Chapter 6
Direction of Trade, Exchange Rate Regimes, and Financial Crises: The Indian Case

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1 Introduction

In international trade research, the gravity model (of different variants) has become popular due to its empirical appeal and success in explaining bilateral trade flows. This model provides a cogent approach to test the role of possible influential variables affecting bilateral trade flows. Since the seminal work of James Anderson in the late 1970s, research in the area of bilateral trade flows using the gravity model gathered significant momentum. Much before Anderson (1979), Tinbergen (1962) and Linnemann (1966) proposed the idea of the gravity model in its simple format where bilateral trade flows are specified to be proportional to the product of the mass (gross domestic product, GDP) of the trading nations and inversely related to the cost (spatial distance). Later, the model is used in its augmented form by incorporating different sets of explanatory variables that affect the trade flows. Over the years, the gravity model has been a powerful tool to explain the bilateral trade flows, estimating trade potentials, identifying the impact of trade groups, explaining the trade pattern, and assessing the cost of border trade (Lin and Wang 2004; Liu and Jiang 2002; Sheng and Liao 2004).

In its extended form, the gravity model covered new explanatory variables. These variables may be classified into two groups, namely exogenous and dummy variables. Exogenous variables include per capita GDP, population, etc. The dummy variables incorporate factors like preferential trade agreement, integration, or participation in any group or organization Shi et al. (2005). For example, Aitken (1973) added a new variable to estimate the impact of the European Economic Community (EEC) on trade of its member nations. Frankel and Wei (1993) found that level of economic development, captured by per capita gross national product (GNP), plays a vital role in shaping a nation's trade flow.

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Traditionally, the gravity equation has been estimated for cross-section data using ordinary least square (OLS) method. The conventional cross-section approach without the inclusion of country-specific effects was found to be misspecified which has led to biased estimates (Matyas 1997). For instance, in a pure cross-sectional study, GDP of the home country becomes constant, and if the log-linear form is considered for the model, then log of the home country's GDP gets confounded with the intercept term. To overcome this limitation, panel data analysis has been suggested as a way out, provided that time series component is not small enough to lead to near multicollinearity with the intercept term. Egger and Pfaffermayr (2003) recommended the use of a three-way model with effects for importer, exporter, and time or explicit introduction of country-pair effects (to account for country-pair heterogeneity).

The trade gravity approach has been frequently used to analyze the trade pattern of different nations with their corresponding trading partners. For instance, in a recent study, Cieślik (2007) utilized the gravity approach to identify the trade effects of free trade agreements (FTAs) during the period 1992–2004. The estimated model, apart from standard variables, contained factors such as geographical proximity, language, common history, and FTA dummies. Cieślik found the impact of bilateral and regional trade agreements to be positive and statistically significant. The analysis was performed on a pooled panel of data with time effects and estimated with heteroscedasticity-adjusted OLS method. The impact of various agreements on trade differed. Cieślik found the regional agreements to be more trade-creating than bilateral agreements. At the same time, the trade effects associated with the European Union (EU) were found to be far greater than the effect of FTAs. Furthermore, the positive impact on trade seems to appear only several years after establishment of liberalized trade arrangement.

The gravity model has been used for empirical analysis in the Indian context too. Batra (2004) used cross-section data for the year 2000 and suggested that the magnitude of India's trade potential is highest with the Asia-Pacific region followed by Western Europe and North America. Countries like China, UK, Italy, and France reveal maximum potential for expansion of trade with India. Similarly, using panel data analysis Bhattacharya and Banerjee showed how factors like colonial heritage and size of the trading partners' economy play a vital role in determining India's direction of trade (DOT). In both the studies, apart from traditional variables (such as GDP and population), some common explanatory variables such as common language, colonial heritage, etc. are used.

So far, in the Indian studies, issues like exchange rate regimes and effect of financial crises on trade have not been addressed within the framework of the gravity model. In the recent past, the world experienced two global meltdowns, one in 1997–1998 (Asian crisis) and another in 2008 which affected the global economy. Though, in terms of its impact, the Asian crisis was confined within the vicinity of its genesis arena, the 2008 crisis has a wider and deeper impact all over the world; in both the cases, Indian trade relation with its trading partners got affected to a considerable extent. Apart from that, it is known that exchange rate regime of the trading partners also affects trade relations since volatility of exchange rate affects trade negatively which is contingent upon the exchange rate regime of the nation under consideration.

