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Pakistan Intra-Industry Trade: A Panel Data Approach

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ABSTRACT: This study examines the determinants of intra-industry trade (IIT) between Pakistan and trade patterns in the period 1980-2006, using a static and dynamic panel data approach. In the recent years, the government of Pakistan had realized factors to liberalize the international trade. The literature of international economics demonstrates that this condition (trade liberalization) induces the IIT. The case study for Pakistan has been negligence in the economic literature. This study uses country-specific characteristics as explanatory variables. This study utilizes country-specific characteristics as explanatory variables. The empirical evidence indicates that IIT is a negative function of the difference in GDP per capita between Pakistan and her trading partners. Furthermore, econometric results point out that trading is influenced by the similar demand. We have also introduced an economic dimension; this proxy confirms the positive effects of IIT. Our findings reveal the importance of scales economies and the variety of differentiated products. The study supports to accept the hypothesis that trading increases if the transportation costs decrease.

Keywords: Intra-industry trade; Pakistan; Comparative advantage; Panel data
JEL Classifications: C20; C30; F12

1. Introduction

When the intra-industry trade was first observed in the 1960s by Verdoorn (1960), Balassa (1966), the authors realized the revolution in economics. Grubel and Lloyd (1975) developed the most popular index for measurement of intra-industry trade i.e. the simultaneous export and import of products in the same product categories. Helpman and Krugman (1985) synthesized the various attempts to model IIT. The tests of theoretical models of intra-industry emerged with Helpman (1987). This author analyzed the OECD countries and tests some hypotheses of the model of Helpman and Krugman (1985). His results were according to the theory.

Hummels and Levinsohn (1995) continued the work of Helpman (1987) and analyzed the results for all OECD countries and then extending to test non-OECD countries with panel data. The authors used the estimators OLS, Fixed Effects and Random Effects. The results have questioned at least partially, the findings obtained by Helpman (1987). Many empirical studies of IIT have focused on IIT between developed countries. Trade between developed versus developing countries in development is usually explained based on the Heckscher-Ohlin theorem. There are some empirical studies of IIT between developed countries and developing countries (see Tharakan, 1986; Balassa and Bauwens, 1987). The pioneering models of IIT appear to Krugman (1979), Lancaster (1980) and Helpman (1981). These models were summarized in Helpman and Krugman (1985) being called in the literature for model Chamberlin Heckcher Ohlin (CHO). These models combine the monopolistic competition and Heckscher Ohlin theory.

Pakistan had adopted commercial policy reforms to promote regional trade. Like other developing economies Pakistan was also followed import-substitution policy for industrialization that was highly supported by high tariff rates, import quotas and overvaluation of exchange rate.
Pakistan has joined two regional-trading blocks i.e. South Asian Association for Regional Cooperation (SAARC) and other is the Economic Cooperation Organization (ECO). The intra-industry trade between ECO and SAARC is very incipient (Kemal, 2004). This paper tests the determinants of intra-industry trade (IIT) between Pakistan and the major ten trade partners (United States, United Kingdom, Japan, Germany, Saudi-Arabia, Canada, France, Italy, Netherlands, and Norway). The time period 1980-2006 has been chosen on the basis of its providing a sufficient number of observations. In static panel data models, Pooled OLS, fixed –effects (FE) and random-effects (RE) are used. The RE estimator was exclude because our sample is not random. Furthermore, the Hausman test rejects the null hypothesis RE versus FE. Therefore, the regression coefficients are estimated using fixed effects. In the FE model, all explanatory variables are potentially correlated with the effects and, therefore, only estimators based on deviations of the observations can be consistent (Arellano and Bover 1995).

We also decided to introduce a dynamic panel data. The estimator used GMM-System permits researchers to solve the problems of serial correlation, heteroskedasticity and endogeneity of some explanatory variables. These econometric problems were resolved by Arellano and Bond (1991), Arellano and Bover (1995), Blundell and Bond (1998, 2000). To estimate the dynamic model, we applied the methodology of Blundell and Bond (1998, 2000). The results presented in this manuscript are generally consistent with the predictions of intra-industry trade studies. The remainder of the paper is organized as follows: Section II presents the theoretical background; Section III presents the index of intra-industry trade, Section IV shows the econometrical model; Section V presents the estimation results; and the final section provides the conclusions and policy implications.

