Business Cycle Synchronization for India: An Appraisal via Trade Intensity

Sumanpreet Kaur[1]

Abstract
Keeping in mind, India's faster growth and trade integration in the world economy, this study attempts to examine the effects of bilateral trade between India and its 16 major trading partners from the developed and developing world, on business cycle co-movements through the channel of trade integration over the period 1980 to 2016. Detrended Real GDP has been used as business cycle indicator for all countries and the bilateral correlations are calculated to ascertain the association. The ABT measure of business cycle divergence is also computed to confirm the results. Two variants of trade intensity measure are constructed for studying the effects of bilateral trade on business cycle synchronization. The empirical evidence suggests that Indian business cycles exhibits significant co-movement with all the countries taken in the sample except for Iraq, as reflected by trend line parameters of rolling correlation coefficients. However, the trade linkage turned out to be significant with Australia, Iran, Japan, Great Britain, Saudi Arabia, Switzerland, Singapore, United Arab Emirates and United States of America for the time period under consideration. The slope coefficients of trade integration further reveal that trade between India and Australia, China, Iran, Saudi Arabia, Singapore and United States of America is of intra-industry type while that with Japan, Switzerland, Great Britain and United Arab Emirates, is of inter-industry type. Thus, in case of industry specific shocks, there will be business cycle synchronization in the intra-industry trading group but no synchronization in the inter-industry trading group. Hence, the relation between business cycle synchronization and trade integration for India, is found to be significant with Australia, China, Iran, Saudi Arabia, Singapore and United States of America out of the total sample taken.

Keywords: Business Cycles, Synchronization, Bilateral Trade, Trade Integration, Trade Intensity.

JEL Codes: E32, F41

1. Introduction

Globalization around the world is supposed to enhance the degree of economic integration across all the countries of the world. It is a well-stated fact that business cycles are a common phenomenon in all the economies worldwide and along with a greater degree of globalization and integration, this phenomenon tends to transmit from one economy to another. As has been aptly said in the literature that trade has been the engine of globalization and growth, but it is worth mentioning here that trade also plays a significant role in transmitting the macro-economic effects around

[1] Ph.D. Research Fellow (NET/UGC), Department of Economics, Panjab University, Sector-14, Chandigarh-160014, India. e-mail: preet.suman912@gmail.com. Ph: +91-8198869997.

the globe. The ever-increasing economic integration of the world economies also facilitates the spread of macro-economic fluctuations across borders. Imbs (2003) has rightly quoted that trade in goods and financial assets affect the cross-country synchronization of business cycles. Therefore, the impact of important trading associates is very much essential to comprehend the business cycle fluctuations of the Indian economy. Keeping in mind the opening up of Indian economy, in the context of structural adjustment programme introduced in the wake of economic reforms in 1991, its mandatory to recognize the business cycles of its trading partners and to check if such anomalies, if any, are getting transmitted to the Indian economy through the channel of trade integration, financial integration, specialization or similarity in structures etc. Moreover, the association of Indian economy with World trade organization (WTO) since its inception further commits the economy to ensure and promote free trade with other member countries, thereby inducing trade integration with the global world. The presence of strong trade ties makes the proposition plausible that countries with stronger and closer trade links tend to be more closely linked in macro-economic performance and consequently, to have highly correlated business cycles. However, the role of trade integration in synchronizing the business cycles is quite ambivalent. The theoretical literature suggests that the effect of trade linkages on business cycle correlations can go either way that is trade may cause synchronization or it may lead to output divergences, depending upon the driving force behind the business cycles (Calderon et al. 2002). For instance, if one goes by the Ricardian or Heckscher-Ohlin theory of trade, then international trade between two countries will lead to a greater degree of specialization, meaning thereby that the trading nations are specializing in respective industries of their comparative advantage. And if the business cycles are occurring due to industry-specific shocks, then, in that case, greater trade linkages will cause lesser output correlations and thus no synchronization between the paired countries. But if the countries are engaging in intra-industry trade (horizontal or vertical specialization) that means trading within the same industry, then larger quantum of trade in differentiated industrial products may lead to higher output correlations and therefore, business cycle synchronizations as well, even in case of industry-specific shocks.

The role of international trade in transmitting the business cycle fluctuations across the countries has been widely documented and investigated (Calderon et al. 2002, 2007; Frankel and Rose, 1997, 1998; Imbs, 2003; Shin and Wang, 2003; Kwan and Kun, 2009). Accordingly, trade linkages have important implications for the formation of optimum currency areas as well. The potency of such a proposal lies in the fact that the trading economies are more likely to benefit from the formation of a currency union if they have higher trade integration and more harmonized business cycles (Frankel and Rose, 1998). It can be seen from the available literature that for industrial economies, the stronger trade linkages pave way for highly correlated business cycles (Clark and Wincoop, 2001; Rose and Engel, 2001). However, the linkages are seen in developing nations as well, though of a weaker magnitude (Calderon et al., 2007).

The present paper aims at analyzing the Indian business cycles for 16 of its major trading partners (namely, Australia, China, Hong Kong, Germany, Great Britain, Indonesia, Iran, Iraq, Japan, Malaysia, Nigeria, Saudi Arabia, Singapore, Switzerland, United Arab Emirates and Unites States of America) to look for significant co-movements, if any. It further identifies the role of bilateral trade in the transmission of such fluctuations across countries. Therefore, the channel of trade integration is considered for checking the propagation and spread of business cycles from the trading partner nations to India. However, there are various channels besides trade integration like financial integration, fiscal co-ordination, monetary policy dependence, similarities in industrial/production structure etc., which can be examined for substantiating the extent of business cycle synchronization across the nations. But for the present study, the channel of trade integration has been taken up keeping in mind the trade association of the Indian economy with other countries of the world. The other channels like financial integration, similarities in production structure, fiscal co-ordination, monetary dependence etc. started showing significant trends only after the structural transformation of the Indian economy, that is after the economic reforms of 1991. Therefore, trade integration has been chosen for carrying out the proposed analysis for the present study.

All in all, an increasing trend in trade intensity signals towards the integration of Indian economy with the global world which is making India vulnerable to fluctuations originating in other countries and thus, necessitates the study to be undertaken under the present framework.

The rest of the paper is organized into successive sections. Section-2 offers some theoretical insights and empirical evidences on effects of economic ties on business cycle co-movements across different nations. Section-3 discusses the data and outlines the econometric methodology used for the empirical evaluation of this paper. Section-4 reports and discusses the empirical findings for India and Section-5 concludes the paper and suggests areas for further research and relevant extensions.

