EFFECTS OF DOLLARIZATION ON ECUADOR’S TRADE FLOWS: A GRAVITY MODEL APPROACH

STUDENT No: 1302083

SEPTEMBER 2014
CONTENTS

ACKNOWLEDGMENT ................................................................. 3

ABSTRACT ............................................................................. 4

SECTION 1: INTRODUCTION ...................................................... 5

SECTION 2: DOLLARIZATION: THE CASE OF ECUADOR ............. 8
  2.1 Background and Current Economic Situation ....................... 8
  2.2 Benefits and Costs: A Review of Theoretical and Empirical Literature ... 11

SECTION 3: THE GRAVITY MODEL OF TRADE ......................... 17
  3.1 A Review of Theoretical and Empirical Literature ............... 17
  3.2 Methodology .................................................................. 21
  3.3 Data ............................................................................. 25

SECTION 4: RESULTS ............................................................... 28
  4.1 Model Specification ....................................................... 28
  4.2 Ecuador’s Exports-Equation and Imports Equations ........... 30
  4.3 Ecuador’s Bilateral Trade-Equation ..................................... 32

SECTION 5: CONCLUSION ......................................................... 35

REFERENCES ......................................................................... 39

APPENDIX A: Macroeconomic Indicators of Ecuador Post-Dollarization ... 42

APPENDIX B: Ecuador’s Bilateral Trade Flow (Dataset) ................. 42

APPENDIX C: Econometric Tests .............................................. 45
LIST OF GRAPHS

GRAPH 1: Basket Oil Prices US dollars.....................................................13

GRAPH 2: Ecuador’s Total Trade Flows Millions of US dollars.....................13

LIST OF TABLES

TABLE 1: Panel Data Estimates of Ecuador’s Exports and Imports..............31

TABLE 2: Panel Data Estimates of Ecuador’s Bilateral Trade Flow..............33
ACKNOWLEDGMENT

First and foremost I would like to thank God and my family for guiding my steps in the right direction and a special thanks to the National Government of the Republic of Ecuador for financing my postgraduate studies.
ABSTRACT

Since Ecuador adopted the US dollar as its domestic currency in 2000, several economic sectors have discussed its real effects on Ecuador's economy mainly on its external sector. This study estimates the impact that dollarization has had on Ecuador's bilateral trade flow with 20 of its main trade partners from 1986 to 2013. By using the Gravity model of trade (well-known tool of predicting bilateral trade among countries) I have found positive and significant estimates for the Dollar dummy variables included in the respective models. The results suggest that Ecuador's trade flows have nearly doubled in average since the dollarization was introduced furthermore its effect is more significant on Ecuador's imports than on its exports.

Key Words: Ecuador, Exports, Imports, Dollarization, Gravity Model of Trade.
SECTION 1: INTRODUCTION

Over the 90’s Ecuador’s economy experienced internal imbalances which were originated mainly in the financial system. The fiscal and current account deficits became unmanageable especially in the late 90’s when some external shocks such as the collapse of the oil prices and the weather phenomenon “El Niño” hit Ecuador’s economy. The first caused a decline in oil revenues by approximately 20 percent in 1998 (Central Bank of Ecuador 2014) and the second had a devastating effect on the export sector infrastructure that same year. Both exacerbated the already deteriorated economic environment.

However, Ecuador’s economy was about to suffer one of the worst crises in its history. In 1999 the high devaluations of the sucre\(^1\), the external debt default and the government’s failed attempts to avoid the collapse of the financial system triggered both economic and political instability (Quispe-Agnoli and Whisler 2006). In an attempt to halt the loss of value of the national currency, the incumbent government proposed to dollarize Ecuador’s economy as an alternative to stabilize the exchange rate.

After years of constant devaluations, the sucre came to an end in 2000 when Ecuador adopted the US dollar as its official currency. During the early 2000’s the enhancement of some macroeconomic indicators pointed towards the decision to dollarize the economy, was an accurate measure to face the economic crisis. Moreover the significant external sector growth, since the dollarization was adopted, has supported the aforementioned hypothesis. On the other hand opponents of the dollarization argue that it has brought more

---

\(^1\) The official Ecuador’s currency from 1884 to early 2000. (Central Bank of Ecuador 2014)
costs than benefits to Ecuador and the undeniable enhancement of Ecuador’s economy responds to other economic factors such as the increase in oil prices and the high level of remittances from Ecuadorian emigrants. All these assertions raise some questions such as “Has the dollarization really contributed to the recovery of Ecuador’s economy?” if so “What have been its effects on Ecuador’s external sector?” and “How significant these has been?”

This study aims to answer some of these questions, mainly those related to the effects of the full dollarization on trade flows between Ecuador and its main trade partners using the framework of the Gravity model of trade. Tinbergen (1962) was one of the first to use an analogy based on Newton’s Gravitation Equation to predict bilateral trade between pairs of countries. Currently the Gravity model of trade is widely used in the economic empirical literature and it becomes a useful instrument to explain the behaviour of trade flows among countries. In its standard version the bilateral trade flow is directly proportional to the countries’ market size, measured generally by their levels of income and it is indirectly proportional to the distance between them. The larger is the market size, the greater is the trade flow between countries. On the other hand, the longer is the distance, the lower is the trade flow between countries since a long distance implies a higher freight cost.

An augmented version of this model typically includes other explanatory variables. The most common specifications involve dummy variables to explain bilateral trade flow as a function of characteristics that both countries share such as language, currency, legal framework or common border. Other models consider not only the aspects that facilitate bilateral trade flow but also those that hinder it such as tariffs, quotas and other barriers to the free trade.
Following the path of these models, several experts have carried out research to measure the effects of a determined currency on trade flows under the idea that a common currency might lead to an increase bilateral trade flow between countries. Andrew Rose (1999) in his study determines that a common currency might increase bilateral trade up to triple the previous level. His subsequent studies with Glick (2001) and Frankel (2002) emphasize the positive effects of a common currency on the international trade.

There is an extensive economic literature that supports the idea that a currency union\(^2\) encourages bilateral trade flow among the countries that comprise it. However it is important to point out that these effects might be more significant when an economy adopts a strong currency as the US dollar. Regarding this idea the dollarization in Ecuador might have affected its trade flows not only with the countries that share the US dollar as their official currency but also with those that do not.

I have proposed two equations that comprise the core of this study, which analyse Ecuador’s external sector. The first equation measures the evolution of Ecuador’s exports and the second measures the evolution of Ecuador’s imports pre and post-dollarization, both include a standard and augmented version of the Gravity model of trade. In the aforementioned models I have included a dummy variable to measure the effects of the dollarization on Ecuador’s trade flows. In addition I have estimated a third equation that explains Ecuador’s trade flows altogether and I have assessed the importance of a common currency in Ecuador’s bilateral trade flow with the United States.

\(^2\) This is understood under the context that two or more countries share a common currency without necessarily establishing any other commitments.
This study has been structured as follows. Section 2 explains Ecuador's economic crisis and the background of the dollarization. In addition it examines the economic literature related to the costs and the benefits of dollarization from a theoretical and empirical point of view. Section 3 presents the basic ideas of the Gravity model of trade and examines empirical literature based on this model. Furthermore it provides the framework used to assess the effects of dollarization on Ecuador’s trade flows. Section 4 analyses the most common econometric specifications within the data panel models and provides the best specifications for the respective models. It also contains the results of the empirical analysis for the three proposed equations. Finally, Section 5 provides a conclusion and some possible extensions of this study.

