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## **Should Bangladesh exports to countries with better institutional or comparatively similar institutional form?**

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## **Abstract**

Using panel data for the years 2006 to 2015, this study empirically investigates the effect of rule of law as an institution on Bangladesh's exports to twenty-eight European Union countries (EU28) based on gravity model analysis. Two-step econometric results suggest that institutional rule of law is strongly associated with Bangladesh's exports, and institutional quality provides evidence of this significant effect. Furthermore, exports of Bangladesh are driven by economic size, market size, and the real exchange rate as well as rule of law. These results are suggestive of an important joint role for both trade and institutions in the long run.

**Key words:** Bangladesh, Gravity model, Institution, Panel data, Rule of law.

**Jel codes:** F13, M21

## 1. Introduction

To achieve the Sustainable Development Goals (SDGs) by 2030, Bangladesh's primary policies are to maintain a higher growth rate and the need of policymakers' realization of the determinants that affect the growth.

After independence in 1971, Bangladesh pursued an inward-looking import substitution policy, but due to the unexpected failure of such policies in terms of growth and balance of payments, Bangladesh has been pursuing open trade policies from the late 1970s (Love & Chandra, 2005b). According to Bakht (2000) that shift (inward-looking import substitution to open trade) in trade regime was gradual and moved towards an export-led growth strategy. Bangladesh's economy sharply accelerated from 1990 for two reasons: firstly, restoration of democracy (rule of law) and, secondly, trade openness or liberalization (Islam, 2001).

Goldman Sachs and famous economist Jim O'Neill identified eleven countries (of which Bangladesh is one) as the NEXT 11 to have high economic potential in the 21<sup>st</sup> century. Over the past decade, Bangladesh's annual average growth was more than 6%, which is one of the top performances in Asia. Total trade of Bangladesh has accelerated from US\$19,175.64 million in 2004 to US\$69,400.66 million in 2015, and the contribution of trade in gross domestic product (GDP) rose from 31.24% to 36.82% during the same period, apparently reflecting the importance of international trade in the economy.

Bangladesh is one of the emerging economies in South Asia, which has substantiated steady growth over the half-decade and expects 7.05 in 2016-2017 (Bangladesh Bureau of Statistics (BBS), 2016). Bangladesh export of goods and services has been boosted from US\$1.86 billion in 1990 to US\$36.86 billion in 2016 over the period, reflecting appreciation of international trade in the economy (Figure 1 and Table 1). Figure 2 shows Bangladesh's major export destinations in Q2 2017.

Table 1: Bangladesh: Exports of goods and services (current US\$)

Figure 1: Exports of goods and services (current US\$)

Figure 2: Bangladesh's major export destinations in Q2 2017

However, most of the export earnings of Bangladesh come from the ready-made garment sector (RMG) and it is nearly 75% of total exports. Such a development indicates that the export sector of Bangladesh is not diversified. Moreover, the export sector is dominated by a few products, such as RMG, leather, and agronomical products, which leads to higher concentration in exports. It is also highly concentrated in export destinations. In 2016, Bangladesh's total global exports earnings was US\$37 billion, of which US\$21 billion exports earnings were from the European Union (EU28) and US\$6 billion from the USA (ITC Trade Map). In addition, Bangladesh's trade sector is struggling to expand due to different supply-side constraints such as a higher dependency on the ready-made garments (RMG) sector, inadequate institutions and infrastructure, inappropriate technology, and limited trade financing. It also faces higher costs of importing raw materials, etc.

The Government of Bangladesh is targeting 8% annual growth by 2020, which is highly ambitious given the poor infrastructure and institutional framework in the economy.

To reach this ambitious annual growth target, policymakers need to reevaluate the determinants that influence the international trade of Bangladesh. In addition, running huge development programs such as the construction of **Padma Bridge** has resulted in large balance of payments deficits, and therefore economists have put emphasis on the expansion of exports. For efficient development and sustainable growth, foreign exchange flow is necessary, and thus international trade is important for Bangladesh.

Bangladesh's international trade is dominated by the USA and the UK. At the end of the 1980s, European countries became the desirable exporting destinations, but Bangladesh's trade with those countries is still rather limited. Thus, it is important to identify in depth the major determining factors that are affecting Bangladesh's trade with European countries. This study applies the generalized gravity model to identify the bilateral trade between Bangladesh and the twenty-eight European Union countries (EU28) over the ten year period from 2006 to 2015 (list shown in Appendix). This study also aims to inform policymakers about the effect of the rule of law on trade between Bangladesh and the EU28 to improve the bilateral trade.

The rule of law focuses on the quality of the legal system and indicates society's perceived

success in upholding fair and predictable rules for social and economic interaction (De Groot et al., 2004). The rule of law is defined in different ways, and in most of the definitions judicial clarification was inconsistent. The most convincing definition of rule of law is given by the World Justice Project (WJP). Based on four universal principles, viz. accountability, just laws, open government, and access and impartial dispute resolution, the WJP defined the rule of law as follows:

**Accountability**

The government as well as private actors are accountable under the law.

**Just Laws**

The laws are clear, publicized, stable, and just; are applied evenly; and protect fundamental rights, including the security of persons and property and certain core human rights.

**Open Government**

The processes by which the laws are enacted, administered, and enforced are accessible, fair, and efficient.

**Accessible and Impartial Dispute Resolution**

Justice is delivered timely by competent, ethical, and independent representatives and neutrals who are accessible, have adequate resources, and reflect the makeup of the communities they serve.

Retrieved from <https://worldjusticeproject.org/about-us/overview/what-rule-law>. These four principles are quoted directly from their official website. Rule of law reflects the perceptions of the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence (Kaufmann et al., 2010).

This study attempts to find out which institutional framework is beneficial for Bangladesh's export using the rule of law as an institution. In this context, the research question is:

Should Bangladesh export to countries with better institutional forms or comparatively similar institutional forms?

## **2. Literature Review**

A number of research studies examined the relationship between trade and growth using cross section econometric analysis and concluded that export growth promotes an economy's overall growth. According to Krugman (1994), trade can effect developing country's growth in two

ways: firstly, labor-intensive producers expand their output in the domestic market, and, secondly, domestic industries protection leads to higher capital intensity production and forces reliance on the market. Bangladesh adopted trade liberalization policy in 1990 to enhance economic growth and foster development. Dollar and Kraay (2001) studies on Bangladesh, India, and Sri Lanka concluded that those countries increased their trade through significant reduction in tariff and non-tariff barriers, and their economies performed well in terms of economic growth and poverty reduction.

Nowadays, the performance of institutions has attained new heights as a new determinant to evaluate the relationship between trade policy and economic growth. Trade, growth, and development are all linked. Adam Smith, in his book *The Wealth of Nations*, gave importance to the “division of labor”, which is the key factor in economic progress as well as for international trade. We can refer to division of labor as a part of institutions, and the quality of institutions is important for international trade. World Governance Indicators (WGI) (Kaufmann et al., 2008) used six different governance indicators to measure the quality of institutions across countries. Those indicators are government effectiveness, rule of law, political stability and no violence, regulatory quality, voice and accountability, and control of corruption. Nevertheless, those WGI indicators have an extreme degree of intercorrelation (Siddiqui & Ahmed, 2013). When all the indicators of WGI have a combined impact on trade, then it will accelerate the international trade.

There is an ongoing debate: do institutions matter for trade? North, in his 1993 Nobel lecture on economic performance through time, mentioned that institutions are the rules of the game; organizations and their entrepreneurs are the players. Institutions represent a necessary condition for the harmonious functioning of markets and allow stable interactions by reducing prevailing uncertainty on markets. In addition, institutions can decrease the transaction cost or decrease the information cost. According to North (1993), rules are not necessarily created for social efficiency; formal rules may also be created in order to serve and satisfy established power (bargaining power) interests, and institutions are a rational solution in front of coordination problems. Rule of law is a better measure of institutional quality (Knack & Keefer, 1995) and better rule of law has a positive impact on real per capita income (Dollar & Kraay, 2000). The relationship between rule of law and GDP per capita is shown in Figure 5.

