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Mercosur an Econometric Perspective

Executive Summary

A trade agreement treatment effect of Mercosur on trade was analyzed using robust fixed effects estimation methods. From the findings we can see that on average Mercosur increased trade between partner countries, but this was before the 1991 by 47.5%. We also find that integration of the region also yields on average 20.9% increase of trade. As we think of power dynamics in Mercosur this serves as a point of bargaining power when negotiating international policy.

Background

The year 1991 signaled to the world that South America would begin to enter a trade alliance that would strengthen the region. This came packaged in the form of Mercosur a trade agreement entered by four of the largest South American economies, Brazil, Argentina, Uruguay, and Paraguay. The formal name given to the treaty was the, *Treaty of Asuncion*, outlining more principles than just monetary gain. Although the treaty was signed in 1991, there are speculations of talks beginning before and the two major players, Brazil and Argentina, preparing their economies to sustain such treaty. The core of Mercosur or, *Treaty of Asuncion*, was to bolster trade between parties as well as promote ideas of Democracy and Economic Development¹. Complimented by social policies among member states which would be incentivized by access to the trade bloc. As we know South America is comprised by much more than 4 countries, and Mercosur will attempt to incorporate them in future amendments to the trade bloc.

¹Mercosur in Brief: <https://www.mercosur.int/en/about-mercursosur/mercursosur-in-brief/>

Moving forward a couple of years it was 1998 that marks another event as the acquisition of new members states and a greater emphasis on democratic values for the trade bloc. It is important to note the democratic components that become embedded within Mercosur as they play a key role in future policy and events. The new addition was, “Protocolo de Ushuaia sobre Compromiso Democrático en el MERCOSUR, la Republica de Bolivia y la Republica de Chile,”² creating a new norm for democratic principles in the region. This also marked the addition of associate states Chile and Bolivia which enjoyed privileges, but not full member privileges. Here we can catch a glimpse of what is to come for Mercosur as it foreshadows what principles it will stand and oust members for.

2005 is a pivotal point in Mercosur as it increases its membership adding more associate states as well as implementing a new infrastructure addition to their trade bloc. The pivotal addition to Mercosur is known as, “Fondo para la Convergencia Estructural del MERCOSUR (FOCEM)”³, a plan to add infrastructure to all member and associate states. This is also the time in which three more countries, Peru, Colombia, and Ecuador, have been added to the member count which more than doubles Mercosur’s membership since its inception. The driving force behind this is that a greater infrastructure should make it easier for countries to trade with one another and the rest of the world. This move should cement the region as a greater player on the international scene.

Currently, Mercosur hosts 11 countries excluding only 2 countries from South America. We can see in Mercosur map provided by the Mercosur trade bloc⁴, that associate countries outnumber Mercosur with some of the in the processes of becoming full members. There is also an interesting fact that Venezuela was suspended in 2016 with reasons that we will explore later in our analysis. Current statistics about Mercosur are as follows⁵:

- Territory extending 14,869,775 squared kilometers.
- Fifth largest economy in the world.
- Energy source leader in renewable sources.

² Treaty Protocol 1998: <https://www.mercosur.int/documento/protocolo-ushuaia-compromiso-democratico-mercursos-bolivia-chile/>

³ Infrastructure 2005 FOCEM: <https://www.mercosur.int/temas/focem/>

⁴ See Appendix I

⁵ Ibid

- Population over 295,007,000.

To continue our analysis, we will see trade impacts of Mercosur on its member and associate countries. Things to keep in mind are that the policy implications of Mercosur are tied with their values that they promote, and we will connect trade flows and how those can aid policy discussions for the region of South America.

Data and Statistics

In order to deploy our regression analysis, we will need a supporting dataset which comes in the form of data from the World Bank. Kindly provided by Professor Gordon Hanson, this dataset (gravity dataset) is characterized by a panel format of 51 years (1964 to 2014) containing 9506 unique country pairs dyads or over 400,000 observations. It includes measures of trade, distance, language, trade agreements, GDP, and colonial history of such countries. We also created our own crucial dummy variables. Our first variable is a Mercosur binary variable which takes the value of 0 if the year was previous to 1991 and the trading partner was not a Mercosur country, and takes the value of 1 if this was the opposite. Our second variable is similar to our first, but our year changes to 2005 as well as the number of Mercosur countries. Argentina, Brazil, Uruguay, and Paraguay are represented in our first binary variable, and Chile, Colombia, Bolivia, Peru and Ecuador are added on with our second. The gravity dataset is the perfect tool and required minimal data preparation before we could deploy our regression models. Before we engage in modeling, let us begin with descriptive statistics of our Mercosur members.