2. Theoretical Literature

The trade patterns are traditionally explained by the Heckscher-Ohlin (HO) model, which predicts that a particular country will exports the products that use its relatively abundant factor intensively and imports the products that use its relatively less abundant factor intensively. According to the HO model, similar countries have little reason to trade, particularly if the trade is in similar products. The IIT literature began in 1960s when Balassa (1966) analyzed the within industries of customs union in Europe. Grubel and Lloyd (1975) introduced a comprehensive index to measure IIT. The pioneering works on IIT (Krugman, 1979, 1980, 1981; Lancaster, 1980; Helpman, 1981) exclude the idea that traditional theories could explain IIT. The basic structure of horizontal IIT models is that products are not differentiated by the quality, but the attributes (Krugman, 1979; Lancaster, 1980; Helpman, 1981; Brander and Krugman, 1983; Eaton and Kierzkowski, 1984). Krugman (1979) considers that consumers have similar preference (Neo-Chamberlinian models). The model of Krugman (1979) demonstrates that IIT occurs between identical economies (geographical proximity). The model of Lancaster (1980), called "Neo-Hotelling model" shows that consumers have a preference map, i.e. "ideal variety". Brander and Krugman (1983) demonstrated that is possible to explain IIT with Cournot style. The authors incorporate transport costs and the reciprocal dumping. Following Lancaster model, Eaton and Kierzkowski (1984) explain that IIT is determined by the prices and the distance between the product spectrums. In vertical IIT models, quality is assumed to be directly related to the capital-labour ratio. A capital-rich country is likely to produce higher-quality products; while a labour-rich country is likely to produce lower- quality products. The Neo Heckscher-Ohlin model of vertical IIT (Falvey, 1981, and Falvey and Kierzkowski, 1987), the capital endowment is assumed to be industry- specific with at least one sector producing a differentiated product in terms of quality (vertical differentiated product). According to Falvey and Kierzkowski (1987) the unequal income is assuming a source of the demand for variety of vertically differentiated products, a larger difference in income will increase the share of vertical IIT.

Shaked and Sutton (1984) explained the VIIT with the "natural oligopoly". The quality is associated on fixed costs. Demand for each quality of the product depends on the distribution of income. Firms face three-part decision process – entry, quality and price. The second stage involves the sunk cost of research and development. Most previous studies examine intra-industry trade (IIT) covering the industries or countries (Greenaway et al. 1994, 1995; Hummels and Levinsohn, 1995; Aquino, 1978). Only a few empirical studies analyze one industry-specific of intra-industry trade (see

for example Clark, 2006; Wakasugi, 2007; Shahbaz and Leitão, 2010; and Leitão et al. 2010). The studies of Clark (2006), Wakasugi (2007) and Leitão et al., (2009) show the importance of fragmentation. Koçyiğit and Şen (2007) seem to explain degree of intra-industry trade (IIT) for the case of Turkey with her main trading partner such as the European Union (EU). The empirical evidence confirms the parallel to Turkey's trade with rest of world while trade with European Union tends to move towards intra-industry trade. Furthermore, growth of IIT between Turkey and the EU indicates that industrial base of Turkey is radically moving towards high-technology products from low-technology since 1996 that was era of Custom union agreement with European Union.

The study of Clark (2006) demonstrated that globalisation will continue to reinforce the idea that there are places more efficient (i.e with low production costs) and that is linked with vertical specialization. Clark used a Tobit and Probit specifications at a country and industry level. Wakasugi (2007) constructed an index of vertical intra-industry trade to measure the fragmentation of production, the author used a gravity model and analysed the impact of VIIT in East Asia, NAFTA, and European Union. Wakasugi (2007) concluded that fragmentation increased with intra-industry trade. The study of Leitão and Faustino (2009) examines the determinants of intra-industry trade in the automobile component sector in Portugal. This manuscript considers Portuguese trade in automobile sector between European Union (EU-27), the BRIC (Brazil, India and China), and United States between 1995 and 2006. The authors using a panel data (static and dynamic panel data: GMM-System). This study concludes that IIT occurs more frequently among countries that are similar endowments.