Figure 3: The relationship between rule of law and GDP per capita

Anderson and Marcouiller (2002) developed a model of import demand with the hypothesis that insecurity constrains trade and, for that, measured institutions through the data of the World Economic Forum (WEF) Executive Survey 1997. They found that when legal systems are capable of enforcing commercial contracts and government economic policy, implemented by transparent and impartial formulation, then trade is expanded by strong institutions. Effective institutions in the importing country lower transaction costs, lower the prices of traded goods, and raise imports, holding constant the characteristics of the exporting country (Anderson & Marcouiller, 2002). De Groot et al. (2004) investigated the effects of institutions on bilateral trade and extended their study in the effectiveness of institutional similarity. Their study found that institutional quality affects the distribution and size of the bilateral trade, and low quality of governance increases the transaction cost. De Groot et al. (2004) also found that institutional dissimilarity affects bilateral trade, while the same kinds of institutions interact more, and countries with bad governance could not benefit from trade with highly developed countries despite the comparative advantages.

Apart from import substitution, many countries persistently seek an export-led growth strategy. The relationship between export and growth was analyzed by use of different studies. Bahmani-Oskooee and Alse (1993) investigated the relationship between exports and economic growth and found evidence of export-led growth for Korea, Malaysia, Pakistan, the Philippines, and Thailand. Another study, carried out by Narayan et al. (2007), examines the export-led growth hypothesis for Papua New Guinea and Fiji, and their study implies that for Fiji there is evidence of export-led growth in the long run, while for Papua New Guinea there is evidence of export-led growth in the short run. To the contrary, Love and Chandra (2005a) investigated the export-led hypothesis for South Asia and concluded with mixed results. They found no causality for Sri Lanka and Pakistan, while India, the Maldives, and Nepal illustrated export-led performance; however, Bangladesh and Bhutan exhibited the opposite results.

As rule of law improves, the measure obviously affects the incentive to invest and hence trade and growth. The rule of law demonstrates two characteristics: maintenance of property rights, and the absence of corruption (Butkiewicz & Yanikkaya, 2006), and property rights are found to have a greater impact on investment and growth (Knack & Keefer, 1995). The rule of



law means the provision of security and the relationship between economic growth and rule of law centralized on property rights (Tiede, 2011).

There are several research studies that investigate the effect of institutions on economic performance. The quality of institutions and trade are firmly correlated with human capital and geographical variables (Rigobon & Rodrik, 2005). Acemoglu et al. (2001) estimated the effect of institutions on economic performance using mortality data and found that institution has a large effect on income per capita. Méon and Sekkat (2008) examined the impact of the quality of institutions on trade using the panel data of 60 countries over the period 1990-2000 and concluded that the quality of institutions has a positive impact on manufactured goods but no impact on non-manufactured goods. Rule of law and democracy reinforce mutually and tend to accelerate each other; both have a beneficial impact on economic performance but the former has a stronger impact on income (Rigobon & Rodrik, 2005).

Wacziarg (1998) used the panel data from 1979-89 of 57 countries and concluded that trade has a positive impact on economic growth. Similarly, the cross-country study of Frankel and Romer (1999) suggests that trade leads to a significant and robust positive effect on income. Dollar and Kraay (2003) highlighted the relative importance of trade and institutions on growth and found significant a joint role of trade and institutions on growth. They also emphasize the importance of both to understand the cross-country differences in growth.

Rule of law will increase the dependency of international trade partners on formal institutions, which will yield more trade. According to Yu et al. (2015), export uncertainty exists across importing countries when those countries do not have proper rule of law institutions, and due to this kind of uncertainty, traders rely on informal institutions such as trust to assess the future of trade. Yu et al. (2015) found that trade partners rely less on trust when a country improves its formal institutions, such as rule of law. ASEAN<sup>1</sup> members, particularly Singapore, Vietnam and Cambodia, benefit significantly from the improvement of the rule of law regionally and such initiative is attracting major investment to those countries (Ewing-Chow et al., 2014).

In international trade, institutions are important in understanding economic performance and to identify how agents negotiate and deal with uncertainty. There are related research studies

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<sup>1</sup> The Association of Southeast Asian Nations (ASEAN) is an organization of countries in Southeast Asia officially formed in 1967 to promote cultural, economic, and political development in the region.

on the impact of institutions on economic growth. Barro, R. J. (1996) used the panel data of 100 countries over 30 years and found that rule of law, smaller government expenditure and lower inflation enhance the growth of real per capita GDP. His results also suggest that an expansion of the political right (which also is an institution) has a weak effect on growth. Institutions matter for economic growth across both time and space (Xu, 2011) and institutional threshold effects on economic growth regarding the relation between institution and economic growth, and these effects depend on the political system (Vaal & Ebben, 2011). However, Glaeser, E. L. et al. (2004) explored the causal link between the institution and economic growth but could not establish the link between those factors. They therefore suggested researchers focus on laws, rules and compliance procedure. Glaeser, E. L. et al. (2004) think that institutions have second order effects on economic performance, while first order effects come from the human and social capital.

### 3. Empirical Analysis

#### 3.1 Descriptive Statistics

Figure 4 presents the rule of law indicator of 2015 for the EU28 and Bangladesh; Figure 5 presents the rule of law indicators of the EU28 from 2006 to 2015, where the EU28 countries are divided into two groups, viz. Western Europe and Eastern Europe (list shown in Appendix B).

Figure 4: Rule of Law Indicator. Source: The Worldwide Governance Indicators, 2016

Rule of law indicators estimated in a range of -2.5 (weak) to 2.5 (strong) with a 90% confidence interval. In figure 6 all countries have positive scores, except Bangladesh and Bulgaria and Bangladesh and Eastern European countries have a comparatively similar institutional rule of law. The rule of law indicator depicted in figure 7 indicates that Western Europe has stronger institutions (rule of law) compared with Eastern Europe.

Figure 5: Rule of Law, European Union 28 Countries. Source: The Worldwide Governance Indicators, 2016

### 3.2 Model

Gravity equation has emerged as the most important econometric tool in international trade to study the ex post effects due to the model's empirical success and convincing analytical framework. There are plenty of research studies where the trade flows and the major determining factors in a gravity model framework have explained econometrically. (Hoekman & Nicita, 2008; Rahman & Ara, 2010; Doumbe & Belinga, 2015). Tinbergen (1962) was the first author to publish an econometric study using the gravity equation for international trade flows. The gravity equation is typically used to explain cross-sectional variation in countries' trade flows in terms of the country's exports, imports, and other related variables (Baier & Bergstrand, 2007). Rahman (2003) used import-export and total trade data in gravity model analysis to investigate trade flow between Bangladesh and its major trading partners. He found that Bangladesh's trade is significantly determined by the size of the economy, GNP per capita, distance, and openness. Blomqvist (2004) explains the trade flows of Singapore by implementing a gravity model analysis, and Anaman and Al-Kharusa (2003) found that market size firmly determined Brunei's trade with the EU by using gravity model analysis.

