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Chapter 12

ECONOMIC GROWTH AND TRADE OPENNESS: AN EMPIRICAL ANALYSIS

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1. Introduction

After the end of the 20th century, there have been a considerable amount of flow of commodities, services, and capital across countries. These international flows have influenced all parts of the world. Whether it is a big or small economy, every country depends upon other countries for access to trade. Open economies let the developed international trade and integration with international markets plays an important role in these economies. After the global trade liberalization process, many countries have loosened their trade barriers. Complex technologies have been developed with globalization, and this has caused a decrease in transportation costs, which have an important place in trade and the outward-oriented growth policies are especially followed by developing countries.

International trade improves economic development by encouraging the exchange of information and promoting technological innovation, thereby enabling countries via their comparative advantages, to achieve economies of scale and scope. Thus, it facilitates stronger competitiveness in both domestic and foreign markets and helps the production process reach its optimum level (Ghazouani et al., 2020). By integration of their markets and technology that increase their output levels and exports, countries are improving their economic growth (EG) after opening their economies to foreign trade. From international trade, countries gain competitiveness and productivity advantages that balance the fragilities brought to their economies by negative imports (Mbogela, 2019).

Absolute advantage theory developed by Adam Smith states that, foreign trade offers entry to large global markets and, by labor specialization, increases production. Especially in developing countries, the size of the domestic market is small, and without international trade this situation hinders EG. With open economies, domestic producers can participate in the competition in larger markets. The Ricardian theory of comparative advantage states that foreign trade is advantageous and enables traders to profit from both production and consumption (Tahir & Khan, 2014). Also, the Ricardian theory assumes that foreign trade allows more effective use of the resources of a country by importing products and services that would otherwise be costly to manufacture inside the country, hence promoting a country's overall EG (Mbogela, 2019).

In today's foreign trade literature, one of the central concerns is trade openness (TO). Many studies seem to use TO as an explanatory variable of macroeconomic variables such as GDP growth, GDP per capita, productivity and inflation. Moreover, TO commonly refers to an economic policy measurement unit of a country, also it is calculated to be the amount of goods and services exported and imported, divided by the gross domestic product. In addition, TO is identified not as trade intensity, but instead as a reduction of political barriers to foreign trade. Countries with higher levels of TO experience faster EG as a result of their easier taking advantage of technological innovations (Pilinkienė, 2016).

Most of the studies use the ratio of trade volume in GDP as an indicator of TO that is the measure of how open a country is to world trade (Mbogela, 2019). In literature, the total of exports and imports as a share of GDP is a commonly used indicator of TO (Guttmann & Richards, 2006).

Higher TP encourages higher foreign investment into the countries; these investments and such investments create further employment opportunities for the domestic labor force. Moreover, high TO allows easier transition to new technologies, which positively affects production levels and encourages entrepreneurship and innovation on the grounds that in the international market producers will need efficient production and competitiveness power (Mbogela, 2019). Consequently, increased levels of TO are related to higher per capita incomes and faster economic development (Gwartney et al., 2001).

Endogenous growth theory states that technological changes are endogenous. Thus, TO, R&D spending, and human capital, that have a positive effect on technological change, can increase EG (Tahir & Khan, 2014).

The degree of openness of countries to international trade, that has been found to have a positive impact on EG in several experimental studies, has recently gained scientific interest. On the other hand, the literature on the factors determining TO is not exhaustive and inadequate (Osei et al., 2019). Dollar & Kraay, (2003), Gries & Redlin, (2012), Tahir & Azid, (2015), Musila & Yiheyis, (2015) can be cited as some examples of studies that find positive relationships between TO and EG.

Although in some studies, the existence of a bidirectional relationship has been proven between EG and TO, there is a great lack of studies in the literature using EG as an exogenous variable, as mentioned frequently above. In this chapter, TO is used as the response variable to contribute to this deficiency in the literature, and the effect of EG on TO is tested using the OLS estimator in 2013 for 213 countries.

This chapter is organized as following. In the section 2 the data and the methodology of the paper is reported. Results of the analysis and diagnostic tests are shown in section 3. In the last section, the conclusions are drawn.