Mercosur members we will be focusing on will only be the 9 that were previously mentioned, Argentina, Uruguay, Brazil, Paraguay, Chile, Bolivia, Peru, Ecuador and Colombia. Mercosur has more members, but we will be focusing on these nine countries due to the nature of our model's treatment effect. This concept will be elaborated in the methodology section. If we take a look at Appendix II⁶ we can see that member states, Argentina, Uruguay, Brazil and Paraguay, have seen constant increase in trade. The dashed line symbolizes when the original Mercosur was founded in 1991 and we can see a delayed impact of trade that takes place. The solid

⁶ See Appendix II

line represents 2005 when Mercosur was bolstered not only in membership but by through FOCEM as well as it was mentioned earlier. These original 4 are labeled as member states. The 5 other associate states⁷ share a similar experience to those of the member states. They have an increase in trade over the 51-year period marked by 1991 and 2005. Increase in trade can be considered trivial as overtime trade tends to increase, but we are interested in knowing what part of that increase was directly linked to Mercosur. Another interesting summary statistic is GDP growth for each country. For our member countries we see intermittent growth in this 51-year period⁸. There are years in which a member country will decrease their percentage GDP growth by up to 10% points. When compared to associate countries it is a similar story with GDP growth responding to periods of shock⁹. Historical points in economic history could potentially reflect the shocks to GDP but that is out of the scope of this analysis. GDP is a primordial determinant of trade as if we can increase GDP by our net exports. GDP is also a variable in our gravity model of trade which will be further analyzed in our methodology section. Therefore, it is important to control for it as we might expect this to bias our results upwards.

Methodology

The mathematical model that will be the foundation of this analysis is the gravity model of trade. It is similar in nature to Newton's gravity model implying that objects are attracted to other objects based on their size and distance from each other. Keith Head applies the same model to trade in his specification named, *Gravity for Beginners*, and derives a mathematical model in terms of economic size and distance.¹⁰ Head's gravity model can be derived as the following:

Gravity Model of Trade

$$T_{ij} = A \frac{Y_i \times Y_j}{D_{ij}}$$

⁷ See Appendix III

⁸ See Appendix IV

⁹ See Appendix V

¹⁰ Keith Head, "Gravity for Beginners", University of British Columbia, February 5, 2003 pg.4-5

From the mathematical equation we can derive that trade defined by distance and size of a country. In our dataset we have variables for weighted distance which is good proxy for distance in the gravity model. As stated in our data and statistics section, GDP is a highly correlated variable with trade as that is what is used for the size of a country, and we will need to control for it. There is also a constant term that is multiplied depending on each case. Professor Gordon Hanson summarizes this model in a simple and concise way, “Big countries trade more than small countries with closer countries rather than far away countries”¹¹. With this theoretical insight we can speculate the economic theory behind Mercosur.

Mercosur is a trade bloc that aims to decrease distance and in turn increase GDP size for all countries which will then drive trade. When we state that it will decrease distance this does not imply physical distance as geographic boundaries have already been set historically. We are referring to distance cost as there is now a free movement of goods from one country in South America to the next, as well as in 2005 infrastructure projects that are taking place. Distance cost is being minimized and therefore as distance decreases, we should theoretically see an increase in trade.

To take this from a mathematical model into a statistical one, we will run a simple Pooled OLS regression to further guide our model specification. The goal of this simple Pooled OLS is not to find causal relationships, but to provide an insight as to what are the variables of importance. To do this we regressed log of trade with log of GDP, log of Distance, colonial history, common ethnic language, and previous trade agreements. What this process inherently runs is a t-test that will test if any of these covariates hold explanatory power as to explaining trade. Our general null and alternative hypothesis for each variable holds this general structure:

$$\text{Null Hypothesis: Covariate} = 0$$

$$\text{Alternative Hypothesis: Covariate} \neq 0$$

After applying this regression model our results are staggering¹². In each case we are able to get a p-value of less than 0.01. This means that at a 99% confidence level we can reject the null

¹¹ Hanson Gordon, *Lecture 2: The Gravity Model of Trade*, School of Global Policy and Strategy, October 1st 2019.

¹² See Appendix VI

hypothesis. In simple terms, all of our covariates hold explanatory power in our model therefore we must control for them when estimating the true effects treatment of Mercosur.

After determining our covariate, we will need to use a more robust model to test our treatment effect. Models which were considered were pooled OLS as well as between effects estimator, but since we are not using the variation between country pairs, we opted out for a fixed effects estimator. Fixed effects estimator will estimate the within variation of country pairs for a given year. In our previous model we would have correlation between our covariates and our unobserved error term. This can create estimates that are inflated or inaccurate leading to misleading conclusions. Fixed effects estimator will fix this problem. Our covariates that vary over time are omitted which are, common language, contiguity, colonial history, and the log of distance. This will help by only leaving our Mercosur treatment effect plus the 2005 strengthening of Mercosur. We will create 2 fixed effect regression models each testing different cases:

- **Country-Pair Fixed Effects** this will attempt to capture the within variation and get the true effect of joining Mercosur on trade. Time trends will be created to soak up any seasonality with our dataset as well as omitting time-invariant explanatory variables.

