade with Trend during the post Great Recession period

Correlation analysis was also undertaken separately for bilateral trade, export, and import flows. Area, economic size, and level of development, as expected, were found to be significant and positively correlated with gross trade, exports and imports (Table 1). Distance, as expected, was found to be significant and negatively correlated with trade.

	<b>LOGTRADE</b>	<b>LOGEXPORT</b>	<b>LOGIMPORT</b>
LOGDIST	-0.27***	-0.24***	-0.26***
LOGAREA	0.30***	0.43***	0.24***
LOGGDP <sub>t</sub>	0.39***	0.40***	0.41***
LOGGDPI <sub>t</sub>	0.40***	0.26***	0.43***
LOGPCGDP <sub>t</sub>	0.12***	0.02	0.20***
LOGPCGDPI <sub>t</sub>	0.40***	0.26***	0.44***
DUMSEAPORT	0.11***	0.36***	0.03
DUMCOMWLTH	-0.02	-0.03	0.01
DUMCOL	-0.10***	0.03	-0.13***
DUMLANG	0.13***	0.01	0.17***
DUMGFC <sub>t</sub>	0.12***	0.05	0.15***
DUMGFC <sub>t-1</sub>	0.13***	0.04	0.16***
DUMGFC <sub>t-2</sub>	0.13***	0.04	0.17***
DUMGFC <sub>t-3</sub>	0.13***	0.03	0.16***
DUMGFC <sub>t-4</sub>	0.13***	0.05	0.16***
DUMGFC <sub>t-5</sub>	0.15***	0.07**	0.17***
DUMGFC <sub>t-6</sub>	0.16***	0.08**	0.17***
DUMGFC <sub>t-7</sub>	0.16***	0.09***	0.18***
DUMGFC <sub>t-8</sub>	0.16***	0.10***	0.17***

Note: \*\*\*:  $p < 0.01$ ; \*\*:  $p < 0.05$ ; and \*:  $p < 0.10$ .  
Source: Author's calculations.

### IV.3. Estimation

Summary statistics of the variables is presented in Table 2. Both GDP and per capita GDP in respect of other countries were found to be highly volatile. Since, it is a balanced panel, it is possible to test for unit root test using Levin-Lin-Chu method. All the variables were found to be stationary, *i.e.*  $I(0)$  (Table 3).

Variables	Mean	Std. Dev.	Min.	Max
LOGTOTRADE	17.15	1.32	14.07	19.89
LOGIMPORT	16.62	1.49	13.13	19.68
LOGEXPORT	15.99	1.24	13.27	19.05
LOGGDP	8.56	2.87	4.22	15.93
LOGGDPIN	11.08	0.28	10.63	11.53
LOGPCGDP	11.61	2.48	6.95	17.33
LOGPCGDPI	10.96	0.23	10.60	11.32

Source: Author's calculations.

Variables	Adjusted t statistics	Conclusion
LOGTOTTRADE	-5.18***	I(0)
LOGEXPORT	-3.19***	I(0)
LOGIMPORT	-4.60***	I(0)
LOGGDP	-3.43***	I(0)
LOGGDPI	-2.85***	I(0)
LOGPCGDP	-2.82***	I(0)
LOGPCGDPI	-2.52***	I(0)

Source: Author's calculations.

To find whether the Great Recession had impacted trade flows, to begin with t-test was employed to test whether the trade flows, exports and imports during the pre-crisis phase were significantly different from that of the crisis and post-crisis phases. The t-statistics, for estimating whether population means of two samples are significantly different from each other, is computed as follows:

$$t = \frac{\mu_1 - \mu_2}{\sigma_{\mu_1 - \mu_2}} \quad (i)$$

where,  $\mu_1$  and  $\mu_2$  are respective means of two different samples; and  $\sigma_{\mu_1 - \mu_2}$  is the variability of difference between the two means.

From the computed t-statistics, it may be inferred that trade flows for the Indian economy during the pre-crisis times were significantly different from that of the crisis and post-crisis times, while the trade flows during crisis and post-crisis times were not significantly different from each other (Table 4). This analysis presents preliminary evidence that the Great recession, *inter alia*, had had some impact on India's trade flows.