2. Literature Review

Few empirical studies which have analyzed the synchronization and correlation amongst trading nations through the channels like inter-industry trade, intra-industry trade, financial integration, specialization, similarity of structures etc. are summed up below for gaining insights of the empirical work done on the theme of this study:

Frankel and Rose (1997) studied the suitability of a country's membership to European Monetary Union on the basis of trade intensity and Frankel and Rose (1998) investigated the entry of a country into a currency area on the basis of trade linkages by using a general equilibrium model of international trade for twenty-one countries over the period of thirty years and concluded that counties with closer trade links tend to have more tightly correlated business cycles. Clark and Wincoop (1999) examined and compared the extent of business cycle synchronization amongst fourteen European countries and nine U.S. regions with dataset on employment and GDP from 1961 to 1997. The study concluded that business cycle correlations are significantly higher U.S. regions than the European nations. Imbs (2003) estimated a system of simultaneous equations for examining for examining the determinants of business cycle synchronization for eighteen countries over time period from 1983 to 1998. The results indicated that nations with similar specialization patterns and financial integration have more synchronized business cycles. Calderon et al. (2002) enquired if trade linkages foster cyclical correlations in developing countries by collecting annual data for 147 countries from 1960-1999. The results were computed by carrying out correlation and regression analysis and robustness was also checked by different measures of bilateral trade and business cycles. The finding revealed that bilateral trade intensity yielded larger cyclical correlation while anomalies in industrial structure show smaller business cycle correlations. Shin and Wang (2003) studied the relationship between trade integration and business cycles for twelve east Asian economies for 1976 to 1997 by analyzing data on real GDP and trade volume. The findings disclosed that the business cycles become correlated through intra-industry trade channel. Harding and Pagan (2006) have defined the concept of synchronization and proposed the tests of heteroscedasticity and serial correlation as the methods for measuring the degree of synchronization and to conclude whether the cycles are unsynchronized or perfectly synchronized. Calderon (2007) enquired if higher trade between Latin American economies and India and China is causing larger output correlations among them by taking a sample of 147 countries for the time period 1965 to 2004. Jayaram *et al*. (2009) analyzed the business cycle synchronization between India and a set of industrial economies in general and U.S. in particular, for the period 1992 to 2008 by employing Harding-Pagan's concordance index and the results suggested that the linkages of Indian business cycle are stronger when measured against a group of industrial nations as opposed to only against U.S. Kwan and Kun (2009) examined business cycle synchronization for China and 10 of its trading partners using annual data for the time period 1971-2007 by computing bilateral output correlations and root mean squared errors. Further, the factors affecting cyclical co-movements were also analyzed in a regression framework and the results suggested that synchronization increased after China's membership of WTO. Trade intensity was found to be negatively related while similarity in industrial structures came out to be positively related with business cycle synchronizations. Plakidis (2010) and Walti (2010) tested the decoupling hypothesis for the emerging markets against the advanced economies. Plakidis (2010) assessed business cycle interdependence between emerging and advanced economies by using annual data on nominal GDP from 1980-2007 and concluded that decoupling hypothesis is rejected for all countries except for USA. Walti (2010) conducted the analysis with the premise of presence of structural break in the degree of business cycle interdependence between the proposed group. The study conducted with annual data from 1980 to 2008 for 30 emerging markets economies and four aggregate groups of advanced economies. Business cycle interdependence and structural break was measured using Euclidean distance and pooled regression analysis. Both the approaches reflected that there has been no decoupling in the recent years, rather, the degree of business cycle interdependence have increased. Afonso and Sequeria (2010) have examined business cycle synchronization for the period 1970-2009 by analyzing output data and demand components for 29 European Union countries by computing synchronization measures for private consumption, government spending, gross fixed capital formation, exports and imports and conducting correlation and regression analysis. The findings revealed that the synchronization has increased over the period of time along with the introduction of a single currency unit. Dees and Zorell (2011) investigated whether economic integration lead to business cycle synchronization amongst countries sing annual data from 1993 to 2007. A system of equations was estimated with output correlation as dependent variable and trade and financial linkages along with similarity in industrial structures as explanatory variables. The results suggested the presence of business cycle synchronization due to economic linkages between the countries.

3. Data and Methods

The present analysis makes use of secondary data with annual frequency from 1980 to 2016, for examining the presence of business cycle synchronization and further, analysing the transmission of cyclical fluctuations from rest of the world into the Indian economy through the channel of trade. Initially, India's top 20 trading partners namely, Australia, Belgium, China, Hong Kong, Germany, Great Britain, Indonesia, Iran, Iraq, Japan, North Korea, Kuwait, Malaysia, Nigeria, Qatar, Saudi Arabia, Singapore, Switzerland, United Arab Emirates and Unites States of America, were chosen to be included for the proposed analysis. But the unavailability of data for North Korea and insufficient observations for Belgium, Kuwait, and Qatar led to the deletion of these four countries from the list and eventually the analysis was undertaken with rest of the 16 countries with balanced data. The data on aggregate economic activity and trade variables is required for India and its trading partners. The data for *real and nominal GDP* is sourced from the *World Bank's World Development Indicators* and the bilateral trade data pertaining to *value of exports (Free on Board) and value of imports (Cost, Insurance and Freight)* for India and the paired nations have been taken from the *International Monetary Fund's Direction of Trade dataset (IMF-DOTS)*. All the series are log transformed and expressed in US Dollars and real GDP is at the base year 2010.

3.1 Bilateral Correlations of detrended real GDP

The core of this study lies in the measurement of bilateral correlations of business cycles and bilateral trade linkages between India and the paired countries. Once the business cycles are estimated, the next step is to measure business cycle synchronization. Since the cyclical components of real GDP are taken as business cycles, therefore, the bilateral correlations of detrended real GDP can be used for examining the degree of business cycle synchronization. Correlation analysis measures the degree of association between two variables and the direction of their relationship. The correlation coefficient is computed as:

$$corr(y_i^c, y_p^c) = \frac{\text{cov}((y_i^c, y_p^c)}{\sqrt{\text{var}(y_i^c)\,\text{var}(y_p^c)}} \quad (1)$$

Where, y_i^c is the business cycle of India and y_p^c is the business cycle of the partner country.

The essence of business cycle co-movements is captured with the help of correlation analysis. It tells the degree of association between the cyclical GDPs of India and its trading partners. The correlation coefficients are calculated over a series of rolling windows so as to obtain a continuous series of bilateral correlations over the period of time, thereby, allowing business cycles synchronization assessment by its own and in the text of trade intensity as well. In this study, a rolling window of 5 years is taken which is justified by the average length of business cycles which is considered as 5 years. The inferences regarding business cycle co-movements can be drawn from the behavior of the correlation coefficient over the period of time. To be more accurate, the trend line parameters of the rolling correlation coefficients have been analyzed in this study to conclude the presence of business cycle synchronization.

Table-1 gives the summary of average business cycle correlation of India with the paired nations for two sub-periods; 1980-1995 and 1996-2016, and the full-time period, 1960-2016, in order to mark a difference and to account for the WTO membership of Indian economy. It can be seen from the difference correlations of the two sub-periods that the cyclical correlations of India have increased after the inception of WTO in 1995 for the majority of nations except for China, Hong Kong, Malaysia, Saudi Arabia, Nigeria, and Singapore. The highest correlation for the full period is exhibited between India and Saudi Arabia with an average coefficient of -0.509199, followed by Singapore (0.444105), Iraq (0.387872), Hong Kong (0.335751), Australia (0.325247) and China (0.302919). All the partner countries considered for correlation have been the members of WTO since 1995 except for UAE which joined in 1996, China in 2001, Iran and Saudi Arabia became members in 2005 and Iraq applied for the membership in 2004 but has still not attained the member status.