Key Question: What is the additional effect Mercosur has on trade compared to non-Mercosur members

- **Country-Pair Fixed Effects Leads and Lags** will be specified to see if the actual effect took place before the implementation or after. The model will help answer the question to see if trade effects on agreements start before or are they delayed. A country can be preparing to enter a trade agreement therefore increasing their trade beforehand, or the effects can be delayed as it takes time for the correct infrastructure to build.

With the previous assumptions we specified a general model that should follow this format. One model for initial treatment and one for the additional effect of 2005 strengthening.

$$MSUR: \ln Y_{it} = \beta_0 + B_1 IEC_{it} + \beta_2 \ln X_{it} + \beta_3 \ln D_i + \delta_1 MES + \epsilon_{it}$$

$$poMSUR: \ln Y_{it} = \beta_0 + B_1 IEC_{it} + \beta_2 \ln X_{it} + \beta_3 \ln D_i + \delta_2 poMES + \epsilon_{it}$$

Where:

$$\begin{aligned} t &= year \\ \ln Y_{it} &= \log \text{value of trade} \\ IEC_{it} &= \text{Importer and Exporter capabilities} \\ \ln X_{it} &= \text{Trade Controls} \\ \ln D_i &= \text{Distance} \\ MES &= \text{Mercosur 1991} \\ poMES &= \text{Mercosur 2005} \end{aligned}$$

Trade Controls(X):

1. Common Language
2. Contiguous
3. Colony
4. Tariffs (GATT/WTO)

We used three different subsets of the population as an initial robustness check. Our first was the whole 9506 unique country pairs, then limiting that to only the countries in Latin America, and lastly using only South American Countries. The theory behind each is as follows. We can use the whole population to check how we compare to the whole rest of the world. Using only Latin American countries can serve as a robustness check as there are trading partners within our sample that do not have similar trading relationships. Following the same logic applied to the first robustness check I followed by using only countries in South America. Something to point out is that our sample gets significantly smaller as we use these robustness checks which mean we might encounter misspecifications; we will just have to adapt if this is the case and use only all country-pairs.

- **All Countries**
 - MSUR
 - PoMSUR

- **Latin America**
 - MSUR
 - poMSUR
- **South America**
 - MSUR
 - poMSUR

Things to consider and solutions

Throughout our initial analysis we have set many assumptions which will be reviewed in this section to test for endogenous assumptions and attempts on fixing them. The first inherent assumption that was made is that this was a standard treatment effect. This means that we assumed that all countries entered into the treatment simultaneously. This statement holds in 1991, but not in 2005 as by then other countries had been joining at different times. Staggered entry as it is referred to in econometrics is a major cause of endogeneity and it needs to be fixed. Baier and Bergstrand further discuss this issue as countries self-select into trade agreements¹³. After consulting with faculty at the School of Global Policy and Strategy we decided that a solution would be Propensity score matching. This technique allows for identification of country pairs that share similarities with Mercosur country pairs in our key variables. After implementation we saw that our sample size was limited by 95% of the original number. Therefore, we decided to opt out of using this technique for our future model estimations.

Sample size was a constant issue as we tried to apply more robustness checks to our models. Since propensity score matching failed, we attempted to use Latin American countries as a pseudo PSM technique. We ran into the same problem of cutting our data by 90%. The problem intensifies if we only use South America. So, for the purposes of this analysis we used the whole sample. Our counterfactual statement now turns into, “What trade on average looks like if countries had not signed and entered into the Mercosur Trade Bloc.”

¹³ Scott Baier and Jeffrey Bergstrand, “Do free trade agreements actually increase members’ international trade? *Journal of International Economics*, 71(2007) p. 72-95

The last of our robustness check came from heteroskedasticity in our residuals. When residuals are heteroskedastic in nature this means that the variance of the residuals is different at different samples of the data. Since we are fitting a linear model this becomes problematic as we lose explanatory power. Therefore, we use robust standard errors to correct our heteroskedastic problem. When we do this, we lose significance within our estimates as well as increasing our standard errors.

Results

Our results correlate well with our story with interesting observations within our three fixed effects models. On average Mercosur did increase trade for the partner members, but we have to take a closer look to estimate the exact effect in both phases.

Looking at our first regression Pooled OLS we can see estimates of our covariates as well as our treatment variables. From our first regression model we can see that as we increase GDP by one percent we should see an increase in trade of about 106.9% at a 99% confidence level. Our next estimate is inversely correlated stating that as we decrease distance by one percent, we estimate a decrease of about 107.1% at a 99% confidence level. This is interesting as it lines up perfectly with our gravity model of trade with one variable being in the numerator while the other sits at the denominator. The rest of our covariates are also statistically significant. Issues that may arise with this model come in the form of overestimating the true effects. If we look at our variable of interest Mercosur in 1991 yields $(e^{1.036}-1)$ a 182% increase in trade for the region and is statistically significant at 99% significance level. Our 2005 variable is said to only account for a 10% increase in trade and not statistically significant. These are flawed estimates and we will compare these to our fixed effects models.