Table 4: t-test for Comparing Group Means						
	Pre-crisis vs Crisis		Crisis vs Post-crisis		Pre-crisis vs Post-crisis	
	t-Stats	Inference	t-Stats	Inference	t-Stats	Inference
Total Trade	-7.39***	Reject H <sub>0</sub>	-1.35	Fail to reject H <sub>0</sub>	-10.71***	Reject H <sub>0</sub>
Export	-3.48***	Reject H <sub>0</sub>	-1.85	Fail to reject H <sub>0</sub>	-6.79***	Reject H <sub>0</sub>
Import	-9.06***	Reject H <sub>0</sub>	-0.86	Fail to reject H <sub>0</sub>	-11.84***	Reject H <sub>0</sub>
Notes: (1) Null hypothesis (H <sub>0</sub> ) – There is no difference between the two sample means. (2) ***: Significant at 1% level of significance.						

To investigate the impact of Great Recession on trade, gravity model of trade, as introduced by Jan Tinbergen (1962), was estimated. Following an analogy with the Newton's law of gravitation, it contends that the trade flows between two countries are influenced by their respective economic sizes (GDP) and proximity (distance). Basically, a gravity equation relates trade flows between countries to their size, level of development, and other variables capturing incentives and barriers to trade. Since data on trade costs are hard to find, a number of variables are generally employed to capture it, which *inter alia* include bilateral distance and dummies for common border, landlocked country, islands, colonial history, common language, member of regional trade agreements, etc. For easy interpretation of elasticity, variables in the gravity model are generally log-transformed. The gravity model can be represented in a simpler way as follows:

$$\ln \text{Trade}_{i,j,t} = \beta_0 + \beta_1 \ln Z_{1i,t} + \beta_2 \ln Z_{2j,t} + \beta_3 \ln Z_{3i,t} + \beta_4 \ln Z_{4j,t} + \beta_5 \ln Z_{5i,t} + \beta_6 \ln Z_{6j,t} + \beta_7 \ln Z_{7i,t} + \beta_8 \ln Z_{8j,t} + \beta_9 \ln Z_{9ij} + \epsilon_{ij,t} \quad (ii)$$

where, Trade is the total trade flows between countries *i* and *j*;  $Z_{1i}$  and  $Z_{2j}$  represent the respective GDPs of the two countries: *i* and *j*;  $Z_{3i}$  and  $Z_{4j}$  represent the level of development of the two economies as measured by per capita GDP;  $Z_{5i}$  and  $Z_{6j}$  capture geographical sizes of the two economies;  $Z_{7i}$ , and  $Z_{8j}$  represent various dummies to control for trade incentives or barriers such as common language, common border.  $Z_{9ij}$  represents the physical distance between the two countries.

A few studies [Ma and Cheng (2005); Berman (2010); Abiad, *et. al.* (2011)] have employed gravity model to analyse post-crisis trade dynamics. Following Ma and



Cheng, *op. cit.*, the above model was augmented to include the crisis dummy. The augmented model is as follows:

$$\begin{aligned} \ln\text{Trade}_{i,j,t} = & \beta_0 + \beta_1 \ln Z_{1i,t} + \beta_2 \ln Z_{2j,t} + \beta_3 \ln Z_{3i,t} + \beta_4 \ln Z_{4j,t} + \beta_5 \ln Z_{5i,t} \\ & + \beta_6 \ln Z_{6j,t} + \beta_7 \ln Z_{7i,t} + \beta_8 \ln Z_{8j,t} + \beta_9 \ln Z_{9ij} \\ & + \beta_{10} \sum_{k=0}^8 \text{crisis}_{ij,t-k} + \epsilon_{i,j,t} \end{aligned} \quad (iii)$$

