# A Panel Data Regression Analysis of Trade, Gender and Textiles in an Indian Context

*Kanupriya**

This study aims at understanding the nuances of the linkages among the variables of GDP, Gender Equality/Inequality, Investment, Trade (Exports and Imports) and Population Growth using panel data analysis. It locates the Indian textile sector within a group of nations —- South Asia, the top developing country textile exporters, the top developed country textile exporters and the top ten textile exporters in the world, thereby rendering a global flavour to this paper. The period of analysis is from 2006-16. The broad conclusion of this study pertains to the positive influence of gender equality, investment and exports on the GDP of a nation, while population growth and gender inequality affect the same negatively. All in all, this paper is a useful source for further analysis on any theme involving the intersection of trade, gender and labour-intensive industries. It serves as a good reminder for policy stakeholders in the domain to mitigate gendered inequalities and boost exports so as to augment economic growth by creating a gender-friendly environment in the industrial sphere.

***Keywords:*** Gender; Indian Textile Sector; Panel Data Analysis; Trade.

## 1. Introduction

THE paper is centred on panel data analysis. It aids in an improved understanding of the effect of gender inequality, textiles exports, population growth and grossfixed capital formation on the Gross Domestic Product (GDP) of a country, here, India relative to a group of nations — South Asia, the top developing country textile exporters, the top developed country textile exporters and the top ten textile exporters in the world. The key notion behind undertaking this analysis is to situate the issue of gender and growth in a single frame. The objective is only to locate the relative importance of gender and trade factors in a nation's GDP growth and set the framework of analysis for subsequent researchers in the domain.

Prior to any further explanation, a short description of the technique of panel data is elicited. Panel data is a combination of cross-sectional and time series data, with the same units being observed over a period of time. These units could be individuals, states, countries or firms. It allows a researcher to control for variables and factors that cannot be measured or observed. It accounts for individual heterogeneity. However, the panel data analysis faces some drawbacks such as the design collection issues i.e. the sampling design and survey and non-response in the surveys (DSS, Princeton University, 2018).

A typical panel data equation could be written and described as follows.

$Y_{it} = \alpha_i + \beta x_{it} + u_{it}$, $i = 1,\ldots, N$ and $t = 1, \ldots T$, where $x_{it}$ is a $K \times 1$ vector of regressors, $\beta$ is a $K \times 1$ vector of parameters to be estimated, and $\alpha_i$ represents time-invariant individual nuisance parameters. Under the null hypothesis, $u_{it}$ is assumed to be independent and identically distributed (i.i.d.) over periods and across cross-sectional units. Under the alternative, $u_{it}$ may be correlated across cross sections, but the assumption of no serial correlation remains (Hsiao *et al.*, 2000).

Broadly, there are three widely used methods of panel data analysis, viz:

(a) *Fixed Effects Model:* Used to control for time-invariant characteristics of the predictor variables on the outcome variables. These time-invariant characteristics are unique to

* Assistant Professor in Economics (Guest), Sri Aurobindo College (Day), University of Delhi.

each individual and are not correlated to other individual characteristics. If the error terms are correlated, then one may have to remodel using the random effects model. The error term does not vary stochastically across time (Hsiao *et al*., 2000).

(b) *Random Effects Model:* When the variation across entities is random of the predictor variables of the model. If the differences across entities have any bearing on the dependent variables, then random effects must be used. Accounts for the serial correlation due to unobserved time-invariant attributes. May lead to omitted variable bias and some of the perceived influencing variables may not be available. The error term varies stochastically over time (Hsiao *et al.*, 2000).

(c) *Pooled OLS Model:* Applied when there are no unique attributes of the units of measurement and no universal effects across time (Hsiao *et al*., 2000).

(d) Some other vital terms to be used in the subsequent section, shall be the Pesaran Cross-Sectional Dependence Test (CD) and the Breusch-Pagan Lagrange Multiplier Test.

