ECONOMIC ANALYSIS & POLICY, VOL. 40 NO. 3, DECEMBER 2010

A Model of Bilateral Trade Balance: Extensions and Empirical Tests

M. Zakir Saadullah Khan,
Department of Economics, Comilla University,
Comilla, Bangladesh
(Email: zskbd@yahoo.com)

and

M. Ismail Hossain
Department of Economics, Jahangirnagar University,
Savar, Dhaka, Bangladesh

Abstract: A re-thinking and clear understanding of the factors underlying a country's balance of trade position is needed as the global trade regime becomes more liberalized. The relationship between the overall trade balance and its determinants as propounded in the standard models may not necessarily be the same with the bilateral trade balances. This study has developed a model of bilateral trade balance that captures the effects of all factors influencing trade balance as suggested by elasticity, absorption, and monetary approaches and the popular Gravity Model with some extensions. Specifically, the present paper postulates that the relative factors determine the trading pattern, and hence the trade balance of a country in bilateral trade with partners while in the earlier models absolute factors determine the trade balance. Using standard panel data techniques the model is empirically tested and the results show significant effects of all the relative factors on the bilateral trade balance of Bangladesh in trading with her partners. The robustness check of the model ensures the validity of the specification.

I. INTRODUCTION

Global macroeconomic crises and the changes in the international trade pattern in the era of globalization have underscored the need for clearer understanding of the factors underlying a country's balance of trade position. While a country's overall trade may be balanced, a country may have bilateral deficits with many of its trading partners (and surpluses with others). The relationship between the overall trade balance and its determinants may not necessarily be the same as with the bilateral trade balances. In this regard, the underlying determinants of the trade balance of the conventional "aggregative" models and how those are applied in empirical studies can be questioned, especially when there is heterogeneity among economies. It is thus necessary to reformulate the trade balance model which can be applied to explain bilateral trade balances and address the heterogeneity issue.

The purpose of this paper is twofold: first, to formulate an appropriate model of trade balances, bilateral as well as overall, that may better suit trade between countries, especially for developing countries. The popular views on trade balance are reviewed. After identifying the standard determinants adjustments have been made to derive an alternative model. Second, the validity of the alternative model has been empirically tested using static panel data analysis techniques to find the crucial relationships between the trade balance of Bangladesh and its determinants.

The organisation of the paper is as follows. Section II reviews the standard model of trade balances. Section III formulates an alternative approach to the trade balance model based on the conventional model adjusted for bilateral trade between countries. Section IV describes the tests results to choose the right method of estimation and Section V presents the estimation result and finally Section VI made the conclusion.

II. THE STANDARD MODEL OF TRADE BALANCE

There are three approaches to explain the factors determining the trade balance – the elasticity approach, absorption approach and monetary approach. A single base-line model of trade balance is derived now that captures the effects of all the factors followed by these three approaches, as employed by Krugman and Baldwin (1987), Rose and Yellen (1989), Rose (1991), Baharumshah (2001). The effects of the 'gravity' factors are also included. The standard model is derived first (Equations 1- 8) from foreign (*j*) and domestic (*i*) countries' supply of exports and demand for imports. Accordingly, it is posited that the demand for imported goods by country-*i* with country-*j* depends upon the relative price of imports and domestic real income

$$M_{ij}^{d} = M_{ij}^{d}(RP_{mi}, Y_i) \tag{1}$$

where, M_{ij}^{d} is the domestic demand for imports by country-*i*, RP_{mi} is the relative price of imported goods to domestically produced goods, and Y_i is the domestic real income.

Let ER_{ji} be the nominal exchange rate, defined as the price of one unit of domestic currency in terms of foreign currency; that is, the number of units of foreign currency per unit of domestic currency. The relative price of imported goods can be expressed as

$$RP_{mi} = \frac{P_{xj}}{ER_{ji}.P_i} = \left(\frac{P_j}{ER_{ji}.P_i}\right)\left(\frac{P_{xj}}{P_j}\right) = (RER_{ji})RP_{xj} \tag{2}$$

Where P_{xj} is the foreign currency price of foreign exports, P_i and P_j are the domestic (country-*i*'s) price indices and foreign (country-*j*'s) price indices of all goods respectively,

RER_{ji} is the real exchange rate, defined as $RER_{ji} = [(1/ER_{ji})(P_j / P_i)]$, so that an increase in RER_{ji} signifies an appreciation of the home (*i*'s) currency, and RP_{xj} is the relative price of foreign (*j*'s) exports of foreign produced goods. Substituting RP_{mi} from Equation (2) into Equation (1) gives the following equation

$$M_{ij}^{d} = M_{ij}^{d}(RER_{ji}.RP_{xj}, Y_i) \tag{3}$$

Similarly, the foreign country's demand for imports depends upon foreign real income (Y_j) and domestic relative export prices.