2. Data and Methodology

2.1. Data

In this chapter, the effect of EG on TO for 213 countries in 2013 as a specific year is investigated. The countries included in the analysis are given in Appendix 1. All the data used in this analysis are annual. TO is calculated as the sum of imports and exports of goods and services divided by GDP. In this chapter, the sum of imports and exports of goods and services as a percentage share of GDP per capita is used as a proxy of TO. In this study, GDP per capita (constant 2010 US$) is used as an indication of EG, and it is the interest variable. The total population and the total unemployment rate, which is the rate of the labor force who do not have a job but are seeking one, are included to the model as control variables. The data of the variables are obtained from World Development Indicators. Table 1 depicts descriptive statistics of the variables.

Table 1. *Descriptive Statistics*

Variable	Obs	Mean	Std. Dev.	Min	Max
trade	188	97.0301	59.40452	23.7285	442.62
gdppc	200	15670.07	22859.25	242.846	172289.9
pop	215	3.31e+07	1.32e+08	10821	1.36e+09
unemp	186	8.231548	6.154471	.28	28.996

To find the true functional forms of the variables, we check the histogram graphs of various transformations of the data which are given in Appendix 2. After looking the histogram graphs and box cox transformation results, it is decided to use the natural logarithm form of the variables apart from the inflation variable that have negative values. The scatterplots of the variables are given in the Figure 1. With the help of this figure, we can see the two-way relationship between the variables separately.

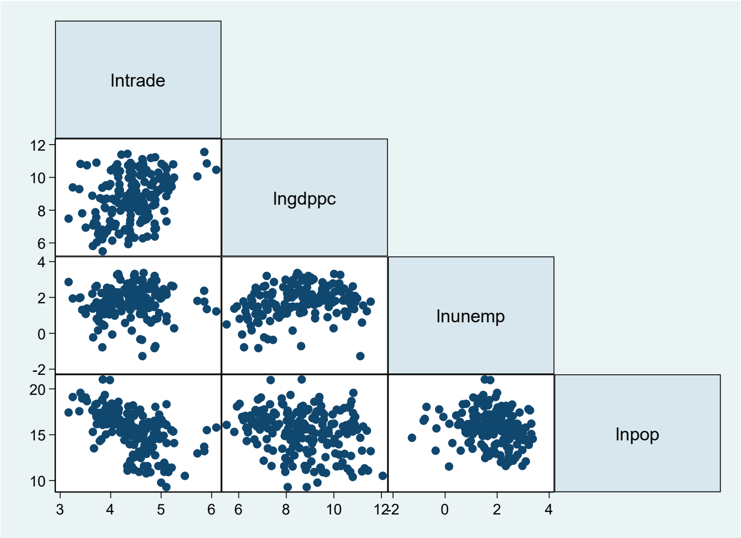

Figure 1. *Scatter Plot Graphs Matrix of the Variables*

2.2. Methodology

Regression models that include only one independent variable is called simple regression models. The basic notation of simple linear regression population model is as follows:

$$y = \beta_0 + \beta_1 x + u \qquad (1)$$

If the regression models include more than one independent variables, they are called multiple regression models. These models used to solve problems that cannot be solved by simple regression also allow us to control many other factors affecting the dependent variable are so these models reduces the risk of falling into the error of being an omitted variable that causes estimators to be biased. The basic notation of multiple linear regression population model with k parameters is shown in (2):

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k + u \qquad (2)$$

In this chapter, two models are used to explain the effects of EG on TO. Firstly, a simple regression model that is the base model is formed. The base model of the study is shown as follows:

$$\ln trade = \beta_0 + \beta_1 \ln gdppc + u \qquad (3)$$

where lntrade that is natural logarithm of the ratio of total imports and exports of goods and services in GDP as the indicator of TP, lngdppc is the natural logarithm form of GDP per capita constant 2010 US$ as the indicator of EG, u is the disturbance term.