Similarly, equations for export [equation (iv)] and import [equation (v)] were formulated as follows:

$$\begin{aligned} \ln\text{Export}_{i,j,t} = & \beta_0 + \beta_1 \ln Z_{1i,t} + \beta_2 \ln Z_{2j,t} + \beta_3 \ln Z_{3i,t} + \beta_4 \ln Z_{4j,t} + \beta_5 \ln Z_{5i,t} \\ & + \beta_6 \ln Z_{6j,t} + \beta_7 \ln Z_{7i,t} + \beta_8 \ln Z_{8j,t} + \beta_9 \ln Z_{ij9} \\ & + \beta_{10} \sum_{k=0}^8 \text{crisis}_{ij,t-k} + \epsilon_{i,j,t} \end{aligned} \quad (iv)$$

$$\begin{aligned} \ln\text{Import}_{i,j,t} = & \beta_0 + \beta_1 \ln Z_{1i,t} + \beta_2 \ln Z_{2j,t} + \beta_3 \ln Z_{3i,t} + \beta_4 \ln Z_{4j,t} + \beta_5 \ln Z_{5i,t} \\ & + \beta_6 \ln Z_{6j,t} + \beta_7 \ln Z_{7i,t} + \beta_8 \ln Z_{8j,t} + \beta_9 \ln Z_{ij9} \\ & + \beta_{10} \sum_{k=0}^8 \text{crisis}_{ij,t-k} + \epsilon_{i,j,t} \end{aligned} \quad (v)$$

Dummy for access to seaport for ease of trade from the country was created. Countries with seaport were assigned a value equal to 1, and the countries with no seaport were assigned a value equal to zero. In the sample, two countries, *viz.*, Austria and Switzerland, not having seaport, were assigned a value equal to zero.

Furthermore, another dummy for a country being a member of Commonwealth of Nations was created. The Commonwealth of Nations are unified by historical legacy; culture; common language; and respect for democratic norms, human rights and rule of law. Firms in adjacent countries having a common language or other relevant cultural features are more likely to understand each other's business practices than the firms operating in a foreign country in a less-similar business environment. Six countries in the sample were members of Commonwealth of Nations, *viz.*, Australia, Canada, New Zealand, South Africa, India, and UK. Dummy for commonwealth members assumes value equal to 1 and is zero for non-members.

Based on historical legacy, colonization could influence trade flows between countries, hence another dummy to control for colonisation effect was also introduced. Out of the countries included in the sample, UK and Denmark had colonized India, therefore, to control for that 'DUMCOL' is introduced, which takes the value equal to 1 for the two countries and is set zero for other countries. Commonality of languages also bolsters trade relations between countries, hence dummy for common language was also introduced. Those countries, which have English as one of the main languages are assigned a value equal to one; for others it is set zero. All the variables, excluding the dummies, were log-transformed.

Dummy for the Great Recession assumes a value equal to 1 for the period from 2008q1 to 2009q4; and is zero for rest of the quarters. As the major impact of the Great Recession for the Indian economy lasted for a year or so, both contemporaneous and upto four quarters lags of crisis dummies were incorporated in the model so as to capture the effect of crisis during its onset and in the following four quarters. This is the variable of our interest.

To begin with, first pooled estimation was undertaken. Pooled estimation was undertaken separately for total trade, exports, and imports (Table 5). Coefficient of distance as an explanatory variable was found to be negative (as anticipated) but insignificant. However, geographical size (area) of nations and per capita GDP of India was found to positive and significant, which was on the expected lines. Contemporaneous dummy for crisis was found to be positive and significant in respect of export, import, and trade equations; while first quarter and second quarter lagged dummy for crisis were found to be positive and significant for trade and import equations, respectively. Positive sign of the coefficients is somewhat puzzling. Three quarter lagged dummy for crisis was found to be negative and significant in respect of the trade, export and import equations, which, in essence, captures the adverse impact of Great Recession on bilateral trade flows<sup>2</sup>. Coefficient estimates suggest that in the third quarter following the crisis, adverse effect of crisis was much higher for bilateral exports followed by total trade and imports.

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<sup>2</sup> For gravity models in log form, the elasticity for a dummy variable can be calculated as: elasticity =  $\exp(\text{coefficient}) - 1$ .