Our first Fixed Effects model omits time invariant covariates and adds a three-year lag to our model. With this model we are attempting to test if the effect was delayed since 1991. From our estimates we can see that in 1991 Mercosur on average increased trade for Mercosur members by 21.16% points being statistically significant at the 90% level. We can also see that in the 3 years to come there was an even greater effect of 29.43% points again significant at the 90% confidence level. Lastly we can see that our 2005 Mercosur variable only accounts for 7.9% of increase in

trade and not statistically significant. I would intuitively expect different results so, our next model will look at the period before the trade agreement as comparison.

Adding just a lead into our Fixed Effects model gives more insight into our model specification. We can begin by noticing that three years prior in 1988 when talks of Mercosur began trade increased by 56.9% statistically significant at the 99% confidence level. Our 1991 Mercosur variable only increases trade by 0.6% and is not statistically significant. Finally, our 2005 Mercosur variable increases trade by 24.4% percent and is statistically significant at the 95% confidence level. What we can determine from this is that there is an effect leading up to Mercosur and then another effect afterwards which I believe is captured by my 2005 variable.

The final model specified will take into account periods before and after the 1991 Mercosur trade bloc to more accurately estimate the true effects. Analyzing our lead variable, it is estimated that in leading up to the trade agreement there is a 47.9% increase in trade statistically significant at the 99% confidence level. In 1991 when the Treaty of Ascuncion was signed we see a decrease in trade of 8%, but it is not statistically significant. Three years after we see a minimal effect of 15% increase, but again not statistically significant. Lastly, we see our last effect in the year 2005 of 20.9% increase in trade which is statistically significant.

From our four models we can deduce the following. Before Mercosur was enacted there was a substantial increase in trade between future member countries driven by unobservable factors. We can estimate that there is a possibility that countries began to open their trade channels prior to Mercosur. Once Mercosur is enacted there is no significant effect until we bolster the agreement by adding more associate countries as well as an infrastructure plan which increases overall trade within the trade bloc. Next, we will analyze what policy implications these findings hold.

Policy Implications

Totalitarian Hinderance of Trade

In 2016 Venezuela was suspended from the Mercosur trade bloc hindering itself because of a totalitarian government. Since our gravity dataset ends in 2014 we cannot estimate the effects on Venezuela leaving Mercosur. What we can estimate is how much trade on average they are losing by being suspended and why this is not beneficial for them as a country.

Further integration of the Region

As we saw that integration has led to a greater yield of trade for Mercosur members overall. As Mercosur plans for the future they can take into consideration how to expand and strategically target members, as even small players can create an increase in trade..

Power Dynamics

Mercosur is led by Brazil and Argentina which are the largest countries in terms of economic output for the region. Other Mercosur members much be wary of these trade effects as they can be leveraged in negotiations.