(i) Pesaran Cross-Sectional Dependence Test (CD)

$2n\ (n\text{-}1)\ \sqrt{}\ (\Sigma_i=1n-1\Sigma_j=_i+ 1nT_{ij}---\sqrt{}\rho_{ij})$

In other words, CD2n (n–1) (Σi=1n–1Σj=i+1nTijρ^ij) based on $\rho_{ij}$ $\rho_{ij}$ without squaring (also distributed as a standard normal) is appropriate both in n*n and in T*T–asymptotic settings. It has remarkable properties in samples of any practically relevant size and is robust to a variety of settings. The only big drawback is that the test loses power against the alternative of cross-sectional dependence if the latter is due to a factor structure with factor loadings averaging zero, that is, some units react positively to common shocks, others negatively (Hsiao *et al*., 2000).

(ii) Breusch Pagan Lagrange – Multiplier Test

The Breusch-Pagan test fits a linear regression model the residuals of a linear regression model (by default the same explanatory variables are taken as in the main regression model) and rejects if too much of the variance is explained by the additional explanatory variables (CRAN, 2018).

This paper has employed the panel data technique to better capture the nuances of the available statistics. It is a widely held belief that panel data analysis scores over cross-sectional or time series study in so far as it seeks to improve the understanding of individual dynamics. By blending the inter-personal differences and intra-individual dynamics, the panel data analysis outperforms the cross-sectional or time-series studies.

Some of these advantages may be elicited as below:

(a) *More Accurate Inference of the Model Parameters:* Owing to greater degrees of freedom and sample variability, the panel data estimates are more efficient (Hsiao *et al*., 2000).

(b) *Controlling the Impact of the Omitted Variables:* Panel data contain information on both the inter-temporal dynamics and the individuality of the entities that may allow one to control the effects of missing or unobserved variables (Hsiao *et al*., 2000).

(c) Generating more accurate predictions for individual outcomes by pooling the data rather than generating predictions of individual outcomes using the data on the individuals in question. The panel data provide an opportunity of learning an individual's behaviour by observing the behaviour of others (Hsiao *et al.,* 2000).

Another important issue that needs to be addressed is regarding the classification of panel data analysis into three broad heads of India within the South Asian Region, India within all the Top Textiles Exporters and India within the Developing Country Group of Top Textiles Exporters. The rationale for doing so involves analysis of the Indian textiles sector within a gender, trade and Gross Domestic Product (GDP) framework *viz-a-viz* the other textiles exporters, be it in the South Asian region or globally.

The paper is divided into the sections. The *first* introduces the

theme of the study. The *second* undertakes a brief review of literature. The *third* elicits the methodology of the paper. The *fourth* discusses its key results, contributions and limitations. The *last* section concludes the study as also gives its future policy implications.

The next segment gives a brief review of literature on the theme.

## 2. Review of Literature

This section describes the theoretical underpinnings of the panel data variables. The Gender Gap Index Score (GGIS) is a comprehensive measure of gender inequality across countries. It measures the performance of countries on some key indicators, namely, health, education, economy and politics to gauge the state of gender equality in a country. It measures women's disadvantage compared to men, and is not strictly a measure of equality in any nation. The variables of average values of export and import (AEXP and AIMP) depict the trade scenario in the Indian textiles sector. Exports should be deemed as a better measure of trade in the textiles sector. The Gross Fixed Capital Formation (GFCF) could be taken to be a measure of investments in the economy. The population growth (PG) variable is believed to affect the GDP variable negatively as per theoretical exposition, especially for developing economies like India (Dyson, 2010). Export growth exerts a significant positive effect on the economic/GDP growth (Ghosh and Ramanayake, 2017).

The analysis in this paper shall help us reach the research hypothesis as desired. The condition of women, trade (exports), GDP and population growth and GFCF are all closely related concepts that partially answer the first research question and hypothesis, albeit in a circular manner, via the impact of textile exports and gender inequality on the GDP growth of a nation.