Table 1 Business Cycle Correlation of India with its Trade Partners

Paired Nation	1980-2016	1980-1994(1)	1995-2016(2)	(2-1)
ARECY	0.053158	0.127641	-0.004826	-0.132467
AUSCY	0.325247	0.015888	0.585448	0.56956
CHECY	-0.3698	-0.521739	0.433203	0.954942
CHNCY	0.302919	0.674378	-0.133455	-0.807833
DEUCY	0.022728	0.124251	-0.097367	-0.221618
GBRCY	0.187968	-0.182726	0.689119	0.871845
HKGCY	0.335751	0.521818	-0.005812	-0.52763
IDNCY	0.123051	0.232991	-0.282733	-0.515724
IRNCY	-0.105152	0.258696	-0.384551	-0.643247
IRQCY	0.387872	0.229864	0.584507	0.354643
JPNCY	0.201458	0.128896	0.322477	0.193581
MYSCY	0.157153	0.307551	-0.113465	-0.421016
NGACY	0.211511	0.345763	0.02822	-0.317543
SAUCY	-0.509199	-0.559361	-0.49334	0.066021
SGPCY	0.444105	0.633505	0.112208	-0.521297
USACY	0.209853	0.019017	0.479066	0.460049

Source: Author's Calculations

The general trend in the level of business cycle synchronization can also be evaluated from the results of trend line parameters of rolling correlation coefficients. As outlined in the previous section, the business cycle synchronization is measured by estimating pure rolling correlation coefficients with 5year window size and the parameters of linear trend line equations of the pure rolling correlation coefficients for the full-time period are reported in Table-2. The time trend is significant for all the trading countries except for Iraq. That means 15 out of 16 countries are showing strong business cycle correlation. However, the trend is upward (positive) for China, Germany, Hong Kong, Iran, Nigeria and Singapore and downward (negative) for UAE, Australia, Switzerland, Great Britain, Indonesia, Iraq, Japan, Malaysia, Saudi Arabia, and the USA. The *F*-statistic is also significant throughout, reflecting the fact that a significant trend exists for business cycle pure rolling correlation coefficients for all the paired trading partners (except, Iraq).

Table 2 Trend-Line Parameters of Pure Rolling Correlation Coefficients

Paired Nation	Constant		Time Variable		Model Fit		
	Coefficient	Sig.	Coefficient	Sig.	R^2	F-Stat.	Sig.
ARE	0.3796***	0.0016	-0.0183***	0.0028	0.2500	10.510***	0.0028
AUS	0.5775***	0.0015	-0.0229**	0.0113	0.1895	7.2489**	0.0113
CHE	0.5303***	0.0000	-0.0311***	0.0000	0.5069	31.8633***	0.0000
CHN	-0.3185***	0.0000	0.0369***	0.0000	0.8447	168.64***	0.0000
DEU	-0.1236	0.1103	0.01097***	0.0079	0.1811	8.0781***	0.0079
GBR	0.5829***	0.0000	-0.0216***	0.0000	0.5871	44.0843***	0.0000
HKG	-0.1313**	0.011	0.0208***	0.0000	0.6890	68.6874***	0.0000
IDN	0.1080***	0.0006	-0.0035**	0.0215	0.1319	5.8639**	0.0215
IRN	-0.4749***	0.0001	0.0317***	0.0000	0.5058	31.7282***	0.0000
IRQ	0.2172*	0.0814	-0.0091	0.1516	0.0652	2.1615	0.1516
JPN	0.3687***	0.0001	-0.0117***	0.0081	0.1794	7.9938***	0.0082
MYS	0.3287***	0.0001	-0.0086**	0.0302	0.1428	5.1632**	0.0302
NGA	-0.1513***	0.0054	0.0168***	0.0000	0.5740	41.7620***	0.0000
SAU	-0.2610***	0.0000	-0.0039***	0.0072	0.2110	8.2886***	0.0072
SGP	0.3232***	0.0000	0.0082***	0.0030	0.2505	10.3605***	0.0030
USA	0.4963***	0.0082	-0.0106*	0.0553	0.1135	3.9670*	0.0553

Note: Coefficients marked with *, **, and ***, are statistically significant at 10 per cent, 5 per cent, and 1 per cent respectively.
Source: Author's Calculations

Alesina, et al. (2002) have created another measure of Business Cycle Divergence that is Root Mean Squared Error. For doing so, the RMSE is calculated for India and the paired country. In the first place, the relative real GDP is calculated for India and the paired nation as $\frac{y_{i,t}}{y_{p,t}}$, where $y_{i,t}$ is India's real GDP at a time "*t*" and $y_{p,t}$ is partner country's real GDP at a time "*t*". With reference to Alesina *et al.* (2002), the second order autoregression is estimated as:

$$\frac{y_{i,t}}{y_{p,t}} = \alpha + \beta \frac{y_{i,t-1}}{y_{p,t-1}} + \gamma \frac{y_{i,t-2}}{y_{p,t-2}} + \varepsilon_{ip,t} \quad (2)$$

Where, $\frac{y_{i,t}}{y_{p,t}}$, $\frac{y_{i,t-1}}{y_{p,t-1}}$ and $\frac{y_{i,t-2}}{y_{p,t-2}}$ are bilateral relative real GDP of India and partner country "*p*" at period "*t*", "*t-1*" and "*t-2*" respectively. The estimated residual term, $\varepsilon_{ip,t}$, measures the relative real GDP that cannot be predicted from the two previous values of relative real GDP. The occurrence of an error is due to randomness. The larger the randomness, the smaller is the business cycle co-movements. The RMSE of the residuals signifies randomness and therefore, can be used as a measure of business cycle divergence:

$$RMSE_{i,p} = \sqrt{\frac{1}{T-3}\sum \varepsilon^2} \quad (3)$$

RMSE is the standard deviation while MSE includes the variances and the bias of the estimators. This way, RMSE becomes the measure of lack of business cycle co-movements or in other words, the measure of business cycle divergence. The analysis for the same is reported in Table 3.

Table 3 Root Mean Squared Error Analysis of India with its Trade Partners

Paired Nation	RMSE	Paired Nation	RMSE
ARE	0.0108	IRN	0.0111
AUS	0.0117	IRQ	0.0090
CHE	0.0284	JPN	0.0137
CHN	0.0195	MYS	0.0048
DEU	0.0170	NGA	0.0045
GBR	0.0112	SAU	0.0284
HKG	0.0070	SGP	0.0054
IDN	0.0055	USA	0.0104

Source: Author's Calculations

The root mean squared error is used to measure the randomness of the error term. The greater the randomness, the smaller will be the business cycle co-movements and *vice-versa*. And smaller values of RMSE implies that randomness will be smaller and business cycle co-movements will be larger. Thus, the results are drawn from the proposition that closer the value of RMSE to "0", the larger will be the business cycle synchronization. As can be seen from the results reported in Table-6.3 that the value of RMSE for all the paired nations is more or less (almost) zero, implying that there is no business cycle divergence whatsoever and there is evidence of business cycle synchronization for all the countries. The results are very well supported and confirmed by the trend analysis of the pure rolling correlation coefficients except for Iraq.