Table 5: Pooled Gravity Estimates (2001q1 to 2013q4)			
	Dependent Variable		
	LOGTRADE	LOGEXPORT	LOGIMPORT
	(1)	(2)	(3)
LOGDIST	-4.854	-1.042	-4.11
LOGAREA	1.429***	1.049***	1.38***
LOGGDP <sub>t</sub>	2.335	3.437***	2.13
LOGGDPIN <sub>t</sub>	-5.614***	-3.925**	-7.06***
LOGPCGDPIN <sub>t</sub>	8.282***	5.298**	10.61***
LOGPCGDP <sub>t</sub>	-0.801	-2.166*	-0.55
DUMSEAPORT	-13.681	-14.187***	-13.66
DUMCOMWLTH	3.156	5.790	3.59
DUMCOL	4.277	2.711	3.79
DUMLANG	-5.843	-8.598**	-5.68
DUMGFC <sub>t</sub>	0.155**	0.091**	0.24***
DUMGFC <sub>t-1</sub>	0.062*	-0.013	0.09**
DUMGFC <sub>t-2</sub>	0.064*	-0.013	0.10**
DUMGFC <sub>t-3</sub>	-0.114**	-0.212***	-0.09*
DUMGFC <sub>t-4</sub>	-0.007	0.061	-0.03
INTERCEPT	39.97	25.042	21.556
No. of Obs.	983	983	983
R <sup>2</sup>	0.95	0.95	0.92

Notes: 1. \*\*\*: p<0.01; \*\*: p<0.05; and \*: p<0.10.  
2. Standard error estimates are robust to disturbances being heteroscedastic and auto-correlated.  
Source: Author's calculations.

Fixed effect estimation was also undertaken. Distinct estimations were undertaken for trade, exports and imports, incorporating country-fixed effect and both country-fixed effect and time effect, separately.

For the trade equation, our variable of interest, three-quarter lagged crisis dummy, was found to be negative and significant suggesting that the Great Recession had an adverse impact on India's bilateral trade for both the equations (Table 6). For the estimation involving only pooled country-fixed effect, it is found that three-quarter lagged crisis event caused a decline in India's bilateral trade. On the contrary, contemporaneous, one-quarter and two-quarter lagged crisis dummy was found to be positive and significant. When apart from country fixed effect, time fixed effect (so as to control for factors affecting the trade flows of all the countries simultaneously) is also considered, third quarter lagged crisis dummy is found to be negative but insignificant, while fourth quarter dummy was found to be positive and significant, which is perplexing.

Table 6: Panel Gravity Estimates for Trade: Fixed Effect (2001q1 to 2013q4)		
	LOGTRADE	
	(1)	(2)
LOGGDP <sub>t</sub>	2.335	2.709
LOGGDPIN <sub>t</sub>	-5.614***	0.870***
LOGPCGDPIN <sub>t</sub>	8.282***	--
LOGPCGDP <sub>t</sub>	-0.801	-1.300
DUMGFC <sub>t</sub>	0.155**	0.202
DUMGFC <sub>t-1</sub>	0.062*	0.049
DUMGFC <sub>t-2</sub>	0.064*	0.097
DUMGFC <sub>t-3</sub>	-0.114**	-0.020
DUMGFC <sub>t-4</sub>	-0.007	0.218*
INTERCEPT	-22.12***	-0.779
<i>Country F.E.</i>	Yes	Yes
<i>Quarter F. E.</i>	No	Yes
<i>No. of Country Pairs</i>	19	19
<i>No. of Obs.</i>	983	983
<i>R<sup>2</sup></i>	0.24	0.28
Notes: 1. ***: p<0.01; **: p<0.05; and *: p<0.10. 2. Standard error estimates are robust to disturbances being heteroscedastic and auto-correlated. Source: Author's calculations.		

In respect of India's bilateral exports as the dependent variable, for both equations when only the country fixed-effect is included and when both country and time fixed effects are considered, three-quarter lagged Great Recession event was found to have a retarding effect on bilateral exports (Table 7).