$$M^d_{ji} = M^d_{ji}(RP_{xi} / RER_{ji}, Y_j) \quad (4)$$

Given that domestic exports equal foreign imports and vice versa, that is, domestic *(i)* countries' supply of exports to foreign (*j*) country (X^s_{ij}) equals demand for imports by foreign (*j*) country from domestic *(i)* country (M^d_{ji}) and vice versa.

$$X^s_{ij} = M^d_{ji} \quad (5)$$

$$X^s_{ji} = M^d_{ij} \quad (6)$$

Following other studies (e.g., Haynes and Stone 1982, Bahmani-Oskooee 1991, Brada, Kutan and Zhou 1997 and Shirvani and Wilbratte 1997), the domestic balance of trade of country-*i* with country-*j* (TB_{ij}) can be expressed as the ratio of exports over imports (X_i/M_i). The (X_i/M_i) ratio or its inverse has been used in many empirical studies on the trade balance-exchange rate relationship (e.g., Onafowora 2003, Bahmani-Oskooee and Brooks 1999, and Gupta-Kapoor and Ramakrishnan 1999) because the ratio is not sensitive to the unit of measurement and can be interpreted as nominal or real trade balance (Bahmani-Oskooee, 1991). This study designates the ratio as real trade balance. The use of the exports – imports ratio allows us to focus on what proportion of import is financed by exports that helps identify the causes of one lagging behind other.

The trade balance as the dependent variable in the empirical work is expressed as

$$TB_{ij} = X^s_{ij} / M^d_{ij} = M^d_{ji} / M^d_{ij} = M^d_{ji}(RP_{xi} / RER_{ji}, Y_j) / M^d_{ij}(RER_{ji}.RP_{xj}, Y_i) \quad (7)$$

Equations (1) – (4) are structural equations that can be solved with (5) and (6), and substituted into (7). Assuming constant or stationary values of RP_{xi} and RP_{xj}, the resulting reduced-form equation can then be written as:

$$TB_{ij} = TB_{ij}(RER_{ji}, Y_i, Y_j) \quad (8)$$

This is the standard model of trade balance which consists of three explanatory variables, real exchange rate (RER_{ji}), real domestic income (Y_i), and real foreign income (Y_j).

The vectors of the three explanatory variables are thought to capture the effects on trade balance in a model that puts together (nets) the elasticity, absorption and monetary approaches.

- According to the *elasticity approach* devaluation improves the trade balance by changing the relative prices between domestically and foreign sourced goods (expressed in the *RER*).
- In the *absorption approach* an exchange rate change can only affect the trade balance if it induces an increase in income which is greater than the increase in total domestic expenditure (absorption).
- The *monetary approach* asserts that exchange rate changes have only temporary effects. Hence, there should be no long-run equilibrium relationship between the trade balance

and exchange rates. With respect to income variable in the short run the monetary approach assumes that an increase in income improves the trade balance, assuming that the Keynesian hypothesis of $0<MPC<1$ holds.

The *Gravity model* is a bilateral trade model pioneered by Tinbergen (1962), Pöyhönen (1963) and Linneman (1966). Its empirical robustness was demonstrated by Bergstrand (1985, 1989). The generalized gravity model of trade states that the volume of trade (exports plus imports) between pairs of countries, T_{ij} is a function of their incomes (GNPs or GDPs), their per capita income and their distance (proxy for transportation costs). The gravity model was formulated in multiplicative form (Kalbasi 2001, Kristjánsdóttir 2005), that is,

$$T_{ij} = \alpha_0 Y_i^{\beta^1} Y_j^{\beta^2} y_i^{\beta^3} y_j^{\beta^4} D_{ij}^{\beta^5} U_{ij} \tag{9}$$

Where Y_i and Y_j indicate the GDP or GNP of countries i and j; y_i and y_j denote respective per capita incomes; D_{ij} measures the distance between the two countries' capital cities (or economic centres); U_{ij} is the error term; and the β^i's are parameters of the model.

The gravity model also represents both export (X_{ij}) and import (M_{ij}) as functions of incomes Y_i and Y_j; per capita incomes y_i and y_j and distance D_{ij}. In addition, exchange rate ER_{ji} and prices (P_i, P_j) in both countries (i and j) are also taken as independent variables in some studies (*e.g.*, Rahman, 2006). Therefore, the trade balance can be expressed as

$$TB_{ij} = \frac{X_{ij}^s}{M_{ij}^d} = \frac{X_{ij}^s(Y_i, Y_j, y_i, y_j, D_{ij}, ER_{ji}, P_i, P_j)}{M_{ij}^d(Y_i, Y_j, y_i, y_j, D_{ij}, ER_{ji}, P_i, P_j)} \tag{10}$$