As explained in Stotsky (2006), Lee and Kim (2009), Elborgh-Woytek *et al.* (2013), Ramanayake and Lee (2015), Hakura *et al.* (2016) (all as quoted in Ghosh and Ramanayake, 2017), GDP is negatively affected by gender gap and population growth but positively impacted by GFCF and exports.

The primary research objective of this paper is to assess the socio-economic impact of trade on the textile women workers in India.

The next section explains the methodology employed in this study.

## 3. Methodology

This analysis estimates the following panel equation.

$$Y_{it} = \alpha_1 + \beta_1 AEXP_{it} + \beta_2 AIMP_{it} + \beta_3 GGIS_{it} + \beta_4 PG_{it} + \beta_5 GFCF_{it} + e_{it}$$

Where, GDP or $Y_{it}$ is the dependent variable. Gender Gap Index Score (GGIS), Average values of Indian textiles exports and imports (AEXP and AIMP), Population growth (PG) and Gross Fixed Capital Formation (GFCF) are the independent variables and $e_{it}$ is the error term. This is to capture the impact of independent variables on GDP of the country, across a vast cross section of different nations, over a period of time from 2006 to 2016, keeping in line with the traditional GDP growth models.

All the values are in logarithmic form to estimate the variables in terms of growth. Also, year and country dummies are not required for this equation since, this is a simplistic analysis of the impact on GDP growth of different variables across a set of countries over a period of time, not with particular reference to any year or country. Technically speaking, the *control variables* are AEXP and GGIS as far as this panel analysis is concerned. The rest are other explanatory variables only secondary in importance as far as the objective of this study is involved.

GDP as the dependent variable places the issue of women and trade at the broader level, setting the tone for specific analysis at later stages. Ultimately, the overall objective of socio-economic empowerment of women is to enhance growth as well as promote empowerment for its own intrinsic sake, given the primacy of the textiles sector in the Indian economy in terms of its share in employment generation, GDP and share in total exports.

As the focus of this study is on Gender and Textiles Trade, the model in the panel data analysis focuses on the same, by incorporating Gender Gap Index, Average Value of Textiles Exports and Imports, Gross Fixed Capital Formation as a proxy for technological upgradation and Population Growth as a proxy for the reproductive rights of women as independent variables. This is in accordance with the theme of this paper as it seeks to place women

within a trade-oriented textiles economy as far as their socio-economic condition is concerned. As per traditional economic theory, any positive human capital formation say in terms of gender emancipation, productivity-augmenting technological upgradation, exports and imports (by way of value-added to the GDP via exports and imports) and lessening of population growth shall serve the GDP well. As per traditional Malthusian theory, growth in population shall serve to reduce the per capita availability of resources, thereby straining the performance on the GDP growth front. Studied from that perspective, population growth could have a negative bearing upon GDP. Also, societies with greater reproductive rights and choices for females tend to have lower population growth rates, thereby providing the link between gender and GDP. Clearly, the conceptualization of the panel data equation in terms of expenditure (including GFCF, AEXP and AIMP) and human capital formation (including PG and GGIS) approaches to measure GDP justifies the theme in line with the basics of valuing GDP.

The selection of the time period needs an explanation. The year 2006 has been chosen keeping in view the unavailability of the Gender Gap Index Scores (GGIS) of the World Economic Forum (WEF) prior to the year 2006. Data for GDP, GFCF and Population Growth are from WDI; that for GGIS is from the Global Gender Gap Report and for

