# Analyzing the Economic Liberalization of 1991 : A Gravity Model approach

Gaurav Raj , 200378

***Abstract*—Economic liberalisation in India occurred in 1991 in response to a protracted economic crisis characterised by rising inflation, stalled growth, and an unsustainable balance of payments. The liberalisation that occurred in 1991 resulted in the opening of the market to foreign competition, which enhanced efficiency and innovation. The liberalisation led to an increase in India's exports and imports as well as a diversity of its trade partners. Using a simplified version of the popular gravity with gravitas model of Anderson and van Wincoop (2003), we test this claim in the Indian context. We collect panel data on India's top trading partners from World Bank and IMF websites and run panel regression on this dataset. The results suggest that India's exports and imports increased significantly after the liberalisation of 1991. Distance and GDP continue to influence bilateral commerce between India and its trading partners, both before and after the liberalisation programme, according to the study. Other effects as a common language and having a common border also effect this trade, however, quite differently that we hypothesized.**

***Index Terms*—Liberalization, Trade, Gravity model**

## I. Introduction

PRIOR to 1991, India's restrictive trade policies and regulations had resulted in a closed and protected market which hindered the growth of economy and development in the industrial sector, as Indian manufacturers were almost monopolistic in their respective sectors. The liberalization of 1991 opened the markets to foreign competition and dismantled the aforementioned restrictions and reduced tariffs. This led to increased efficiency and innovation as a result of the improved access to technology, capital and markets. The post 1991 period was marked by the following :

**Increase in trade :** Bhattacharya and Bhattacharya (2015) found that the liberalization was marked by a significant increase in exports and imports, as well as an increase in foreign direct investment.

**Increase in competitiveness :** Kaur and Kumar (2017) found that liberalization led to increase in competitiveness of Indian firms, as they were forced to adapt to the changing market conditions and compete with foreign firms. The study found that the liberalization policy led to an increase in the productivity and efficiency of Indian firms, as well as an improvement in their technological capabilities.

**Non-uniform proliferation :** Adam and Bevan (2003) note that economic liberalization has had a positive impact on economic growth, but the effect is not uniform across all sectors. It also notes that there is a need for further reforms to sustain and deepen India's growth.

Of these, we seek to quantitatively verify the first; i.e., has the trade in India increased with introduction of the 1991 reforms. We do so using a mixture of the intuitive gravity model and one proposed by Anderson and van Wincoop(2003), essentially introducing a new measure of multilateral resistance. The gravity model is a widely used framework in international trade analysis that examines the determinants of trade flows between countries. The model is based on the assumption that trade flows are determined by the economic size of the trading partners and the distance between them. The gravity model has been used to analyze the impact of various factors on trade flows, including trade agreements, exchange rate regimes, and infrastructure.

The gravity model is particularly well-suited for analyzing the impact of economic liberalization on trade flows. The liberalization of the Indian economy in 1991 led to a significant increase in foreign investment, which in turn led to an increase in trade flows. By examining the determinants of trade flows using the gravity model, this paper aims to provide insights into the impact of economic liberalization on India's trade patterns.

## II. Background

After attaining independence in 1947, the Indian economy was heavily regulated and shielded from foreign competition for several decades. The government pursued a policy of import substitution industrialization (ISI) to promote domestic industries by safeguarding them from foreign competition through tariffs and import restrictions. This policy resulted in the expansion and diversification of the industrial sector, but at the expense of inefficiency, low productivity, and lack of competitiveness.

By the end of the 1980s, the Indian economy was beset by significant economic issues, including a balance of payments crisis, rising inflation, and a substantial fiscal deficit. To resolve these issues, the government was compelled to seek assistance from the International Monetary Fund (IMF) and implement a series of economic reforms. The reforms included an economic liberalisation, deregulation of industries, reduction of tariffs and import restrictions, and a transition towards a more market-based economy.

1991's economic liberalisation marked a significant turning point in India's economic history. The reforms resulted in an

increase in economic growth, industrial expansion, and foreign investment. The liberalisation of the economy also resulted in a transition towards a market-oriented economy that places a greater emphasis on private enterprise and competition.