SECTION 2: DOLLARIZATION: THE CASE OF ECUADOR

2.1 Background and Current Economic Situation

Ecuador has an economy highly dependent on oil exports and therefore is susceptible to changes in its price. Over the 1990’s Ecuador’s failed attempts to improve its international trade, along with deep fiscal deficits and high external debt, triggered a downturn in the economy. In the late 1990’s these issues were exacerbated by several adverse shocks including the El Niño weather phenomenon and a drop in oil prices, which led Ecuador’s economy into a one of the worst economic crises in its history (Quispe-Agnoly and Whisler 2006).

During this period the sucre devalued from 686 sucres per US dollar in January 1990 to 7,245 sucres per US dollar in January 1999. However in 1999 the sucre suffered the most significant devaluation of its history even higher
than that registered during the 1990’s. In late 1999 the official exchange rate was 19,858 sucres per US dollar which represented a loss of its foreign exchange value by approximately 174 percent (Central Bank of Ecuador 2014).

The frequent devaluations of the sucre triggered a lack of confidence in the national currency; this led to a banking crisis which was aggravated by the government’s attempt to freeze bank deposits in order to avoid a financial collapse in March 1999. Later that year, the default on Brady bonds impeded the government to be able to get the resources to face the economic crisis through the issue of public sector bonds (United Nations 2000).

In January 2000 Ecuador was immersed in a deep economic crisis accompanied by political instability. In order to stabilize the exchange rate and avoid a further contagion of the banking system, the president Jamil Mahuad proposed the full dollarization of the economy. Due to the lack of early action to beat the economic crisis, Mahuad was shortly deposed and the vice president Gustavo Noboa assumed the presidency. He continued promoting the full dollarization as an alternative to mitigate the crisis (Quispe-Agnoly and Whisler 2006). Finally the Congress of Ecuador approved the official dollarization of the economy in March 2000 (United Nations 2003). The conversion was set at 25,000 sucres per US dollar.

Initially the dollarization had a significant effect on interest rates which fell considerably. The high sucre devaluation caused severe inflation prior to dollarization, which remained in 2000 (United Nations 2003), according to the World Bank database the inflation rate was 96.09 percent that year. The country risk became less volatile, this was a consequence not only of the elimination of
currency risk but also of the external debt restructuring in August 2000 (Quispe-Agnoly and Whisler 2006).

In the subsequent years some macroeconomic indicators improved substantially. Appendix A shows the key economic indicators post-dollarization. The annual inflation rate decreased radically from 96.09 percent in 2000 to 37.68 percent in 2001. During the last decade the inflation rate has been decreasing yearly reaching an average level of between 4 and 5 percent in the last 5 years. Unemployment is another indicator which has shown favorable changes post-dollarization. The unemployment rate in early 2000’s was roughly 9 percent, currently the unemployment rate does not exceed 5 percent. It is important to highlight that the decrease in the unemployment rate was a consequence not only of greater economic stability, but also of higher migration of the labor force\(^3\) mainly to the United States (United Nations 2003).

It is important to point out that there were other factors that contributed in stabilizing Ecuador’s economy, such as tax collection improvement and a rally in oil prices (United Nations 2003). These factors, in addition to those previously mentioned, have contributed to Ecuador achieving a steady growth rate of GDP. Ecuador’s GDP grew by roughly 4 percent during the early 2000’s and it showed a positive trend until 2009. Although the global economic crisis affected the growth rate of Ecuador’s GDP during this year, it remained positive. Some important measures were taken by the government to mitigate the effects of the economic crisis, such as exonerations on taxes for exports affected by the

\(^{3}\) The high migration has also contributed with the dollarization process and its subsequent success since Ecuadorian’s remittances represent a significant source of foreign currency. (Fretes, Giugale and López 2003)
crisis, taxes on capital outflows and tax incentives for domestic companies which reinvest their profits (Rodríguez 2010). Currently the growth rate of Ecuador’s GDP remains steady and significant.

With regard to Ecuador’s external sector, which will be discussed in detail later, it has seen significant growth since the dollarization was adopted. According to the Central Bank of Ecuador database, Ecuador’s exports have increased on average by 15 percent yearly while Ecuador’s imports have increased on average by 18 percent yearly, thus the discussion focuses on whether the dollarization is a factor that has contributed with this growth or rather it has been a limiting factor to achieve a higher external sector growth, according to the favorable economic conditions of the last decade.

2.2 Benefits and Costs: A Review of Theoretical and Empirical Literature

Economic literature suggests that a common currency has important benefits in trading mainly for the reduction of transaction costs among countries. This benefit is key to assuming that dollarization might have a significant effect on Ecuador’s trade flows.

The theory of Optimum Currency Area described by Mundell (1961) explains that a common currency provides advantages of trading among countries, these benefits are associated to the stability that a fixed exchange rate offers. Cohen (2000) highlights that under a common currency there is no costs of currency conversion which is a benefit shared by both the currency owner and the country which adopts this currency. Both aforementioned statements might be applied to the case study of Ecuador, since Ecuador
shares a common currency precisely with its main trade partner the United States.

Levy and Sturzenegger (2003) emphasize the importance of common currency mainly when a country adopts a strong foreign currency as the US dollar. Firstly, they argue that exchange rate volatility has negative effects on trading, therefore under a common currency this volatility might be reduced which agrees with the theory of Optimum Currency Area. Secondly, they agree with Cohen (2000) that a common currency reduces transaction costs associated to currency conversion. Rose (1999) finds that countries that share a common currency, trade almost three times more than countries with their individual currencies and the effect of having a common currency is larger than the effect of controlling the exchange rate volatility.

According to the Central Bank of Ecuador database, Ecuador’s exports and imports post-dollarization have grown steadily with a similar trend, excluding 2009 when the global economic crisis struck, as explained above. However this growth depends not only on the dollarization but also on both external and internal factors.

The fact that Ecuador’s exports and imports have increased significantly post-dollarization has encouraged experts to conduct research to analyse the dollarization effects on both sectors. As stated, Ecuador’s economy is highly dependent on oil exports therefore it is expected that oil-price changes have significant effects on its trade flows. Graph 1 shows oil-price fluctuations from 1986 to 2013 and Graph 2 shows Ecuador’s exports and imports during the same period.
As can be seen exports, imports and oil-price have a similar trend over time. Both exports and imports show positive annual growth rates with the exception of 2009 during the global economic recession. That year oil prices dropped from 94.45 US dollars per barrel to 61.06 US dollars per barrel, thus
Ecuador’s exports decreased by 26.33 percent while Ecuador’s imports decreased by 19.96 percent. Keeley and Kess (2013) argue that Ecuador’s economy is based on commodity exports therefore its stability is susceptible to external shocks and global economic crises. Both exports and imports recovered post crisis however their growth rate is not as high as it was at the beginning of the dollarization.

It is also important to consider internal factors for instance, Ecuador’s attempts to diversify its economy which has had consequences over both sectors. The Government has intended through safeguarding measures to reduce imports and encourage exports. The most current version of Ecuador’s Constitution includes policies to promote import substitution and increase production of higher valued-added goods. However the effectiveness of these policies depends on improvement of both productivity and competitiveness (WTO 2011). In conclusion the dollarization might have an effect on the steady increase of both exports and imports in Ecuador but the main reasons of this increase could be explained by other relevant aspects that occurred post-dollarization.