Leitão and Faustino (2009) also show that trade increases if the transportation costs decrease. Yoshida et al. (2009) consider the vertical intra-industry trade (VIIT) between Japan and various European countries. The authors conclude that IIT between European countries and Japan increases with their corresponding Japanese FDI (foreign direct investment), especially for new EU member countries. The study of Leitão, Faustino and Yoshida (2010) shows that production in each country promotes higher vertical IIT of auto parts and components industry. Havrlsyshyn and Kunzel (1997) analyzed the intra-industry trade of Arab- countries. The authors concluded that Arab –region overall does not have highly advanced industrial base, with an average IIT index of 0.25 for the period 1992-1994. The study of Havrlsyshyn and Kunzel (1997) show that intra-industry trade is emerging in the Arab World. However, trade relations between Arab countries and the United States and the European Union (especially Germany and the United Kingdom) have indices of sustainability.

3. Measurement of Intra-Industry Trade

The level of IIT is generally measured by the so-called Grubel and Lloyd (1975) index. They defined IIT as the difference between the trade balance of industry *i* and the total trade of this same industry. In order to make the comparison easier between industries or countries, the index is presented as a ratio in which the denominator is total trade.

$$IIT_i = 1 - \frac{|X_i - M_i|}{(X_i + M_i)} \Leftrightarrow IIT_i = \frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)} \qquad (1)$$

Where X_i and M_i are export to partner country *i* at time *t*.

The index is equal to 1 if all trade is of the intra-industry trade type. If IIT is equal to 0, all trade is inter-industry trade.

3.1. Econometrical Model

Following the literature our study applies a gravity equation with panel data. The dependent variable used is intra-industry trade (*IIT*). The data for the explanatory variables is sourced from the World Bank, World Development Indicators (2008). The source has used for the dependent variable is Federal Bureau of Statistics (FBS is the Pakistan's official organization).

3.2. Explanatory Variables

In accordance with the theory, we have chosen the following explanatory variables:

-Economic differences between countries (DGDP): this is difference in GDP (PPP, incurrent international dollars) between Pakistan and the partner country. Loertscher and Wolter (1980) suggest a negative sign for the IIT model. Linder (1961) considers that countries with similar demands will trade similar products. Hummels and Levinshon (1995) and Greenaway et al. (1994) found a negative sign. The study of Turkcan (2005) also found a negative sign. Recent studies of Ferto and Soós (2008), and Leitão and Faustino (2009) found a positive sign.

-MinGDP: this is the lowest value of GDP per capita (PPP, in current international dollars) between Pakistan and the partner country. This variable is included to control for relative size effects. According to Helpman (1987) and Hummels and Levinshon (1995), a positive sign is expected, which is consistent with the hypothesis of a negative correlation between the share of IIT and dissimilarity in per-capita GDP.
- MaxGDP: this is the higher/highest value of GDP per capita (PPP, in current international dollars) between Pakistan and the partner country. This variable is also included to control for relative size effects. A negative sign is expected, as in Helpman (1987), Hummels and Levinshon (1995) and Greenaway et al. (1994). A negative sign is consistent with the hypothesis that the more similar countries are in economic dimension, the greater the IIT between them.
- DIM: is the average of GDP per capita between Pakistan and the partner country. Usually the studies utilized this proxy to evaluate the potential economies of scales and the variety of differentiated product. Umemoto (2005) found a positive sign. The study of Leitão and Faustino (2009) also found a positive sign to Portuguese case.
-DIST: this is the geographical distance between the Pakistan and the partner country. Balassa (1986) argues that IIT will be greater when trading partners are geographically close. A longer distance will increase the transaction and transportation costs. Thus, there is a negative relationship between the share of IIT in the industry and geographical distance. Hummels and Levinshon (1995) found a negative sign.
- FDI (Foreign Direct Investment inflows): the relationship between IIT and the level of FDI in a particular industry is somewhat ambiguous since FDI may be a substitute for the trade. Gray (1988) considers an ambiguous relationship between FDI and IIT. Greenaway et al. (1994) estimated a positive sign for the coefficient of this variable;
-TIMB (Trade Imbalance): Following Lee and Lee (1993) our paper considers the trade imbalance as control variable, where TIMB is defined as:

$$TIMB_j = \frac{\left|X_j - M_j\right|}{\left(X_j + M_j\right)} \tag{2}$$

This variable represents the net trade as a share of trade and takes a value of zero at the lower extreme if there is no trade imbalance and a value of one if there are neither exports nor imports. According to the theory, a negative correlation between this control variable and IIT is expected.