In the light of this background, it would be of interest to examine India's DOT with selected major trade partners, by addressing the issues, namely impact of financial crises and exchange rate regime changes. For this purpose, India's 25 major trade partners (in terms of total trade volume) are considered for analysis which constitutes 75–80 % of India's total trade since 1997–1998 to 2009–2010.

2 Theoretical Background

The gravity equation, as a tool for explaining bilateral trade patterns, was originally proposed by Tinbergen in the year 1962 (Tinbergen 1962). Despite its unquestionable success in empirical studies, it was often criticized for insufficient theoretical foundations. This drawback has been more than eliminated in the past 20 years with the rise of new trade theory with its rich microfoundation. It is worth to stress, that the gravity equation can be formally derived within an imperfectly competitive set-up with increasing returns to scale and firm-level product differentiation as well as within a perfect competition set-up with product differentiation at the national level. The gravity equation in the simplest form postulates that bilateral trade between two countries is directly proportional to economic size of the trading partners and inversely proportional to the distance between them, thus resembling the famous Newton's gravity law. The economic size of the partners is usually given by real income (Y). In mathematical notation, the simple gravity equation has the following structure:

$$\mathrm{TT_{ij}} = \left(A^* Y_{\mathrm{i}}^{\alpha *} Y_{\mathrm{j}}^{\beta}\right) / {D_{\mathrm{ij}}}^{\varphi},$$

where $\mathrm{TT_{ij}}$ denotes total trade flow between the nations, Y denotes the economic mass (GDP), D_{ij} denotes the distance between them, and i and j denote the two nations, respectively.

α, β, φ denote the parameters. A is some constant, known as gravity parameter.

Log linearizing the above equation yields the following form:

$$\ln \mathrm{TT_{ij}} = \ln A + \alpha \ln Y_{\mathrm{i}} + \beta \ln Y_{\mathrm{j}} + \varphi \ln D_{\mathrm{ij}}.$$

The basic gravity equation is frequently extended to incorporate other factors affecting (stimulating or hindering) bilateral trade flows. These could include, for instance, incomes per capita of trade partners. The gravity model implies that the larger, more prosperous and closer two countries are to each other, the more likely they are to trade. The model could be further augmented to incorporate cultural and linguistic proximity, historical links, and various barriers to trade. In the popular set-up, two different components of barriers to trade are often included which have a spatial and nonspatial dimension. Apart from the impact of distance, the spatial exogenous barriers severely affecting transport cost are, for instance, given by common border (adjacency) or landlockedness. The removal of nonspatial barriers (trade liberalization) is commonly proxied by dummies for regional or bilateral trade agreements.

3 Data and Methodology

The data used in this study are annual data covering India's major 25 trade partners which consistently constituted 75–80 % of India's total trade volume over the time period 1997–1998 to 2009–2010. There are altogether 338 observations, 13 time series components (years), and 26 cross-sectional entities (26 nations including India). The 25 nations along with their respective exchange rate regime are listed in the Appendix. Data on GDP is collected from Penn World Table and they are purchasing power parity (PPP) adjusted. To get the data, we actually multiplied the term per capita GDP (cGDP) of the nations with their corresponding population, both of which are available in the above mentioned data source. Trade volume data are collected from the website of the Ministry of Commerce and deflated by the corresponding year's consumer price index (CPI) of the USA, so as to get real value of the trade flow. CPI of the USA is obtained from the US Department of Labor. Great circle distance between the nations' capital is measured as a proxy for distance variable and data are obtained from Centre d'Etudes Prospectives et d'Informations Internationales (website: http://www.cepil.fr/anglaisgraph/bdd/distances.htm), under the file name "dist_cepii.dta" (in kilometres). The distance is calculated using great circle calculation. Here, two types of dummy variables are used, one to capture the effect of exchange rate regime of the trade partners and another is a time dummy to grasp the effect of the two major financial crises over India's trade volume. For the determination of exchange rate regimes of the trading partners, we have taken the help from different sources like working papers of International Monetary Fund (IMF; e.g., de facto exchange rate arrangements and anchors of monetary policy, 31 July 2006), World Bank publications, etc. For the time dummy, we assigned the values 1 for the post-crisis periods like 1998 (i.e., after the Asian crisis) and for the recent global meltdown, we also assigned the value 1 for 2008–2009 as well as 2009–2010 since the impact of this crisis is wider in its persistence unlike the previous one. Though India is believed to have escaped the crisis internally, the adverse effect of it is experienced globally which in turn affected the trade relation of India.