There are other important advantages of full dollarization that are not exclusively related to trade flows. Levy and Sturzenegger (2003) describes two additional benefits associated to having a common currency. They mention as a first benefit the credibility enhancement due to the following; firstly, a passive monetary policy prevents unanticipated money creation by the domestic central bank which eliminates the unexpected inflation issue. Secondly, a strong financial constraint on government spending leads to further fiscal discipline, since it cannot resort to inflationary financing of its deficit. The second benefit is
related to the reduction of country risk which is an advantage derived from the
credibility enhancement. However the authors identify the second benefit as a
feature of economic and monetary unions which is not the case of Ecuador,
which adopted US dollar unilaterally.

There are various costs associated with the dollarization of an economy.
Economic literature states that the loss of exchange rate flexibility as a means
to improve competitiveness is one of the key disadvantages against trade flows
in a dollarized economy. Palley (2003) argues that a flexible exchange rate
might be used not only to stabilize the trade balance but also to isolate the
economy from external shocks. Panizza, Stein and Talvi (2003) contradict this
argument in their research into the costs of dollarization, they find insufficient
evidence to conclude that more flexible regimes are better than fixed regimes to
face external shocks.

The fact that a country can make use of its exchange rate to enhance its
competitiveness does not necessarily imply a better performance of its
economy, although empirical evidence holds that exchange-rate depreciation
has a positive effect on exports and output. Beckerman and Cortés (2002)
contend that this positive effect is reduced since the employers and workers
anticipate the decrease in real wages and hence they take this into account to
adjust wages. Moreover the fear of depreciation may have negative effects on
financial intermediation.

Ecuador’s non-oil exports are more likely to be affected by the fixed
exchange rate. In the early 2000’s Ecuadorian’s exporters complained about
this apparent disadvantage, since an overvalued dollar might have negative
effects mainly on the competitiveness of Ecuador’s exports. Hanke (2003) argues that the appreciation of the real exchange rate during the first three years of dollarization in Ecuador was not sufficiently significant to affect Ecuador’s exports considerably.

Graph 2 above also shows Ecuador’s non-oil exports post-dollarization. As can be seen the initial appreciation of the real effective exchange rate did not have an important effect on Ecuador’s non-oil exports which decreased by 5 percent in 2001, however its effect was apparently significant on imports which increased by 44.12 percent that year. Ecuador’s imports might have increased owing not only to the appreciation of the currency, but also to the recovery of public and private consumption (United Nations 2003). According to the World Bank database the real effective exchange rate stabilized since 2003 and currently its variations on average are closer to 4 percent.

Other costs of the dollarization include the loss of independent monetary policy since economic authorities cannot make use of this management tool to stabilize the economy. Hanke (2003) conversely argues that the loss of independent monetary policy might be seen as a benefit since monetary policy may be used wrongly as an instrument of governmental leverage mainly in the emerging-markets.

The loss of the lender of last resort implies that the central bank has limited capacity to inject liquidity to the financial sector in the event of a shortage. Hanke (2003) explains that under this scheme private banks tend to be more responsible with their credit lending since in the event of a financial
crisis or an unexpected liquidity requirement, the central bank may not be able
to satisfy these needs quickly.

The loss of seigniorage not only includes the cost of acquiring the foreign
currency to establish it as domestic currency, but also the cost associated with
the future purchase of that currency (Levy and Sturzenegger 2003). Matthews
et al. (2006) compute both costs associated with the loss of seigniorage in
Ecuador. They find that the first cost related to the currency conversion
represented approximately 3.7 percent of GDP while the second cost
associated with the future increases in the stock currency was roughly 2.51
percent GDP. Hanke (2003) contends that the loss of seigniorage is offset by
both lower interest rates and lower debt service costs since a common currency
facilitates financial transactions.

SECTION 3: THE GRAVITY MODEL OF TRADE

3.1 A Review of Theoretical and Empirical Literature

The Gravity model of trade is an analogy based on Newton’s Law of
Gravitation which states that two bodies $i$ and $j$ are attracted to one another by a
gravitational force ($GF_{ij}$) which is proportional to the mass of each body ($m_i$ and
$m_j$) and inversely proportional to their distance ($D_{ij}$). Newton’s law of universal
gravitation is described as:

$$GF_{ij} = \frac{m_im_j}{D_{ij}} \quad i \neq j$$

By analogy the formula above may be applied to predict international
trade flows among countries. According to Anderson (2010) a potential bilateral
trade flow across country $i$ and country $j$ is directly proportional to the mass of
goods or factors of production which are attracted from supplier $i$ to demander $j$ and indirectly proportional to the distance between countries.

Common Gravity models of trade use trade flows, exports or imports instead of the gravitational force. Distance is usually measured using the shortest distance between two countries, mass is commonly associated with Gross Domestic Product (GDP) of the trading countries (Reinert 2008). Therefore the Gravity equation may be expressed as:

$$T_{ij} = \frac{GDP_i GDP_j}{D_{ij}} \quad i \neq j$$

Where:
- $T_{ij}$: Trade flow between country $i$ and country $j$
- $GDP_i$: GDP of country $i$
- $GDP_j$: GDP of country $j$
- $D_{ij}$: Distance between country $i$ and country $j$

Gravity models of trade are estimated with natural logarithms ($\ln$) in order to get a log-linear model, thus the equation above becomes:

$$\ln T_{ij} = \ln GDP_i + \ln GDP_j - \ln D_{ij} \quad i \neq j$$

The log-linear structure of the Gravity model allows us to analyse trade flows as function of economic variables across countries in term of elasticities.

Jan Tinbergen (1962), who received the first Nobel Prize in economic science, was the first to use a Gravity model of trade to explain trade flows. His first approach was to analyse trade flows across 18 of the most developed countries in the world. He then extended his work by analysing 42 countries whose trade represented about 70 percent out of world trade flow in 1959.

Tinbergen analyses trade flows as a function of Gross National Product (GNP) among trading countries and the distance between them. Further
research in the field have taken this basic model as a starting point for more complex studies via the inclusion of other explanatory variables such as total population, GDP per capita, exchange rate and additional variables that have significant effects on trade flows.

The idea behind the model used by Tinbergen is that trade flows depend directly on the country’s market size measured by GNP or GDP and therefore it is expected that a positive relationship exists between these variables. On the other hand the distance between countries affects trade flows negatively due to the transportation costs, thus it is expected that a negative relationship exists between these variables.

A vast number of studies about the Gravity trade model have also included qualitative characteristics in the form of dummy variables. Tinbergen (1962) also includes dummy variables for trade agreements and neighbouring countries.

Many empirical studies have used an augmented version of the Gravity model of trade to explain the effects of a common currency on bilateral trade as Rose (1999) previously mentioned, some of these studies are describe below.

In a subsequent study Glick and Rose (2001) conclude that a pair of countries that decide to form part of a union currency double their bilateral trade while a pair of countries which leave a union currency reduce their bilateral trade by half. Frankel and Rose (2002) find similar results suggesting that a currency union might triple trade among the trade partners.

The most important aspect about the above-mentioned studies is that these focus on small economies including Ecuador’s. Frankel and Rose (2002) argues that the benefits of adopting a foreign currency are greater when this
belongs to a large economy since countries tend to trade with their larger neighbours. They also conclude that the effects of a union currency on small countries’ trade might not be the same for the large ones.

These studies provide relevant information about the benefits of sharing a common currency even when this has been adopted unilaterally. It is important to notice that the mentioned studies not only involve the US dollar as the common currency but also other strong currencies.