***TABLE 4.1***

**PANEL DATA RESULTS**

| Variable/Statistic | Estimates (India in South Asia inclusive of both AEXP and AIMP) Fixed Effects Model | Estimates (India in South Asia excluding AIMP) Fixed Effects Model | Estimates (India within all the Top Ten Textiles Exporters) pooled OLS Model | Estimates (India and other Developing Country Textiles Exporters Fixed Effects Model |
|---|---|---|---|---|
| lnGGIS | -1.14** (0.37) | -1.17** (0.35) | -4.50*** (0.58) | -1.68* (0.62) |
| lnAEXP | 0.46 (0.38) | 0.49* (0.20) | 0.95*** (0.12) | 0.74* (0.32) |
| lnAIMP | 0.05 (0.24) | – | 1.21*** (0.12) | 0.85 (0.17) |
| lnFFCF | 0.35* (0.12) | 0.34* (0.12) | 0.56*** (0.03) | 0.23 (0.31) |
| lnPG | -1.01* (0.37 | -1.04* (0.30) | -0.03 (0.08) | -0.04 0.59) |
| $R^2$ | 0.90 | 0.90 | 0.90 | 0.49 |
| Adjusted $R^2$ | 0.86 | 0.87 | 0.89 | 0.39 |
| Pesaran Cross-Sectinoal Dependence (CD) Text | z = 0.95, p-value = 0.34 | z = 0.98, p-value = 0.33 | _ | z = 1.79, p-value = 0.08 |
| Lagrange Multiplier-(Breusch-Pagan) Test for Balanced Panels | – | – | $Chi^2$ = 1.98, df = 1, p-value = 0.16 | – |
| Number of Observations (N) | 22 | 22 | 110 | 55 |

***Note on Significance Codes:*** **'***'** represent 99.99 per cent level , **'**'** represent 99 per cent level, **'*'** represents 95 per cent level and **'.'** represents 90 per cent level of significance as per R 3.5.1 software.

***Source:*** Author's calculations.

average textiles exports and imports from WITS.

The next section gives the panel data results and discusses the same.

## 4. Results and Discussion

For the first regression equation of India in South Asia inclusive of both AEXP and AIMP, it is to be noted that the South Asian region comprises India, Pakistan, Bangladesh, Nepal, Bhutan, Sri Lanka, Maldives and Afghanistan; their values have been clubbed under the head of South Asia.

As the Table depicts, with a percentage point increase in gender inequality, the value of Indian GDP falls by 1.14 percentage points. Similarly, with a percentage point increase in the population growth, GDP falls by 1.01 percentage points. For the other variables of Average Export and Import Values and Gross Fixed Capital Formation, rise by a percentage point leads to an increase in GDP value by 0.46, 0.05 and 0.35 percentage points respectively. This is in consonance with the traditional gender and trade theories for the Indian context (Ghosh and Ramanayake, 2017).

The analysis shows that the GGIS, GFCF and PG exert a significant influence on GDP of India for the period under study. The level of significance is 1 per cent for GGI (Gender Gap Index) and 5 per cent for GFCF (Gross Fixed Capital Formation) as well as for PG (Population Growth). Thus, in line with common sense and theoretical foundations, GDP is negatively affected by gender inequality and population growth but positively affected by gross fixed capital formation.

The model so constructed is based on the natural logarithmic values of the variables selected from the World Development Indicators (WDI) of the World Bank database. The average values of export and import (AEXP and AIMP) in the textiles & clothing (T & C) sector have been culled from the WITS database.

The fixed effects model has been developed keeping in view the theoretical relevance of its structure and the underlying robustness check of the same, not to forget the pressing need to capture the heterogeneity/individuality in the dataset, especially with regard to the values of the Indian within the South Asian panel units.

As the results depict, there is no serial correlation in the fixed effects model for the p- value is more than 5 per cent (viz. 34 per cent) as per the Pesaran's CD test. This situation leads to rejection of the alternative hypothesis and acceptance of the null hypothesis of no serial correlation in the fixed effects model. Thus, the model is statistically sound.

However, this model may not suffice for this paper if only the AIMP variable is found to be significant. The AEXP too must be significant, for which dropping a less important variable, viz. the AIMP may be prudent. Accordingly, the second equation implements this method to see whether AEXP becomes significant after dropping AIMP.

As the table depicts, with a percentage point increase in gender inequality, the value of Indian GDP falls by 1.17 percentage points. Similarly, with a percentage point increase in the population growth, GDP falls by 1.04 percentage points. For the other variables of Average Export and Gross Fixed Capital Formation, rise by a percentage point leads to an increase in the GDP value by 0.49 and 0.34 percentage points respectively. This is in consonance with the traditional gender and trade theories for the Indian context (Ghosh and Ramanayake, 2017).