Thus based on the gravity model and assuming fixed relative prices[1], the bilateral trade balance function can be represented as

$$TB_{ij} = \frac{X_{ij}^s}{M_{ij}^d} = TB_{ij}\,(Y_i, Y_j, y_i, y_j, D_{ij}, ER_{ji}, P_i, P_j) \tag{11}$$

The real exchange rate (RER_{ji}) of equation (8) captures the effect of both exchange rate (ER_{ji}) and price level movements (P_i, P_j) in paired countries. RER_{ji} denotes the relative prices, the price of one country's exports relative to foreign prices of related goods expressed in a common currency. The overall inflation or rise in the price level raises the real effective exchange rate and so affects the trade balance. Therefore the three variables ER_{ji}, P_i, P_j of equation (11) can be replaced by a single variable RER_{ji} of equation (8) and therefore, the model stands as

$$TB_{ij} = TB_{ij}\,(Y_i, Y_j, y_i, y_j, RER_{ji}, D_{ij}) \tag{12}$$

This is the benchmark model of this study which combines the major factors of the popular theories in determining the trade balance of a country. An alternative model of trade balance has been developed based on the standard model.

[1] This is a reasonable assumption for Bangladesh at the aggregate level as the terms of trade moves around 100 for a long time with some deterioration in recent years.

III. THE MODEL OF BILATERAL TRADE BALANCE – AN EXTENSION

The basic idea of the extended model is that, in bilateral trade the absolute size of a country in terms of income and population is not so important, rather the relative size (relative to trading partners) determines the export supply and import demand. In the standard model of trade balance GDP measures both productive and absorption capacity of a country. In the extended model GDP of the exporting country measures productive capacity, while the per capita GNP better measures absorption capacity of the importing country.

Since the trade balance of a country is denoted by the ratio of exports to imports (X_{ij}/M_{ij}), in bilateral trade the GDP of country-*i* relative to her partner country-*j* has impact on her trade balance. The GDP ratio of the trading pair (GDP_j/GDP_i) shows the relative production capacity of partner country (country-*j*) compared to home country. This also measures the relative size of a country compared to her trading partner.

The ratio of per capita income (y_j/y_i) is a key determinant of import demand since it represents the relative absorption capacity of trading country pairs. Therefore, in the extended model of bilateral trade balance, relative GDP ($GDP_j/GDP_i = Y_j/Y_i$) and relative per capita income (y_j/y_i) are considered in lieu of the first four variables of the model (12). These new variables capture the relative size of the country in terms of income, population and per capita income differences since the ratio y_j/y_i is a unit free representation of the per capita income differential. The RER_{ji} in the standard model captures the relative price level of two trading partners and their bilateral exchange rate and is an important determinant of trade balance.

The Gravity model introduces distance as a proxy for transportation cost which is an important determinant of trading decision. A suitably weighted distance measure can also capture the impact of adjacency of a country to its trading partner(s) or the common border between them. These are considered as separate variables in models of trade between two countries by some researchers using ‘gravity’ factors (Adam and Cobham 2007, Deardorff 1997, Faruqee 2004).

As a proxy for transportation cost, the absolute ‘distance’ of domestic country *i* from its trading partners (D_{ij}) does not have enough explanatory power, since a country does not trade equally with all partners. Transportation cost depends not only on distance but also on volume (weight) of the traded commodity. Estimation based on the absolute distance as proxy for transportation cost is not appropriate, rather the trade-weighted distance proxies the transport cost.

In international trade, exports are usually in f.o.b. (free on board) terms and imports in c.i.f (cost, insurance and freight). That is, the international transport cost is associated mainly with imports. In weighing the distance with respect to trade, imports are the appropriate delegate. Therefore, the extended model takes bilateral import-weighted distance (MWD_{ij}) as a proxy for transportation cost.

Therefore, the trade balance model of equation (12) stands as

$$TB_{ij} = TB_{ij}\left(\frac{Y_j}{Y_i}, \frac{y_j}{y_i}, RER_{ji}, MWD_{ij}\right)$$

or

$$TB_{ij} = TB_{ij}(RGDP_{ji}, RPGNI_{ji}, RER_{ji}, MWD_{ij}) \tag{13}$$

where $RGDP_{ji} = {GDP_j}/{GDP_i}$ and $RPGNI_{ji} = {y_j}/{y_i}$

Equation (13) is the extended model of trade balances which is expected to better explain the trading relationship between countries. This may be especially so for developing countries where income is low, resources are scarce and it is hard to achieve an exportable surplus. It seems that the absolute economic factors do not determine the balance of bilateral trade rather the relative position of a country compared with her partners with respect to such factors determines the trade balance.

IV. THE METHOD AND THE DATA

In order to estimate the equation of trade balance based on function (13), this study presents it in log-linear form following a numbers of studies like Haynes and Stone (1982), and Bahmani-Oskooee (1991), Bahmani-Oskooee (2001), Thapa (2002) and Hussain, Sen and Keong (2003). The attractive feature of the log-linear model is that the slope coefficient measures the elasticity of the dependent variable with respect to the independent variable.