In the second model, the control variables thought to be a relationship with dependent variable are added to the model. The model with control variables has the following form:

$$\ln trade = \beta_0 + \beta_1 \ln gdppc + \beta_2 \inf + \beta_3 \ln unemp + \beta_4 \ln pop + u \qquad (4)$$

where, lnunemp is the natural logarithm of the unemployment rate, lnpop is the natural logarithm of the total population.

In the OLS analysis, our aim is to make inferences regarding the population parameters. To check whether the results of the OLS estimators are not misleading and to trust the coefficients and test statistics, estimators have to be BLUE (best linear unbiased estimator). For estimators to be BLUE, OLS assumptions must be met. These assumptions include linearity in parameters, no heteroscedasticity, no autocorrelation, no exact collinearity between independent variables and the model should be specified correctly. As working with cross section data, we do not test the autocorrelation because there is no time dimension in these types of data. In this chapter, the assumptions of OLS are checked after the regression analysis in the diagnostic tests part (Gujarati & Porter, 2009; Wooldridge, 2010, 2016; Greene, 2002).

3. Econometric Results

3.1. Results of the OLS Analysis

This study has two model that are base model and model with control variables. Firstly, we perform an OLS analysis with our base model. Table 2 indicates the OLS estimation results of the base model.

Table 2. *OLS estimation findings with base model*

Variables	(1) lntrade
lngdppc	0.117***
	(0.0240)
Constant	3.399***
	(0.211)
Observations	183
R-squared	0.117

Standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

According to the OLS results, the parameter of GDP per capita is positive and statistically significant. Also, the constant term is statistically significant. This model can explain the TO by 12%. OLS estimation results of the second model is given in Table 3. After adding the control variables to the model, it is seen that significance and sign of the GDP per capita that is interest variable do not change. GDP per capita is positively and significantly related to TO. Also, no relation is found between unemployment rate and TO, the coefficient of unemployment rate is not statistically significant. The coefficient of the total population is found statistically significant and negatively related with TP. Constant is statistically significant. R-squared value increases, and it becomes 0.332. R-squared value refers the ratio of variance in TP variable that can be explained by GDP per capita, unemployment rate and population rate. In other words, our second model can explain the TP by 33%.

Table 3. *OLS estimation results of the model with control variables*

Variables	(1) lntrade
lngdppc	0.0999***
	(0.0225)
lnunemp	-0.0498
	(0.0379)
lnpop	-0.132***
	(0.0183)
Constant	5.720***
	(0.375)
Observations	168
R-squared	0.332

Standard errors in parentheses

*** *p<0.01*, ** *p<0.05*, * *p<0.1*

3.2. Diagnostic Tests

In this section the necessary diagnostic tests of OLS estimation are performed to see whether we can trust our results and the OLS assumptions are met or not. The main diagnostic tests for cross-sectional data are multicollinearity, heteroscedasticity, linearity, model specification and normality test. For checking the multicollinearity, we check both correlation matrix of independent variables and the variance inflation factor (VIF) results. Results of multicollinearity tests are presented in Appendix 3. According to the test results, it is seen that there is no exact linear relationship between the independent variables.

Another assumption we have to check is whether there is no heteroscedasticity which means the variability of disturbances are equal. To check this assumption, we perform Breusch-Pagan / Cook-Weisberg test. The null hypothesis of this test is the disturbance variances are equal. Test results are given in the Appendix 4. According to the result we do not reject the null hypothesis so there is no heteroscedasticity.

Another assumption that is the linearity in parameters are tested with Augmented Component Plus Residual plots that are presented in the Appendix 5 for all independent variables, respectively. Looking at the graphs formed for lngdppc and lnunemp, it can be seen that the smoothed line is almost coincident with the ordinary regression line. The plot for lnpop is a bit more problematic but overall, we do not have to be worried about the non-linearities.