## III. Literature Review

Although there have been a multitude of papers in the general sense of exploring the trade and growth impacts of the Liberalization policy, they few rely on the gravity model to do so. Bhagwati and Pangariya (2002) and Ahluwalia (2001) use descriptive methods and secondary sources to analyze the impacts of the reforms and give conceptual frameworks to illustrate and confirm their arguments.
Adam and Bevan (2003) use econometric techniques to estimate the relationship between economic liberalization and economic growth, using a time-series data set spanning the period from 1950 to 1997. However, their model is far from the gravity model we propose, instead, they use a growth accounting framework to estimate the contributions of capital, labor, and total factor productivity to economic growth, and then assess the impact of economic liberalization on each of these factors. Raj and Sen (2001) use panel data methods to estimate the effect of economic reforms on productivity growth and profitability in the Indian manufacturing sector.

In recent years, however, there has been an inclination to use one of the many varieties of the gravity model, proposed originally by Tinbergen(1962), who first proposed the model to explain the bilateral trade flows between countries. The gravity model Baldwin and Harrigan (2011), derived the model from basic economic theory and showed how it can be used to analyze the determinants of bilateral trade flows. Head and Meyer (2014) proposed a new estimation method that accounts for the frequent occurrence of zero trade flows in bilateral trade data, as the traditional gravity model fails when the trade flow between nations is zero.
Anderson and van Wincoop (2003) propose a new approach to estimating the gravity model, which addresses the ”border puzzle” - the fact that many bilateral trade flows are zero or near-zero despite the absence of physical or policy barriers to trade. In their work, they introduce multilateral resistance, where the authors suggest that trade costs between two countries not only directly affect their bilateral trade flows but also indirectly affect their trade with other countries. This is because trade costs affect the relative prices of goods and services, which in turn affect demand and supply for these goods and services in other countries.

Urata and Okabe (2010) use the gravity model to find that FTAs have a positive and statistically significant impact on trade flows, although the magnitude of the impact varies depending on the type of FTA and the countries involved. They also that the impact of FTAs on trade flows is greater for countries with smaller economies and greater geographical distance. Similarly, Kien (2009) analyzes the Free Trade Agreement between ASEAN countries, the AFTA using the gravity approach and concludes that the AFTA has had a positive and statistically significant impact on trade flows between member countries.

Guiso, Sapienza and Zingales (2008) use the gravity with gravitas model to analyse the effect of culture and economic behavior and argue that cultural differences can significantly affect economic outcomes. Jacks and Pendakur argue that the maritime revolution that introduced steamships and decreased the cost of trade along with an increase in reliability in shipping facilitated global trade in the past two centuries tremendously. Giovanni and Levchenko (2009) explore trade openness and volatility using Anderson and van Wincoop's model. They use a combination of theoretical models and empirical data to explore this link and hypothesize that increased trade openness can lead to both higher and lower levels of macroeconomic volatility, depending on the specific characteristics of a country's economy and its trade relationships.

The effects of liberalization on trade itself has not been as widely studied, however, there have been some discussions of trade liberalizations and FTAs on other socio-economic aspects. George (2010) challenges the advocates of liberalization and argues that it has contributed to increasing inequality, environmental degradation, and social unrest around the world. Similarly, Robbins (2003) reviews the effects of liberalization on inequality in developing countries, and concludes that while the effects on inequality have been mixed, it may be because of the different implementations of these policies in different countries.

## IV. Methodology

To study the effects of Liberalization, we will borrow concepts from the intuitive gravity model and Anderson and van Wincoop's model. Here, we document the route through which we get there. In this section, we will first look at the intuitive gravity model given by Tinbergen (1962), and then move on to Anderson's model, concluding with our modified model and the specifications of each variable.

### A. *The Intuitive Gravity Model*

The traditional gravity model assumes that the volume of trade between two nations is directly related to the size of their respective economies and inversely proportionate to the distance between them.

According to the physical principles, the force of attraction between two things is directly proportional to their mass and inversely proportional to their distance. In economics, it is hypothesized that larger economies exert a stronger pull on commerce, whereas bigger distances operate as a disincentive to trade.

The traditional gravity model can be written in the mathematical form as follows :

$$T_{ij} = k * (GDP_i)^{b_1} * GDP_j{}^{b_2} / (D_{ij})^{b_3}$$

where
$T_{ij}$ = Trade volume between the two countries i and j
$k$ = a constant
$GDP_i$ = GDP of country i
$D_{ij}$ = Distance between country i and j

In the log linearized form, this can be written as follows :

$$\ln T_{ij} = b_0 + b_1 * \ln GDP_i + b_2 * \ln GDP_j - b_3 * \ln D_{ij} + e_{ij}$$

, where $e_{ij}$ is the stochastic error term.

The purpose of this econometric task is to estimate the unknown b parameters. Ordinary least squares (OLS) is the econometric counterpart of lines of best fit, which are used to demonstrate the relationship between trade and GDP or trade and distance.