3.2 Bilateral Trade Intensities

After ascertaining the bilateral correlations between India and the paired countries, the next step is to compute the 2 different proposed variants of trade intensity as suggested by Frankel and Rose (1997, 1998). The first variant is normalized by total trade while the second variant is normalized by nominal GDP of the paired countries. The next step is to carry out the regression analysis for determining the impact of trade intensities on business cycle correlations.

The trade linkages are computed through the sum bilateral exports and imports between the two countries normalized by either their total output or total foreign trade. Following Frankel and Rose (1997, 1998), the bilateral trade linkage is measured by constructing two variants of trade intensity measures between two India and the partner country at a point in time *t*. Both the variants can be expressed mathematically as:

$$TI_{i,j}^{1} = \frac{1}{T}\sum_{t=1}^{T}\frac{X_{i,p,t} + M_{i,p,t}}{X_{i,t} + M_{i,t} + X_{p,t} + M_{p,t}} \quad (4)$$

$$TI_{i,j}^{2} = \frac{1}{T}\sum_{t=1}^{T}\frac{X_{i,p,t} + M_{i,p,t}}{Y_{i,t} + Y_{p,t}} \quad (5)$$

where $X_{i,p,t}$ denotes total merchandise exports from country India to partner country, $M_{i,p,t}$ represents imports to India from partner country, $X_{i,t}$ and $X_{p,t}$ are India's and the partner country's total exports to the world, $M_{i,t}$ and $M_{p,t}$ are India's and the partner country's total imports from the world economy respectively, $Y_{i,t}$ denotes nominal GDP of India and $Y_{p,t}$ denotes nominal GDP in partner country at time *t*. The $T_{i,j}^{1}$ normalizes the trade intensity by the total trade of the paired nations and is dependent on the size of foreign trade while $T_{i,j}^{2}$ normalizes the trade intensity by nominal GDP of partner nations and therefore it is dependent on size. From these measures of trade intensity, the business cycles can be reported to converge or diverge depending upon the nature of trade, i.e., whether intra-industry or inter-industry trade prevails between the paired countries.

3.3 Regression Framework- Specification and Identification of Empirical Model

The impact of trade integration, measured by bilateral trade intensity, on business cycle co-movements/synchronization, measured by bilateral business cycle correlations, can be tested by running the following regression model:

$$corr(y_{it}, y_{pt}) = \alpha + \beta TI_{i,p,t} + \varepsilon_{i,p,t} \quad (6)$$

However, testing of this regression model will be ambiguous if a dummy variable for WTO membership of Indian economy is not included in it. The WTO is an apex institution which promotes and facilitates free trade amongst the member countries. Therefore, keeping in mind the membership status of the chosen countries and the Indian economy as well, it becomes plausible to account for the membership of WTO in this regression equation. Thus, the above equation can be modified and re-written as:

$$corr(y_{it}, y_{pt}) = \alpha + \beta TI_{i,p,t} + \gamma WTO\_DUM \times TI_{i,p,t} + \varepsilon_{i,p,t} \quad (7)$$

Where $WTO\_DUM \times TI_{i,p,t}$ is the coefficient dummy and is the product of WTO and $TI_{i,p,t}$. India has been the member of WTO since its inception, as on 1st January 1995. So, the dummy variable is defined as:

$$WTO_t\_DUM = \begin{cases} 1; \text{if India is member of WTO} \\ 0; \text{otherwise} \end{cases}$$

In the above equation, β and γ are the parameters of interest and they both depending on the size of degree of specialization in trade; the signs and magnitude of β and γ matters the most. If trade amongst countries follows the Heckscher-Ohlin proposition, then it will lead to greater specialization and inter-industry trade and therefore, will cause lesser output correlations, thus no business cycle synchronization. If this is the case, the signs of β and γ are expected to be negative. However, if the countries are engaging in intra-industry trade, then the larger trade will lead to greater output correlations and higher business cycle synchronization. In this case, the signs of β and γ are expected to be positive (Calderon et al. 2002).

3.3.1 Unit Root Analysis

The first step in regression analysis calls for the execution of unit root analysis in order to test the orders of integration for the variable under consideration and to decide the suitable technique to be employed for computing the estimates. Therefore, the ADF test is performed for the constructed variables that are bilateral correlations, 2 variants of trade intensities (TI1 and TI2) and 2 variants of WTO coefficient dummies ($WTO\_DUM \times TI1$ and $WTO\_DUM \times TI2$). The ADF test is performed thrice, with drift, with drift and trend, and without drift and trend. The detailed unit root results are reported in the appendices 1 to 5. for these five variables in respective tables. And the summary of unit root analysis is reported in Table-4 where I(0) signifies stationarity at the level and I(1) denotes stationarity at first difference. It can be inferred from the results that Bilateral correlation is stationary at level for all countries, while trade intensities vary in their order of integration for different countries. For instance, for few countries, they are stationary at level and for other, they are stationary at first difference. However, the coefficient dummies for WTO are stationary at first order of integration for all the nations. Thereby, it can be concluded that the variables under consideration are a mix of I(0) and I(1) and therefore it calls for the application of ARDL modeling in order to obtain regression estimates.

Table 4 Summary of Unit Root Results

Paired Nation	Bilateral Correlation	TI1	TI2	WTO_DUM×TI1	WTO_DUM×TI2
ARE	I(0)	I(1)	I(1)	I(1)	I(1)
AUS	I(0)	I(0)	I(0)	I(1)	I(1)
CHE	I(0)	I(0)	I(1)	I(1)	I(1)
CHN	I(0)	I(1)	I(1)	I(1)	I(1)
DEU	I(0)	I(0)	I(1)	I(1)	I(1)
GBR	I(0)	I(0)	I(1)	I(1)	I(1)
HKG	I(0)	I(1)	I(1)	I(1)	I(1)
IDN	I(0)	I(1)	I(0)	I(1)	I(1)
IRN	I(0)	I(0)	I(1)	I(1)	I(1)
IRQ	I(0)	I(1)	I(1)	I(1)	I(1)
JPN	I(0)	I(0)	I(1)	I(1)	I(1)
MYS	I(0)	I(0)	I(1)	I(1)	I(1)
NGA	I(0)	I(1)	I(1)	I(1)	I(1)
SAU	I(0)	I(1)	I(1)	I(1)	I(1)
SGP	I(0)	I(0)	I(1)	I(1)	I(1)
USA	I(0)	I(1)	I(1)	I(1)	I(1)

Source: Author's Calculations

3.3.2 Specification of ARDL Regression Model for Empirical Analysis

In the present study, there is a mixture of I(0) and I(1) variables and to test the presence of a long-run relationship between bilateral business cycle correlations and the bilateral trade intensity, ARDL models are developed for each pair and two different variants of trade intensity. All in all, 32 ARDL regressions are run for 16 pairs of countries (India paired with each of the 16 countries taken in the sample) twice for 2 different variants of trade intensity (one variant normalized by total foreign trade and other by nominal GDP). The bounds test is used to conclude regarding the existence of a long-run relationship and the impact of trade intensity on business cycle co-movements is inferred from the sign and magnitude of long-run coefficients. The Error correction term gives inferences regarding the stability of the model that whether the model will converge back to its equilibrium situation from a disequilibrium situation or not. Accordingly, the Model-1 and Model-2 are framed under ARDL modeling for conducting the empirical analysis of the proposed objectives:

Model-1:

$$\left.\begin{array}{c} corr(y_{it}, y_{pt}) = \alpha + \beta TI1_{i,p,t} + \gamma WTO\_DUM \times TI1_{i,p,t} + \varepsilon_{i,p,t} \\ OR \\ corr(y_{it}, y_{pt}) = \alpha + \sum_{l=1}^{p} \beta_l TI1_{i,p,t} + \sum_{j=1}^{k} \sum_{l=0}^{m_j} WTO\_DUM \times TI1_{i,p,t}{}'\gamma_{j,l} + \varepsilon_t \end{array}\right\} \quad (8)$$

Model-2:

$$\left.\begin{array}{c} corr(y_{it}, y_{pt}) = \alpha + \beta TI2_{i,p,t} + \gamma WTO\_DUM \times TI2_{i,p,t} + \varepsilon_{i,p,t} \\ OR \\ corr(y_{it}, y_{pt}) = \alpha + \sum_{l=1}^{p} \beta_l TI2_{i,p,t} + \sum_{j=1}^{k} \sum_{l=0}^{m_j} WTO\_DUM \times TI2_{i,p,t}{}'\gamma_{j,l} + \varepsilon_t \end{array}\right\} \quad (9)$$

The ARDL modeling technique is developed by Pesaran et al. (2001) and it will provide regression estimates for the long-run relationship between bilateral correlations, trade intensities, and WTO coefficient dummies for the present endeavor. The first and foremost step in estimating an ARDL model is the lag structure specification. The optimal lag length can be decided by following any or the majority of lag length criterions like AIC, SC, FPE, and HQ. The model can be run with the fixed-lag specification or automatic lag selection as well. The present models have been estimated with maximum lags 4 with automatic lag selection as per the Schwarz Information criterion (SC).

The next step accounts for the Bounds test for confirming the long-run relationship amongst the chosen variables. Table 5 reports Wald test F-statistics values for drawing conclusions about the Bounds test. As can be seen from Table 6.5 that the long run relationship amongst the selected variables is substantiated for Australia, China, Great Britain, Iran, Japan, Saudi Arabia and the United States of America for Model-1 and Model-2. In addition to this, the results for Model-1 also accounts for a long-run relationship for Switzerland and Indonesia. Similarly, Bounds test for Model-2 marks the long-run relationship between the United Arab Emirates and

Singapore. That means cointegration is not present for Germany, Hong Kong, Iraq, Malaysia and Nigeria for both the models and for the United Arab Emirates and Singapore for Model-1 and for Switzerland and Indonesia for Model-2. The conclusions are drawn for the acceptance or rejection of long-run relationships on the basis of lower and upper bound values for degrees of freedom equal to 2. The critical values for lower and upper bound are reported in Table 6.

Table 5 ARDL Bounds Test Results: Wald Test F-Statistics Values

Paired Nation	Degrees of Freedom	Model 1	Model 2
ARE	2	0.90	7.48****
AUS	2	14.38****	10.05****
CHE	2	7.23****	2.47
CHN	2	4.74*	8.04****
DEU	2	3.34	4.06
GBR	2	6.61****	15.33****
HKG	2	2.88	2.82
IDN	2	7.08****	3.59
IRN	2	5.01*	7.53****
IRQ	2	1.39	1.72
JPN	2	4.26*	6.48****
MYS	2	3.36	2.87
NGA	2	3.80	2.11
SAU	2	7.03****	4.85*
SGP	2	2.54	6.50****
USA	2	6.94****	9.15****

Note: Coefficients marked with *, **, ***, **** are statistically significant at 10 per cent, 5 per cent, 2.5 per cent and 1 per cent respectively.

Source: Author's Calculations

The main aim of the present study is to establish a relationship between business cycle synchronization and trade linkages for 16 countries selected as major trading partners for the Indian economy. For doing so, the impact of trade intensities and WTO coefficient dummies on bilateral correlations are validated through the long-run coefficients of the ARDL regression, estimated for Model-1 and Model-2 only for those countries for which Bounds test was significant, implying the presence of a long-run relationship. The main interest lies in the sign and magnitude of slope coefficient of trade intensity and coefficient dummy as it tells whether the trade is following Heckscher-Ohlin ideology by engaging in inter-industry trade, thus leading to complete specialization. In that case, slope coefficients are expected to be negative. However, if there is intra-industry trade leading to vertical specialization then the slope coefficient is expected to be positive (Calderon et al. 2002).

Table 6 Critical Values of Lower Bound (I_0) and Upper Bound (I_1) for Degrees of Freedom = 2

Significance Level	Lower Bound (I_0)	Upper Bound (I_1)
10 per cent	3.17	4.14
5 per cent	3.79	4.85
2.5 per cent	4.41	5.52
1 per cent	5.15	6.36

Source: Pesaran *et al.* (2001)

The estimates for Model-1 reveal that India is having significant intra-industry trade with Australia, Saudi Arabia, and the United States of America, though the membership of WTO is significantly affecting the results only for Saudi Arabia out of these three. Further, the WTO coefficient dummy also turns out to be significant for Switzerland and China reflecting inter-industry trade for the former and the intra-industry trade for the latter. India is enjoying inter-industry trade with Japan as well, as reflected by the negative sign of trade intensity and WTO dummy coefficients.

The estimates for Model-2 signify that India is engaged in inter-industry trade with the United Arab Emirates and Japan, signified by the coefficients of both the trade intensity and the WTO coefficient dummy. However, intra-industry trade is found between India and Australia, China, Iran, Singapore and United States of America, the WTO coefficient dummy signify the same for Australia. However, the WTO coefficient dummy for Great Britain reveals the pattern of trade to be the inter-industry type.

The patterns of trade to be the intra-industry type for Australia, China, and the United States of America, and inter-industry for Japan have been confirmed by both the models. The Ricardian theory and the law of comparative advantage postulate that trade must give rise to complete specialization and it shall be of the inter-industry type, that is, trade in different industries. However, the actual trade scenario offers a picture where nations are engaging in intra-industry trade. Intra-industry trade can be defined as simultaneous exports and imports of products of the same industry. The pattern of intra-industry trade is interesting to account for as it gives the notion that the trading countries are willingly aiming at horizontal or vertical specialization. The basis of intra-industry trade (IIT) lies in the spread of consumerism and product differentiation which makes the consumer the king and aims at offering the consumer different varieties with varied attributes and quality.

This way, higher intra-industry trade integration predicts that the trading country is highly integrated with the world economy. The setting up of World Trade Organization (WTO) in 1995 persuaded its member countries to a great extent for reforming their manufacturing tariffs and controls, which enabled the cross-border trade flows and consequently, enhanced the level of intra-industry trade between developed-developed and developed-developing countries. With the inception of WTO and its subsequent conferences, India has also entered into a number of Regional Trade Agreements (RTAs), located both within and outside Asia (Aggarwal and Chakraborty, 2017).