Klein (2002) carries out one of the first specific studies to measure the effects of dollarization on trade flows between the United States and its trade partners. Initially he conducts several regressions based on the Gravity model of trade in which he included industrial and non-industrial countries. His study determines that there is very little evidence that currency unions promote trade between the United States and another country. The result is the same even when his study considers only the United States’ trade with non-industrial countries though these countries are more likely to dollarize their economies.

On a deeper analysis Klein sight to determine whether the United States trade more with the countries in which the US dollar is widely accepted. For his study he takes into account 7 official and unofficial dollarized countries\(^4\). The coefficients on the currency union dummy variables for 6 out of 7 countries are also insignificant emphasizing the results previously obtained in the other regressions. On the other hand Lin and Ye (2010) suggest that estimates computed by Klein could be biased if the dollarization decision of these

\(^4\) The countries considered in this study were Bahamas, Bermuda, Dominican Republic, Guatemala, Liberia, Panama and Argentina. It is important to point that the only one official dollarized economy is Panama and Ecuador was not included in this analysis. For a more detail about the other Gravity model variables for these regressions. See Klein (2002) p. 11-12.
countries was not random, since the dollarization choice might be correlated with the observable explanatory variables. Based on this reasonable fact they control the model for non-random policy adoption. Contrary to Klein’s statement, the results suggest that the dollarization increases the bilateral trade between the United States and the previously mentioned countries besides there is also evidence that it strengthens the trade flows among dollar-zone countries.

There has been several empirical studies that intend to explain the trade between a determined country and its main trade partners using a Gravity model of trade. Those that includes a dummy variable for common currency are more likely to explain economic and monetary unions as the European Union. With respect to empirical studies about the effects of dollarization on Ecuador’s trade there are few studies which involve other types of specifications.

One of the most recent was carried out by Bova and Thaver (2012) which use an unrestricted correction error model in which they include a dollar dummy variable. They conclude that dollarization has a significant effect on Ecuador’s exports and imports but only in the short run. In a subsequent study Bova and Thaver (2014) use the bound test approach for cointegration to estimate Ecuador’s export demand function exclusively with the United States. The results show that the dollarization has a negative effect on Ecuador’s exports to United States in both long-run and short-run.

3.2 Methodology

I have computed three augmented Gravity equations for Ecuador’s trade: Ecuador’s exports-equation, Ecuador’s imports-equation and Ecuador’s bilateral trade-equation.
The exports-equation is based on the Tinbergen (1962) standard Gravity equation for exports from one country to another. I have used the basic explanatory variables such as GDP of the exporting country, GDP of the importing country and the distance between them and I have added other explanatory dummy variables such as common language, trade agreements and Dollar which measures the dollarization effects on Ecuador’s exports. In addition I have included the real effective exchange rate\(^5\) (REER) in order to verify if its effect on Ecuador’s exports was insignificant as it was established by Hanke (2003).

Analogously imports-equation relates Ecuador’s imports with the same explanatory variables and thus the Gravity equations for Ecuador’s exports and imports are as follow:

\[
\ln X_{Ejt} = \beta_0 + \beta_1 \ln GDP_{Et} + \beta_2 \ln GDP_{jt} + \beta_3 \ln D_{Ej} + \beta_4 \ln REER_{Et} + \beta_5 L_{Ej} + \beta_6 AC_{Ejt} + \beta_7 PPA_{Ejt} + \beta_8 Dollar_{Ejt} + u_{Ejt}
\]

\[
\ln M_{Ejt} = \beta_0 + \beta_1 \ln GDP_{Et} + \beta_2 \ln GDP_{jt} + \beta_3 \ln D_{Ej} + \beta_4 \ln REER_{Et} + \beta_5 L_{Ej} + \beta_6 AC_{Ejt} + \beta_7 PPA_{Ejt} + \beta_8 Dollar_{Ejt} + u_{Ejt}
\]

Where:

- \(X_{Ejt}\): Exports from Ecuador to country \(j\) at time \(t\)
- \(M_{Ejt}\): Imports of Ecuador from country \(j\) at time \(t\)
- \(GDP_{Et}\): GDP of Ecuador at time \(t\)
- \(GDP_{jt}\): GDP of country \(j\) at time \(t\)
- \(D_{Ej}\): Distance between Ecuador and country \(j\)
- \(REER_{Et}\): Real Effective Exchange Rate of Ecuador at time \(t\)
- \(L_{Ej}\): Dummy variable, which takes the value of 1 if Ecuador and country \(j\) share a common language and 0 otherwise.

\(^5\) It is the index obtained from the value Ecuador’s currency against a weighted average of foreign currencies.
$AC_{Ejt}$ Dummy variable, which takes the value of 1 if Ecuador and country $j$ are members of Andean Community at the time $t$ and 0 otherwise

$PPA_{Ejt}$ Dummy variable, which takes the value of 1 if Ecuador has Partial Preferential Agreements with the country $j$ at the time $t$ and 0 otherwise

$Dollar_{Ejt}$ Dummy variable which takes the value of 1 if Ecuador trades with US dollars with the country $j$ at the time $t$ and 0 otherwise

$u_{Ejt}$ Error term which explains other influences on Ecuador’s trade at time $t$

The expected signs of the parameters for both equations are $\beta_1, \beta_2>0$ and $\beta_3<0$ (Reinert 2008). The expected sign of $\beta_4$ must be positive for the exports-equation and negative for the imports-equation since a devaluation of the REER increases exports and decreases imports.

The expected signs for the coefficient of the dummy variables $\beta_5, \beta_6$ and $\beta_7$ must be positive since that common language and trade agreements are likely to strengthen trade among countries and $\beta_8$ according to economic theory about the common currency must be positive for the two equations.

Following Rose (1999), Glick and Rose (2001), and Klein (2002) I have also estimated Ecuador’s bilateral trade flow, expressed as the sum of exports and imports. The independent variables for this Gravity model of trade are in term of products and it is common to include the Linder hypothesis as another explanatory variable, and therefore the Ecuador’s bilateral trade-equation is as follows:

---

6 It is based on the fact that two countries with similar GDP per capita have similar demand structures therefore they will tend to trade more with each other. It is established as the absolute value of the difference between GDPs per capita of the trading countries.
\[
\ln X_{Mejt} = \beta_0 + \beta_1 \ln(GDP_{Et}GDP_{jt}) + \beta_2 \ln\left(\frac{GDP_{Et}GDP_{jt}}{N_{Et}N_{jt}}\right) + \beta_3 \ln D_{Ej}
\]

\[
+ \beta_4 \ln \left| \frac{GDP_{Et}}{N_{Et}} - \frac{GDP_{jt}}{N_{jt}} \right| + \beta_5 L_{Ej} + \beta_6 AC_{Ejt} + \beta_7 PPA_{Ejt}
\]

\[
+ \beta_8 Dollar_{Ejt} + u_{Ejt}
\]

Where:

- \(X_{Mejt}\): Bilateral trade flow (exports plus imports) between Ecuador and country \(j\) at time \(t\)
- \(GDP_{Et}\): Product of GDP of Ecuador with GDP of country \(j\) at time \(t\)
- \(GDP_{Et}GDP_{jt}/N_{Et}N_{jt}\): Product of GDP per capita of Ecuador with GDP per capita of country \(j\) at time \(t\)
- \(D_{Ej}\): Distance between Ecuador and country \(j\)
- \(GDP_{Et}/N_{Et} - GDP_{jt}/N_{jt}\): Difference between GDP per capita of Ecuador and GDP per capita of country \(j\) at time \(t\).
- \(L_{Ej}\): Dummy variable, which takes the value of 1 if Ecuador and country \(j\) share a common language and 0 otherwise.
- \(AC_{Ejt}\): Dummy variable, which takes the value of 1 if Ecuador and country \(j\) are members of Andean Community at the time \(t\) and 0 otherwise.
- \(PPA_{Ejt}\): Dummy variable, which takes the value of 1 if Ecuador has a Partial Preferential Agreement with the country \(j\) at the time \(t\) and 0 otherwise.
- \(Dollar_{Ejt}\): Dummy variable which takes the value of 1 if Ecuador trades with US dollars with the country \(j\) at the time \(t\) and 0 otherwise.
- \(u_{Ejt}\): Error term, which explains other influences on Ecuador’s trade at time \(t\).