Along with research objectives, questions have been raised about using the econometric techniques and model. In recent years, the gravity model has held center stage in the study of ex post trade effects. This research study followed the Krugman and Maurice (2005) variation of the gravity model. To find answers to the research questions, this study uses two-step analysis with a different gravity model. Two-step analysis of this gravity model has the following form:

First Step: Importance of institutions and the EU28

$$\log(\text{Export}_{it}) = \alpha_0 + \alpha_1 \log(\text{GDP}_{jt}) + \alpha_2 \log(\text{POP}_{jt}) + \alpha_3 \log \text{EXR}_{ijt} + \alpha_4 \text{RoL}_{jt} + \varepsilon_{ijt} \dots \quad (1)$$

$$\log(\text{Export}_{it}) = \alpha_0 + \alpha_1 \log(\text{GDP}_{jt}) + \alpha_2 \log(\text{POP}_{jt}) + \alpha_3 \log \text{EXR}_{ijt} + \alpha_5 (\text{RoL}_{jt} - \text{RoL}_{it}) + \rho_{ijt} \dots \quad (2)$$

Second Step: Comparison between Western Europe and Eastern Europe

$$\log(\text{Export}_{it}) = \alpha_0 + \alpha_1 \log(\text{GDP}_{wt}) + \alpha_2 \log(\text{POP}_{wt}) + \alpha_3 \log \text{EXR}_{iwt} + \alpha_4 \text{RoL}_{wt} + \theta_{iwt} \dots (3)$$

$$\log(\text{Export}_{it}) = \alpha_0 + \alpha_1 \log(\text{GDP}_{et}) + \alpha_2 \log(\text{POP}_{et}) + \alpha_3 \log \text{EXR}_{iet} + \alpha_4 \text{RoL}_{et} + \delta_{iet} \dots (4)$$

$$\log(\text{Export}_{it}) = \alpha_0 + \alpha_1 \log(\text{GDP}_{wt}) + \alpha_2 \log(\text{POP}_{wt}) + \alpha_3 \log \text{EXR}_{iwt} + \alpha_5 (\text{RoL}_{wt} - \text{RoL}_{it}) + \theta_{iwt} \dots (5)$$

$$\log(\text{Export}_{it}) = \alpha_0 + \alpha_1 \log(\text{GDP}_{et}) + \alpha_2 \log(\text{POP}_{et}) + \alpha_3 \log \text{EXR}_{iet} + \alpha_5 (\text{RoL}_{et} - \text{RoL}_{it}) + \delta_{iet} \dots (6)$$

Where:

$j = 1, 2, 3 \dots \dots 28$

$i = 1$  (Bangladesh)

$w = 1, 2, 3 \dots 15$  (Western European Countries)

$e = 1, 2, 3 \dots 13$  (Eastern European Countries)

$\text{Export}_{it}$  = Bangladesh's export to country  $j$  in time  $t$

$\text{Export}_{wt}$  = Bangladesh's export to country  $w$  in time  $t$

$\text{Export}_{et}$  = Bangladesh's export to country  $e$  in time  $t$

$\text{GDP}_{jt}$  = Country  $j$ 's GDP in time  $t$

$\text{GDP}_{wt}$  = Country  $w$ 's GDP in time  $t$

$\text{GDP}_{et}$  = Country  $e$ 's GDP in time  $t$

$\text{POP}_{jt}$  = Population of country  $j$  in time  $t$

$\text{POP}_{wt}$  = Population of country  $w$  in time  $t$

$\text{POP}_{et}$  = Population of country  $e$  in time  $t$

$\text{EXR}_{ijt}$  = Real exchange rate between Bangladesh and country  $j$  in time  $t$

$EXR_{iwt}$  = Real exchange rate between Bangladesh and country  $w$  in time  $t$

$EXR_{iet}$  = Real exchange rate between Bangladesh and country  $e$  in time  $t$

$RoL_{jt}$  = Rule of Law country  $j$  in time  $t$

$RoL_{wt}$  = Rule of Law country  $w$  in time  $t$

$RoL_{et}$  = Rule of Law country  $e$  in time  $t$

$RoL_{jt} - RoL_{it}$  = Rule of Law differences between country  $i$  and country  $j$  in time  $t$

$\varepsilon_{ijt}$  = Error term

$\rho_{ijt}$  = Error term

$\theta_{ijt}$  = Error term

$\delta_{ijt}$  = Error term

### 3.3 Data Description

The data set contains annual export flows, GDP, population, exchange rate, and rule of law of Bangladesh and the twenty-eight European Union countries (EU28), the list shown in table 1, for the time period from 2006 to 2015. Annual exports are calculated as average of monthly figures, which are taken from the International Trade Center (ITC) Trade Map database. (Such data is freely accessible on the ITC's official website: <http://www.trademap.org/>.) The GDP of the EU28 in time  $t$  is used as a measure of economic size. This variable is expected to have a positive impact for trade. The gross domestic product (GDP) of the EU28 is obtained from the World Bank (WB) in US current dollars. (It was updated on 21 November 2017: <https://data.worldbank.org/>). Population is included in the gravity model in order to estimate the market size. The larger the market the more it exports; therefore, market size is expected to turn out with a positive sign. The EU28 population data is obtained from OECD statistics; those data not included in the OECD are obtained from the World Bank.

Empirical studies on exchange rates show that exchange rate has a stronger relation with trade (Bergstrand, 1985; Dell'Ariccia, 1999), and Hossain and Alauddin (2005) quoted from Rahman (1995) and Bayes et al. (1995) that a better exchange rate promotes Bangladesh's international competitiveness and accelerates exports. Therefore, the exchange rate is included as an explanatory variable in the model. Data of exchange rates for both the EU28 and

Bangladesh are obtained from Bangladesh Bank. The effect of the real exchange rate on exports of Bangladesh to the EU28 is expected to be positive. Bangladesh's currency depreciation speaks for a fall in the real exchange rate; as a result, exports would be competitive and thereby export growth will increase.

Finally, rule of law used as quality of institution. Exchange rate data for both the EU28 and Bangladesh were obtained from the World Bank's Worldwide Governance Indicators (WGI) project. (This data is freely accessible in on the WGI official website: <http://info.worldbank.org/governance/wgi/wgidataset.xlsx>.) A higher level of rule of law reduces the probability of losing money since contract breakers have to take their responsibility and are more likely to lose their case.

## 4. Results and Discussion

### 4.1 FIRST STEP: EU28 and Institution

The estimation results of bilateral trade between Bangladesh and the EU28 using gravity models 1 and 2 are given in tables 2 and 3, respectively. In both tables, the first column shows the results extracted from the random effects and the results from fixed effects, and pooled estimation methods are shown in columns two and three, respectively.

Gravity model 1 runs through three estimation methods and shows to be consistent. The results are depicted in **table 2**. The magnitudes of the coefficients in the random effect, fixed effect and pooled OLS estimations are notably different, but the coefficient of rule of law is similar and significant in random and fixed estimation procedures, whereas it is slightly different in pooled OLS methods. To find the appropriate estimation method, the Hausman test (Appendix C) for fixed versus random effects model and the Breusch-Pagan LM test (Appendix D) for random effects versus OLS was carried out. Finally, the F-test (Appendix E) for fixed effects versus pooled OLS model was carried out. The result of the Hausman test ( $\text{Prob} > \chi^2 = 0.037$ ) indicates a probability and the result of the Breusch-Pagan LM test ( $\text{Prob} > \chi^2 = 0.0000$ ) indicates a very small P-value. The F-test ( $\text{Prob} > F = 0.0000$ ) shows the same P-value, which means we should follow the random effects model.

The random effects estimation result for the gravity equation (1), where the R-squared value is 0.794, indicates that the regression is very predictable by the independent variables. In other words, the coefficient of determination ( $R^2$ ) explained 79% of variations in the dependent variable by the explanatory variables. All coefficients of the model except the population of

the EU28 are statistically significant at the 1% level. The significance of the gravity model suggests that the exports of Bangladesh to the EU28 countries are better explained by this model.