Table 7: Panel Gravity Estimates for Export: Fixed Effect (2001q1 to 2013q4)		
	LOGEXPORT	
	(1)	(2)
LOGGDP <sub>t</sub>	3.437***	3.635***
LOGGDPIN <sub>t</sub>	-3.925**	0.410*
LOGPCGDPIN <sub>t</sub>	5.298**	--
LOGPCGDP <sub>t</sub>	-2.166*	-2.452*
DUMGFC <sub>t</sub>	0.091*	0.081
DUMGFC <sub>t-1</sub>	-0.013	-0.047
DUMGFC <sub>t-2</sub>	-0.013	0.019
DUMGFC <sub>t-3</sub>	-0.212***	-0.144*
DUMGFC <sub>t-4</sub>	0.061	0.124
INTERCEPT	-2.841	8.73
<i>Country F.E.</i>	Yes	Yes
<i>Quarter F. E.</i>	No	Yes
<i>No. of Country Pairs</i>	19	19
<i>No. of Obs.</i>	983	983
<i>R</i> <sup>2</sup>	0.42	0.45
Notes: 1. ***: p<0.01; **: p<0.05; and *: p<0.10.		
2. Standard error estimates are robust to disturbances being heteroscedastic and auto-correlated.		
Source: Author's calculations.		

For the equation with bilateral imports as the dependent variable, when only country-fixed effect is incorporated, three-quarter lagged crisis event is found to retard India's bilateral imports (Table 8). Contrary to expectations, contemporaneous, first quarter and second quarter lagged crisis dummy were found to be positive and significant. Furthermore, when both country and time fixed effects were considered, third-quarter lagged Great Recession event was not found to be significant; rather contemporaneous, second and fourth quarter lagged crisis event was found to be positive and significant, which is perplexing.

Table 8: Panel Gravity Estimates for Import: Fixed Effect (2001q1 to 2013q4)		
	LOGIMPORT	
	(1)	(2)
LOGGDP <sub>t</sub>	2.129	2.609
LOGGDPI <sub>t</sub>	-7.064***	1.097**
LOGPCGDPI <sub>t</sub>	10.614***	--
LOGPCGDP <sub>t</sub>	-0.554	-1.235
DUMGFC <sub>t</sub>	0.245***	0.290**
DUMGFC <sub>t-1</sub>	0.089**	0.079
DUMGFC <sub>t-2</sub>	0.098**	0.164**
DUMGFC <sub>t-3</sub>	-0.088*	0.022
DUMGFC <sub>t-4</sub>	-0.033	0.287***
INTERCEPT	-33.27***	-3.80
<i>Country F.E.</i>	Yes	Yes
<i>Quarter F. E.</i>	No	Yes
<i>No. of Country Pairs</i>	19	19
<i>No. of Obs.</i>	983	983
<i>R<sup>2</sup></i>	0.23	0.26
Notes:		
1. ***: p<0.01; **: p<0.05; and *: p<0.10.		
2. Standard error estimates are robust to disturbances being heteroscedastic and auto-correlated.		
Source: Author's calculations.		

#### **IV.3.1. Least Square Dummy Variable Corrected Estimator**

The above estimation could suffer from endogeneity problems. GMM estimators are suited for conditions with large number of cross-sections and small number of time periods. Least Squares Dummy Variable Corrected (LSDVC) estimator proposed by Kiviet (1995), Judson and Owen (1999), Bun and Kiviet (2001 and 2003) is considered as a suitable panel data technique in the case of small samples where GMM cannot be applied efficiently. This method is initialised by a dynamic panel estimate and is based on a recursive correction of the bias of the fixed effects estimator. For panels of all sizes, a corrected LSDV estimator generally has the lowest root mean square error (Judson and Owen, 1999). We estimate the model using bias corrected least squares dummy variable (LSDVC) estimation proposed by Kiviet (1995). It controls for both individual effects and the endogeneity of the lagged dependent variable.

Separate estimations were undertaken for total trade, exports, and imports, and for each one of them, distinct estimations were considered by including all the countries (baseline estimation), only the advanced economies, and the EMEs.