The analysis shows that the GGIS, AEXP, GFCF and PG exert a significant influence on GDP of India for the period under study. The level of significance is 1 per cent for GGIS (Gender Gap Index Score) and 5 per cent for GFCF (Gross Fixed Capital Formation) AEXP (Average Value of Exports) as well as for PG (Population Growth). Thus, in line with common sense and theoretical foundations, GDP is negatively affected by gender inequality and population growth but positively affected by Exports and Gross Fixed Capital Formation. Also, dropping the AIMP variable from the model has resulted in significance of the AEXP variable, a desirable outcome for the purpose of the study since, the paper is concerned with the impact of trade in the textiles sector (largely, proxied by AEXP) on the condition of women and hence, GDP. It is a widely accepted fact across scholarly and policymaking circles that deteriorating condition of women employees impacts the GDP adversely.

The model so constructed is based on the natural logarithmic values of the variables selected from the World Development Indicators (WDI) of the World Bank database. The average values of export

(AEXP) in the textiles & clothing (T & C) sector have been culled from the WITS database.

The fixed effects model has been developed keeping in view the theoretical relevance of its structure and the underlying robustness check of the same, not to forget the pressing need to capture the heterogeneity/individuality in the dataset, especially with regard to the values of the Indian within the South Asian panel units.

As the results depict, there is no serial correlation in the fixed effects model for the p-value is more than 5 per cent (viz. 33 per cent) as per the Pesaran's CD test. This situation leads to rejection of the alternative hypothesis and acceptance of the null hypothesis of no serial correlation in the fixed effects model. Hence, the model is statistically sound.

The third panel equation explains the results for all the top ten textiles exporters in the world.

The top ten textiles exporters in terms of value are India, China, Italy, Germany, USA, Turkey, Vietnam, Pakistan, France and Spain over the period under study, viz. 2006-16, as per the *World Trade Statistical Review Database, 2018*.

As the table depicts, with a percentage point increase in gender inequality, the value of Indian GDP falls by 4.50 percentage points. Similarly, with a unit increase in the population growth, GDP falls by 0.03 units. For the other variables of Average Export, Average Import and Gross Fixed Capital Formation, rise by a unit leads to an increase in GDP value. This is in consonance with the traditional gender and trade theories for the Indian context (Ghosh and Ramanayake, 2017).

The analysis shows that the GGIS, AEXP, AIMP and GFCFAB exert a significant influence on GDP of India for the period under study. The level of significance is 0.001 for GGIS (Gender Gap Index Score), AEXP (Average Value of Exports), AIMP (Average Value of Imports) and for GFCF (Gross Fixed Capital Formation). Thus, in line with common sense and theoretical foundations, GDP is negatively affected by gender inequality but positively affected by the other variables, including textiles exports.

The model so constructed is based on the logarithmic values of the variables selected from the World Development Indicators (WDI) of the World Bank database. The average values of export and import (AEXP and AIMP) in the textiles & clothing (T & C) sector have been culled from the WITS database.

As the p-value is more than 0.05, there is no need to use time-fixed effects, and this model is apposite. Thus, pooled OLS model of this form is appropriate for this study.

The last equation runs the results for India within other developing country group of textiles exporters. It is to be noted that developing nations include India, Pakistan, Vietnam, China and Turkey; these countries have been identified on the basis of IMF's *World Economic Outlook Classification, 2018*.

The analysis shows that GGIS, AEXP and PG exert a significant influence on GDP of India for the period under study. The level of significance is 5 per cent for GGI (Gender Gap Index) and AEXP (Average Value of Exports) and 10 per cent for PG (Population Growth). Thus, in line with common sense and theoretical foundations, GDP is negatively affected by gender inequality but positively affected by the other variables, including textiles exports.