4.1 The Method

Taking logarithms and adding time subscripts (t) and an error term (u_{it}) to equation (13) the estimating equation of trade balance becomes:

$$ln(TB_{ij})_t = \alpha_0+\beta_1 ln(RGDP_{ji})_t+\beta_2 ln(RPGNI_{ji})_t + \beta_3 ln(RER_{ji})_t + \beta_4 ln(MWD_{ij})_t+u_{it} \quad (14)$$

This is the empirical model of this study. It is a generalization of the different types of specification to be used in the empirical analysis based on different estimation techniques of static panel data econometrics.

The signs for the estimators associated with the variables in the model are expected to be similar to traditional theoretical expectations. It is expected that the effects of real exchange rate (RER_{ji}) and of the import-weighted distance (MWD_{ij}) on trade balance are negative. The more the real exchange rate (RER_{ji}) index drops the more there is a depreciation of the exporter's (country-*i*'s) currency with respect to the currency of her trading partner (country-*j*'s), hence the trade balance (TB_{ij}) improves with increasing export competitiveness (elasticity approach). Import-weighted distance, being proxy for transport cost, has negative impact on the trade balance.

The signs of the coefficients of relative GDP ($RGDP_{ji}$) and relative per capita GNI ($RPGNI_{ji}$) are ambiguous. The higher relative GDP ($RGDP_{ji}$) implies that country-*j* (partner country) produces more goods compared with country-*i* (home country) and partner country comparatively has more capacity to meet her domestic demand as well as has more exporting capacity. This implies that the partner country-*j* will export more to and import less from country-*i*. Larger countries have more diversified production and tend to be more self-sufficient (Kalbasi, 2001) and therefore, will have negative impact on the bilateral trade balance of small home country-*i*. That is, β_1 is expected to be negative. In other words, an increase in GDP of partner country-*j* relative to GDP of home country-*i* ($RGDP_{ji} = GDP_j/GDP_i$) will see a deterioration in the trade balance of home country.

If country-*j* (partner country) demands more of her domestic goods due to higher relative per capita GNI, in other words a higher per capita income differential (absorption effect), β_2 would be negative. On the contrary, if she demands more of country-*i*'s goods due to this income (absorption) rise, the sign of β_2 will be positive. The different absorption effects also depend on the type of goods demanded by country-*i*'s export partners for a rise in their per capita income. The *Engel curve* phenomena which postulates that the percentage of income spent on necessary goods declines as income increases, is equally applicable in the case of international trade.

In estimation of the model, panel data of bilateral trade between Bangladesh and her major trading partners are used and individual effects are included in the regressions. The trade balance models were estimated in most studies using either cross-section data or time-series data. Recently panel data econometric techniques have gained popularity in analyzing the relationship between variables. Use of panel data in estimating common relationships across countries is particularly appropriate because it allows the identification of country-specific effects that control for missing or unobserved variables (Judson and Owen, 1996).

This study has applied the static panel data analysis technique to check the validity of the trade balance model developed. The static models of panel data analysis are restricted versions of the general trade balance model of equation (14), which is a log-linear specification but places no restrictions on the parameters. For the sake of discussion of the statistical overview, the general model of equation (14) is represented in a different fashion as equation (15) below:

$$ln(TB_{ijt}) = a_0 + \alpha_t + \alpha_{ij} + \beta'_{ijt} Z_{ijt} + u_{it} \tag{15}$$

Where TB_{ijt} is trade balance of country-*i* in trading with country-*j* in year $t = 1,2,..T,$ and $Z_{ijt} = [z_{it}, z_{jt},....]$ is the $1 \times k$ vector of variables of the trade balance model. The intercept has three parts: one common to all years and country pairs, a_0; one specific to year t and common to all pairs, α_t; and one specific to the country pairs and common to all years, α_{ij}. The third intercept term α_{ij} is referred to as the country-specific unobserved effect. There is heterogeneity between countries with respect to their characteristics, which have effects on international trade. The unobserved characteristics of bilateral trading relationships between these heterogeneous economies constitute an important issue that needs to be addressed. The disturbance term u_{it} is assumed to satisfy the usual regression model conditions.

For estimation, restrictions are imposed on the parameters of the model. The standard single-year cross-section model imposes the restrictions that the slopes and intercepts are the same across country pairs, that is, $\alpha_{ij} = 0$ and $\beta_{ijt} = \beta_t$; and where a_0 and α_t cannot be separated

$$ln(TB_{ijt}) = a_{0t} + \beta'_t Z_{ijt} + u_{it} \tag{16}$$

Assuming that all the classical disturbance-term assumptions hold, the cross-section model is estimated by ordinary least square (OLS) for each year.