Table 2: Regression results of the EU 28 (first step), equation 1 with three different estimations

The GDP of the EU28 turns out positive signs and has a significant impact on Bangladesh's exports. Its coefficient value is 0.763, which would be conceivable as keeping all other variables constant; a 1% increase in the EU28 GDP will on average lead to an increase in the exports of Bangladesh by 0.763%. The population of the EU28 countries also has a positive and significant effect on Bangladesh's exports at a 1% level of significance. The value of its coefficient is 0.665, which would be conceivable as keeping all other variables constant; an increase of one percentage point in the population of the EU28 countries will on average lead to an increase in the exports of Bangladesh by 0.665%. The exchange rate variable also turns out a positive sign and is significant at a 1% level of significance. Its coefficient value of 8.883 would be conceivable keeping all other variables constant. A one percentage point increase in the exchange rate or a 1% depreciation of Bangladesh's currency will on average lead to an increase in the exports of Bangladesh by 8.883%. Finally, the results for rule of law, which are important and crucial for this study, are explained below.

Rule of law of the EU28 also turns out a positive sign and is significant at 1% level of significance. Its coefficient value is 1.282 and, technically, can be interpreted as a unit of 0.10. Improvement in rule of law of the EU28 will increase the exports of Bangladesh on average by 26.03%.

$$[(e^{1.282} - 1) * 100 \cong 260.384].$$

Table 3: Regression results of the EU 28 (first step), equation 2 with three different estimations

Gravity model 2 runs through three estimation methods for consistency. The results are depicted in **table 3**. The magnitudes of the coefficients in random effect, fixed effect and pooled

OLS estimation are notably different, but the coefficient of rule of law is similar and significant in random and fixed effect methods but slightly different in pooled OLS estimation procedures. The Hausman test (Appendix F), the Breusch-Pagan LM test (Appendix G) and, finally, the F-test (Appendix H) were carried out to find the appropriate estimation method. The result of the Hausman test ( $\text{Prob} > \chi^2 = 0.083$ ) indicates a probability, and the result of the Breusch-Pagan LM test ( $\text{Prob} > \chi^2 = 0.0000$ ) indicates a very small P-value. The F-test ( $\text{Prob} > F = 0.0000$ ) shows the same P-value, which means we should follow the random effects model.

Random effects estimates results for the gravity equation (2), where R-squared value is 0.796, indicates that the regression is very predictable by the independent variables. In other words, the coefficient of determination ( $R^2$ ) explains 79% variations in the dependent variable by the explanatory variables. All coefficients of the model except population of the EU28 are statistically significant at the 1% level. The significance of the gravity model suggests that the exports of Bangladesh to the EU28 countries are better explained by this model.

The GDP of the EU28 turns out positive signs and has a significant impact on Bangladesh's exports. Its coefficient is 0.798, which would be conceivable as keeping all other variables constant. A 1% increase in the EU28 GDP will lead to an increase in the exports of Bangladesh on average by 0.79%. The population of the EU28 countries also has a positive and significant effect on Bangladesh's exports at 1% level of significance. The value of its coefficient is 0.621, which would be conceivable as keeping all other variables constant; an increase of one percentage point in the population of the EC countries will lead to an increase in the exports of Bangladesh on average by 0.62%. The exchange rate variable also turns out a positive sign and is significant at 1% level of significance. Its coefficient value is 8.110 and would be conceivable as keeping all other variables constant. A one percentage point increase in the exchange rate or 1% depreciation of Bangladesh's currency will lead to an increase in the exports of Bangladesh on average by 8.11%.

Finally, the rule of law is different between the EU28 and Bangladesh. This difference is also crucial for this study. The difference in rule of law between the EU28 and Bangladesh also turns out a positive sign; and is significant at 1% level of significance. Its coefficient value of 1.056 can technically be interpreted as a 0.1 unit improvement in the differences in rule of law between the EU28 and Bangladesh and will increase the exports of Bangladesh on average



by 18.74%  $[(e^{1.056} - 1) * 100 \cong 187.484]$ .

#### **4.2 SECOND STEP: Comparison between the Western and Eastern European Union**

To compare the effect of the rule of law between Eastern and Western Europe with Bangladesh's trade, comparative results from gravity equations (3) and (4) are depicted in **table 4**. Similarly, the comparative results from gravity equations (5) and (6) are depicted in **table 5**. In those comparisons, this study only followed the random effects method.

Table 4: Comparison of Eastern and Western European Union, equation 1 with random effect estimation
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From the comparative results depicted in **table 4**, in both Western and Eastern Europe, the coefficient of GDP is positive, but Western Europe has a significant and higher impact on Bangladesh's exports compared with Eastern Europe. The coefficient of GDP for Western Europe and Eastern Europe are 1.355 and 0.743, respectively, which would be conceivable keeping all other variables constant. A 1% increase in GDP of both Western and Eastern Europe will lead to an increase in the exports of Bangladesh on average by 1.355% and 0.743%, respectively. The populations of both Western and Eastern Europe have a positive but insignificant effect on Bangladesh's exports. The exchange rate has a very important role in the least developed countries and, here, both Western and Eastern Europe have a positive and significant impact on Bangladesh's exports. In Western Europe its coefficient value is 10.77, whereas it is 6.662 for Eastern Europe. Apparently, Western Union currency has a larger impact on Bangladesh's exports compared with that of Eastern Europe.

Finally, the coefficient of rule of law for both Western and Eastern Europe turns out a positive sign. The value of the coefficient for Western Europe is 0.777, which is significant at 5% level of significance. It can be interpreted as 0.1 unit improvement in the rule of law between Western Europe and Bangladesh and will increase the exports of Bangladesh on average by 11.74%  $[(e^{0.777} - 1) * 100 \cong 117.493]$ . Comparatively, the coefficient for Eastern Europe is 1.9, which is significant at 1% level of significance. It can be interpreted as 0.1 unit improvement in rule of law between the EU28 and Bangladesh and will increase the exports of Bangladesh on average by 56.85%  $[(e^{1.9} - 1) * 100 \cong 568.589]$ .

Table 5: Comparison of Eastern and Western European Union, equation 2 with random effects estimation
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From the comparative results depicted in **table 5**, in both Western and Eastern Europe, the GDP turns out positive signs but, like the previous comparison, only Western Europe has a significant and higher impact on Bangladesh's exports compared with Eastern Europe. The coefficients of GDP for both Western and Eastern Europe are 1.309 and 0.667, respectively, which would be conceivable keeping all other variables constant. A 1% increase in the GDP for both Western and Eastern Europe will lead to an increase in the exports of Bangladesh on average by 1.309% and 0.667%, respectively. The populations of both Western and Eastern Europe also have a positive but insignificant effect on Bangladesh's exports. The exchange rate has a positive and significant impact on Bangladesh's exports. In Western Europe its coefficient value is 10.186, whereas it is 5.935 for Eastern Europe. Apparently, Western Union currency has a larger impact on Bangladesh's exports compared with that of Eastern Europe.

Finally, the coefficient for the effect of differences in rule of law for both Western and Eastern Europe turns out a positive sign. The value of its coefficient for Western Europe is 0.737, which is significant at 5% level of significance. It can be interpreted as 0.1 unit improvement in the rule of law between Western Europe and Bangladesh and will increase the exports of Bangladesh on average by 10.89%  $[(e^{0.737} - 1) * 100 \cong 108.965]$ . Comparatively, the coefficient for Eastern Europe is 1.372, which is significant at 1% level of significance. It can be interpreted as 0.1 unit improvement in rule of law between the EU28 and Bangladesh and will increase the exports of Bangladesh on average by 29.43%  $[(e^{1.372} - 1) * 100 \cong 294.322]$ .

### **4.3 DISCUSSION**

From the first step of our analysis, it was apparent that Bangladesh's exports to the twenty-eight European countries are strongly influenced by economic size, market size, exchange rate and rule of law. Also, the positive correlation with exports indicates that a big market size will increase Bangladesh's exports. When we compared the results of model 1 with model 2, we found that the values of all the coefficients had decreased except economic size. This means

that when the rule of law of Bangladesh is counted in our analysis, Bangladesh's exports to the EU28 decline by the market size, exchange rate, and the institutional rule of law. Apparently, institutional rule of law are necessary means Bangladesh should improve its institutional rule of law to increase its exports to the EU28 countries.