Appendix I

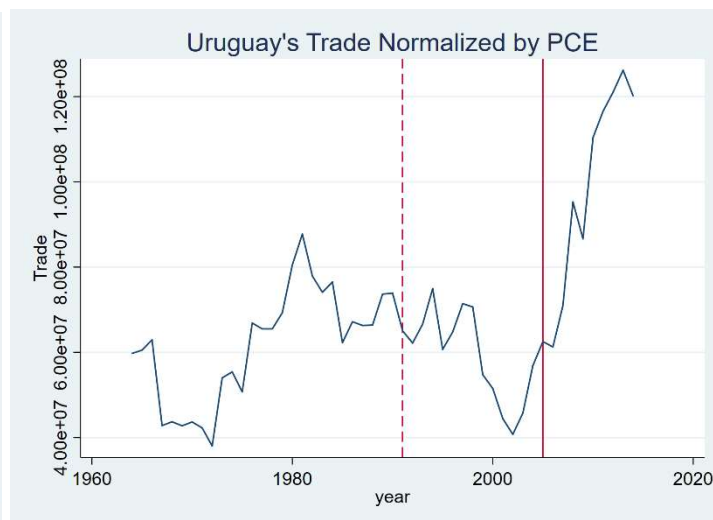
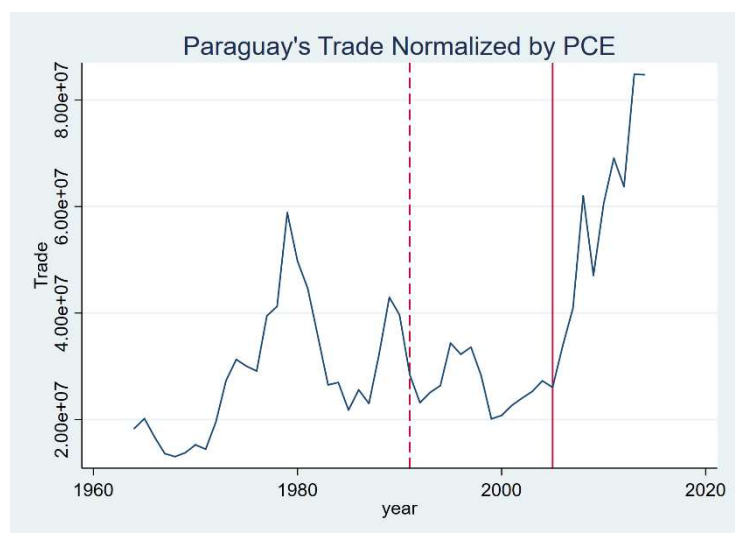
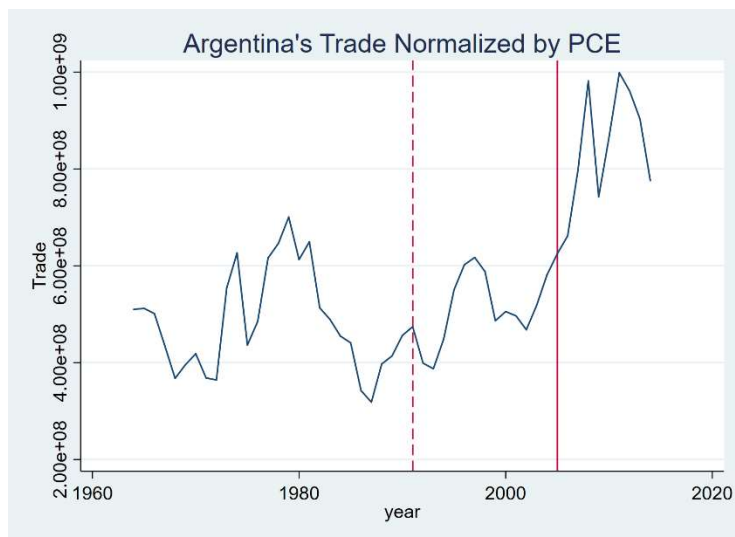
Mercosur's Member Countries