In the trade equation, one quarter lagged trade volume was found significant with the expected positive sign in all the three estimations suggesting persistence of trade (Table 9). Per capita GDP of other countries was found to boost trade for baseline estimation (when all the countries in the sample are included) and that with involving trade only with the advanced economies. First and second quarter lagged dummy for crisis were not found to be significant. Third quarter following the onset of Great Recession, dummy for crisis was found to have an adverse impact on trade for all the estimations. On the other hand, fourth quarter lagged dummy for crisis, rather than having an adverse impact, was found to have a favourable impact on trade, which is contrary to expectations.

	(1) Baseline	(2) For AEs	(3) For EMEs
DEPVAR <sub>t-1</sub>	0.92***	0.92***	0.94***
LOGPCGDPIN	0.09	-0.002	0.22
LOGPCGDP	0.13*	0.55**	-0.05
DUMGFC	0.07**	0.10***	0.04
DUMGFC <sub>t-1</sub>	0.02	-0.001	0.04
DUMGFC <sub>t-2</sub>	0.03	0.03	0.04
DUMGFC <sub>t-3</sub>	-0.18***	-0.17***	-0.20**
DUMGFC <sub>t-4</sub>	0.13***	0.13***	0.15**
No. of Country Pairs	19	11	8
Note: ***: p<0.01; **: p<0.05; and *: p<0.10. DEPVAR – Dependent Variable; AEs: Advanced Economies; EMEs: Emerging Market Economies. Source: Author's calculations.			

In the bilateral import estimation, one quarter lagged import volume was found significant with expected positive sign in all the three estimations suggesting persistence of imports (Table 10). As in second estimation, per capita GDP of only the advanced countries was found to boost India's bilateral import volume. Per capita GDP of Indian economy was not found significant. Contemporaneous dummy for crisis (in case of baseline estimation and that in respect of advanced economies) was found to be significant and have favorable influence on import, which is contrary to expectations. Similarly, fourth quarter lagged dummy for crisis, rather than having an adverse impact, was found to have a favourable impact on bilateral imports, which is contrary to expectations. Third quarter following the onset of Great Recession, dummy

for crisis was found to have an adverse impact on trade for all the estimations, which was on the expected lines.

Table 10: Least Square Dummy Variable Corrected Estimator (2001q1 to 2013q4) (DEPENDENT VARIABLE – LOGIMPORT)			
	(1) Baseline	(2) For AEs	(3) For EMEs
DEPVAR <sub>t-1</sub>	0.923***	0.86***	0.93***
LOGPCGDPIN	0.094	0.12	0.28
LOGPCGDP	0.163	0.61**	-0.07
DUMGFC	0.083**	0.13***	0.05
DUMGFC <sub>t-1</sub>	0.025	0.00	0.07
DUMGFC <sub>t-2</sub>	0.033	0.04	0.02
DUMGFC <sub>t-3</sub>	-0.210***	-0.21***	-0.20*
DUMGFC <sub>t-4</sub>	0.170***	0.17***	0.19**
No. of Country Pairs	19	11	8
Note: ***: p<0.01; **: p<0.05; and *: p<0.10. DEPVAR – Dependent Variable. Source: Author's calculations.			

In the export equation, one quarter lagged export volume was found significant with expected positive sign in all the three estimations suggesting persistence of exports (Table 11). As in second estimation, per capita GDP of only the advanced countries was found to boost India's bilateral export volume. Per capita GDP of Indian economy was found to prop up export in the case of baseline estimation as also the estimation involving India's bilateral exports to the EMEs. Crisis dummy (neither contemporaneous nor lagged) was found to have any significant influence on India's bilateral export volume. This contrary to expectations.