Another assumption that needs to be investigated is the normal distribution of errors. However, it should be noted that the normal distribution of error terms is not a necessary assumption for the unbiased estimation of the regression coefficients. When determining the model, by looking at the histogram graphs of the various forms of the variables, the forms in which the distribution of the variables were closest to the normal distribution had been chosen. To test the normality, kernel density plot is formed with the normal density plot. Also, iqr test created by Lawrence C. Hamilton and Shapiro-Wilk W (Swilk) test are used to detect normality. All of them are represented in Appendix 6. As it can be seen in Appendix 6, Kernel density estimate plot of model is found to be close to the normal density plot. In iqr test, the existence of any severe outliers can be an adequate reason to reject the assumption of normality. According to results, there found no severe outliers. Swilk test results support the same findings. We cannot reject the null hypothesis that is the residuals are normally distributed. As a result, residuals are approximately normally distributed.

When performing regression analysis, model specification should be tested whether a significant variable that should be in the model is omitted or whether an unrelated variable is added to the model. If these problems exist, model specification error that affects the estimation of regression coefficients can occur. Ramsey Reset test is used to examine whether there is an omitted variable. It is performed both for base model and the model with control variables and the results is given in the Appendix 7. Both for the base model and the model with control variables, since null hypothesis that is the model has no omitted variables cannot be rejected, it can be seen that the model is formed correctly.

4. Conclusion

The aim of this book chapter is to investigate the effects of EG on TO. Two models are proposed to analyze the relationship between EG and TO. First model is the base model including only the EG indicator as explanatory variable. On the second model, unemployment rate and population size of the countries are added to the base model as control variables to check the robustness. After all necessary diagnostic tests are implemented, it has been found that the model satisfies all the OLS assumptions. According to this result, we can trust the OLS regression results, its coefficients and test statistics. The result of the base model shows that there is a statistically significant and positive relationship between EG and TO. 1% increase in the GDP per capita used as proxy for EG leads to 0.12% increase in TO. The R-squared value of the model is found to be 0.12, thus this model can explain 12% of the change in TO. Considering the results of the second formed after adding the control variables, it is seen that the result in the base model do not change. It is explored that there is also a statistically significant and positive relationship between EG and TO. 1% increase in the EG causes 0.1% increase in TO. Value of the R-squared increases to

0.33 hence the second model can explain 33% of the change in TO. In the second model, it is explored that the coefficient of unemployment rate is not statistically significant and there is a negative and significant relationship between population size of the countries and TO.

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Appendix 1. Countries

List of Countries

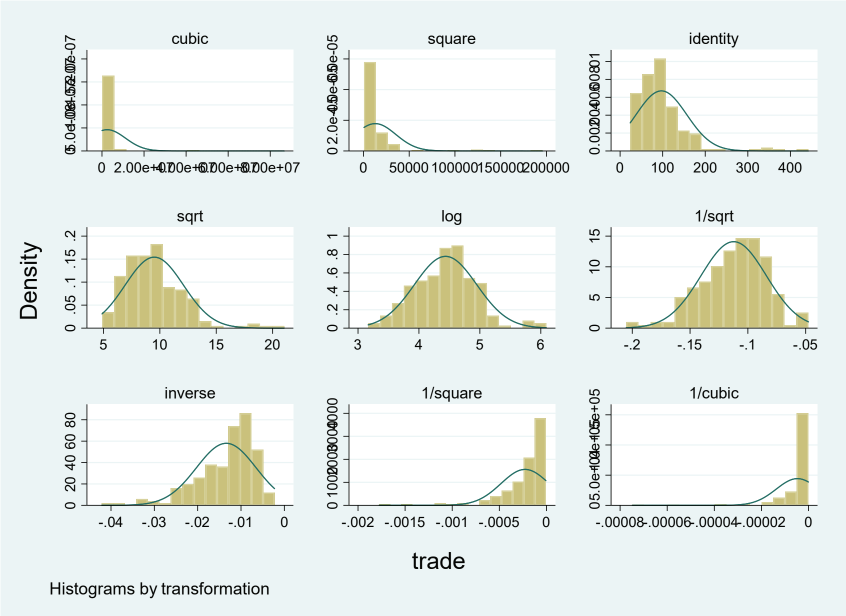
Afghanistan	Burundi	Faroe Islands
Albania	Cabo Verde	Fiji
Algeria	Cambodia	Finland
American Samoa	Cameroon	France
Andorra	Canada	French Polynesia
Angola	Cayman Islands	Gabon
Antigua and Barbuda	Chile	Gambia
Argentina	China	Georgia
Armenia	Colombia	Germany
Aruba	Comoros	Gibraltar
Australia	Congo, Dem. Rep.	Greece
Austria	Congo, Rep	Greenland
Azerbaijan	Costa Rica	Grenada
Bahamas	Cote d'lvoire	Guam
Bahrain	Croatia	Guatemala
Bangladesh	Cuba	Guinea
Barbados	Curacao	Guinea-Bissau
Belarus	Cyprus	Guyana
Belgium	Czech Republic	Haiti
Belize	Denmark	Honduras
Benin	Djibouti	Hong Kong SAR, China
Bermuda	Dominica	Hungary
Bhutan	Dominician Republic	Iceland
Bolivia	Ecuador	India
Bosnia and Herzegovina	Egypt, Arab Rep.	Indonesia
Botswana	El Salvador	Iran
Brazil	Equatorial Guinea	Iraq
British Virgin Islands	Eritrea	Ireland
Brunei Darussalam	Estonia	Isle of Man
Bulgaria	Eswatini	Israel
Burkina Faso	Ethiopia	Italy