● Associate members ● Full members



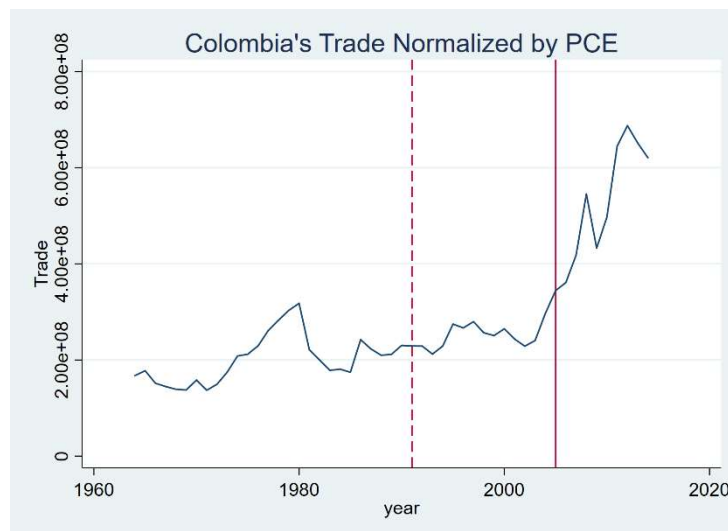
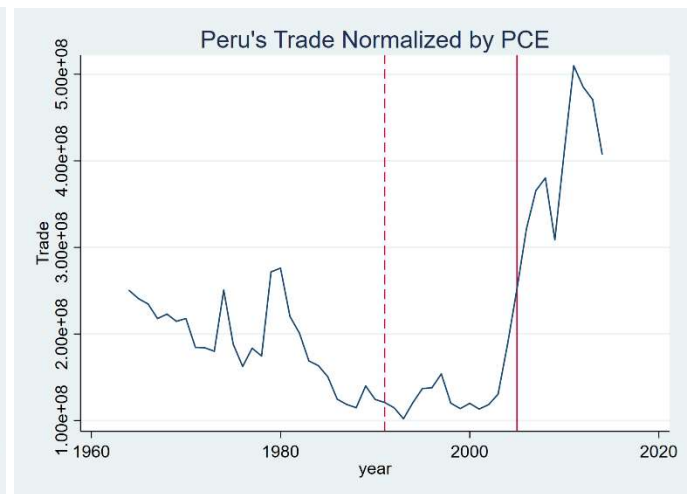
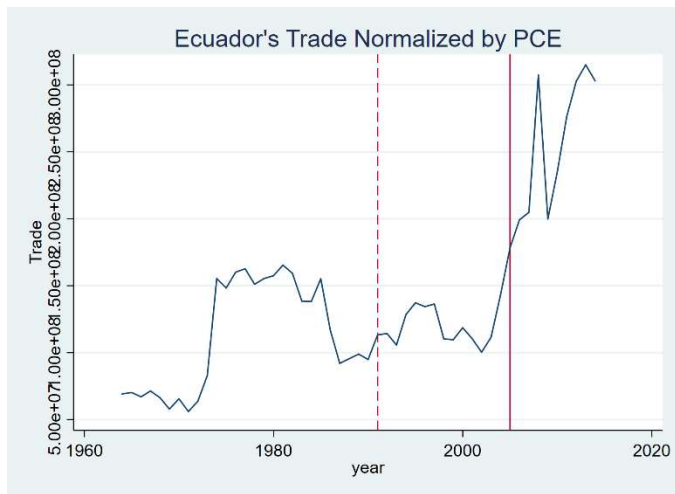
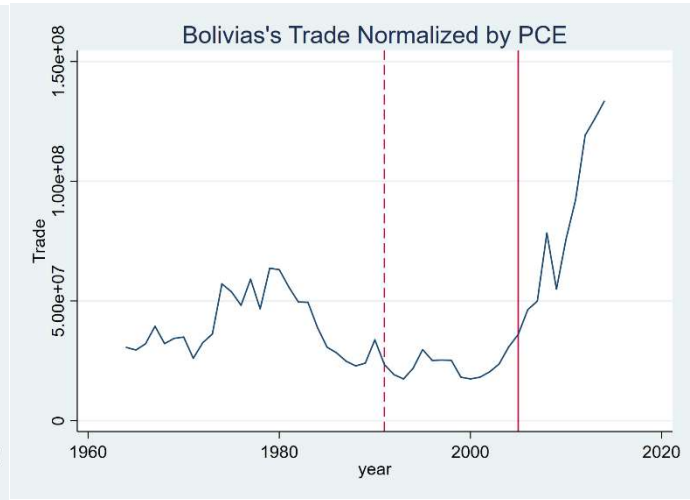
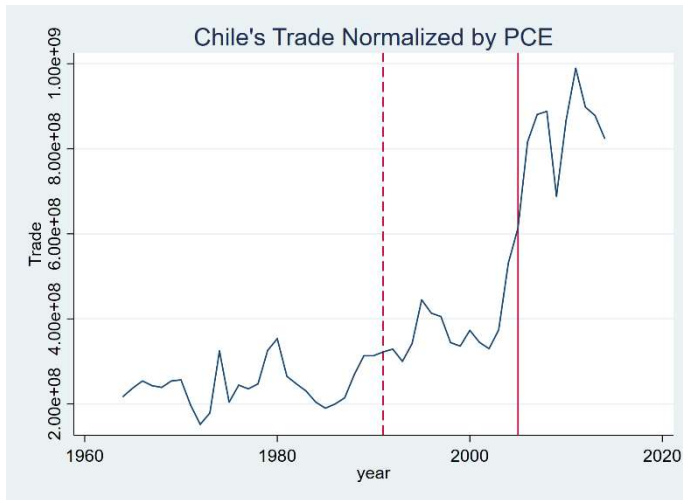
Appendix II

(Mercosur Member Countries)