However, on further analysis, it is clear that some spects of this equation are flawed. For instance, suppose countries I and k sign a preferential trade agreement that reduces tariffs on their respective goods. Even though country j is not a signatory to the agreement, economic theory predicts that such a move could have an effect on its commerce. Indeed, these are evident in real world examples of trade creation and diversification. However, this does not appear in the intuitive model. Hence there is a need for a better model.

### *B. Anderson and van Wincoop's model*

Issues with the traditional gravity model calls for structural changes in the model to account for these issues. Perhaps the most famous work in this direction has been that by Anderson and van Wincoop (2003), whose model is given as follows :

$$\ln T_{ij} = \ln Y_i + \ln Y_j + \ln Y + (1-\sigma) * (\ln \tau_{ij} - \ln \Pi_i - \ln P_j)$$
$$\Pi_i = \Sigma (\tau_{ij}/P_j)^{1-\sigma} * Y_j/Y$$
$$P_j = \Sigma (\tau_{ij}/\Pi_i)^{1-\sigma} * Y_i/Y$$
$$\ln \tau_{ij} = b_1 * \ln D_{ij} + b_2 * lang + b_3 * bor$$
$$Y = \Sigma Y_i$$

Where
$Y_i$ represents GDP of country i
$\sigma$ is the elasticity of substitution, and
$\tau_{ij}$ represents the trade costs, which include the distance ($D_{ij}$) variable and the dummies *lang* and *bord*, which are 1 if the countries share a common language and border, and 0 otherwise.

A modified version of this can be obtained by grouping together the i and j terms together. The resultant equation is as follows :

$$\ln T_{ij} = C + F_i + F_j + (1-\sigma) * (\ln \tau_{ij})$$
$$C = -logY$$
$$F_i = \ln Y_i - \ln \Pi_i$$
$$F_j = \ln Y_j - \ln P_j$$
$$\ln \tau_{ij} = b_1 * \ln D_{ij} + b_2 * lang + b_3 * bor$$

We will use a similar model for the purpose of our estimation.

### *C. Our Model*

We retain the basics of the above model in our estimation. Specifically, since we are considering only the top 10 trading partners of India, namely USA, China, Saudi Arabia, UAE, Malaysia, Germany, Hong Kong, Indonesia, South Korea and Russia, we create the GDP, distance, common language, common border and country fixed effects variables for each of these and define the following model :

$$\ln T_{jt} = b_0 + b_1 * \ln D_{ij} + b_2 * lang + b_3 * bor + b_4 * \ln GDP_i + b_5 * \ln GDP_j + b_6 * libn + b_7 * \alpha_j + e_{ijt} \quad (1)$$

where

$T_{jt}$ is the trade volume of India with country j
($D_{ij}$) is the distance variable and the dummies *lang* and *bor* are 1 if the countries share a common first language and border, and 0 otherwise.
$GDP_i$ = GDP of country i
$\alpha_j$ is the multilateral resistance with the jth country, calculated as

$$\alpha_j = \Sigma_{k \neq j} {GDP_k}^{\sigma} * D_{ik}^{\nu}$$

where $\sigma$ = 0.5 and $\nu$ = -0.5 $libn$ is the dummy variable for liberalization (0 before 1991 and 1 afterwards).

One may perhaps question the arbitrary assignment of $\sigma$ to 0.5 and $\nu$ to -0.5, but I will attempt to explain them briefly after explaining this choice of the multilateral resistance term.

The gravity model allows us to hypothesize trade is a direct function of GDP of partner countries and an inverse function of the distance between them. Through the $\alpha_j$ term, which happens to be a proxy for the multilateral resistance term, we wish to capture the effects of trade of India with other countries on our target partner country. This, as explained earlier, can be written as the sum of trade proxies with all other countries, which is essentially what the $\alpha_j$ term is. This then explains the positive exponent of the GDP term of the partner country and a negative exponent for the distance with the same country. The particular choice of values of these exponents, it turns out, does not matter as long as they are suitably close to 1.

### Dataset Preparation

GDP and Trade data on the top 10 trading partners of India aforementioned (based on the total volume of trade) was collected using the International Monetary Fund and World Bank websites. Distance, language and border data was used from Wikipedia. It must be noted that China only implies mainland China and excludes Taiwan and Hong Kong. Our data is thus a strongly balanced panel data with 41 years of

observations for 10 countries. Using the formula for $\alpha_j$, a column for the same is then created and codes in R run.