The estimated gravity model has the following log-linear form:

$$\begin{aligned}\ln \mathrm{trade}_{\mathrm{ijt}} = \alpha + \beta \ln \mathrm{gdp}_{\mathrm{it}} + \gamma \ln \mathrm{gdp}_{\mathrm{jt}} + \varphi \ln \mathrm{dis}_{\mathrm{ij}} + \Upsilon \ln \mathrm{pop}_{\mathrm{it}} + \Omega \ln \mathrm{pop}_{\mathrm{jt}} \\ + \phi D_{\mathrm{ik}} + \lambda T_t + e_{\mathrm{ijt}}. \end{aligned} \tag{6.1}$$

where α is constant term and common to all years and all nations, trade means the total bilateral trade between i th trade partners and j(India), $\mathrm{gdp}_{\mathrm{it}}$ signifies the gross domestic product of ith trade partner in the tth year, $\mathrm{gdp}_{\mathrm{jt}}$ means the gross domestic product of India in tth year, similarly pop signifies population of trading nation and India respectively, D denotes the dummy variable of exchange rate regime of ith nation, T is a time dummy which assumes the value 1 when year = 1998, 2008, 2009 and 0 otherwise, e_{ijt} is the error term. In Eq (6.1), 'ln' refers to logarithm of the variables and k = 1, 2.

Another version of the above equation has been empirically tested by replacing GDP with cGDP, i.e., per capita GDP of the respective nations so as to test whether the level of development of the countries has any significant impact over trade relation between nations or not.

$$\ln \text{trade}_{\text{ijt}} = \alpha + \beta \ln \text{cgdp}_{\text{it}} + \gamma \ln \text{cgdp}_{\text{jt}} + \varphi \ln \text{dis}_{\text{ij}} + \Upsilon \ln \text{pop}_{\text{it}} + \Omega \ln \text{pop}_{\text{jt}} + \phi D_{\text{ik}} + \lambda T_t + e_{\text{ijt}}. \tag{6.2}$$

Choosing an appropriate estimation technique is of prime importance in this context. Generally, in case of panel data with dummy variables, fixed-effect or random-effect models are used without further scrutinizing the problems of possible existence of nonspherical error which violates the basic assumptions of the models and leads to imprecise estimation. Though our model yields satisfactory results in case of fixed-effect over random-effect models which has been tested with the help of Hausman test, disturbances are tested to be heteroscedastic (each country has its own variance). In such circumstances, Winsten regression with panel-corrected standard errors (PCSE) is accepted as a useful technique to resolve the above mentioned problem. Papazogulou (2006) and Marques (2008) also suggested use of the PCSE in such circumstances and empirically validated their arguments. Apart from that, the balanced panel data sets fulfill the required desiderata of being moderately long in terms of time dimension (number of years = 13). PCSEs are similar to White's heteroscedasticity-consistent standard errors for cross-sectional estimators, but are better because they take advantage of the information provided by the panel structure of the data. Through Monte Carlo studies, Beck and Katz (1995) demonstrate that PCSEs produce more reliable standard errors than feasible generalized least squares Feasible Generalized Least Square (FGLS) methods.

4 Estimation Results

To start with, Eqs. (6.1) and (6.2) are estimated as fixed-effect and random-effect models. The Hausman test suggests superiority and applicability of the fixed-effect model over its counterpart since probability of chi square is obtained as 0.0006 which leads to rejection of the null hypothesis of no systematic difference in coefficients of the two models.

Once the fixed-effect model is tested to be applicable, we check the possible existence of cross-sectional heteroscedasticity since every trading partner has a differential impact over trade relation with India and there is a fair chance of possible heterogeneity among the cross-sectional units, i.e., countries. Modified Wald test to test group-wise heteroscedasticity in panel data context shows that there is a high degree of heteroscedasticity among the cross-sectional levels. So we test the two models (Eqs. 1 and 2) as PCSE model and the absence of contemporaneous correlation of the error terms is tested with the help of Pesaran's test which suggests poor contemporaneous correlation of cross-sectional error terms. This particular finding supports the applicability of the PCSE model.