Table 11: Least Square Dummy Variable Corrected Estimator (2001q1 to 2013q4) (DEPENDENT VARIABLE - LOGEXPORT)			
	(1) Baseline	(2) For AEs	(3) For EMEs
DEPVAR <sub>t-1</sub>	0.856***	0.79***	0.87***
LOGPCGDPIN	0.156**	0.04	0.37**
LOGPCGDP	0.128	0.78***	-0.11
DUMGFC	-0.007	0.02	-0.02
DUMGFC <sub>t-1</sub>	0.031	0.04	0.02
DUMGFC <sub>t-2</sub>	-0.016	-0.05	0.03
DUMGFC <sub>t-3</sub>	-0.045	0.01	-0.13
DUMGFC <sub>t-4</sub>	0.030	-0.002	0.06
No. of Country Pairs	19	11	8
Note: ***: p<0.01; **: p<0.05; and *: p<0.10. DEPVAR – Dependent Variable. Source: Author's calculations.			

## V. Concluding Observations

In the present analysis, gravity model of trade was estimated (pooled, fixed effect, and LSDVC) to explain the determinants of India's trade, exports and imports in the wake of Great Recession. First pooled estimation was undertaken separately for total trade, exports, and imports. Pooled estimation suggests that the adverse impact of Great Recession on India's trade flows was visible in third quarter following the onset of crisis. Further, fixed effect estimations were undertaken using: only country-fixed effect and both country fixed effect and time effect. Fixed effect estimation also suggested that India's trade flows, exports and imports were adversely impacted in the third and fourth quarter following the onset of Great Recession. As a robustness check exercise, as also for overcoming endogeneity issues, LSDVC estimation was undertaken. Estimations suggest that Great Recession had an adverse impact on India's bilateral trade volumes and import volumes. The adverse impact of crisis was visible only after the third quarter following the onset of Great Recession.

From the foregoing analysis, it is found that the Great Recession did have an adverse impact on India's bilateral trade, which, in turn, had caused slowdown in economic growth. The findings validate that trade channel acted as a conduit for transmission of Great Recession impulses to the Indian economy. Nevertheless, its sound macro-economic fundamentals and institution of counter-cyclical fiscal and monetary policies

shielded the economy from the worst onslaught of the Great Recession. *Ipsa facto*, decline in India's bilateral trade volumes were relatively lesser than that of many advanced economies and the EMEs.

From the foregoing analysis, it becomes evident that as the Indian economy becomes progressively more integrated with the global economy, it is inevitable that the cross-border crisis impulses would afflict the economy, *inter alia* through trade channel. Hence, so as to provide adequate cushions/ safety-nets to the economy for absorbing adverse external shocks and thereby stabilise it, it important that domestic-oriented demand management policies are also pursued. This could be achieved by re-orienting production processes to cater to domestic demand as foreign demand-based production processes might not necessarily be welfare enhancing at times when external demand conditions turn adverse and fragile.

One of the limitations of the present analysis is that it examines the transmission of Great Recession impulses to the Indian economy only from the perspective of trade channel. While this has been deliberate, this is not to undermine the role played by other channels in the transmission of crisis impulses to the Indian economy. Since the ratio of trade openness to financial openness for the Indian economy works out to be less than unity, the scope for transmission of Great Recession impulses to the economy through finance channel was relatively more than that of trade channel. The dominance of finance channel in transmission of crisis impulses to the Indian economy was also highlighted by RBI (2010). Deliberate choice of trade channel for investigating the impact of Great Recession was, *inter alia*, guided by the consideration of making it more focused study as also bridging the gap in literature. Investigation of the impact of Great Recession on the Indian economy through other channels is left as an exercise for future studies.