Table 7 Long Run Coefficients of Bilateral Correlation as Dependent Variable

Paired Nation	Model-1		Model-2	
	TI1	WTO_DUM×TI1	TI2	WTO_DUM×TI2
ARE	N.A.	N.A.	-347.37*** (0.0008)	-26.72*** (0.0033)
AUS	1047.69*** (0.0000)	17.17 (0.1462)	1221.81*** (0.0010)	13.94*** (0.0008)
CHE	3.46 (0.9819)	-34.07*** (0.0003)	N.A.	N.A.
CHN	-264.15 (0.2351)	45.35*** (0.0005)	211.76*** (0.0040)	0.84 (0.9413)
GBR	124.18 (0.4317)	-21.73 (0.1343)	47.71 (0.9242)	-26.09** (0.0366)
IDN	-30.98 (0.9203)	-6.04 (0.6313)	N.A.	N.A.
IRN	1650.03 (0.1636)	12.30 (0.6906)	716.74*** (0.0084)	17.76 (0.4443)
JPN	-609.35* (0.0664)	-55.64** (0.0390)	-1030.02** (0.0197)	-29.33** (0.0119)
SAU	454.76*** (0.0059)	37.25*** (0.0076)	-59.08 (0.7199)	4.82 (0.7073)
SGP	N.A.	N.A.	348.69*** (0.0004)	-15.06** (0.0200)
USA	1843.83** (0.0263)	55.79 (0.1335)	1458.96** (0.0217)	13.37 (0.5694)

Notes: i) Coefficients marked with *, **, and ***, are statistically significant at 10 per cent, 5 per cent and 1 per cent respectively and ii) N.A. stands for Not Applicable.
Source: Author's Calculations

India's bilateral IITs with partner countries have increased over the period. Various researchers from time to time have conducted intra-industry trade analysis for the Indian economy (Veeramani, 1999, 2001, 2003; Bhattacharya, 1994; and Burange, 2008). And the results reported in the present endeavor, are being supported by them. Veeramani (2003) pointed out that intra-industry trade picked up and expanded largely after the process of liberalization since previously import substitution policy did not provide avenues for this kind of trade due to the prohibition of competing imports. Burange (2008) noticed that India's intra-industry trade has grown over the years and it is larger for the regions of Asia and Europe. The regions like the United States of America and the Middle East are also picking up lately but that for Australia is showing meager values. The structural transformation of the Indian economy, which initiated in the 1980s but got intensified during 1990s, got reflected in its direction and the pattern of trade through the restructuring of its production units. The empirical evidence from other countries also suggests that liberalization process through the ease of controls and policies aid in the expansion of international trade with a significant edge towards intra-industry trade (Balassa, 1986). The findings of the present attempt also signal towards the spread of intra-industry for the Indian economy for the majority of its trade partners.

The broad categories of intra-industry trade product groups in which India trades with its major trading partners include "Live Animals, Vegetable Products, Animal and Vegetable Fats, Prepared Foodstuffs, Mineral Products, Products of Chemical and Allied Industries, Plastic and Rubber Articles, Raw Hides and Skin, Wood and Articles of Wood, Pulp of Wood, Textiles, Footwear, Headgear, Articles of Stone, Plaster and Cement, Natural and Cultured Pearls, Base Metals, Machinery and Mechanical, Appliances, Vehicles, Aircraft and Transport Equipment, Optical, Photographic Precision Equipment Arms and Ammunitions, Miscellaneous Manufactured Products, Works of Art etc." However, the instances of inter-industry trade are few. But the results of this study suggest that India is involved in inter-industry trade with Switzerland, Japan, United Arab Emirates, and Great Britain.

Table 8 Error Correction Form of Bilateral Correlation as Dependent Variable

Paired Nation	Model-1		Model-2	
	ECT	P-Value	ECT	P-Value
∂ ARE	N.A.	N.A.	-1.1127***	0.0002
∂ AUS	-0.6780***	0.0000	-0.5084***	0.0001
∂ CHE	-1.0019***	0.0006	N.A.	N.A.
∂ CHN	-0.7206***	0.0001	-1.3066***	0.0002
∂ GBR	-0.6332***	0.0003	-0.8519***	0.0000
∂ IDN	-0.7364***	0.0004	N.A.	N.A.
∂ IRN	-0.2932**	0.0174	-0.3783**	0.0126
∂ JPN	-0.6857***	0.0032	-0.7503***	0.0004

∂ SAU	-0.8538***	0.0010	-0.7150***	0.0009
∂ SGP	N.A.	N.A.	-1.1208***	0.0003
∂ USA	-0.3788***	0.0037	-0.4196***	0.0011

Notes: i) Coefficients marked with *, **, and ***, are statistically significant at 10 per cent, 5 per cent and 1 per cent respectively ii) Bold values reflects models with significant long-run coefficients and iii) N.A. stands for Not Applicable.
Source: Author's Calculations

Table 8 reports the results of Cointeq-1 or the error correction form for the chosen countries for both the models. It can be seen hat the error correction term (ECT) is negative and significant for all the countries taken, reflecting that the models are stable and will converge back to equilibrium in case of any disturbance. However, for Model-1, Switzerland has the greatest speed for converging back to equilibrium from a disequilibrium situation and for Model-2, China has the highest speed adjustment parameter in case of any disequilibrium point even higher than that of Switzerland in Model-1

3.3.2.1 Regression Analysis: Differenced VAR

Further, the countries for which Bounds test does not come out to be significant and the null of no long-run relationship could not be rejected, are later tested for short-run relationships, if any, under differenced VAR mechanism. VARs account for contemporaneous relationships and are modeled at level i.e., I(0) order of integration. However, if a series at a greater order of integration needs to be modeled with VAR then, differenced VAR is a fitting option wherein the deltas for the variables of interest are calculated and entered into the model equation. Accordingly, the VAR process in differenced form can be written as:

$$\left.\begin{aligned}\Delta Y_t = c + A_1\Delta Y_{t-1} + A_2\Delta Y_{t-2} + A_\rho\Delta Y_{t-\rho} + \dots\dots\dots\dots + B_0\Delta X_t + B_1\Delta X_{t-1} + B_2\Delta X_{t-2}\\ + \dots\dots\dots\dots + B_\rho\Delta X_{t-\rho} + D_0\Delta Z_t + D_1\Delta Z_{t-1} + D_2\Delta Z_{t-2} + \dots\dots\dots\dots + D_\rho\Delta Z_{t-\rho} + \varepsilon_t\end{aligned}\right\} \quad (10)$$

$$where,\ \Delta Y_t = \Delta corr(y_{it}, y_{pt})$$

$$and,\ \Delta X_t = \Delta TI,\ \Delta Z_t = \Delta WTO\_DUM \times TI$$

The above equation will be estimated twice for every country paired with India, corresponding to the two variants of trade intensity. Thus, two models will be estimated for this differenced VAR equation, Model-1 and Model-2 for TI1 and TI2 respectively.