Jamaica	Monaco	Samoa
Japan	Mongolia	Saudi Arabia
Jordan	Montenegro	Senegal
Kazakhstan	Morocco	Serbia
Kenya	Mozambique	Seychelles
Kiribati	Myanmar	Sierra Leone
Korea, Dem. People's Rep.	Namibia	Singapore
Korea, Rep.	Nauru	Sint Maarten (Dutch part)
Kosovo	Nepal	Slovak Rep.
Kuwait	Netherlands	Slovenia
Kyrgyz Rep.	New Caledonia	Solomon Islands
Lao PDR	New Zealand	Somalia
Latvia	Nicaragua	South Africa
Lebanon	Niger	South Sudan
Lesotho	Nigeria	Spain
Liberia	North Macedonia	Sri Lanka
Libya	Northern Mariana Islands	St. Kitts and Nevis
Liechtenstein	Norway	St. Lucia
Lithuania	Oman	St. Martin (French part)
Luxembourg	Pakistan	St. Vincent and Grenadines
Macao SAR, China	Palau	Sudan
Madagascar	Panama	Suriname
Malawi	Papua New Guinea	Sweden
Malaysia	Paraguay	Switzerland
Maldives	Peru	Syrian Arab Republic
Mali	Philippines	Tajikistan
Malta	Poland	Tanzania
Marshall Islands	Portugal	Thailand
Mauritania	Puerto Rico	Timor-Leste
Mauritius	Qatar	Togo
Mexico	Romania	Tonga
Micronesia, Fed. Sts.	Russian Fed.	Turkey
Moldova	Rwanda	Turkmenistan
Trinidad and Tobago	San Marino	Turks and Caicos Islands
Tunusia	Sao Tome and Principe	Tuvalu

Uganda
Ukraine
United Arab Emirates
United Kingdom
United States
Uruguay
Uzbekistan
Vanuatu
Venezuela
Vietnam
Virgin Islands (U.S.)
West Bank and Gaza
Yemen
Zambia
Zimbabwe