The restrictions that the cross-section methods impose, yield biased results because they do not control for heterogeneous trading relationships between countries. The time-series analysis imposes analogous assumptions about the comparability of different observations in time and also yields biased results. The panel data methods explicitly take unobserved heterogeneity into account.

There are several types of panel analytic models – Pooled Ordinary Least Squares (POLS), Fixed Effects Models (FEM), and Random Effects Models (REM). To select the right estimator for the model various tests has been performed to check whether classical OLS assumptions hold for the model and remedies are suggested. Then the trade balance model has been estimated using appropriate method(s).

4.2 The Data

The extended model of the trade balance developed as Equation (14) has been examined empirically for the case of Bangladesh using data on bilateral trade between Bangladesh and her major trading partners during the 1980-2005 period. Bilateral panel data of total 50 major trading partners of Bangladesh (20 industrialised and 30 developing partner countries) covers 75% – 82% of Bangladesh's trade in both directions. Export and import statistics over the sample period have been collected from *Direction of Trade Statistics (DOT)* database on the IMF website. The countries are chosen on the basis of importance as a trading partner of Bangladesh and availability of required data. The GDP and per-capita GNI data have been collected from *World Development Indicator (WDI)* database of the World Bank and nominal exchange rate and consumer price indices to calculate *RER*s have been collected from the *International Financial Statistics (IFS)* database of the IMF. In measuring import-weighted distance (MWD_{ij}), the geographical distance between Dhaka (the capital city of Bangladesh) and the capital cities of respective partner countries are obtained from World Bank website (www.econ.worldbank.org) and have been weighted by the ratio of bilateral import volume from respective partners to total import volume of Bangladesh (W_{ij}) in respective years. All observations are annual and were processed following required procedures.

V. TESTS OF THE MODEL

Before carrying out panel data estimations, it is necessary to choose the appropriate estimation techniques for the model and test for the characteristics of specification. The likelihood ratio test for individual effects and Hausman test are performed to decide whether individual effects are treated as country-specific or period specific and for such effects choice are made between fixed or random. Tests for heteroscedasticity, autocorrelation and multicollinearity assist specification and estimation.

The following tests are first carried out to help choose the estimation techniques.

5.1 Test for Individual Effects

To test for the presence of individual effects the unrestricted specification of the model in equation (14) must be estimated first using a two-way fixed effects estimator. The joint significance of all of the effects as well as the joint significance of the cross-section effects (here, the country-specific effects) and the period effects are tested separately.

Three restricted specifications have been estimated: one with period fixed effects only, one with cross-section fixed effects only, and one with only a common intercept. All three sets of tests results are presented in Appendix A1.

Results show the joint significance of all these tests using sums-of-squares (F-test) and the likelihood function (Chi-square test). The two statistic values and the associated p-values strongly reject the null that the effects are redundant. It indicates the presence of strong individual effects (country-specific effects) in the first case, period effects in the second case and joint significance of all of the effects in the third case.

In this study, impacts of the determinants of the model differ between country pairs due to heterogenous country characteristics. It is of interest to identify the country-specific effects and to explore the possibility of heterogeneity across countries. Since time series variability is deemed sufficient to allow reasonably precise estimates, we specify the static model by assuming that the parameters are constant over time and might be variable across countries. Cross-section specific (i.e. country-specific) effects of the model have also been performed and the presence of this type of effect is confirmed by the test result.

5.2 Fixed Effects versus Random Effects – The Hausman Test

In the estimation, unbalanced panel data have been used, and individual effects are included in the regressions. So it has to be decided whether they are treated as fixed or as random. A central assumption in random effects estimation is that the random effects are uncorrelated with the explanatory variables. One common method for testing this assumption is to employ the Hausman (1978) test to compare the fixed and random effects estimates of coefficients. Hausman test indicates whether the specific effects are correlated or not with the explanatory variables.

To perform the Hausman test, first a model with random effects specification has to be estimated. The high value of Hausman Chi-square statistics (that is, low p-value) favours Fixed Effects Modelling and low value of Hausman Chi-square statistics (that is, high P-value) favours Random Effects Modelling. The result of Hausman Test statistics suggests that Fixed Effects Model (FEM) is the appropriate panel data estimator for this study, since the Chi-square statistic ($\chi^2 = 93.47$) provides no evidence against the null hypothesis that there is no misspecification.

5.3 Test of Multicollinearity

To check whether there is multicollinearity in the model the simple correlation coefficients between the explanatory variables have been examined. The values of all the correlation coefficients between explanatory variables are lower than 0.80. Following some authors (e.g., Studenmund, 2001) it is argued that the test does not detect the existence of severe multicollinearity of explanatory variables of the model.