For estimating the differenced VAR, the optimal lag length is computed by following the lag length criterion. Since the estimation procedure is sensitive to lag length selection, therefore, the VAR estimation for each country is conducted by choosing an appropriate lag length. Since the data underhand is at an annual frequency, therefore the unrestricted VAR system for the maximum of four lags has been evaluated assuming all selected variables as endogenous without any exogenous variable in the model. Four lag length criterions have been used to verify the number of lags namely, Akaike information criterion (AIC), Schwarz information criterion (SC), Final prediction error (FPE) and Hannan-Quinn information criterion (HQ). The results for the same have been reported in Table-9 and Table-10 for Model-1 and Model-2 respectively (It can be noted that these 2 variants of models are governed by the two variants of trade intensities that have been taken up for the analysis purposes) and the minimum value has been reported in the table because the model which minimizes the value of these criteria is selected as the one with the optimal lag length (Asteriou and Hall 2006).

Table 9 Lag Length Selection Criterion for Differenced VAR Models (Variant-1)

Paired Nation	AIC		SC		FPE		HQ	
	Criterion Value	Optimal Lag Length	Criterion Value	Optimal Lag Length	Criterion Value	Optimal Lag Length	Criterion Value	Optimal Lag Length
ARE	-20.2427*	2	-19.6033*	1	3.33e-1*	2	-19.9845*	1
DEU	-21.451*	1	-20.891*	1	9.74e*	1	-21.272*	1
HKG	-21.3662*	1	-20.805*	1	1.06e-3*	1	-21.1869*	1
IRQ	-16.9448*	1	-16.3843*	1	8.82e-1*	1	-16.7655*	1
MYS	-20.6716*	1	-20.1112*	1	2.12e-1*	1	-20.4923*	1
NGA	-17.6275*	1	-17.2469*	1	4.55e-1*	1	-17.3422*	2
SGP	-21.4141*	1	-20.8536*	1	1.01e-1*	1	-21.2348*	1

Note i) AIC stands for Akaike information criterion, SC stands for Schwarz information criterion, FPE stands for Final prediction error, HQ stands for Hannan-Quinn information criterion and LR stands for sequential modified LR test statistic.
ii) "*"indicates lag order selected by the criterion significant at 5 per cent.
Source: Author's Calculations

Table 10 Lag Length Selection Criterion for Differenced VAR Models (Variant-2)

Paired Nation	AIC		SC		FPE		HQ	
	Criterion Value	Optimal Lag Length	Criterion Value	Optimal Lag Length	Criterion Value	Optimal Lag Length	Criterion Value	Optimal Lag Length
CHE	-21.4012*	2	-20.7317*	1	1.05e-1*	2	-21.1122*	1
DEU	-22.4399*	1	-22.2998*	1	3.61e-1*	1	-22.3951*	1
HKG	-21.5877*	1	-21.2656*	1	8.50e-1*	1	-21.4084*	1
IDN	-20.9065*	1	-20.3460*	1	1.68e-1*	1	-20.727*	1
IRQ	-18.4026*	1	-17.8421*	1	2.05e-1*	1	-18.2233*	1
MYS	-22.3171*	2	-21.7182*	1	4.19e-*	2	-22.0994*	1

NGA	-18.431*	2	-18.1985*	1	2.04e-*	2	-18.2936*	1

Note: i) AIC stands for Akaike information criterion, SC stands for Schwarz information criterion, FPE stands for Final prediction error, HQ stands for Hannan-Quinn information criterion and LR stands for sequential modified LR test statistic.
ii) "*" indicates significant criterion value at 5 per cent.

Source: Author's Calculations

It can be noted that the majority of the criterions have validated the inclusion of one lag in case of all the three variables in differences, namely bilateral correlation, trade intensity, and WTO coefficient dummy. Therefore, nine VAR models are estimated twice for different variants of trade intensities and corresponding WTO coefficient dummies. In total, VAR is estimated 18 times for India and the paired nation to get short-run relationship results.

Table 11 portrays the results of differenced VAR estimation. The differences or deltas for the variables are computed depending on their orders of integration (shown in Table-6.4) and the VAR is estimated using an optimal lag length of 1 as suggested by majority test statistics of criterions like AIC, SC, FPE, HQ, and LR test statistic. The coefficients in Model-1 and Model-2 reflect that there is a relationship between bilateral correlation themselves for all but the evidence of a short-run relationship between bilateral correlations and trade intensity is found only for Hong Kong in Model-1. However, Model-2 shows the absence of any relationship between bilateral correlations and trade intensity, whatsoever, for all countries. Thus, Model-1 concludes that there is a short-run relationship between trade intensity and business cycle correlations for Hong Kong. Moreover, the facts and figures also suggest that Hong Kong is the fourth largest destination for Indian exports and Hong Kong also takes the role of a re-exporter of Indian products to mainland China. The Indian exports to Hong Kong broadly comprise of articles of jewelry and precious metals, diamonds, leather products, cotton yarn, electrical apparatus, rubber products etc. Indian economy also indulges in imports from Hong Kong ranging from gold, silver, pearls, telephone sets, automated data processing machines, watches, monitors and projectors, plastic articles to so many other items.

Table 11 Coefficients of Differenced VAR for Bilateral Correlation as a Dependent Variable

Paired Nation	Model-1			Model-2		
	D(Bilateral Correlation)	D(TI1)	D(WTO_DUM ×TI1)	D(Bilateral Correlation)	D(TI2)	D(WTO_ DUM ×TI2)
ARE	0.767* [5.550]	-200.845 [-0.692]	11.471 [0.756]	N.A.	N.A.	N.A.
CHE	N.A.	N.A.	N.A.	0.762* [5.954]	75.71396 [0.188]	13.571 [0.641]
DEU	0.374* [2.133]	-99.189 [-1.007]	-17.296 [-0.903]	0.376* [2.128]	779.756 [0.860]	-27.733 [-1.182]
HKG	0.5994* [4.599]	-912.36* [-3.259]	2.634 [0.201]	0.610* [4.150]	-567.535 [-1.589]	10.290 [0.586]
IDN	N.A.	N.A.	N.A.	0.585* [3.831]	9.235 [0.152]	23.015 [0.961]
IRQ	0.7677* [6.269]	1.163 [0.035}	-7.5096 [-0.413]	0.761* [6.198]	-10.250 [-0.231]	-7.357 [-0.255]
MYS	0.584* [3.811]	45.770 [0.448]	17.504 [0.925]	0.565* [3.443]	291.681 [0.454]	16.707 [0.688]
NGA	0.367* [2.058]	-45.515 [-0.494]	-22.541 [-1.162]	0.368* [2.068]	-70.926 [-0.591]	-29.258 [-1.155]
SGP	0.671* [4.185]	49.242 [0.596]	4.643 [0.379]	N.A.	N.A.	N.A.

Notes: Figures in [ ] brackets are t-statistics and * denotes the statistical significance of coefficients at 5 per cent by comparing t-statistic with 1.96.