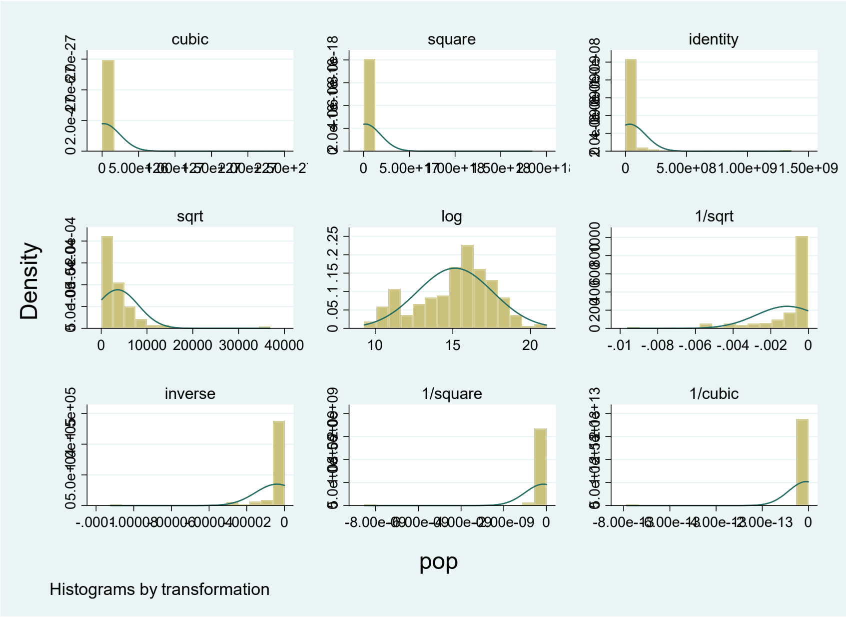
Appendix 2: Histograms

Histogram for transformations for trade openness

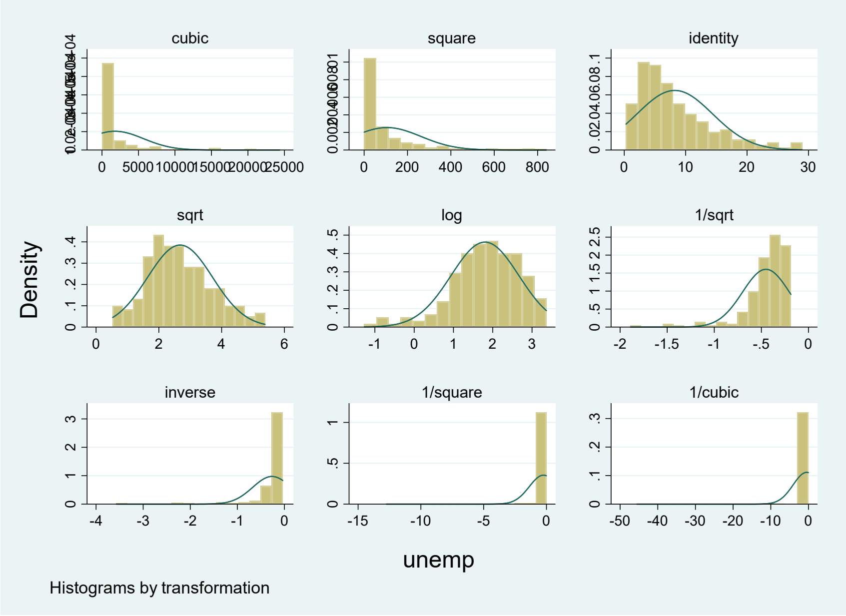


Histogram for transformations for gdp per capita

Histograms for transformations for total population



Histograms for transformations for total unemployment rate



Appendix 3: Correlation Matrix Results

	lngdppc	lnunemp	lnpop
lngdppc	1.0000		
lnunemp	0.2491	1.0000	
lnpop	-0.1487	-0.1677	1.0000