5.4 Test of Heteroscedasticity

In panel data analysis homoscedasticity is an underlying assumption. Consequently, the assumption of homoscedasticity in the panel sample data needs to be tested. To test the heteroscedasticity in the model the Park Test method has been adopted, which has good power of detecting herteroscedasticity of unknown form. The Park test of model (14) has detected the existence of heteroscedasticity in the observations within group and in every observation. So, the most popular remedy for heteroscedasticity, called – heteroscedasticity corrected standard errors technique is used for estimation of the fixed effects of the model. It focuses on improving the estimation of the standard errors of estimators without changing the estimates of the slope coefficients.

5.5 Test for Serial Correlation

The estimation of the fixed effects model provide the Durbin-Watson (DW) test statistics at about 0.80 which indicates the presence of serial correlation in the residuals.To remedy the first-order serial correlation – the Generalized Least Squares (GLS) estimator – is used to yield unbiased and efficient parameter estimates. The conventionally better way to estimate GLS equations is the *AR(1)* method, which is a step-one process that estimates all the parameters as well as the coefficient of serial correlation. The *AR(1)* method estimates the model using iterative nonlinear regression techniques, which is more relevant to the model.

VI. TRADE BALANCE OF BANGLADESH – THE EMPIRICAL RESULTS

The results of individual effect test (likelihood ratio) above suggest use of fixed effect estimation techniques only in the cross-section, *i.e*. estimating the model including country-specific fixed effects. The Hausman test has suggested that fixed effect of Panel estimation is the appropriate strategy to be adopted.

Since no severe multicollinearity is found among the explanatory variables, the model of equation (14) above is estimated taking all variables for all 50 countries for 26 year, the number of observation is 1227. The estimation uses White's heteroscedasticity-corrected covariance matrix estimator, which is considered to be a robust method. This focused on improving the estimation of the standard errors without changing the estimates of the slope coefficients[2].

In the present model, the intercept terms α_0 is considered to be country-specific and the slope coefficients are considered to be the same for all countries. Appendix A2 reports the country-specific effects (fixed effects) of White's heteroscedasticity corrected model regression result.

The coefficient of relative GDP (*RGDP*) is negative (-2.29) and highly significant (p = 0.000). This implies that, trade balance of Bangladesh deteriorates when GDP of partner countries increases relatively more than that of Bangladesh. It means partners' production and exporting capacity increases at a higher rate than that of Bangladesh. In bilateral trade, this usually results in more export to Bangladesh or less import from Bangladesh, and hence, adversely affects the balance of trade of Bangladesh.

The coefficient of the relative per capita GNI is positive (2.330199) and also highly significant as expected. Since the per capita GNI is the determinant of absorption capacity of a country, therefore, higher relative per capita GNI (*RPGNI*) implies higher absorption capacity of the country. Due to increase in absorption capacity, it is expected that the country imports more. Trading partners of Bangladesh with higher *RPGNI* relatively import more from Bangladesh,

2 Since heteroscedasticity causes problems with the standard errors but not with the β coefficients, it makes sense to improve the estimation of the SE(β)s in a way that does not alter the estimates of the slope coefficients.

improving its balance of trade. It justifies the *Linder hypothesis*[3] in case of Bangladesh.

The negative sign of the coefficients of real exchange rate (*RER*) and import-weighted distance (*MWD*) are as expected. The coefficients are highly significant. The negative sign of the coefficient of real exchange rate (RER_{ij}) implies that the more the index of RER_{ij} drops the more there is depreciation of Bangladeshi Taka (as exporter currency) with respect to the currencies of her trade partners. This will increase the export competitiveness of Bangladesh and hence will improve her trade balance (TB_{ij}).

The import-weighted distance (MWD_{ij}) as a proxy for transport cost represents an obstacle (or 'resistance') to trade. The significant negative value of the coefficient of MWD_{ij} indicates that Bangladesh tends to import relatively more from neighbouring countries than to export and results in negative effect on her trade balance. However, the low value of elasticity of transport cost (-0.844), indicates that the trade balance of Bangladesh is not very sensitive to transport cost, as expected. A 1% increase in transportation cost decreases the bilateral trade balance of Bangladesh expressed as ratio of export to import by 0.84%.

The reported *R*-square and *F*-statistics of the regression output in Appendix A2 are based on the difference between the residuals sums of squares from the estimated model, and sums of the squares from a single constant-only specification, not from a fixed-effect-only specification. As a result, the interpretation of these statistics is that they describe the explanatory power of the entire specification, including the estimated fixed effects reported in Appendix A2. The *R*-square is 0.757 and *F*-statistics is highly significant with $p = 0.00$. This implies that including estimated fixed effects, the entire model explains 76 percent of variations in the trade balance.