Source: Author's Calculations

4. Concluding Remarks

In this era of globalization, the economies of the world are more or less getting affecting by disturbances taking place in other parts of the world. This transmission of fluctuations from one country to another can be attributed to the strong economic ties between them which further foster the synchronization in their respective business cycles. Keeping in mind the ever-increasing financial linkages, trade linkages, similarities in production structures, co-ordination of monetary and fiscal policy, one can never deny the impact of such integration on each other's business cycles. With the same thought of reasoning, an endeavor has been made in this study to examine the presence of business cycle synchronization for India and 16 of its trade partners over the period of 1980 to 2016, in the first place. And secondly, the existence of output correlations is subject to the qualification of trade linkage between India and the sample countries. The overall results submitted by both the models (corresponding to the respective variant of trade intensity employed), suggest that the trade linkage turned out to be significant with Australia, Iran, Japan, Great Britain, Saudi Arabia, Switzerland, Singapore, United Arab Emirates and United States of America for the time period under consideration. The slope coefficients of trade integration further reveal that trade between India and Australia, China, Iran, Saudi Arabia, Singapore and the United States of America is of intra-industry type while that with Japan, Switzerland, Great Britain, and the United Arab Emirates, is of inter-industry type. Thus, in the case of industry-specific shocks, there will be business cycle synchronization in the intra-industry trading group but no synchronization in the inter-industry trading group. Further, the differenced VAR results for Model-1 reflected the short-run relationship between trade linkages and business cycle correlations for India and Hong Kong only. However, Model-2 denies such a relationship for all the countries considered for differenced VAR.

Thus, the relation between business cycle synchronization and trade integration for India is found to be significant with Australia, China, Iran, Saudi Arabia, Singapore and the United States of America out of the total sample taken. This finding highlights the fact that trade plays an important role in transmitting the output fluctuations from one country to another, thereby, bringing their business cycles closer to each other. However, the intra-industry trade has flourished significantly since the structural transformation of the economy, making it more liberalized and open to trade in similar product ranges. The broad categories of intra-industry trade product groups in which India trades with its major trading partners include Live Animals, Vegetable Products, Animal and Vegetable Fats, Prepared Foodstuffs, Mineral Products, Products of Chemical and Allied Industries, Plastic and Rubber Articles, Raw Hides and Skin, Wood and Articles of Wood, Pulp of Wood, Textiles, Footwear, Headgear, Articles of Stone, Plaster and Cement, Natural and Cultured Pearls, Base Metals, Machinery and Mechanical, Appliances, Vehicles, Aircraft and Transport Equipment, Optical, Photographic Precision Equipment Arms and Ammunitions, Miscellaneous Manufactured Products, Works of Art etc. But as far as the inter-industry trade channel is concerned, India is actively participating with few nations.

However, this is just one channel of transmission which has been investigated in the present endeavor, there are many other channels like financial integration, monetary dependence, fiscal closeness, specialization, similar structures etc. which shall be considered to get a universal view of co-movements in business cycles across nations. Accordingly, this present research can be extended further for investigating all other possible channels for propagating the business cycle fluctuations from one economy to another, leading to higher magnitudes of correlations, and business cycle synchronization across borders.

****

References

Afonso, A. & Sequeira, A. (2010). Revisiting business cycle synchronization in the European Union. Retrieved from https://www.repository.utl.pt/bitstream/10400.5/2859/1/DEWP22.pdf

Aggarwal, S. & Chakraborty, D. (2017). Determinants of India's Bilateral Intra-industry Trade over 2001-2015: Empirical Results. *South Asia Economic Journal*, *18*(2), 296-313.

Alesina, Alberto, Robert J. Barro, and Silvana Tenreyro. (2002). Optimal currency areas. *NBER macroeconomics annual* 17: 301-345.

Asteriou, D. and Hall, S.G. (2006). Applied Econometrics: a modern approach using eviews and microfit. PalgraveMcMillan, New York.

Balassa, B. (1986). Intra-industry Trade among Exporters of Manufactured Goods, in (Ed) Greenaway, D. and Tharakan, P.K.M., Imperfect Competition and International Trade: The Policy Aspects of Intra-Industry Trade, Wheatsheaf Press, Brighton.

Bhattacharyya, R. (1994). India's Intra-Industry Trade: An Empirical Analysis (1970-1987). *Indian Economic Journal*, *42*(2), 54.

Burange, L. G. & Chaddha, S. J. (2008). *Growth in India's intra-industry trade*. Working Paper UDE 24/2/2008, Mumbai: Department of Economics, University of Mumbai.

Calderon, C., Chong, A. & Stein, E. (2002). Trade intensity and business cycle synchronization: are developing countries any different?' Central bank of Chile, Working paper No. 195.

Calderon, C., Chong, A. & Stein, E. (2007). Trade intensity and business cycle synchronization: Are developing countries any different? *Journal of international Economics*, *71*(1), 2-21.

Clark, T. E. & Van Wincoop, E. (2001). Borders and business cycles. *Journal of international Economics*, *55*(1), 59-85.

Dées, S. & Zorell, N. (2012). Business cycle synchronization: disentangling trade and financial linkages. *Open Economies Review*, *23*(4), 623-643.

Frankel, J. A. & Rose, A. K. (1997). Is EMU more justifiable ex post than ex ante? *European Economic Review*, *41*(3-5), 753-760.

Frankel, J. A. & Rose, A. K. (1998). The endogenity of the optimum currency area criteria. *The Economic Journal*, *108*(449), 1009-1025.

Harding, D. & Pagan, A. (2006). Synchronization of cycles. *Journal of Econometrics*, *132*(1), 59-79.

Imbs, J. (2004). Trade, finance, specialization, and synchronization. *Review of Economics and Statistics*, *86*(3), 723-734.

Jayaram, S., Patnaik, I. & Shah, A. (2009). Examining the decoupling hypothesis for India. *Economic and Political Weekly*, 44(44), 109-116.

Kwan, C. M. & Kun, K. Y. (2009). Business cycle synchronization among China and her trading partners. *Unpublished thesis for the Degree of Bachelor of Business Administration, Hong Kong Baptist University, Hong Kong, China.*

Pesaran, M. H., Shin, Y. & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.

Plakidis, A. (2010). Business cycle synchronization: An application to BRIC economies. Retrieved from https://thesis.eur.nl/pub/8457/Plakidis.docx

Rose, A. & Engel, C. (2002). Currency unions and international integration, Journal of Money, Credit and Banking 34, 1067-1089.

Shin, K. & Wang, Y. (2003). Trade integration and business cycle synchronization in East Asia. *Asian Economic Papers*, *2*(3), 1-20.

Veeramani, C. (1999). Intra-Industry Trade under Economic Liberalization: The Case of Indian Capital Goods Industries. Journal of Indian School of Political Economy, 11(3): 455-73

Veeramani, C. (2001). India's intra-industry trade under economic liberalization: Trends and country specific factors. *Centre for Development Studies, working paper*, (313).

Veeramani, C. (2003). Liberalization, Industry-Specific Factorsand Intra-Industry Trade in India. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.501.7517&rep=rep1&type=pdf

Walti, S. (2010). No decoupling, more interdependence: business cycle co movements between advanced and emerging economies, Swiss National Bank. Retrieved from https://mpra.ub.uni-muenchen.de/20869/1/MPRA_paper_20869.pdf