International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

The Gravity Model of Trade: A Theoretical Perspective and Relevance for Exploring India's Global Trade Potential

Dr. Hiral Sheth, Assistant Professor, Department of Economics, Kishinchand Chellaram College, Churchgate, Mumbai-400020, Maharashtra, India

Abstract

Trade reforms formed an integral part of the comprehensive programme of structural reforms initiated in India in 1991-92. These reforms have led to a perceptible change in the performance of the external sector in India. This is evident from the increase in trade to GDP ratio in India. However, India's share in world trade is still very low and appears unimpressive when compared with other Asian countries such as China, Malaysia, Korea and Thailand . India's share in world trade is less than one per cent. In comparison, China corners about 5 per cent of world trade and Korea has a 2.5 per cent share in total world trade There is, therefore, a clear need to enhance the volume of India's trade with the rest of the world. In this context an estimation of India's trade potential is appropriate.

This paper aims to estimate trade potential for India using the gravity model approach. The gravity model is the workhorse of the applied international trade literature. Gravity model is one of the most popular empirical tools for modeling bilateral trade flows. The Gravity model, as in physics, analyses trade between countries through the geographical "distance" between the countries and their economic "size". Untapped trade potential is indicated in case India's trade with any country is less than that predicted by the gravity model. The policy implications associated with the findings of untapped trade potential would extend from the necessity of country specific trade promotion and bilateral integration to the need to anticipate relevant distributional changes due to the effect of the expansion in bilateral trade flows in the near future.

Keywords: gravity model, international trade, India, trade potential.

Introduction - The Gravity Model

The gravity equation is a simple empirical model for analyzing bilateral trade flows between geographical entities. The gravity model for trade is analogous to the Newtonian physics function that describes the force of gravity. The model explains the flow of trade between a pair of countries as being proportional to their economic "mass" (national income) and inversely proportional to the distance between them. The model has a lineage that goes back

to Tinbergen (1962) and Poyhonen (1963), who specified the gravity model equation as follows:

Tradeij = a. GDPi.GDPj / Distanceij ….. (1)

where Tradeij is the value of the bilateral trade between country i and j, GDPi and GDPj are country i and j's respective national incomes. Distanceij is a measure of the bilateral distance between the two countries and a is a constant of proportionality.

Taking logarithms of the gravity model equation as in (1) we get the linear form of the model and the corresponding estimable equation as:

Log (Tradeij) = a + b1 log (GDPi.GDPj) + b2log(distanceij) + uij…. (2)

Where a, b1 and b2 are coefficients to be estimated. The error term captures any other shocks and chance events that may affect bilateral trade between the two countries. Equation (2) is the core gravity model equation where bilateral trade is predicted to be a positive function of income and negative function of distance.

Theoretical Foundations

While the core gravity equation has been used for empirical analysis since the econometric studies of trade by Tinbergen (1962) and Poyhonen (1963), the theoretical foundations to the model are of more recent origin. The most classic and early application of the model to international trade was perhaps by Linnemann (1966).

Trade theorists have found the model to be consistent with theories of trade based upon models of imperfect competition and with the Hecksher – Ohlin model. Frankel (1997) credits Helpman and Krugman (1985) for the standard gravity model. The derivation of a proportionate relationship between trade flows and country size as given by Helpman do not include a role for distance. There are several reasons, though, for the inclusion of distance as an explanatory variable. Some of these explanations are as follows:

ÿ Distance is a proxy for transport costs

ÿ Distance is an indicator of the time elapsed during shipment. For perishable goods the probability of surviving intact is a decreasing function of time in transit

ÿ Synchronization costs: when factories combine multiple inputs, the timing of these needs to be synchronized so as to prevent emergence of bottlenecks. Synchronization costs increase with increasing distance.

ÿ Transaction costs: distance may be correlated with the costs of searching for trading opportunities and the establishment of trust between potential trading partners.

ÿ Cultural distance: It is possible that greater geographical distance is correlated with larger cultural differences. Cultural differences can impede trade in many ways such as inhibiting communication, clashes in negotiating styles etc.

Bergstrand's (1985) version of the imperfect substitute's theory incorporated a role for shipping costs, proxied in practice by distance. Deardorff (1995) has derived the gravity model from Hecksher-Ohlin theory. Deardorff shows that the gravity model can be derived from two extreme cases of the classical framework of the Hecksher-Ohlin model. The first case is frictionless trade, in which the absence of all impediments to trade in homogenous products causes producers and consumers to be indifferent among trading partners. Resolving this indifference randomly expected trade flows correspond exactly to the simple frictionless gravity equation if preferences are identical and homothetic or if demands are uncorrelated with supply and they depart from that equation systematically when there are such correlations. The second case is that different countries produce distinct goods, as in the H-O model with complete specialization. Expression for bilateral trade are derived, first with Cobb-Douglas preferences and then with constant elasticity of substitution preferences. Distance is included in the second of the two models.

Trade theories based upon imperfect competition and the Hecksher-Ohlin model justify the inclusion of the core variables –income and distance. Most studies have however, included additional variables to control for differences in geographic factors, historical ties and at times economic factors like the overall trade policy and exchange rate risk.

The particular theoretical model that best describes the empirical findings of the gravity model is a matter of contention. The main point, however, is that it seems possible to derive the gravity model equation from a variety of leading theories. The equation, it is often said, has gone from an amazing poverty of theoretical foundations to an embarrassment of riches!