The product of GDPS and GDPS per capita are variables associated with market size and therefore \(\beta_1\) and \(\beta_2\) must be positive. The expected signs for the other coefficients are the same as previously discussed \(\beta_5, \beta_6, \beta_7, \beta_8>0\) and \(\beta_3<0\). In addition it is expected that the estimated elasticities of GDPS, GDPS per capita and distance tend to be 1 in value (Reinert 2008). The expected sign
for $\beta_4$ must be negative since the greater is the difference between GDPs per capita of two countries; the lower is the trade flow between them.

### 3.3 Data

The Gravity equations have been computed with a balanced panel data of 532 observations about Ecuador's trade flow from 1986 to 2013 with the following 20 countries according to the importance of trading partnerships with Ecuador: the United States, Argentina, Brazil, Chile, Mexico, Venezuela, Bolivia, Colombia, Peru, Belgium, Luxembourg, France, Netherlands, Italy, United Kingdom, Germany, Spain, Japan, China and Australia\(^7\). The data on Ecuador's exports and imports has been obtained from the database of the Central Bank of Ecuador. GDP and REER data has been obtained from the World Bank database. Both Ecuador's trade flows and GDP (constant 1995 US dollar) are in millions of US dollars. Data on distance in kilometres was calculated between Quito (capital of Ecuador) and the capital cities of its trading partners.

The Language dummy variable refers to the common language shared by Ecuador (Spanish official language) and its trading partners. The information for dummy variables related to trade agreements was obtained from Organization of American State's Foreign Trade Information System. It is important to point out that Ecuador's trade agreements may be classified into two groups Multilateral Agreements and Partial Preferential Agreements. I have included in the equations a dummy variable for each group.

---

\(^7\) Belgium and Luxembourg are treated as a unique country according to the available data. In addition the trade flow with Australia includes data on other countries that comprise Oceania.
The first dummy variable focuses on the Andean Community which is a multilateral agreement among Ecuador, Colombia, Peru and Bolivia from May 1969 to the present date. Venezuela was considered a member of the Andean Community until 2006 and has been taken into account as member to that date. It is worthy to point out that Ecuador and Venezuela have signed different type of trade agreements since 2006; furthermore both are members of ALBA (the Bolivarian Alliance for the Peoples of Our America)\(^8\).

The second dummy variable collates information about Ecuador’s Partial Preferential Agreements and includes less intensive trade agreements such as the Economic Complementation Agreement between Ecuador and Chile (January 2010), the Granting of Tariff Preferences between Brazil and Ecuador (February 2012) and the Preferential Trade Agreements between Ecuador and some members of MERCOSUR (Southern Common Market) (October 2004) and Mexico (August 1987). Some of these trade agreements entered into force over the last decade according to Ecuador’s Ministry of Foreign Trade, therefore they might have a significant effect on Ecuador’s trade.

This dummy variable also contains the information about the ATPDEA (Andean Trade Promotion and Drug Eradication Act 1992) which is a trade preference that the United States granted to the Andean countries Colombia, Ecuador and Peru through elimination of tariffs on some of their products (Pro Ecuador 2012). This trade agreement has been renewed periodically from 1992 until 2013. Currently Ecuador does not have this trade benefit since Ecuador

\(^8\) It was established in order to achieve an integration for the countries of Latin America and Caribbean and strengthen alliances in economic, political and social matters (ALBA-TCP, 2010)
decided to finish it unilaterally in June 2013 claiming sovereignty and commercial independence.

Finally the Dollar dummy variable analyses 13 years of dollarization from 2001 to 2013 though Ecuador was an unofficial dollarized economy a few years before 2000, these years are not taken into account since the equations intend to depict the effects of the full dollarization on Ecuador’s trade. The year 2000 was not taken into account either as part of the period of dollarization, since the transition of Ecuador’s currency from the sucre to the US dollar occurred gradually during this year.

There is an important fact which should be considered with respect to the specification of the Dollar dummy variable. Prior studies commonly include a currency dummy variable to explain the trade flows among countries that share a common currency. In this model I seek to explain the differences among Ecuador’s trade before and after dollarization, therefore I have considered dollarization as a variable that might affect Ecuador’s trade, not only with the countries with which shares a common currency but also with those that Ecuador does not. The idea behind this argument is that the US dollar represents a more stable currency than the sucre for the export and import sectors.

It is also important to consider the role that Ecuador has had as an ALBA member since June 2009. The ALBA members use a regional trade currency

---

9 Applying this idea and according to the dataset used, the only one trade partner that shares the same currency with Ecuador is the United States of America. In that sense it would not be possible explain the changes in Ecuador’s trade with its other trade partners since dollarization was implemented.

10 ALBA member countries are Venezuela, Cuba, Bolivia, Nicaragua, Dominica, Ecuador, Saint Vincent and The Grenadines, Antigua and Barbuda, and Santa Lucia (ALBA-TCP, 2010).
called Sucre\textsuperscript{11} (Unified System for Regional Compensation) for its acronym in Spanish. One of its main objectives is to reduce trade dependence on the US dollar as medium of exchange and thus to reach a suitable regional stability (SUCRE-ALBA 2010). Although Ecuador is a new member it has already carried out some important trade transactions with some of the ALBA members, therefore this agreement might have considerable effects on Ecuador’s trade and reduce the influence that dollarization has on it.

**SECTION 4: RESULTS**

4.1 Model Specification

In order to establish the model specification for the above equations, I have carried out several tests to determine their accuracy. The results of these tests can be seen in Appendix C.

The equations were estimated initially using a Pooled model\textsuperscript{12} and a Random Effects model\textsuperscript{13}. I have applied a Breusch-Pagan Lagrange Multiplier test for Random Effects model to observe which specification is more accurate according to the dataset. The result suggested that a Random Effects model is more appropriate than a Pooled model.

The equations were then estimated using a Fixed Effects model\textsuperscript{14} in order to analyse if this model provides more accurate estimates than those

---

\textsuperscript{11} Virtual currency used as a trade currency among ALBA members. Although it has the same name as the extinct Ecuador’s currency, there is no relationship between them.

\textsuperscript{12} According to the dataset it is expected that the heterogeneity or individual effect is unobserved, therefore under this specification the estimates might be biased and inconsistent (Greene 2012).

\textsuperscript{13} It produces consistent estimates if the unobserved heterogeneity or individual effect is uncorrelated with the explanatory variables (Greene 2012).

\textsuperscript{14} Regarding that the unobserved heterogeneity or individual effect might be correlated with the explanatory variables (Greene 2012).
obtained by a Random Effects model. I have computed a Hausman-test, the
results suggested that the Fixed Effects model is a better specification for the
equations.

Finally to control heterogeneity in the models, it is necessary to test
temporal effects that might have affected Ecuador’s trade. For instance, the
global financial crisis had an important effect on the GDP growth of the
Ecuador’s trade partners since it led countries to impose trade-restrictive
measures (United Nations 2010). I have applied F test to measure the
significance of temporal effects in the models. The results suggested that
temporal dummy variables are altogether significant.