From the first segment of the comparison between Western and Eastern Europe, economic size and the exchange rate of Western Europe largely influence exports of Bangladesh compared with Eastern Europe. To the contrary, market size and institutional rule of law of Eastern Europe influence Bangladesh's exports more compared with Western Europe. In the second segment, when we compare the results of the final two models, i.e. when Bangladesh's rule of law is counted in our analysis, there is the suggestion of the same results as in the previous comparison. The results of these two comparisons indicate that the exports of Bangladesh are largely influenced by countries with a comparatively similar institutional form rather than a better institutional form.

Improvement of the rule of law is strongly associated with Bangladesh's exports regardless of similar or better institutional form. Economic size, market size, and the exchange rate are three factors which are very important in trade as these three factors affect trade considerably. The markets of Eastern Europe are potential for Bangladesh, but economic size and exchange rates also play important roles in improving the price competitiveness of Bangladesh. In spite of similar institutional rule of law influences, Bangladesh trade largely but if Bangladesh improves its institutional rule of law, then, in future, it will become similar to Western Europe, and this would also be beneficial for Western Europe. This study highlights the importance of institution to exports and implies that similar institutional rule of law has a stronger impact, which accelerates the exports of Bangladesh.

## **5. Conclusion**

This study attempts to determine the effect of the rule of law as an institution on Bangladesh's trade with twenty-eight European Union countries (EU28) and to indicate that either Bangladesh's exports depend on the quality (better or similar) of institution or not. The purpose of this study is to provide intuition about the importance of institutions to Bangladesh's exports as well as economic growth. The results indicate that Bangladesh's trade with the EU28 is

positively influenced by the EU28's economic size, market size, exchange rate, and rule of law (institution). The theoretical and applied effect of the institutions on trade and especially on export is very important for developing countries such as Bangladesh. According to Rodrik (2000), this is because institutions affect economic growth by influencing property rights, incentive structures and transaction costs. The estimated results of this study imply the importance of improvement of the rule of law for promoting exports of Bangladesh to European countries. (Here, we consider the rule of law as an institution.) However, despite this study it is found that similar institutional rule of law has a stronger impact on Bangladesh's exports, but we can conclude that better institutions of Bangladesh can reduce the institutional differences between Bangladesh and the European Union countries, which will accelerate Bangladesh's exports to the EU28 and likewise developed countries.

This study emphasizes the interaction between rule of law as an institution and trade as well as economic growth. However, this study does not include the other institutional forms due to correlation between them, which is a limitation of this study. When all institutional measures are combined in one index, then such institutional study will reveal a higher degree of complimentary effects of institutions on trade. In the modern economy, rule of law has more influence on international trade compared with other institutions because investors rely on the protection of formal laws. From a policy perspective, the emphasis should be given to all forms of institutions, especially the elimination of corruption, strengthening the Department of Patents, Designs and Trademarks (DPDT), and improving bureaucratic efficiencies because they are crucial to promoting export. However, strengthening justice departments and accordingly enforcing the rule of law, supported by political motivation, would be effective.

### **Authors' contributions**

MSP coordinated to the design and idea of the study, data collection, analysis and interpretation of data, and wrote the manuscript draft. SRB contributed to development of the concept, analysis and manuscript revision. TP contributed to manuscript construction, data collection, data entry, revision, editing, and structure. All authors have approved the final manuscript.

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### **Competing interests**

The authors declare that they have no competing interests.

### **Availability of Data and Materials**

The datasets are available from the corresponding author on a de-identified basis on reasonable request.

## Reference(s)

Acemoglu, D. et al. (2001). The colonial origin of comparative development: An empirical investigation. *The American Economic Review*, 91(5), 1369-1401.

Anaman, K. A. and Al-Kharusi, L. H. S. (2003). Analysis of trade flows between Brunei Darussalam and the European Union. *ASEAN Economic Bulletin*, 20 (1), 60-73.

Anderson, J.E. and Marcouiller, D. (2002). Insecurity and the pattern of trade: An empirical investigation. *The review of Economics and Statistics*, 84 (2), 342-352.

Baier, S. L. and Bergstrand, J. H. (2007). Do free trade agreements actually increase members' international trade?. *Journal of International Economics*, 71, 72–95.

Bahmani-Oskooee, M. and Alse, J. (1993). Export growth and economic growth: an application of cointegration and error-correction modeling. *Journal of Developing Areas*, 27, 535-42.

Bakht, Z. (2000). Trade liberalisation, exports and growth of manufacturing industries in Bangladesh. In M. Huq & J. Love (Eds.), *Strategies for industrialisation: The case of Bangladesh* (pp. 87–152). Dhaka: The University Press Limited.

Barro, R. J. (1996). Determinants of economic growth: A cross-country empirical study. NBER Working Paper 5698, National Bureau of Economic Research.

Bayes, A. et al. (1995). Trends in external trade sector: Trade and Aid. Experience with economic reform: Centre for Policy Dialogue (ed.), *A review of Bangladesh's Development*, University Press Limited, Dhaka.

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. Harvard University press.

Blomqvist, H. C. (2004). Explaining trade flows in Singapore. *ASEAN Economic Journal*, 18 (1), 25-46.

Butkiewicz, J. L. and Yanikkaya, H. (2006). Institutional quality and economic growth: Maintenance of the rule of law or democratic institutions, or both?. *Economic Modelling* 23, 648–661.

Dell'Araccia, G. (1999). Exchange rate fluctuation and trade flows: evidence from the European Union. *IMF Staff papers*, 46 (3).

Dollar, D. Kraay, A. (2000). Property Rights, Political Rights, and the Development of Poor Countries in the Post-Colonial Period. World Bank Working Papers.

Dollar, D. and Kraay, A. (2001). Trade, growth, and poverty. World Bank, Development Research Group. Washington, D.C.

Dollar, D. and Kraay, A. (2003). Institutions, trade, and growth. *Journal of Monetary Economics*, 50, 133–162.

Doumbe, E. D. and Belinga, T. (2015). A gravity model analysis for trade between Cameroon and twenty-eight European Union Countries. *Open Journal of Social Sciences*, 3, 114-122.

Ewing-Chow, M. et al. (2014). The facilitation of trade by the rule of law: the cases of Singapore and ASEAN. World Trade Organization Publication.

Foreign Trade Statistics (2016), Bangladesh Bureau of Statistics (BBS), Bangladesh

Frankel, J. A. and Romer, D. (1999). Does trade cause growth? *The American Economic Review*. 89(3), 379-399.

Glaeser, E. L. et al. (2004). DO INSTITUTIONS CAUSE GROWTH?. Working Paper 10568, National Bureau of Economic Research.

De Groot, H. L. F., Linders, G. J. et al. (2004). The Institutional Determinants of Bilateral Trade Patterns. *Kyklos*, 57, 103–123.

Hoekman, B. and Nicita, A. (2008). Trade policy, trade costs and developing country trade. Policy Research Working Paper No. 4797, World Bank, Washington, DC.

Hossain, M. A., and Alauddin, M., (2005). Trade Liberalization in Bangladesh: The Process and Its Impact on Macro Variables Particularly Export Expansion. *The Journal of Developing Areas*, 39(1), 127-150.

Islam, S. (2001). The textile and clothing industry of Bangladesh in a changing world economy. Dhaka: Centre for Policy Dialogue and the University Press Limited

Kaufmann, D. et al. (2010). The Worldwide Governance Indicators: Methodology and Analytical Issues. Policy Research Working Paper 5430, World Bank Development Research Group.

Kaufmann, D., Kraay, A., Mastruzzi, M. (2008). Governance Matters VII: Governance Indicators for 1996–2007. World Bank Policy Research.