VIF Results

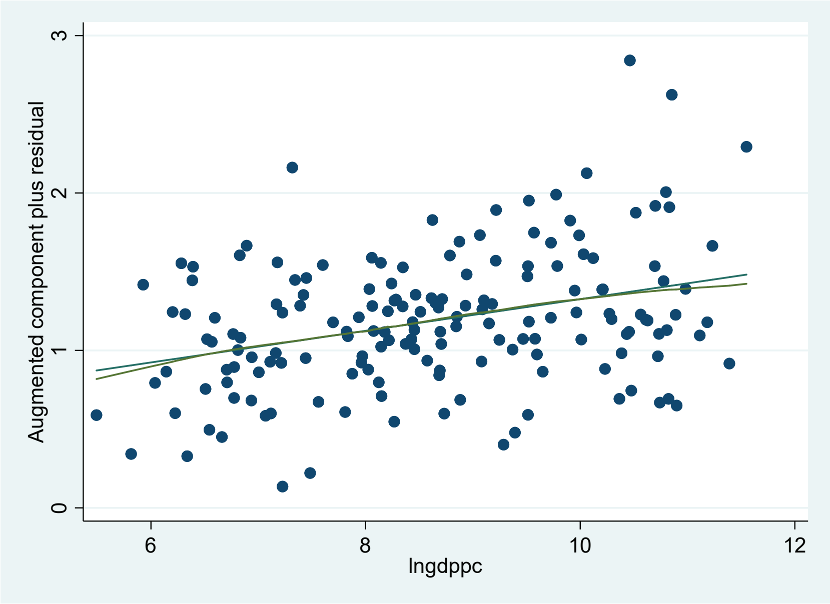
Variable	VIF	1/VIF
lngdppc	1.09	0.913722
lnunemp	1.09	0.919292
lnpop	1.04	0.966127
Mean VIF	1.07	

Appendix 4: Heteroskedasticity Test Results

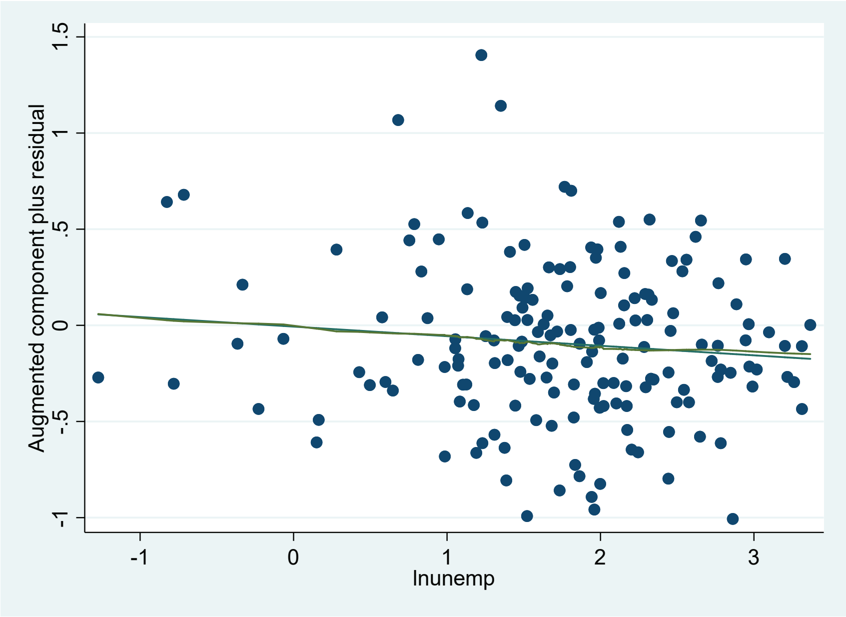
```
Breusch-Pagan / Cook-Weisberg test for
heteroskedasticity
Ho: Constant variance
Variables: fitted values of lntrade

chi2(1)      =     1.97
Prob > chi2  =   0.1602
```