Once the best specification for the three equations has been established,
I have tested for serial correlation, heteroskedasticity and contemporaneous
correlation. The results are also shown in Appendix C.

It is probable that exports in the current year \( t \) are correlated to the
exports in the past year \( t-1 \). In order to determine whether it is an issue for the
dataset, I have applied the Wooldridge test. The results showed the presence of
serial correlation in the models, therefore it is necessary to estimate the three
equations using an autoregressive Fixed Effects model of order 1.

Egger (2001) contends that an AR(1) model is suitable to explain
bilateral trade flow and its estimates are consistent and efficient since this
eliminates the systematic differences that might exist between the observed
bilateral trade flow and its in-sample prediction.

In order to assess heteroskedasticity I have carried out a Modified Wald
test which confirms the presence of heteroskedasticity in the equations. Another
important issue related to panel data is the cross-sectional dependence or contemporaneous correlation. Although I have included temporal effects that affect all entities equally at time t, it is also important to determine whether the entities are correlated to each other at a given point in time t. The Breusch-Pagan Lagrange Multiplier of independence determined a contemporaneous correlation issue.

Once I have computed the tests mentioned above I have estimated a FGLS (Feasible Generalized Least Squares) model which may be used to correct the problems previously discussed, and therefore its estimates are the most accurate given the dataset.

4.2 Ecuador's Exports-Equation and Imports-Equation

Table 1 shows the standard and augmented Gravity models of trade for Ecuador's exports and imports. As can be seen the signs and the significance of the coefficients remain constant in all the models.

With regard to the augmented exports-equation, FGLS coefficients are highly significant and their signs are consistent with those that the Gravity model of trade predicts. The coefficient of REER is positive but insignificant which confirms what Hanke contends about the null effects of REER appreciation on Ecuador's bilateral trade during the first years of dollarization. Trade agreements AC and PPA coefficients are also positive but not significant.

Ecuador's exports depend directly on its own GDP and that of its trade partners. In fact an increase in 1 percent of Ecuador's GDP, increases its exports by 2.436 percent. Analogously an increase in 1 percent of its trade partners' GDP, increases Ecuador's exports by 0.767 percent. The coefficient of
$D$ shows that Ecuador’s exports decrease by 0.761 percent for every 1 percent that distance increases between Ecuador and its respective trade partner.

The estimate for the Dollar dummy variable shows a positive sign which is significant at 5% level. The effect of dollarization on Ecuador’s exports can be measured taking the exponential of the Dollar coefficient\(^{15}\), the result suggests that Ecuador’s exports have increased by 61 percent due to the dollarization (see Appendix B-Graph A).

Finally the positive coefficient of $L$ implies that Ecuador’s exports are roughly 46 percent\(^{16}\) higher with countries that share Spanish as their official language.

### Table 1: Panel Data Estimates of Ecuador’s Exports and Imports

<table>
<thead>
<tr>
<th>Variables</th>
<th>Exports</th>
<th></th>
<th>Imports</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard Model</td>
<td>Augmented Model</td>
<td>Standard Model</td>
<td>Augmented Model</td>
</tr>
<tr>
<td>$Dollar$</td>
<td>0.469** (0.203)</td>
<td>0.476** (0.211)</td>
<td>0.922* (0.246)</td>
<td>0.942* (0.357)</td>
</tr>
<tr>
<td>$\ln(GDP_E)$</td>
<td>2.437* (0.211)</td>
<td>2.436* (0.180)</td>
<td>0.288 (0.252)</td>
<td>0.018 (0.297)</td>
</tr>
<tr>
<td>$\ln(GDP_j)$</td>
<td>0.727* (0.033)</td>
<td>0.767* (0.042)</td>
<td>0.778* (0.046)</td>
<td>0.846* (0.046)</td>
</tr>
<tr>
<td>$\ln(D)$</td>
<td>-0.987* (0.103)</td>
<td>-0.761* (0.123)</td>
<td>-1.149* (0.050)</td>
<td>-0.982* (0.083)</td>
</tr>
<tr>
<td>$\ln(REER)$</td>
<td>0.173 (0.470)</td>
<td>-0.681 (0.564)</td>
<td>0.417** (0.185)</td>
<td>0.049 (0.216)</td>
</tr>
<tr>
<td>$L$</td>
<td>0.375** (0.168)</td>
<td>0.105* (0.061)</td>
<td>0.105* (0.037)</td>
<td>0.049 (0.216)</td>
</tr>
<tr>
<td>$AC$</td>
<td>0.309 (0.278)</td>
<td>0.049 (0.216)</td>
<td>0.105* (0.061)</td>
<td>0.049 (0.216)</td>
</tr>
<tr>
<td>$PPA$</td>
<td>0.031 (0.061)</td>
<td>0.105* (0.037)</td>
<td>0.105* (0.061)</td>
<td>0.049 (0.216)</td>
</tr>
</tbody>
</table>

Observations: 532

Standard errors in brackets: * significant at 1%; ** significant at 5% and *** significant at 10%. Intercept and year dummies unreported.

\(^{15}\) $\exp(0.476)=1.610$, where 0.476 is the FGLS estimate for Dollar (see Table 1-Exports)

\(^{16}\) $\exp(0.375)=1.455$, where 0.375 is the FGLS estimate for $L$ (see Table 1-Exports)
In line with the exports-equation, the imports-equation shows that most of the FGLS estimates are highly significant and their signs are consistent with those expected by the Gravity model of trade.

The augmented model shows that the coefficients of Ecuador’s GDP, AC and REER are insignificant. Ecuador’s imports depend directly on the GDP of its trade partners. An increase of 1 percent in GDP of its trade partners results in an increase of Ecuador’s imports by 0.846 percent. On the other hand Ecuador’s imports decrease by 0.982 percent for every 1 percent that distance increases between Ecuador and its trade partners.

The coefficient of Dollar is also positive and highly significant at 1%. According to this estimator, the dollarization has increased Ecuador’s imports by approximately 157 percent\(^{17}\) (see Appendix B-Graph B).

The coefficient of L implies that Ecuador’s imports are 52 percent\(^{18}\) higher with countries that share Spanish as their official language. The same analysis may be used to explain the effects of PPA on Ecuador’s trade. Ecuador’s imports are 11 percent\(^{19}\) greater with the countries with which has signed Partial Preferential Agreements.

### 4.3 Ecuador’s Bilateral Trade-Equation

The estimates of Ecuador’s bilateral trade-equation can be seen in Table 2. In line with the above equations I have estimated a standard and two augmented Gravity models. The second augmented model excludes the trade flows with the United States in order to evaluate the effects of the dollarization

\(^{17}\) exp (0.942) is 2.565, where 0.942 is the FGLS estimate for Dollar (see Table 1-Imports)

\(^{18}\) exp (0.417)=1.517, where 0.417 is the FGLS estimate for L (see Table 1-Imports)

\(^{19}\) exp(0.105)=1.111, where 0.105 is the FGLS estimate for PPA (see Table 1-Imports)
on Ecuador’s bilateral trade with its trade partners which use a different currency and the same time it allows to determine the significance of a common currency on it.