The estimation results of autocorrected error structured model in Appendix A3 also support the above analysis though the values of the coefficient are slightly different for the explanatory variables. The reason might be that the estimation drops one observation for each cross-section (country) when performing autocorrelation correction doing AR(1) differencing. The magnitude and the sign of the coefficients are very similar.

VII. CONCLUSION

In an era of globalization and trade liberalization a clearer understanding of the factors underlying a country's balance of trade position is needed. The extended trade balance model developed in this study captures the effects of all the factors influencing trade balance as suggested by conventional elasticity, absorption and monetary approaches and the Gravity Model.

In the standard models, absolute factors like domestic GDP, trading partners' GDP, domestic per capita income, partners' per capita income, distance between trading countries and the real exchange rate between trading partners determine the trade balance. The extended model postulates that relative value of GDP of trading countries, relative per-capita income, real exchange rate, and import-weighted distance (MWD_{ij}) between countries determine the trading pattern and hence the trade balance of a country in bilateral trade with partners.

The empirical results provide some useful insights into the trade balance of Bangladesh.

[3] Linder hypothesis suggests that, the demand structure in two countries will be similar for the similarities of per capita income.

The static panel data analysis explores the cross-country variations as well as the time-invariant country-specific effects on trade balance with heterogeneous economies and finds significant effects of all relative factors on the trade balance of Bangladesh. The robustness check ensures the validity of the new specification.

REFERENCES

Adam, C. and D. Cobham (2007). Modelling multilateral trade resistance in a gravity model with exchange rate regimes. Conference Paper No. CDMC07/02, CASTLECLIFFE, School of Economics & Finance, University of St. Andrews, UK.

Baharumshah, A. Z. (2001). The Effect of Exchange Rate on Bilateral Trade Balance: New Evidence from Malaysia and Thailand, Asian *Economic Journal*. 15: 291-311.

Bahmani-Oskooee, M. (1991). Is There a Long-Run Relation Between the Trade Balance and the Real Effective Exchange Rate of LDCs?, *Economic Letters*. 36: 403-407.

Bahmani-Oskooee, M. (2001). Nominal and Real Effective Exchange Rates of Middle Eastern Countries and their Trade Performance, *Applied Economics. 33: 103-111.*

Bahmani-Oskooee, M. and T. J. Brooks (1999). Bilateral J -Curve Between U.S. and her Trading Partners, *Weltwirtschaftliches Archiv*. 135: 156-165.

Bergstrand, J.H. (1985). The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence, *The Review of Economics and Statistics*. 67: 474-81.

Bergstrand, J.H. (1989). The Generalised Gravity Equation, Monopolistic Competition, and the Factor Proportion Theory in International Trade, *Review of Economics and Statistics*. 77: 143-53.

Brada, J. C., A.M. Kutan and S. Zhou (1997). The Exchange Rate and the Balance of Trade: The Turkish Experience, *Journal of Development Studies*. 33: 675-692.

Deardorff, A. (1997). Determinants of Bilateral Trade: Does Gravity Work in a Classical World?. Jeffrey Frankel (ed.). *The Regionalization of the World Economy*. Chicago: University of Chicago Press.

Faruqee, H. (2004). Measuring the Trade Effects of EMU. IMF Working Paper No. WP/04/154, International Monetary Fund.

Gupta-Kapoor, Anju and Uma Ramakrishnan (1999). Is There a J -Curve? A New Estimation for Japan, *International Economic Journal*. 13: 71-79.

Hausman, Jerry A. (1978). Specification Tests in Econometrics, *Econometric*a. 46: 1251–1272.

Haynes, S.E., and J.A. Stone (1982). Impact of the Terms of Trade on the U.S. Trade Balance: A Reexamination, *The Review of Economics and Statistic*s. 64: 702-706.

Hussain, H., L.K Sen and C.C. Keong. (2003). The Impact of Devaluation on Malaysia Trade Balance. Discussion paper, Asia Pacific Environment Conference, Malaysia. Available on the web: http://www.geocities.com/venusliewks/proceedings/Malaysia_Devaluation_TradeBalance.pdf.

International Monetary Fund (2006). International Financial Statistics (IFS) CD-Rom 2006.

IMF's Direction of Trade Statistics (DOT), 1980-2005, www.imfstatistics.org/DOT.

IMF's International Financial Statistics (IFS) Yearbook, 1980-2006, IMF.

Judson, R.A. and A.L. Owen (1999). Estimating Dynamic Panel Data Models: A Practical Guide for Macroeconomists, *Economic Letters*. 65: 9-15.

Kalbasi, H. (2001). The Gravity Model and Global Trade Flows, Paper presented at the 75th International Conference on Policy Modelling for European and Global Issues, Brussels. July 5-7.

Kristjánsdóttir, Helga (2005). A Gravity Model for Exports from Iceland. Working Paper 14, Centre for Applied Microeconometrics (CAM), University of Copenhagen.