## References

- Abiad, A.; Topalova, P.; Mishra, P. (2011). *How Does Trade Evolve in the Aftermath of Financial Crises?*, International Monetary Fund Working Papers 11/3, IMF: Washington.
- Akin C. (2006). 'Multiple Determinants of Business Cycle Synchronization', February 10, 2006. Available [Online] <http://economics.ca/2006/papers/0310.pdf>
- Arellano, M; and Bond, S. (1991), 'Some Tests of Specification for Panel Data: Monte Carlo Evidence and an application to employment equations', *Review of Economic Studies*, 1991, 58, 277-297.
- Berman, N., Philippe M. (2010). The Vulnerability of Sub-Saharan Africa to the Financial Crisis: The Case of Trade," CEPR Discussion Paper No. 7765, Centre for Economic Policy Research: London.
- Bun M.J.G., Kiviet J.F. (2001). The Accuracy of Inference in Small Samples of Dynamic Panel Data Models. Tinbergen Institute Discussion Paper TI 2001-006/4.
- Bun M.J.G., Kiviet J.F. (2003). On the Diminishing Returns of Higher Order Terms in Asymptotic Expansions of Bias. *Economics Letters*, 79, 145-152.
- Eichengreen, B.; Rose, A. (1999). Contagious currency crises: Channels of Conveyance." in Takatoshi Ito and Anne Krueger, eds. *Changes in Exchange Rates in Rapidly Developing Countries: Theory, Practice, and Policy Issues*. Chicago: University of Chicago Press, 29-50.
- Federal Reserve Bank of St. Louis (USA) Database. Available [Online] <https://fred.stlouisfed.org>
- Fidrmuc, J.; and Korhonen. I. (2010). 'The Impact of Global Financial Crisis on Business Cycles in Emerging Economics, *Journal of Asian Economics*, 21, 293–303.
- Gujarati, D. N.; Porter, D. C.; Gunasekar, S. (2012). *Basic Econometrics*, 5<sup>th</sup> Ed., Tata McGraw Hill Education Private Limited: New Delhi.
- Harrigan, J. (2000). *The impact of the Asia Crisis on US Industry: An Almost Free Lunch?*, Federal Reserve Bank of New York Economic Policy Review 6(3): 71-79.
- International Monetary Fund. Direction of Trade Statistics, IMF Website. Available [Online] <http://www.elibrary-data.imf.org/>
- Judson R.A., Owen, A.L. (1999). Estimating Dynamic Panel Data Models: A Guide for Macroeconomists. *Economics Letters*, **65**, 9-15.
- Kiviet J.F. (1995). On Bias, Inconsistency and Efficiency of Various Estimators in Dynamic Panel Data Models. *Journal of Econometrics*, **68**, 53-78.
- Ma, Z.; and Cheng, L.K. (2005). *The Effects of Financial Crises on International Trade*, NBER Working Paper No. 10172, National Bureau of Economic Research: Cambridge, Massachusetts.

- Mason, P. (1998). *Contagion: Monsoonal Effects, Spillovers, and Jumps Between Multiple Equilibria*, International Monetary Fund Working Paper No. WP/98/142, IMF: Washington.
- Mohanty, D. (2010). 'Global Financial Crisis and the Indian Economy', RBI Bulletin, November, Reserve Bank of India: Mumbai, 2010.
- Rajesh, Raj (2016). 'Business Cycles in India: Anatomy and Dynamics', Ph.D. Thesis, IIT Patna.
- Reserve Bank of India (2010). *Report on Currency and Finance, 2008-09*; Reserve Bank of India: Mumbai.
- Tinbergen, J. (1962). *Shaping the World Economy; Suggestions for an International Economic Policy. Books (Jan Tinbergen)*. Twentieth Century Fund, New York. Available [Online] <https://repub.eur.nl/pub/16826>
- UNCTAD Handbook of Statistics 2015, UN, Geneva.

## Annex 1: List of Countries included in the Estimation

S. No.	Country	Symbol	Advanced or EME
1.	Austria	ASTR	Advanced
2.	Australia	AUS	Advanced
3.	Brazil	BR	EME
4.	Canada	CAN	Advanced
5.	China	CHN	EME
6.	Denmark	DEN	Advanced
7.	Indonesia	IND	EME
8.	Japan	JP	Advanced
9.	Korea	KOR	Advanced
10.	Mexico	MEX	EME
11.	New Zealand	NW	Advanced
12.	Russia	RUS	EME
13.	Saudi Arabia	SARB	EME
14.	South Africa	SA	EME
15.	Sweden	SWDN	Advanced
16.	Switzerland	SWI	Advanced
17.	Turkey	TUR	EME
18.	United Kingdom	UK	Advanced
19.	United States of America	USA	Advanced
20.	India	IN	EME