**TABLE 2:** Panel Data Estimates of Ecuador’s Bilateral Trade Flow

<table>
<thead>
<tr>
<th>Variables</th>
<th>Standard Model</th>
<th>Augmented Model A</th>
<th>Augmented Model B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dollar</td>
<td>0.644*</td>
<td>0.725*</td>
<td>0.721*</td>
</tr>
<tr>
<td></td>
<td>(0.205)</td>
<td>(0.195)</td>
<td>(0.239)</td>
</tr>
<tr>
<td>(\ln(\frac{GDP_E GDP_J}{N_E N_J}))</td>
<td>0.748*</td>
<td>0.784*</td>
<td>0.694*</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.038)</td>
<td>(0.060)</td>
</tr>
<tr>
<td>(\ln\left(\frac{GDP_E GDP_J}{N_E N_J}\right))</td>
<td>-0.005</td>
<td>0.096</td>
<td>0.111</td>
</tr>
<tr>
<td></td>
<td>(0.075)</td>
<td>(0.082)</td>
<td>(0.089)</td>
</tr>
<tr>
<td>(\ln(D))</td>
<td>-1.077*</td>
<td>-0.709*</td>
<td>-0.516*</td>
</tr>
<tr>
<td></td>
<td>(0.084)</td>
<td>(0.119)</td>
<td>(0.141)</td>
</tr>
<tr>
<td>(\ln\left(\frac{GDP_E GDP_J}{N_E N_J}\right))</td>
<td>-0.083**</td>
<td>-0.110**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.041)</td>
<td>(0.045)</td>
<td></td>
</tr>
<tr>
<td>(L)</td>
<td>0.456*</td>
<td>0.595*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.136)</td>
<td>(0.149)</td>
<td></td>
</tr>
<tr>
<td>(AC)</td>
<td>0.440**</td>
<td>0.426**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.171)</td>
<td>(0.169)</td>
<td></td>
</tr>
<tr>
<td>(PPA)</td>
<td>0.070***</td>
<td>0.111**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.036)</td>
<td>(0.056)</td>
<td></td>
</tr>
</tbody>
</table>

**Observations** | 532 | 532 | 504

Standard errors in brackets. * significant at 1%, ** significant at 5%, and *** significant at 10%

 Intercept and year dummies unreported

Model B excludes the United States

With regards to the augmented Model A, all FGLS estimates are significant with the exception of the product of GDPs per capita. The expected signs are also consistent with the economic theory. Ecuador’s bilateral trade flow depends directly on the market size which implies that an increase in 1 percent of the economy size will increase the Ecuador’s bilateral trade flow by 0.784 percent. Ecuador’s bilateral trade flow decreases by 0.709 percent for
every 1 percent that distance increases between Ecuador and its trade partner. The negative sign of the coefficient of the difference between GDPs per capita supports the Linder hypothesis and shows that Ecuador’s bilateral trade flow decreases by 0.08 percent for every 1 percent that the gap increases between GDPs per capita of the respective countries.

*Dollar* coefficient is positive and significant at 1% level. The dollarization has increased Ecuador’s bilateral trade flow by approximately 107 percent\(^{20}\) since dollarization was adopted (see Appendix B-Graph C).

The coefficient of \(L\) implies that Ecuador’s bilateral trade flow is 58 percent\(^{21}\) greater with countries that share its official language. Ecuador’s bilateral trade flow is 55 percent\(^{22}\) higher among Andean Community members and 7 percent\(^{23}\) higher with the countries with which has signed Partial Preferential Agreements. It is important to point out that trade agreements are more significant when trade flows are treated altogether rather than separately.

The second augmented model excluding the United States does not show significant changes in the estimates. The coefficient of the *Dollar* dummy variable remains significant even though its magnitude decreases. It shows that the dollarization has been significant on Ecuador’s bilateral trade flow not only with the United States but also with its other trade partners (see Appendix B-Graph D).

---

\(^{20}\) \(\exp(0.725) = 2.065\), where 0.725 is the FGLS estimate for *Dollar* (see Table 2-Model A)

\(^{21}\) \(\exp(0.456) = 1.578\), where 0.456 is the FGLS estimate for \(L\) (see Table 2-Model A)

\(^{22}\) \(\exp(0.440) = 1.553\), where 0.440 is the FGLS estimate for \(AC\) (see Table 2-Model A)

\(^{23}\) \(\exp(0.070) = 1.073\), where 0.070 is the FGLS estimate for \(PPA\) (see Table 2-Model A)
SECTION 5: CONCLUSION

Ecuador adopted the US dollar as its domestic currency 14 years ago, since then several studies have been carried out to determine the effects of the dollarization on Ecuador’s economy. The main purpose of this study was to analyse the effect that dollarization has had on Ecuador’s trade flows with 20 of its main trade partners, by using the Gravity model of trade. I have considered the period pre and post dollarization from 1986 to 2013 and I have obtained the following results.

The US dollar has contributed to increase Ecuador’s exports by approximately 61 percent. The increase of Ecuador’s exports is notable since the dollarization was introduced in the country; however it is important to take into account that it has been accompanied by other important factors such as the increase in oil prices and the increase in remittances which have boosted the external sector. Ecuador’s non-oil exports also have been affected positively during the last decade. This feature may be attributed not only to dollarization but also to trade agreements.

With regard to Ecuador’s imports, the results suggest that dollarization has increased them by approximately 157 percent. It is important to highlight that in the early 2000’s Ecuador’s imports increased significantly due to the high investment in capital goods geared to increase the oil production (United Nations 2003). The current government has established safeguarding measures to constraint the imports and encourages the domestic industry. The fact that Ecuador no longer has its own currency has led to the economic authorities applying controls over the external sector since Ecuador depends on the speed...
at which the US dollars enter and leave of its economy, a monetary-flow imbalance might be harmful for its stability.

In order to analyse in detail Ecuador’s bilateral trade flow (sum of exports and imports) I have estimated two augmented Gravity model of trade. The results suggested that the dollarization has increased Ecuador’s bilateral trade flow by approximately 107 percent. As I have mentioned previously most of this percentage is determined by the increase of Ecuador’s imports. I have also estimated a model excluding the trade flows between Ecuador and the United States. The results suggested that the dollarization has had a positive effect on Ecuador’s bilateral trade even with those trade partners that do not share a common currency.

Although all estimates for the Dollar dummy variable are highly significant for all models, these are smaller in magnitude than those estimated by Rose (2000), Glick and Rose (2001) and Frankel and Rose (2002) in their studies to measure the effects of a common currency on bilateral trade flows. At the same time these results contradict those obtained by Klein (2002) who found little evidence that dollarization increases the bilateral trade flow between the United States and other dollarized economies.

According to the results of the augmented Gravity models, the other variables are also determinants to analyse Ecuador’s trade flows such as GDP growth, sharing a common language with its trade partners and establishing of trade agreements. The results suggested that ATPDEA which was included in the PPA dummy variable is not highly significant for Ecuador’s exports. It is important to highlight the Ecuadorian exporters’ concern about Ecuador’s
unilateral renunciation of these tariff preferences in 2013. The subsequent years will show the real effect of this decision on Ecuador’s exports.

An interesting analysis to isolate the effect of oil price on Ecuador’s exports could consider only Ecuador’s non-oil exports, since these might be more likely to be affected by dollarization. However, the analysed dataset included Ecuador’s total exports and imports by country of destination, according to the database available in the Central Bank of Ecuador. In that sense, the results probably could differ from those that I have obtained with this dataset.