The obvious hypothesis from our discussion about the reforms and the gravity equation of total trade would be a positive and significant coefficient for the dummy **libn**, which would indicate that the reforms of 1991 did actually impact trade in India. I would like to reserve my judgements for the multilateral resistance variable of each country for the empirical analysis. The coefficients of GDP and distance are both expected to be significant, although differing in signs. I would also expect a positive coefficient for the variable lang and bor.

The **'plm'** library in R is used for running a panel regression on our dataset and arriving at the results. To decide between fixed effects and random effects regression, Hausman test is run, which gives a p-value of 0.97. This indicates a strong preference to use the random effects model. The code snippet for the panel regression is mentioned as follows :

```
> #converting the distance variable to a numeric type
> data$Distance..in.km. <- gsub("\\$|,", "", data$Distance..in.km.)
> data$dist <- as.numeric(data$Distance..in.km.)
> #defining the log variables
> data$T <- log(data$Total..in.mn..USD.)
> data$GDPi <- log(data$GDP.India.)
> data$GDPj <- log(data$GDP.country.)
> data$Dij <- log(data$dist)
> #creating a panel data
> pdata <-pdata.frame(data, index = c("Country", "Year"))
>
> #fitting a random effects model
> re <- plm(T ~ GDPi + GDPj + Dij + Libn + Lang + Bor + MR_final, data  = pdata, model = "random")
```

Fig. 1. Code Snippet for Panel regression

## V. Results

Based on the conclusion and procedure from the section above, we run a pooled and random effects regression on our model, whose results are given as follows:

```
Residuals:
      Min.    1st Qu.     Median    3rd Qu.       Max.
-3.9995286 -0.3377389  0.0044265  0.3607190  2.1274871

Coefficients:
             Estimate Std. Error z-value  Pr(>|z|)
(Intercept) -9.544538   6.655242 -1.4341  0.151533
GDPi         1.856490   0.259301  7.1596 8.092e-13 ***
GDPj         0.609216   0.101037  6.0296 1.643e-09 ***
Dij         -1.634598   0.716919 -2.2800  0.022606 *
Libn         0.376342   0.130700  2.8794  0.003984 **
Lang         1.767933   0.974679  1.8139  0.069699 .
Bor         -2.562741   0.634140 -4.0413 5.316e-05 ***
MR_final    -0.099110   0.033077 -2.9963  0.002733 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    1609.3
Residual Sum of Squares: 227.87
R-Squared:      0.85841
Adj. R-Squared: 0.85594
Chisq: 2437.09 on 7 DF, p-value: < 2.22e-16
```

Fig. 2. Random Effects Regression Results

A brief summary of these results is as follows :

- The coefficients for GDP of both India and the partner country are positive and significant.
- Coefficient for Distance is negative and significant .
- Liberalization has a positive and significant coefficient, thus proving our hypothesis and demonstrating that trade was indeed positively affected by the policies of 1991.
- Language turns out to be positive but insignificant, and counter-intuitively, border turns out to be significant but negatively related with trade.
- The Multilateral Resistance term coefficient is negative and significant.

The results of the pooled OLS model are as follows:

```
Residuals:
     Min.   1st Qu.    Median   3rd Qu.      Max.
-3.998942 -0.513282 -0.030085  0.607134  2.190466

Coefficients:
             Estimate Std. Error  t-value  Pr(>|t|)
(Intercept) -12.775461   3.685775  -3.4662 0.0005849 ***
GDPi          1.974572   0.270287   7.3055 1.498e-12 ***
GDPj          0.471219   0.067644   6.9661 1.338e-11 ***
Dij          -1.234572   0.251541  -4.9080 1.339e-06 ***
Libn          0.394652   0.151867   2.5987 0.0097026 **
Lang          1.763000   0.252412   6.9846 1.190e-11 ***
Bor          -2.280131   0.198836 -11.4674 < 2.2e-16 ***
MR_final     -0.092487   0.038558  -2.3986 0.0169117 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    1940.2
Residual Sum of Squares: 317.61
R-Squared:      0.8363
Adj. R-Squared: 0.83345
F-statistic: 293.393 on 7 and 402 DF, p-value: < 2.22e-16
```

Fig. 3. Pooled OLS Results

These results suggest that :

- The coefficients for GDP of both India and the partner country are positive and significant.
- Coefficient for Distance is negative and significant .
- Liberalization has a positive and significant coefficient, thus proving our hypothesis and demonstrating that trade was indeed positively affected by the policies of 1991.
- Language turns out to be positive and significant, and border again turns out to be significant but negatively related with trade.
- The Multilateral Resistance term coefficient is negative and significant.