3.3. Model Specification

$$IIT_{it} = \beta_0 + \beta_1 X_{it} + \delta t + \eta_i + \varepsilon_{it} \tag{3}$$

Where: *IIT* is the Pakistan IIT index; X is a set of explanatory variables. All variables are in the logarithm form; η_i is the unobserved time–invariant specific effects; δt captures a common deterministic trend; ε_{it} is a random disturbance assumed to be normal, and identically distributed (IID) with E (ε_{it}) =0 and Var(ε_{it})=σ^2 >0.

The model can be rewritten in the following representation:

$$IIT_{it} = \rho IIT_{it-1} + \beta_1 X_{it} - \rho X_{it-1} + \delta t + \eta_i + \varepsilon_{it} \tag{4}$$

3.4. Regression Models

In this section we present the results with country characteristics as explanatory variables. We include in this estimation the main trade patterns of Pakistan (United States, United Kingdom, Japan, Germany, Saudi-Arabia, Canada, France, Italy, Netherlands, and Norway). In table 1, the determinants of IIT can be observed with fixed effects model. All explanatory variables are significant at 1% level: (LogDGDP, LogMinGDP, LogMaxGDP, LogDIM, LogTIMB , and LogDIST), with exception FDI.

Table 1. Determinants of Intra-industry Trade: Fixed Effects Estimator

Variables	Coefficient	Expected Signs
LogDGDP	-0.4688 (-4.237)***	(-)
LogMinGDP	1.888 (3.068)***	(+)
LogMaxGDP	1.259 (3.981)***	(-)
LogDIM	0.807 (3.790)***	(+)
LogDIST	-0.161 (-6.704)***	(-)
LogFDI	-0.041 (-1.291)	(+/-)
LogTIMB	-0.165 (-8.421)***	(-)
Adj. R^2	0.612	
Observations	265	

T-statistics (heteroskedasticity corrected) are in round brackets.
*** statistically significant, respectively at the 1% levels.

The coefficient for difference between per- capita incomes, in logs (LogDGDP) is negative and significant at 1 per cent level. Turkcan (2005) found a negative sign. This results shows that the IIT will be influenced by similar products. Following the empirical model of Helpman and Krugman (1985) and Hummels and Levinsohn (1995), our study also includes two variables to control for relative size effects. We can see that both are statically significant, but only the lower value of GDP (LogMinGDP) has an expected sign. For the variable LogDIM (average of GDP per capita) that is used to evaluate the economic dimension. The theoretical predictions give it a positive sign (Umemoto, 2005; Yoshida et al. 2010). Our result is according with these previous studies. The geographical distance (LogDIST) presents a negative correlation confirming the results of Bandiger and Breuss (2008), and Clark (2006).

The relationship between IIT and FDI (foreign direct investment) is ambiguous. As in Gray (1988), we can conclude an ambiguous relationship between FDI and IIT. Greenaway, Hine, and Milner (1994) found a positive correlation. The trade imbalance (LogTIMB) is an important variable to explain IIT. As in Lee and Lee (1993), we found a negative sign. As table 2 shows, the equation presents consistent estimates, with no serial correlation (m1, m2 statistics). The specification Sargan test show that there are no problems with the validity of instruments used both equations. The model presents six significant variables ($LogIIT_{it-1}$, LogDGDP, LogMaxGDP, LogDIM, LogDIST, and LogTIMB). As expected, the lagged dependent variable is positive. The GMM system estimator is consistent if there is no second-order serial correlation in the residuals (m2 statistics). We used the test of Windmeijer (2005) to small sample correction to have consistent stand errors. The instruments in levels used are LogIIT(2,9), LogDGDP(2,9), LogTIMB(2,9) for first differences. For levels equations, the instruments are used first differences all variables lagged t-1.