Knack, S. and Keefer, P. (1995). Institutions and economic performance: cross-country tests using alternative institutional measures. *Economics and Politics* 7(3), 207–227.

Krugman, P.R. (1994). Rethinking International Trade. Massachusetts: The MIT press

- Krugman, P. R. and Maurice, O. (2005). *International economics: theory and policy*. 7 ed, Boston, Addison-Wesley.
- Love, J. and Chandra, R. (2005a). Testing export-led growth in South Asia. *Journal of Economic Studies*, 32 (2), 132 - 145
- Love, J. and Chandra, R. (2005b). Testing export-led growth in Bangladesh in a multivariate VAR framework. *Journal of Asian Economics* 15, 1155-1168.
- Méon, P. G. and Sekkat, K. (2008). Institutional quality and Trade: Which institution? Which Trade?. *Economic Inquiry*, 46(2), 227-240.
- Narayan, P. K. and Narayan, S. et al. (2007), Export-led growth hypothesis: evidence from Papua New Guinea and Fiji. *Journal of Economic Studies*, 34(4), 341- 351.
- North, D.C. (1993). *Economic performance through time*. Nobel Prize Lecture in Economics.
- Rahman, M. M. (2003). A panel data analysis of Bangladesh's trade: the gravity model approach. University of Sydney. <http://www.etsg.org/ETSG2003/papers/rahman.pdf> (accessed August 22, 2016).
- Rahman, S. H. (2002). *Trade and Industrialization in Bangladesh: An Assessment*. Helleiner, G.K. (ed.), *Manufacturing for exports in the developing worlds: Problems and Possibilities*, Routledge, London and New York.
- Rahman, M. M. and Ara L. A. (2010). Bangladesh trade potential: a dynamic gravity approach. *Journal of International Trade Law and Policy*, 9 (2), 130-147.
- Rodrik, D. (2000). *Institutions for high-quality growth: what they are and how to acquire them*. NBER working paper no. 7540. National Bureau of Economic Research, MA.
- Rigobon, R. and Rodrik, D. (2005). Rule of law, democracy, openness and income. *Economics of Transition*, 13(3), 533-564.
- Siddiqui, D. A. and Ahmed, Q. M. (2013). The effect of institutions on economic growth: A global analysis based on GMM dynamic panel estimation, *Structural Change and Economic Dynamics* 24, 18–33.
- Tiede, L. (2011). The Rule of Law and Economic Growth: Where are We?. *World Development*, 39(5), 673–685.
- Tinbergen, J. (1962). *Shaping the World Economy*. The Twentieth Century Fund, New York
- Vaal, A. and Ebben, W. (2011). Institutions and the Relation between Corruption and Economic Growth. *Review of Development Economics*, 15(1), 108–123.



Wacziarg, R. (1998). Measuring the dynamic gains from trade. Policy Research Working Paper No. 2001. The World Bank.

Worldwide Governance Indicators (2016), World Bank. Available at: <http://info.worldbank.org/governance/wgi/wgidataset.xlsx>)

Xu, G. (2011). The role of law in economic growth: A literature review. *Journal of Economic Surveys*, 25 (5), 833- 871.

Yu, S. et al. (2015). Trade, trust and the rule of law. *European Journal of Political Economy* 37, 102–115.



Figure 2: Exports of goods and services (current US\$)

Source: World Bank (2017)

(<https://data.worldbank.org/indicator/NE.EXP.GNFS.CD?end=2016&locations=BD&start=1990>)

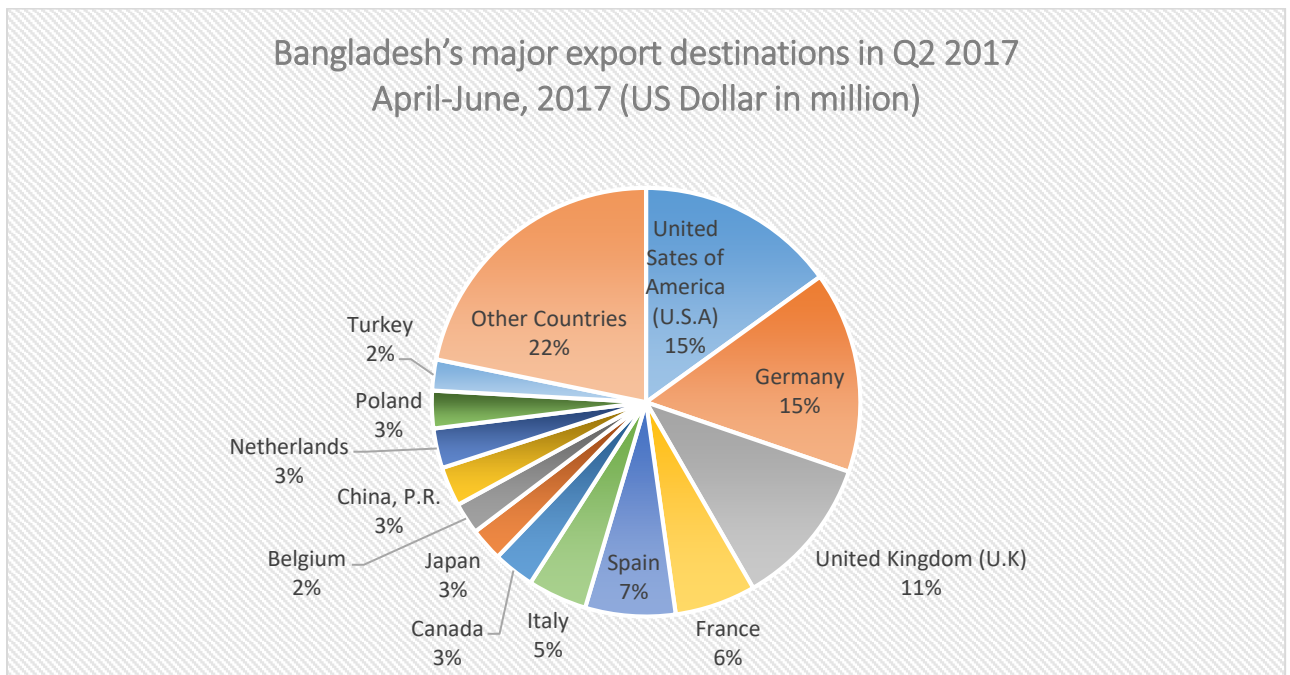


Figure 2: Bangladesh's major export destinations in Q2 2017

Source: Bangladesh Bank (2017)

([https://www.bb.org.bd/econdata/export/exp\\_rcpt\\_country\\_commodity.php](https://www.bb.org.bd/econdata/export/exp_rcpt_country_commodity.php))