It must be noted that the Random Effects and Pooled OLS models are very similar to each other in terms of coefficient values and significance. The only notable exception to this is the language term. We discuss the implications of these results in the following section.

## VI. Discussion

Although we have used both the Random effects and Pooled OLS models, it must be noted that the Pooled OLS model is more effective when the individuals in a panel are different across the time coordinates. However, since we are analyzing the same countries across all the years, it would make more sense to discuss the results of the random effects model.

With this discussion concluded, we move on to discuss the coefficients and significance of our individual variables.

It is clear that the GDP terms, both of India and the partner country have positive and significant coefficients. This is expected, as this confirms to the very basic tenet of the gravity model where trade is positively related to GDPs of the participating countries. The extremely low p-value suggests a high significance of these terms.

Another obvious and expected result is the coefficient of the Distance term, that turns out to be negative and significant. Indeed, this is in line with the intuitive gravity model which implies an inverse relation with the distance term. Our model has thus been very faithful to the gravity model till now.

Further, the coefficient for language turns out to be positive by not significant. This would imply that cultural effect, though positively related, are not significant to the bilateral trade between countries. On the other hand, having a common border turns out to be negatively significant, which is perplexing to say the least. Indeed, we would expect that a common border would facilitate trade between countries due to the logistical ease. We must then, therefore, account for these results either by assessing our dataset or proposing possible reasons for this anomaly.
It should be noted that the only country with a common border in our dataset is China, relations of India with whom have been tumultuous to say the least. Additionally, having a common border can more often than not lead to boundary disputes that can sour relation between countries and force exhibition of this negative trade correlation. Other possible reasons for this negative correlation can be subject to future research. The MR term has a negative and significant coefficient, which would posit that increasing trade with all other countries apart from the target country is dilutive to trade with the target country.

The most crucial result, however, has been that of the liberalization term, that turns out to be positive and significant. This validates this paper's hypothesis that liberalization was indeed accretive to trade flows in India post 1990. The significance level is satisfactory, but not too high, which would suggest that liberalization, though important, has neither been the only cause for the increased trade flow nor the most important.

## VII. Conclusion

By using an amalgamation of concepts from the intuitive gravity model and the gravity with gravitas model, we have tested the effect of liberalization on the trade flows between India and its top partner countries. In the process, we established and validated the basic gravity model and found that GDP of partner countries has a direct relation to bilateral trade and distance between the countries has an inverse relation. We also found that culture plays a role in trade between countries and border plays an important role as well, however, a negative one. Finally, we validate our initial hypothesis and establish that the Economic Liberalization of 1991 indeed positively affected trade in India.

## VIII. References

1) Jeffrey Frankel and Andrew Rose, "An Estimate of the Effect of Common Currencies on Trade and Income", The Quarterly Journal of Economics, Volume 117, Issue 2, May 2002, Pages 437–466
2) Luigi Guiso, Paola Sapienza and Luigi Zingales, "Cultural Biases in Economic Exchange?", The Quarterly Journal of Economics, Volume 124, Issue 3, August 2009, Pages 1095–1131
3) David S Jacks and Krishna Pendakur , "Global Trade and the Maritime Transport Revolution", The Review of Economics and Statistics (2010) 92 (4), Pages 745–755
4) Julian di Giovanni and Andrei A. Levchenko , "Trade openness and volatility ", The Review of Economics and Statistics , August 2009, Vol. 91, No. 3 (August 2009), pp. 558-585
5) James E. Anderson, Eric van Wincoop, "Gravity with Gravitas: A Solution to the Border Puzzle", The American Economic Review, Vol. 93, No. 1 (Mar., 2003), pp. 170-192
6) Maria Cipollina , Luca De Benedictis , Luca Salvatici , Claudio Vicarelli, "Policy Measurement and Multilateral Resistance in Gravity Models", Nov 2016, MPRA Paper No. 75255,
7) Nguyen Trung Kien, "Gravity Model by Panel Data Approach: An Empirical Application with Implications for the ASEAN Free Trade Area", ASEAN Economic Bulletin, Vol. 26, No. 3 (December 2009), pp. 266-277
8) Scott L. Baier , Jeffrey H. Bergstrand, "Estimating the effects of free trade agreements on international trade flows using matching econometrics", Journal of International Economics 77 (2009) 63–76