Table 2. Determinants of Intra-industry Trade: GMM-SYS Estimator

Variables	Coefficient	Expected Signs
$LogIIT_{it-1}$	0.405 (2.82)***	(+)
LogDGDP	-1.599 (-2.10)**	(-)
LogMinGDP	1.506 (1.38)	(+)
LogMaxGDP	1.017 (2.03)**	(-)
LogDIM	-2.887 (-1.98)**	(+)
LogDIST	-0.093 (-2.32)**	(-)
LogFDI	-0.012 (-1.10)	(+/-)
LogTIMB	-0.057 (-6.21)***	(-)
C	-16.994 (-1.93)**	
M1	-1.388 [0.165]	
M2	0.3574 [0.721]	
WJS, df=8	30.39 [0.234]	
Sargan df=688	13.54 [1.000]	
Observations	246	

T-statistics (heteroskedasticity corrected) are in round brackets.

The null hypothesis that each coefficient is equal to zero is tested using second -step robust standard error. T-statistics (heteroskedasticity corrected) are in round brackets. ***, **, and * indicates statistically significance, respectively at the 1%, and 5% level. P-values are in square brackets. Year dummies are included in all specifications (this is equivalent to transforming the variables into deviations from time means, i.e. the mean across the fourteen countries for each period). M1 and M2 are tests for first-order and second–order serial correlation in the first-differenced residuals, asymptotically distributed as N (0, 1) under the null hypothesis of no serial correlation (based on the efficient two-step GMM estimator). W*JS* is the Wald statistic of joint significance of independent variables (for first-steps, excluding time dummies and the constant term). Sargan is a test of the over-identifying restrictions, asymptotically distributed as χ^2, under the null of instruments' validity (with two-step estimator). ***/**- statistically significant, respectively at the 1% 5% levels.

The variable LogDGDP (difference in GDP per capita), used also by Hummels and Levinshon (1995) and Greenaway et al. (1994) has a significant and predicted negative effect on IIT. The variable, LogDIM (average of GDP), used also by Greenaway et al., (1994), the expected sign is positive, and the result is contradictory. The proxy geographic distance (LogDIST) presents a negative sign, confirming the theoretical forecast proposed by the literature. The variable trade imbalance (LogTIMB) is negatively correlated with IIT. Lee and Lee (1993) found a negative correlation between trade imbalance and IIT.

4. Conclusion

The objective of this manuscript was to analyze some of the determinants of intra-industry trade. This study presents an important contribution. The intra-industry trade of Pakistan have neglected by researchers. Our results are robust with static (Fixed Effects) and dynamic (GMM-system) panel data. Empirical evidence shows that the variable (LogDGDP) used to evaluate the similarities between trade partners presents a negative impact on IIT, when we used Fixed Effects model, and GMM-System. These results are according to the literature (Loertscher and Wolter, 1980). The economic dimension measured by the logarithm of average GDP of two trading partners also has a significant and positive impact on IIT, when we used Fixed Effects model. According to the literature we expected a negative sign to geographical distance, we find this sign. The control variable (TIMB) is significantly, negatively related to the IIT. South Asia Free Trade Agreement (SAFTA) could be an important marc to Pakistan, but intra-trade in SAFTA is incipient. Our study shows that the principal export markets are United States, Saudi-Arabia, United of Kingdom and Germany.

Empirical findings presented in this research pose several compelling economics. Pakistan should be to reduce the trade barriers in sectors that have a potential for IIT. If Pakistan is looking for greater diversity in its exports and hopes to become more competitive in the world market, the growth of small and medium-sized firms should be promoted. Pakistan needs to obtain competitive advantages in new products with capital intensive and technological innovation. The increase of intra-industry will be associated to product differentiation, quality, brand and design. In terms of economic policy the Government can promote agreements or contracts programs or subsidies for production and research and development (R&D). Moreover, the government should promote political education and training. This measure must be seen in a long-term. In other words, the effects are not certainly immediate.

The creation of new factors of production (human capital and knowledge) that takes several years and depends on the education system, and the ability of companies to own new products and technologies. This study has some limitations. This manuscript examines only the characteristics of the countries. It will be necessary to introduce the characteristics of industries as explanatory variables. This possibility justifies a future investigation.

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