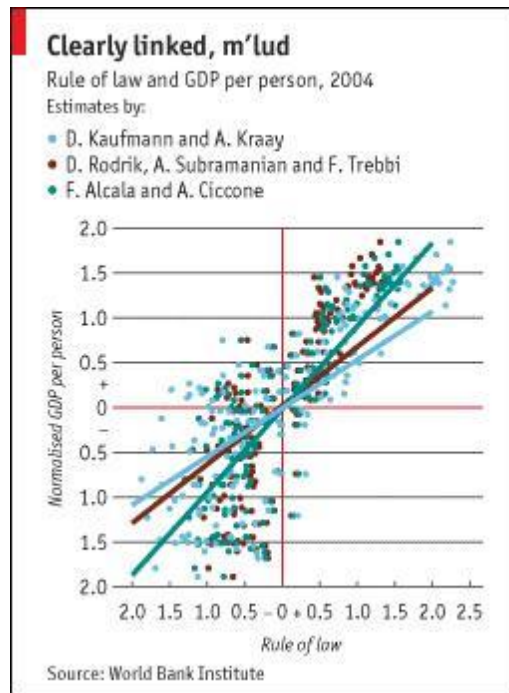


Figure 3: The relationship between rule of law and GDP per capita

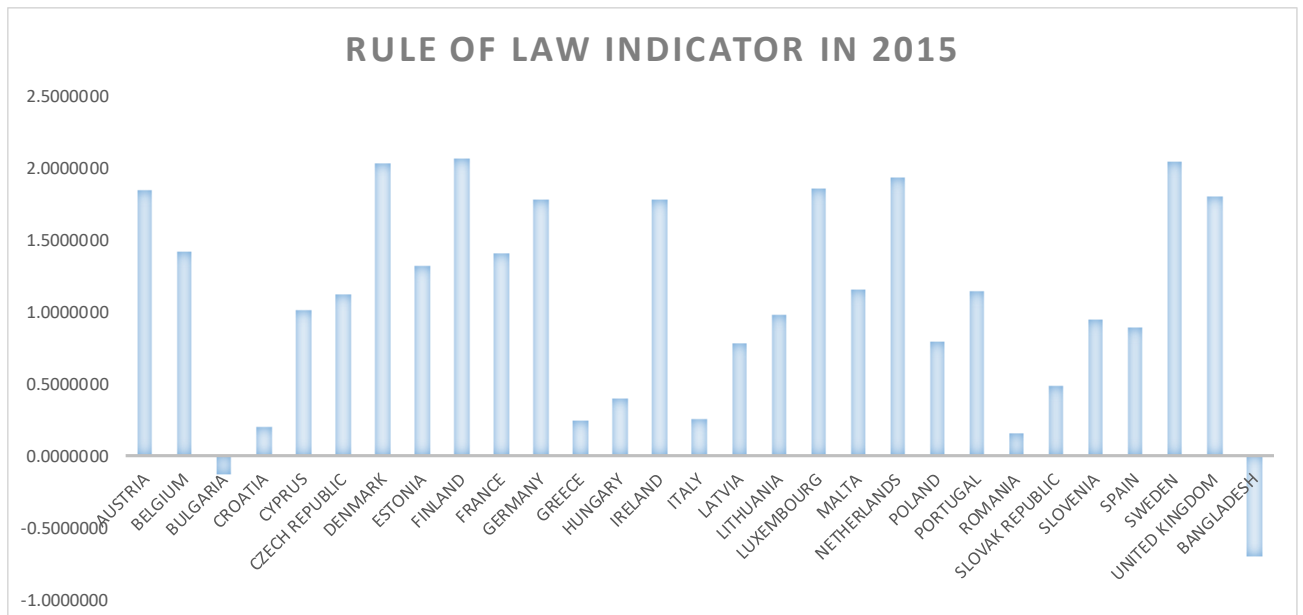


Figure 4: Rule of Law Indicator, Source: The Worldwide Governance Indicators, 2016

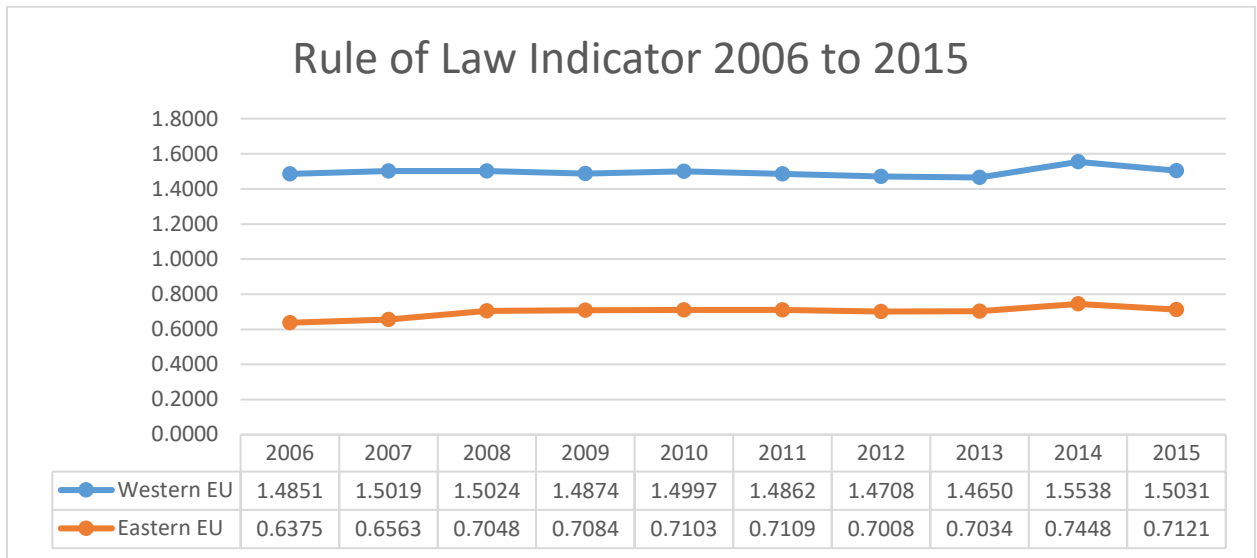


Figure 5: Rule of Law European Union 28 Countries, Source: The Worldwide Governance Indicators, 2016

Table 2: Bangladesh: Exports of goods and services (current US\$)

Year	Amount (in Billions)	Year	Amount (in Billions)	Year	Amount (in Billions)
1990	1.86	1999	6.02	2008	16.18
1991	2.06	2000	6.58	2009	17.35
1992	2.40	2001	7.22	2010	18.47
1993	2.99	2002	6.79	2011	25.62
1994	3.03	2003	6.87	2012	26.88
1995	4.12	2004	7.25	2013	29.03
1996	4.50	2005	9.99	2014	32.83
1997	5.07	2006	11.74	2015	33.82
1998	5.87	2007	13.53	2016	36.86

Table 2: Regression result of EU 28 (first step), equation 1 with three different estimations

Explanatory Variables	Random Effects		Fixed Effects		Pooled OLS	
	Coefficient	P value P >  z	Coefficient	P value P >  t	Coefficient	P value P >  t
<i>Constant</i>	27.311	0.001	16.250	0.140	9.141	0.366
$\log(GDP_{jt})$	0.763	0.007	0.725	0.032	1.570	0.000
$\log(POP_{jt})$	0.665	0.042	4.924	0.003	-0.220	0.305
$\log(EXR_{ijt})$	8.883	0.000	8.220	0.000	8.876	0.000
$RoL_{jt}$	1.282	0.000	1.608	0.000	0.358	0.091
$R^2$	0.794		0.680		0.807	
$R^2_{adj}$	Not Applicable		Not Applicable		0.805	

Table 3: Regression results of EU 28 (first step), equation 2 with three different estimations

Explanatory Variables	Random Effects		Fixed Effects		Pooled OLS	
	Coefficient	P value $P >  z $	Coefficient	P value $P >  t $	Coefficient	P value $P >  t $
<i>Constant</i>	24.186	0.002	17.753	0.113	8.076	0.415
$\log(GDP_{jt})$	0.798	0.005	0.638	0.072	1.576	0.000
$\log(POP_{jt})$	0.621	0.060	4.602	0.006	-0.22	0.289
$\log(EXR_{ijt})$	8.110	0.000	7.567	0.000	8.601	0.000
$(RoL_{jt} - RoL_{it})$	1.056	0.000	1.139	0.000	0.349	0.097
$R^2$	0.796		0.664		0.807	
$R^2_{adj}$	Not Applicable		Not Applicable		0.805	

Table 4: Comparison of Eastern and Western European Union, equation 1 with Random Effect estimation