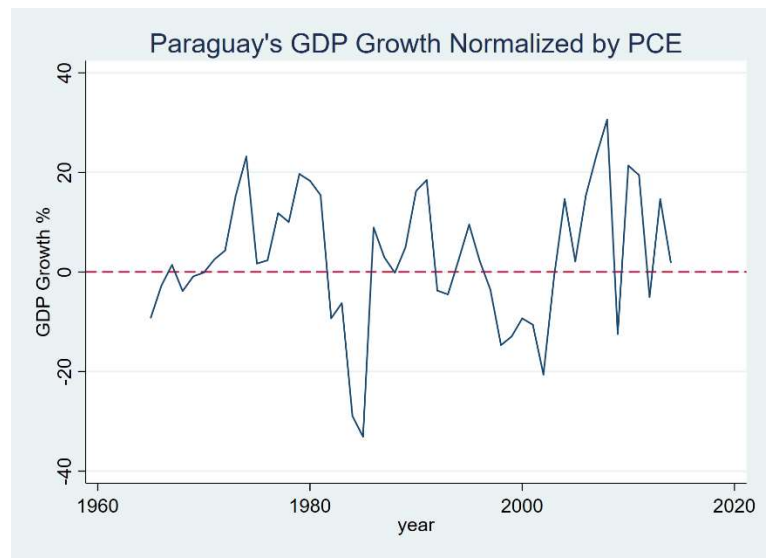
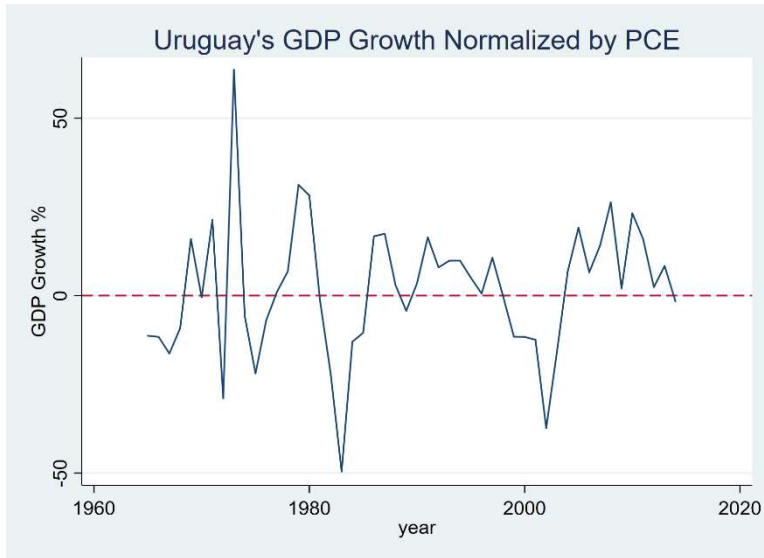
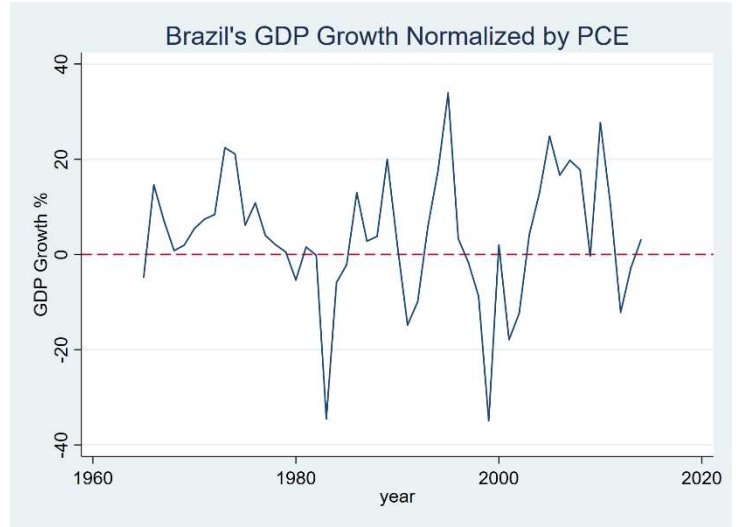