The gravity model of international trade has a remarkably consistent history of success as an empirical tool. The elasticities of trade with respect to both income and distance are consistently high, signed correctly and statistically significant in an equation that explains a reasonable proportion of the cross-country variation in trade. It is to be noted however, that, in analyzing trade between country A and B, the gravity model makes no provision for third party effects i.e. the model does not take into account the conditions and opportunities that prevail between A and C and B and C.

Review of Literature

Among the many studies using the gravity framework, a high percentage shares the research task of predicting trade potentials. Rahman (2003) has estimated trade potential for Bangladesh using panel data approach with economic factors like openness, exchange rates etc rather than natural factors. Christie (2002) estimates trade potential for Southeast Europe using ordinary least square estimation on cross section data from 1996- 99. Kalbasi (2001) has analyzed the volume and direction of trade for Iran in a 76-country sample. The group of countries has been divided into developing and industrial countries and trade flows have been examined to determine the impact, if any, of the stage of development on bilateral trade.

Several studies have analyzed the trade enhancing impact of preferential trading arrangements. These studies predict the additional bilateral trade that would be a consequence of the economic integration of a set of economies. Both the cross section and panel data approach has been used by these studies. The cross-section as also the panel data approach is mainly static and refers to a long run relationship. Frankel (1997) has used the gravity model to investigate a host of issues like the estimates of trading blocs, role of currency links etc using cross-section and panel data. Frankel and Wei (1993) have examined bilateral trade patterns throughout the world and analyzed the impact of currency blocs and exchange rate stability on trade.

The most recently developed gravity model, by UNCTAD-WTO Trade Centre is *TradeSim.* This is being used for the estimation of trade potentials for countries with limited trade relations in the past, in particular transition economies. The model is in general being used to analyze the bilateral trade flows of developing countries with their trading partners.

Exploring India's Global Trade Potential with Gravity Model

Batra (2004) undertook an analysis of cross-sectional data consisting of India's trade for the year 2000.She used pooled OLS and used an augmented gravity model to find statistically significant positive effects of both GDP and regional trade groupings. She also incorporated a dummy variable for a common border between the two countries, in addition, and estimated that sharing a common border has a positive effect on trade, holding other factors constant. Using this model, she estimated India's trade potential with different countries, which revealed that India's trade potential has the highest magnitude with South-East Asian countries. Within specific country groupings/trade arrangements, she finds that India's trade potential is maximum with Pakistan in SAARC, with Oman, Qatar and Kuwait in the GCC, and with the Philippines and Cambodia in the ASEAN region.

Bhattacharya et al (2006) undertook a gravity model analysis for 177 countries with which India had trade relations at least once between 1950 and 2000. They found that the gravity model can explain about 43 to 50 per cent of the fluctuations in India's trade and that India's trade responds less than proportionally to size and more than proportionally to distance. They explored the effect of having a common coloniser, using the common language as a dummy variable, and found that it has a significant positive effect. They estimated that India's trade is more with developed nations rather than developing trading partners.

Conclusion

The research paper tries to build on a theoretical foundation of the gravity model. It has been known since the seminal work of Jan Tinbergen (1962) that the size of bilateral trade flows between any two countries can be approximated by a law called the 'gravity equation' by analogy with the Newtonian theory of gravitation. Just as planets are mutually attracted in proportion to their sizes and proximity, countries trade in proportion to their respective GDPs and proximity.

References

1.Batra, Amita. 2006. "India's Global Trade Potential: The Gravity Model Approach." Global Economic Review 35 (3): 327–61.

2.Bergstrand, Jeffrey H. (1985) "The gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence". Review of Economics and Statistics 71, no. 1.

3.Bhattacharyya, R. & Banerjee, T (2006). Does the gravity model explain India's direction of trade? A panel data approach. Research and Publication Department, IIMA.

4.Christie, Edward (2002) "Potential Trade in Southeast Europe: A Gravity Model Approach", WIIW Working Paper No. 21.

5.Deardorff, Alan (1995) "Determinants of Bilateral Trade: Does Gravity Work in a Classical World?", paper presented at conference on The Regionalization of the World Economy, NBER, Woodstock, Vermont.

6.Frankel, Jeffrey A (1997) " Regional Trading Blocs", Institute for International Economics.

7.Frankel, Jeffrey and Shang-Jin Wei (1993) "Trade Blocs and Currency Blocs", Working Paper No. 4335, NBER, Cambridge, MA.

8.Helpman, Elhanan and Paul R. Krugman (1985) " Market Structure and Foreign Trade: Increasing Returns, Imperfect competition, and the International Economy", Cambridge: MIT Press.

9.Kalbasi, Dr. Hassan (2001) " The Gravity Model and Global Trade Flows", Paper in the Conference of EcoMod, Washington DC.

10.Poyhonen, Pentti, (1963) " A Tentative Model for the Volume of Trade Between Countries", Weltwirtschaftliches Archiv 90.

11.Rahman, Mohammad Mafizur (2003) " A Panel Data Analysis of Bangladesh's Trade: The Gravity Model Approach". University of Sydney.

12.Tinbergen Jan (1962), "An Analysis of World Trade Flows: in Shaping the World Economy, ed. by Jan Tinbergen, New York, The Twentieth Century Fund.