The estimates of the first equation are shown in Table 6.1, from which we can see that the estimated coefficients and their respective influence over the trade volume are

Table 6.1 Estimated coefficients of the first model

	Coefficients	Standard error	Z value	$p > \mathrm{I\,Z\,I}$	Confidence interval	
$ldis_{ij}$	– 0.0554969	0.0364087	−1.52	0.127	– 0.0158629	0.1268567
$lpop_{it}$	0.3684939	0.0869616	4.24			0.1980522
$Lpop_{jt}$	0.289156	0.0577158	5.01	0.000	0.6423419	
$lGDP_{it}$	0.4763637	0.0946438	0.000	0.5389355	0.661822	
$lGDP_{jt}$	0.647689	0.107056	6.05	0.000	0.2789651	0.6901256
D2	0.415815	0.0961075	4.33	0.000	0.2274477	0.6041822
D3	0.2952705	0.1038122	2.84	0.049	– 0.0581976	0.3487386
T_t	– 0.0253897	0.1765531	−0.14	0.000	– 0.3714274	0.320648
Constant	1.604799	1.218702	−1.32	0.188	– 3.99341	0.7838122

Here, the suffix i represents the trading nation and j represents India

in accordance with their expectation of the traditional gravity model. On an average, over the years, GDP of the home country (India) has greater impact on trade volume than its trading partners and it indicates that economy size of India has significant impact on trade since the Z statistic is very high.

Similarly, population size of both the nations has a statistically significant impact on trade volume. A 1 % increase in population size of India causes a 0.28 % increase in trade of India on an average. But a similar change in population of the trading partner has a greater impact than that of India. Since the model is in log-linear form, we interpret the coefficients as measures of elasticity. A 1 % change in India's GDP in turn makes a positive change of around 0.65 % in trade volume, whereas a similar change of the trading nation's GDP has a little smaller influence since the coefficient value is 0.4763. A positive sign of both the coefficients signify similar impact on trade volume between India and its trade partners. A possible economic rationale behind this might be the increasing demand for Indian products abroad which is propelled by the increasing market size of the trading partners.

One apparently astonishing finding is the impact of the distance variable which is no longer influential since it is not statistically significant, though it has marginal negative impact on trade volume (coefficient value is – 0.055 but Z value is not high enough). Over time, technological advancement has greater impact on trade and exchange across the globe and it reduces the transaction or shipping costs that used to affect the trade relation between nations which are spatially distant. Banerjee and Bhattacharya (2006) also found that India trades less with their neighboring nations compared to the other nations of the world.

Exchange rate regimes of the trading partners also play a significant role in determining their trade relation with India. We have broadly classified the exchange rate regimes of the trading partners into three categories. The first one covers the nations with independently floating or managed-floating exchange rate. The second one covers those nations which come under the fixed exchange rate regime or exchange arrangement with no legal separate tender, and the third one comprises the nations with crawling peg, etc. We have considered two dummy variables to capture the impact of exchange rate regimes. Dummy variable D2 incorporates the nations with exchange rate arrangement with no separate legal tender and in this

Table 6.2 Estimated coefficients of the second model

	Coefficients	Standard error	Z value	$p > \mathrm{I\,Z\,I}$	Confidence interval	
$\ln cGDP_{it}$	0.376754	0.198645	1.897	0.062	– 0.0651837	0.3465595
$\ln cGDP_{jt}$	0.467834	0.232456	2.015	0.051	– 0.067165	0.3556378
D2	0.399682	0.095028	4.205	0.000	0.2174482	0.5941876
D3	0.2852406	0.110712	2.576	0.045	– 0.0571872	0.3456389
T_t	– 0.0276748	0.1765531	– 0.1567506	0.000	– 0.3815276	0.320648

Other variables like population and distance are not tabulated, since they show a similar kind of impact on trade volume as shown in Table 6.1

case, the nation adopting such regimes implies the complete surrender of the monetary authorities' control over domestic monetary policy (e.g., Germany and Italy). D2 also incorporates the nations with fixed exchange rate regime (e.g., China) where the center has significant control over monetary policy. Another dummy D3 is used for the nation which has either floating exchange rate regime, where exchange rate is solely determined by the marker forces (e.g., developed countries like USA, UK, and Japan and emerging economies like Taiwan, etc.), or managed-floating exchange rate regime like India, where monetary authority directly or indirectly intervenes the foreign exchange market according to the need of the economy.