Krugman, P.R. and R.E. Baldwin (1987). The Persistence of the U.S. Trade Deficit, *Brookings Papers on Economic Activit*y. 1: 1-43.

Linneman, H. (1966). *An Econometric Study of International Trade Flows*. Amsterdam: North Holland.

Onafowora, O. (2003). Exchange rate and Trade Balance in East Asia: Is There a J–curve? *Economics Bulletin*. 5: 1–13.

Poyhonen, P. (1963). Toward A General Theory of International Trade, *Ekonomiska Samfundets Tidskrift, Tredje serien*. 16: 69-77.

Rahman, M.M. (2006). The Determinants of Bangladesh's Trade: Evidences from the Generalized Gravity Model, The Economic Society of Australia's 33rd Conference of Economists 2004, The University of Sydney, Australia.

Rose, A. K. (1991). The Role of Exchange Rates in a Popular Model of International Trade: Does the 'Marshall-Lerner' Condition Hold?, *Journal of International Economics*. 30: 301-316.

Rose, A.K. and J.L. Yellen (1989). Is There a J-curve? *Journal of Monetary Economics*. 24: 53- 68.

Studenmund, A.H. (2001). *Using Econometrics – A Practical Guide*. San Franciso, CA: Addision Wesley Longman.

Shirvani, H. and B. Wilbratte (1997). The Relationship between the Real Exchange Rate and the Trade Balance: an Empirical Reassessment, International *Economics Journal*. 11: 30-50.

Thapa, N.B. (2002). An Econometric Analysis of the Impact of Real Effective exchange Rate of Economic Activities in Nepal. *Economic Review: Occasional Paper*. 14: 17-36.

Tinbergen, J. (1962). *Shaping the World Economy: Suggestions for an International Economic Policy*. New York: The Twentieth Century Fund.

World Bank (2007). World Development Indicators (WDI) 2007 CD-Rom, World Bank, Washington D.C.

World Bank website: www.econ.worldbank.org

APPENDIX A1: TEST OF INDIVIDUAL EFFECTS OF THE TRADE BALANCE MODEL

Redundant Fixed Effects Tests
Test cross-section and period fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	32.744815	(49,1148)	0.0000
Cross-section Chi-square	1072.995324	49	0.0000
Period F	2.403730	(25,1148)	0.0001
Period Chi-square	62.603979	25	0.0000
Cross-Section/Period F	22.951704	(74,1148)	0.0000
Cross-Section/Period Chi-square	1114.168655	74	0.0000

APPENDIX A2: HETERO-CORRECTED FIXED EFFECT MODEL

Dependent Variable: LN_TB
Method: Panel Least Squares
Sample: 1980 2005
Periods included: 26
Cross-sections included: 50
Total panel (unbalanced) observations: 1227
White cross-section standard errors & covariance (no d.f. correction)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RGDP	-2.293594	0.370574	-6.189298	0.0000
LN_RPGNI	2.330199	0.324672	7.177084	0.0000
LN_RER	-0.048809	0.007637	-6.390687	0.0000
LN_MWD	-0.844100	0.042031	-20.08269	0.0000
C	-2.147029	0.735316	-2.919873	0.0036

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.757492	Mean dependent var	-0.760070
Adjusted R-squared	0.746534	S.D. dependent var	1.990707
S.E. of regression	1.002229	Akaike info criterion	2.885342
Sum squared resid	1178.235	Schwarz criterion	3.110335
Log likelihood	-1716.157	Hannan-Quinn criter.	2.970002
F-statistic	69.13104	Durbin-Watson stat	0.799915
Prob(F-statistic)	0.000000		

APPENDIX A3: AUTOCORRELATED ERROR STRUCTURED FIXED EFFECTS MODEL

Dependent Variable: LN_TB
Method: Panel Least Squares
Sample (adjusted): 1981 2005
Periods included: 25
Cross-sections included: 50
Total panel (unbalanced) observations: 1164
Convergence achieved after 7 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RGDP	-1.575483	0.532314	-2.959688	0.0031
LN_RPGNI	2.487704	0.565412	4.399811	0.0000
LN_RER	-0.049836	0.014768	-3.374519	0.0008
LN_MWD	-0.941325	0.026524	-35.49000	0.0000
C	-3.106193	1.162900	-2.671074	0.0077
AR(1)	0.585811	0.023076	25.38608	0.0000

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.849239	Mean dependent var	-0.779205
Adjusted R-squared	0.841898	S.D. dependent var	1.960569
S.E. of regression	0.779563	Akaike info criterion	2.385931
Sum squared resid	673.9594	Schwarz criterion	2.625002
Log likelihood	-1333.612	Hannan-Quinn criter.	2.476123
F-statistic	115.6852	Durbin-Watson stat	2.264888
Prob(F-statistic)	0.000000		
Inverted AR Roots	.59		