The model so constructed is based on the logarithmic values of the variables selected from the World Development Indicators (WDI) of the World Bank database. The average values of export and import (AEXP and AIMP) in the textiles & clothing (T & C) sector have been culled from the WITS database. The fixed effects model has been developed keeping in view the theoretical relevance of its structure and the underlying robustness check of the same, not to forget the pressing need to capture the heterogeneity/individuality in the dataset.

As the results depict, there is no serial correlation in the fixed effects model for the p-value is more than 5 per cent (viz. 0.07) as per Pesaran's CD test. This situation leads to rejection of the alternative hypothesis and acceptance of the null hypothesis of no serial correlation in the fixed effects model. Thus, the model is sound, both theoretically as well as empirically.

Table 4.2 briefly summarises the findings of the panel data analysis.

As the panel data results depict, exports, gender equality and investment exert a positive impact on a nation's economic growth,

*TABLE 4.2*

**APPROPRIATE PANEL MODEL FOR EACH COUNTRY GROUP**

| S. No. | Country Group | Appropriate Panel Model |
|---|---|---|
| 1. | India within South Asia | Fixed Effects Model |
| 2. | India within All Top Textiles Exporters | Pooled OLS Model |
| 3. | India within Developing Nation Exporters | Fixed Effects Model |

***Source:*** Author's calculations.

while population growth and gender inequality exert a negative influence. This corroborates the findings in traditional literature on the theme.

One of the key contributions of this study is that it is one of its kind on this topic, especially when it comes to a comparative study framework. The limitations are pertaining to exclusion of other important human capital formation variables in the panel equation of the likes of education, health and environmental quality in a country. Inclusion of the same could have given a better perspective on the theme involving trade, gender and textiles. Nevertheless, this study could serve as a useful reference for future researchers in the domain.

The next segment concludes the study and also lists its future policy implications.

## 5. Conclusion and Future Policy Implications

This study explained the linkages among the variables of GDP, Gender Equality/Inequality, Investment, Trade (Exports and Imports) and Population Growth. The study located the Indian context within a global framework to arrive at better informed conclusions pertaining to these linkages.

The broad conclusion of this study is in line with traditional literature on this theme. Exports, gender equality and investment exert a positive impact on a nation's economic growth, while population growth and gender inequality exert a negative influence.

The future researchers should use this study as a useful reference point as far as the impact of trade and gender inequality/equality is concerned for the GDP of any economy. The paper aids in understanding the crucial nuances among the variables of trade (exports), gender and the textile sector. The same study could be extended to other female labour-intensive sectors not just in India but for any country in the World. The paper could employ similar or different variables for the purpose as mentioned in the Results and Discussion section.

All in all, the paper is a useful source for further analysis on any theme involving the intersection of trade, gender and labour-intensive industries. It serves as a good reminder for policy stakeholders in the domain to mitigate gendered inequalities and boost exports so as to augment economic growth by creating a gender-friendly environment in the industrial sphere.

**REFERENCES**


1. CRAN (2018), Testing Linear Regression Models. Retrieved from https://cran.rproject.org/web/packages/lmtest/lmtest.pdf/.
2. DSS, Princeton University (2018), Getting Started in Stata and R. Retrieved from https://dss.princeton.edu/training/.
3. Ghosh, T., and Ramanayake, S.S. (2017), Role of Gender Gap in Economic Growth: Analysis on Developing Countries Versus OECD Countries, Working Paper No. WP-2017-031, Indira Gandhi Institute of Development Research, Mumbai.
4. Hsiao, C., Lahiri, K., Lee, L.F., and Veall, M.R. (2000), Features-Book Reviews - Analysis of Panels and Limited Dependent Variable Models: In Honour of GS Maddala, *Economic Journal*,110 (464), p. 509.
5. World Bank (2018), *World Development Indicators*. Retrieved from https://databank.worldbank.org/source/world-development-indicators.
6. World Economic Forum (2006-16), *Global Gender Gap Reports*. Retrieved fromhttps://www.weforum.org/reports.
7. *World Economic Outlook* (2018). Retrieved fromhttps://www.imf.org/external/pubs/ft/weo/2018/01/weodata/index.aspx.


•