Explanatory Variables	Western European Union		Eastern European Union	
	Coefficient	P value $P >  z $	Coefficient	P value $P >  z $
<i>Constant</i>	21.670	0.056	17.545	0.213
$\log(GDP_{jt})$	1.355	0.001	0.743	0.091
$\log(POP_{jt})$	0.109	0.785	0.815	0.106
$\log(EXR_{ijt})$	10.770	0.000	6.662	0.000
$RoL_{jt}$	0.777	0.020	1.900	0.000
$R^2$	0.852		0.471	

Table 5: Comparison of Eastern and Western European Union, equation 2 with Random Effects estimation

	<b>Western European Union</b>		<b>Eastern European Union</b>	
<b>Explanatory Variables</b>	<b>Coefficient</b>	<b>P value P &gt;  z </b>	<b>Coefficient</b>	<b>P value P &gt;  z </b>
<i>Constant</i>	20.910	0.061	17.791	0.218
$\log(GDP_{jt})$	1.309	0.002	0.667	0.154
$\log(POP_{jt})$	0.141	0.726	0.745	0.155
$\log(EXR_{ijt})$	10.186	0.000	5.935	0.001
$(RoL_{jt} - RoL_{it})$	0.737	0.016	1.372	0.002
$R^2$	0.852		0.476	

## Appendices

### Appendix A. List of twenty-eight European Union countries (EU28)

Austria	Estonia	Italy	Portugal
Belgium	Finland	Latvia	Romania
Bulgaria	France	Lithuania	Slovak Republic
Croatia	Germany	Luxembourg	Slovenia
Cyprus	Greece	Malta	Spain
Czech Republic	Hungary	Netherlands	Sweden
Denmark	Ireland	Poland	United Kingdom

### Appendix B. List of Eastern and Western European Union countries

<b>Western European Countries</b>	<b>Eastern European Countries</b>
Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain, Sweden, United Kingdom <sup>2</sup>	Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovak Republic, Slovenia

<sup>2</sup> United Kingdom now negotiating with the European Union (EU) about the withdrawal of their membership according to the BREXIT referendum, took place on 23<sup>rd</sup> June 2016 in the United Kingdom.



Appendix C: The Hausman test for fixed versus random effects model (Equation 1)

```
. quietly xtreg logexp_bang logcgdp_eut logpop_eut logexg_igtusd in_ruf_e, fe
. estimates store fixed
. quietly xtreg logexp_bang logcgdp_eut logpop_eut logexg_igtusd in_ruf_e, re
. estimates store random
. hausman fixed random
```

	Coefficients			
	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
logcgdp_eut	.725934	.7638532	-.0379191	.1849907
logpop_eut	4.924878	.6659978	4.25888	1.619947
logexg_igt~d	8.220992	8.883438	-.6624456	.2241005
in_ruf_e	1.608792	1.282584	.3262077	.2240711

b = consistent under Ho and Ha; obtained from xtreg  
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

```
chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
        =      10.17
Prob>chi2 =      0.0377
(V_b-V_B is not positive definite)
```

Appendix D: The Breusch-Pagan LM test for random effects versus Pooled OLS (Equation 1)

```
. quietly xtreg logexp_bang logcgdp_eut logpop_eut logexg_igtusd in_ruf_e, re
. xttest0
```

Breusch and Pagan Lagrangian multiplier test for random effects

logexp\_bang[logdis\_ij,t] = Xb + u[logdis\_ij] + e[logdis\_ij,t]

Estimated results:

	Var	sd = sqrt(Var)
logexp_~g	6.676133	2.583821
e	.3135501	.5599554
u	1.106013	1.051672

Test: Var(u) = 0

```
chibar2(01) = 686.95
Prob > chibar2 = 0.0000
```

Appendix E: F-test for fixed effects versus Pooled OLS (Equation 1)

```
. reg logexp_bang logcgdp_eut logpop_eut logexg_igtusd in_ruf_e
```

Source	SS	df	MS			
Model	1504.87747	4	376.219368	Number of obs =	280	
Residual	357.763597	275	1.30095854	F( 4, 275) =	289.19	
Total	1862.64107	279	6.67613286	Prob > F =	0.0000	
				R-squared =	0.8079	
				Adj R-squared =	0.8051	
				Root MSE =	1.1406	

logexp_bang	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
logcgdp_eut	1.570052	.1978348	7.94	0.000	1.180589	1.959515
logpop_eut	-.2205103	.2143485	-1.03	0.305	-.6424828	.2014621
logexg_igtusd	8.876769	2.048907	4.33	0.000	4.843232	12.9103
in_ruf_e	.3587404	.2117506	1.69	0.091	-.0581177	.7755985
_cons	9.14121	10.10046	0.91	0.366	-10.74283	29.02525

```
. test logcgdp_eut logpop_eut logexg_igtusd in_ruf_e
```

- ( 1) logcgdp\_eut = 0
- ( 2) logpop\_eut = 0
- ( 3) logexg\_igtusd = 0
- ( 4) in\_ruf\_e = 0

```
F( 4, 275) = 289.19
Prob > F = 0.0000
```

Appendix F: The Hausman test for fixed versus random effects model (Equation 2)

```
. quietly xtreg logexp_bang logcgdp_eut logpop_eut logexg_igtusd dif_ruf_eb, fe
. estimates store fixed
. quietly xtreg logexp_bang logcgdp_eut logpop_eut logexg_igtusd dif_ruf_eb, re
. estimates store random
. hausman fixed random
```

	— Coefficients —			
	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
logcgdp_eut	.6384225	.7989684	-.160546	.2080155
logpop_eut	4.602946	.6216605	3.981285	1.628152
logexg_igt~d	7.567051	8.11074	-.5436888	.2739318
dif_ruf_eb	1.139828	1.056516	.0833124	.1442379

b = consistent under Ho and Ha; obtained from xtreg  
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

```
chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
          = 8.24
Prob>chi2 = 0.0831
(V_b-V_B is not positive definite)
```

Appendix G: the Breusch-Pagan LM test for random effects versus Pooled OLS (Equation 2)

```
. quietly xtreg logexp_bang logcgdp_eut logpop_eut logexg_igtusd dif_ruf_eb, re
. xttest0
```

Breusch and Pagan Lagrangian multiplier test for random effects

logexp\_bang[logdis\_ij,t] = Xb + u[logdis\_ij] + e[logdis\_ij,t]

Estimated results:

	Var	sd = sqrt(Var)
logexp_~g	6.676133	2.583821
e	.318845	.5646636
u	1.105484	1.05142

Test: Var(u) = 0

```
chibar2(01) = 686.07
Prob > chibar2 = 0.0000
```

Appendix H: F-test for fixed effects versus Pooled OLS (Equation 2)

```
. reg logexp_bang logcgdp_eut logpop_eut logexg_igtusd dif_ruf_eb
```

Source	SS	df	MS	Number of obs =	280
Model	1504.7577	4	376.189425	F( 4, 275) =	289.07
Residual	357.883367	275	1.30139406	Prob > F =	0.0000
Total	1862.64107	279	6.67613286	R-squared =	0.8079
				Adj R-squared =	0.8051
				Root MSE =	1.1408

logexp_bang	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
logcgdp_eut	1.576082	.1971514	7.99	0.000	1.187964 1.964199
logpop_eut	-.226989	.2136038	-1.06	0.289	-.6474953 .1935173
logexg_igtusd	8.601489	2.056208	4.18	0.000	4.553581 12.6494
dif_ruf_eb	.3492253	.2095569	1.67	0.097	-.0633143 .761765
_cons	8.076235	9.900714	0.82	0.415	-11.41459 27.56706

```
. test logcgdp_eut logpop_eut logexg_igtusd dif_ruf_eb
```

- ( 1) logcgdp\_eut = 0
- ( 2) logpop\_eut = 0
- ( 3) logexg\_igtusd = 0
- ( 4) dif\_ruf\_eb = 0

```
F( 4, 275) = 289.07
Prob > F = 0.0000
```