Appendix III

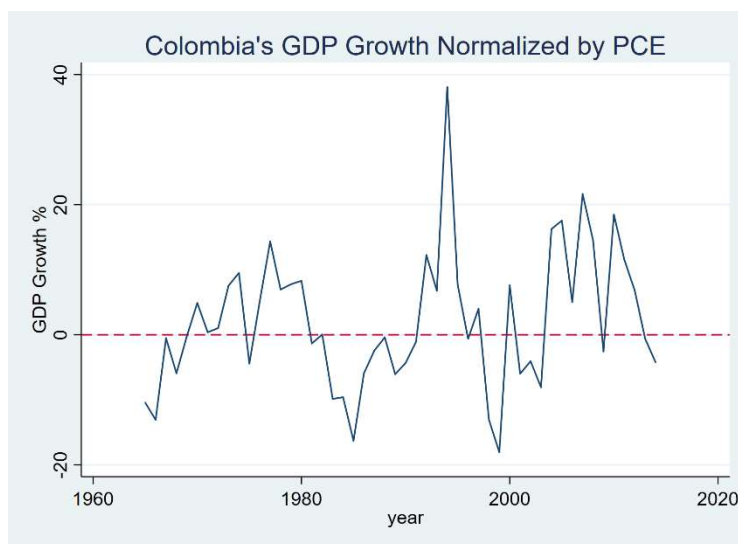
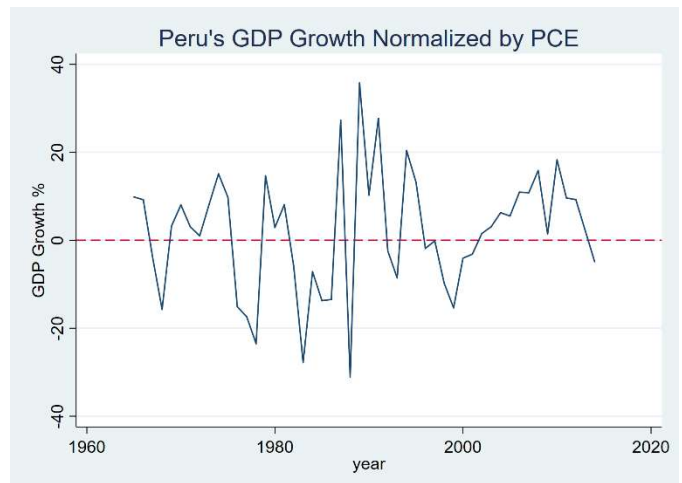
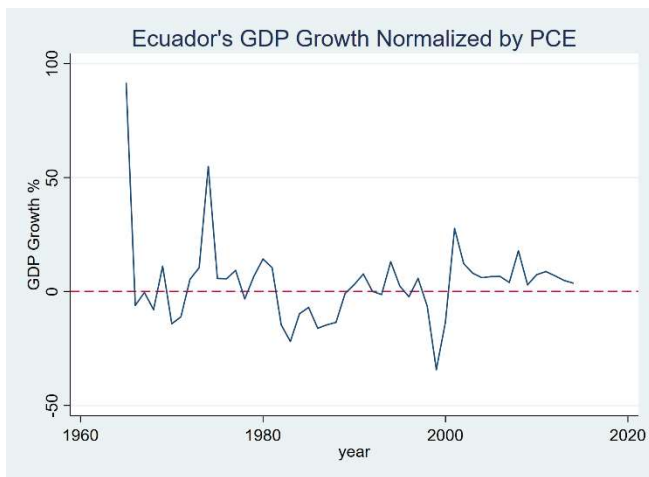
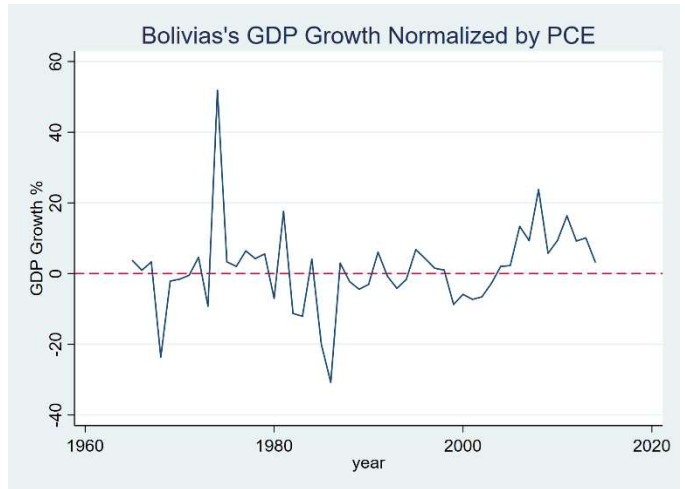
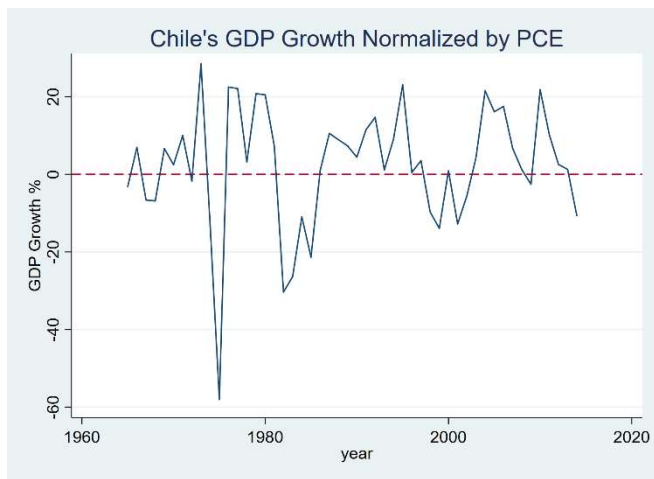
(Mercosur Associate Countries)



Appendix IV



Appendix V



Appendix VI

	POOLED OLS	FIXED EFFECTS(LAG)	FIXED EFFECTS(LEAD)	FIXED EFFECTS (LEADS AND LAGS)
	Log of Trade	Log of Trade	Log of Trade	Log of Trade
LOG OF GDP	1.069*** (0.002)	0.793*** (0.015)	0.782*** (0.015)	0.777*** (0.015)
LOG OF DISTANCE	-1.071*** (0.004)	0 (.)	0 (.)	0 (.)
CONTIGIOUS	0.589*** (0.021)	0 (.)	0 (.)	0 (.)
LANGUAGE	0.686*** (0.010)	0 (.)	0 (.)	0 (.)
COLONY	0.748*** (0.017)	0 (.)	0 (.)	0 (.)
WTO/GATT	0.273*** (0.021)	0.248*** (0.057)	0.210*** (0.049)	0.233*** (0.056)
LEAD 3 YEARS			0.451*** (0.111)	0.392*** (0.110)
1991 MERCOSUR	1.036*** (0.056)	0.192* (0.089)	0.00620 (0.113)	-0.0886 (0.094)
LAG 3 YEARS		0.258* (0.106)		0.140 (0.100)
2005 MERCOSUR	0.102 (0.070)	0.0796 (0.092)	0.219** (0.084)	0.190* (0.089)
N	340344	324858	314877	299391
ADJ. R-SQ	0.655	0.849	0.846	0.850
	Standard errors in parentheses			
	* p<0.05	** p<0.01	*** p<0.001"	