Appendix 5: Linearity Tests

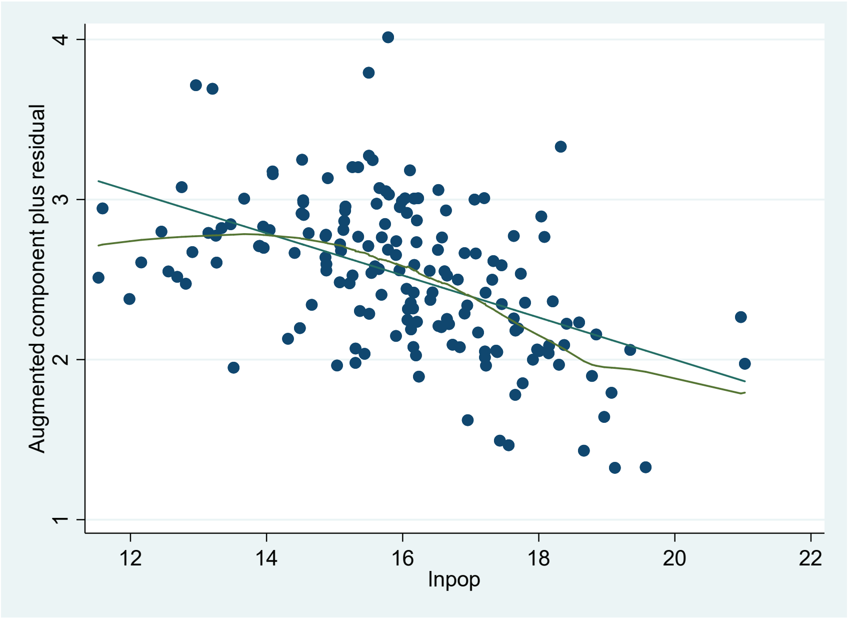
Linearity Test for lngdppc Variable



Linearity Test for lnunemp Variable

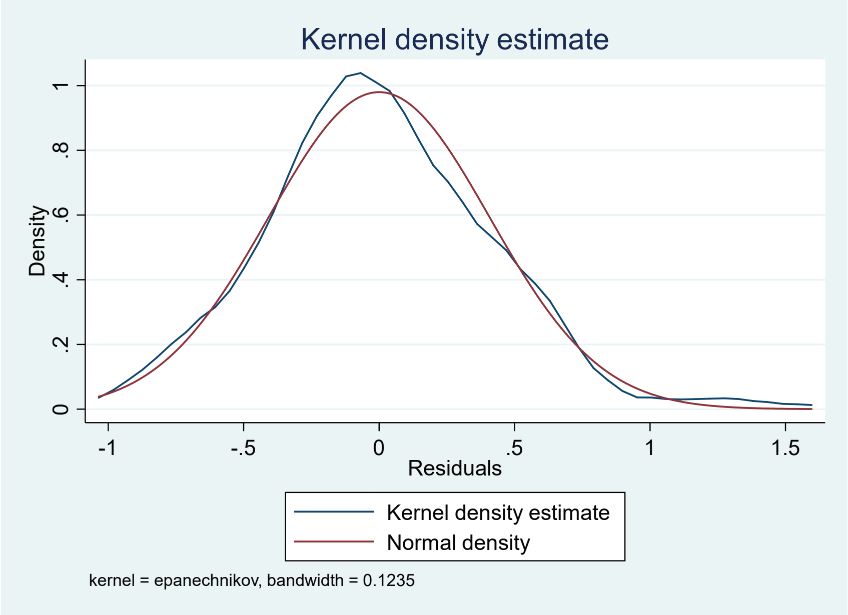


Linearity Test for lnpop Variable



Appendix 6: Normality and Outliers Test Results

Kernel Density Plot of the Residuals



Shapiro-Wilk W Test

```
                   Shapiro-Wilk W test for normal
data

    Variable |        Obs       W            V
z       Prob>z
-------------+----------------------------------------
-------------------
           r |        168    0.98600      1.796
1.336    0.09083
```

Test for outliers (iqr test)

```
   mean= -2.7e-10         std.dev.=  .4071
(n= 168)
 median= -.0289    pseudo std.dev.=  .3824
(IQR=  .5159)
10 trim= -.0077

low         high

-------------------
                                  inner fences
-1.035       1.028
                             # mild outliers     0
3
                             % mild outliers
0.00%       1.79%

                                  outer fences
-1.809       1.802
                             # severe outliers   0
0
                             % severe outliers
0.00%       0.00%
```

Appendix 7: Ramsey Test Results

Ramsey Test Results for Base Model

```
Ramsey RESET test using powers of the fitted
values of lntrade
       Ho:  model has no omitted variables
                 F(3, 178) =      0.19
                  Prob > F =      0.9060
```

Ramsey Test Results for the Model with Control Variables

```
Ramsey RESET test using powers of the fitted
values of lntrade
       Ho:  model has no omitted variables
                 F(3, 161) =      2.21
                  Prob > F =      0.0895
```