That India's trade potential is there with all the nations of both the groups of different exchange rate regimes as both the dummy coefficients show low p value but its potential with fixed and exchange rate arrangement with no legal tender countries is more prominent. Coefficients of the dummy D2 is highly significant since the corresponding p value is very low. But coefficient of the dummy D3 is marginally significant and it has lesser incremental impact on trade volume. Nations with fixed peg or exchange rate arrangement with no legal tender have an average positive impact of about 0.42 %, whereas that of floating or managed-floating exchange rate nations is only around 0.29 %. This reveals that India's trade potential with those nations is stronger than their counterparts. India's recent (last one decade) trade relation with nations like China, Saudi Arabia, and Kuwait supports the above finding. Since in the recent past developed nations (those under floating exchange rate regime along with some emerging economies like Thailand) have gone through some economic crises, even though their trade relation (trade volume) with India in absolute terms has increased on an average, growth rate has not been that impressive compared to the major trading partners belonging to the other regime.

The time dummy "T" which is introduced to capture the impact of the two major crises on trade volume shows expected signs. Occurrence of those crises had an adverse impact on trade and the coefficient has been statistically highly significant. On an average, the crises impacted 0.025 % of trade volume over the period under consideration.

In the second model, the per capita income of the trading partners as well as India is not observed which shows that the so-called level of development (as measured by per capita GDP) does not have any impressionable impact on trade, whereas economic mass (GDP) has significant impact which is inferred from the result of the first model. It can be seen from Table 6.2 that coefficients of cGDP of India as well as other nations are statistically insignificant because of their low Z value. Other factors like distance and population of both nations have retained the influence on trade and exchange rate regimes as it is observed from the first model.

5 Conclusion

The present chapter investigates the extent of empirical success of the traditional gravity model in explaining India's DOT with its major 25 trading partners from 1997–1998 to 2009–2010. The study employs the widely used regression model (PCSE) developed by Paris and Winstern, so as to get unbiased and robust estimates of the gravitational trade model. The empirical findings suggest that apart from expected influence of the traditional variables like GDP, population, etc., other factors like exchange rate regime and financial crisis also play a vital role in shaping the bilateral trade relation of India with its major 25 trading nations in the last decade. Factors like geographical distance and cGDP have not emerged as influential variables to affect the trade relation of the nation to a considerable degree, whereas nations under fixed exchange rate regime as well as fixed peg or exchange rate arrangement with no legal tender are found to have more potential to trade than the nations under floating or managed-floating exchange rate. The two major crises, namely the Asian crisis (1997) and the recent (2008) US housing market crash, are also found to a have profound negative impact on Indian trade relations with its partners. The study may be extended further and carried out at a disaggregated level to discriminate between import and export.

Appendix

Table 6.3 Exchange rate regimes of countries

Country	Exchange rate regime	Monetary policy target	Country	Exchange rate regime	Monetary policy target
Australia	Independent or floating	Inflation targeting framework	Brazil	Independent or floating	Inflation targeting framework
Belgium	Exchange arrangement with no separate legal tender	Euro area policy framework	China	Fixed peg	Exchange rate anchor
France	Exchange arrangement with no separate legal tender	Euro area policy framework	Germany	Exchange arrangement with no separate legal tender	Euro area policy framework
Hong Kong	Floating	Other	Iran	Crawling peg	Monetary aggregate target
Indonesia	Floating	Monetary aggregate target	Italy	Exchange arrangement with no separate legal tender	Euro area policy framework
Japan	Floating	Other	South Korea	Floating	Inflation targeting framework
Malaysia	Managed floating with no predetermined path of exchange rate	Other	Kuwait	Fixed peg arrangement against US dollars (2001 onwards)	Exchange rate anchor
Russia	Managed floating with no predetermined path for the exchange rate	Other	Taiwan	Floating or independent	Other
Thailand	Managed floating with no predetermined path for the exchange rate	Inflation targeting framework	Singapore	Managed floating with no predetermined path for the exchange rate	Other
Switzerland	Floating or independent	Other	Saudi Arabia	Fixed peg arrangement	Exchange rate anchor
UK	Floating or independent	Inflation targeting framework	USA	Floating or independent	Other
UAE	Fixed peg arrangement	Exchange rate anchor			

"Other" signifies that corresponding countries have no explicitly stated nominal anchor, but rather monitor various indicators in conducting monetary policy

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