Nevertheless, this study provides empirical evidence presenting the positive effects of the dollarization on Ecuador’s trade flows and shows that these have been more significant in the import sector. Further studies could consider other features related to the dollarization and its effects on the Ecuadorian economy. Proponents of the dollarization might be more interested in analysing its effects on the positive aspects that Ecuador has experienced since the dollarization was introduced such as low inflation rate, low unemployment rate and steady GDP growth. On the other hand, the opponents might be more interested about its detriments such as the loss of independent monetary policy, the loss of seignorage and the loss of exchange rate flexibility which may affect significantly the external sector.

The current president of Ecuador, Rafael Correa has been a strong critic of the dollarization in Ecuador however he has made clear that his government will keep this monetary scheme, since leaving the US dollar would be highly expensive for the country. The government’s plans for the medium and long run
are focused on the strengthening of Ecuador's external sector through currency unions mainly with the Latin American countries.
REFERENCES


APPENDIX A: Macroeconomic Indicators of Ecuador Post-Dollarization

<table>
<thead>
<tr>
<th>Year</th>
<th>Inflation rate annual %</th>
<th>Unemployment rate annual %</th>
<th>GDP growth annual %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>96.09</td>
<td>9.00</td>
<td>0.01</td>
</tr>
<tr>
<td>2001</td>
<td>37.68</td>
<td>10.70</td>
<td>4.02</td>
</tr>
<tr>
<td>2002</td>
<td>12.48</td>
<td>9.10</td>
<td>4.10</td>
</tr>
<tr>
<td>2003</td>
<td>7.93</td>
<td>11.40</td>
<td>2.72</td>
</tr>
<tr>
<td>2004</td>
<td>2.74</td>
<td>8.60</td>
<td>8.21</td>
</tr>
<tr>
<td>2005</td>
<td>2.41</td>
<td>7.70</td>
<td>5.29</td>
</tr>
<tr>
<td>2006</td>
<td>3.03</td>
<td>7.70</td>
<td>4.40</td>
</tr>
<tr>
<td>2007</td>
<td>2.28</td>
<td>6.10</td>
<td>2.19</td>
</tr>
<tr>
<td>2008</td>
<td>8.40</td>
<td>7.30</td>
<td>6.36</td>
</tr>
<tr>
<td>2009</td>
<td>5.16</td>
<td>6.50</td>
<td>0.57</td>
</tr>
<tr>
<td>2010</td>
<td>3.56</td>
<td>5.00</td>
<td>2.95</td>
</tr>
<tr>
<td>2011</td>
<td>4.47</td>
<td>4.20</td>
<td>7.83</td>
</tr>
<tr>
<td>2012</td>
<td>5.10</td>
<td>4.10</td>
<td>5.12</td>
</tr>
<tr>
<td>2013</td>
<td>2.74</td>
<td>4.57</td>
<td>4.00</td>
</tr>
</tbody>
</table>


APPENDIX B: Ecuador's Trade Flows (Dataset)

Graph A: Ecuador's Exports (Dataset)

**Graph B: Ecuador's Imports (Dataset)**

**Millions of USD**

**Source:** Central Bank of Ecuador, Foreign Trade Bulletin (1986-2013)

**Graph C: Ecuador's Bilateral Trade Flow (Dataset)**

**Millions of USD**

**Source:** Central Bank of Ecuador, Foreign Trade Bulletin (1986-2013)
Graph D: Ecuador's Bilateral Trade Flow
(Dataset excluding the United States)
Millions of USD

APPENDIX C: Econometric Tests

Breusch-Pagan Lagrange Multiplier Test for Random Effects Model

\[ H_0: \sigma_u^2 = 0 \]
\[ H_1: \sigma_u^2 \neq 0 \]

<table>
<thead>
<tr>
<th>Models</th>
<th>Exports</th>
<th>Imports</th>
<th>Bilateral Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>chibar2(01)</td>
<td>Prob&gt;chibar2</td>
<td>chibar2(01)</td>
</tr>
<tr>
<td>Standard</td>
<td>3380.23</td>
<td>0.0000</td>
<td>1823.12</td>
</tr>
<tr>
<td>Augmented A</td>
<td>3116.64</td>
<td>0.0000</td>
<td>1740.23</td>
</tr>
<tr>
<td>Augmented B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We reject the null hypothesis. There is significant evidence of differences across countries, therefore it is better to use the Random Effects Model instead of the Pooled Regression for the equations.

Hausman-Test

\[ H_0: \text{difference in coefficients not systematic} \]
\[ H_1: \text{difference in coefficients systematic} \]

<table>
<thead>
<tr>
<th>Models</th>
<th>Exports</th>
<th>Imports</th>
<th>Bilateral Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>9.96</td>
<td>0.0069</td>
<td>8.15</td>
</tr>
<tr>
<td>Augmented A</td>
<td>11.01</td>
<td>0.0265</td>
<td>19.46</td>
</tr>
<tr>
<td>Augmented B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We reject the null hypothesis. There is evidence of correlation between the error terms and the regressors, therefore it is better to use the Fixed Effects Model instead of the Random Effects Model for the equations.
F-Test for Temporal Effects

H₀: η₁=η₂=...=ηₜ=0
H₁: η₁=η₂=...=ηₜ≠0

<table>
<thead>
<tr>
<th>Models</th>
<th>Exports</th>
<th>Imports</th>
<th>Bilateral Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F(27,df)</td>
<td>Prob&gt;F</td>
<td>F(27,df)</td>
</tr>
<tr>
<td>Standard</td>
<td>15.14</td>
<td>0.0000</td>
<td>6.50</td>
</tr>
<tr>
<td>Augmented A</td>
<td>14.11</td>
<td>0.0000</td>
<td>6.98</td>
</tr>
<tr>
<td>Augmented B</td>
<td>4.90</td>
<td>0.0000</td>
<td></td>
</tr>
</tbody>
</table>

We reject the null hypothesis. There is evidence of temporal effects, therefore the temporal dummy variables must be included in the equations.

Wooldridge Test

H₀: no first-order autocorrelation
H₁: first-order autocorrelation

<table>
<thead>
<tr>
<th>Models</th>
<th>Exports</th>
<th>Imports</th>
<th>Bilateral Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F(1,df)</td>
<td>Prob&gt;F</td>
<td>F(1,df)</td>
</tr>
<tr>
<td>Standard</td>
<td>23.031</td>
<td>0.0001</td>
<td>42.522</td>
</tr>
<tr>
<td>Augmented A</td>
<td>20.467</td>
<td>0.0003</td>
<td>18.773</td>
</tr>
<tr>
<td>Augmented B</td>
<td>82.343</td>
<td>0.0000</td>
<td></td>
</tr>
</tbody>
</table>

We reject the null hypothesis. There is evidence of first-order autocorrelation for the equations.
Modified Wald Test

H₀: \( \sigma_i^2 = \sigma^2 \) for all i  
H₁: \( \sigma_i^2 \neq \sigma^2 \) for all i

<table>
<thead>
<tr>
<th>Models</th>
<th>Exports</th>
<th>Imports</th>
<th>Bilateral Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>506.21</td>
<td>0.0000</td>
<td>298.14</td>
</tr>
<tr>
<td>Augmented A</td>
<td>411.85</td>
<td>0.0000</td>
<td>215.29</td>
</tr>
<tr>
<td>Augmented B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We reject the null hypothesis. There is evidence of heteroskedasticity for the equations.

The Breusch-Pagan Lagrange Multiplier Test of Independence

H₀: cross-sectional independence  
H₁: cross-sectional dependence

<table>
<thead>
<tr>
<th>Models</th>
<th>Exports</th>
<th>Imports</th>
<th>Bilateral Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>chi2(df)</td>
<td>Prob</td>
<td>chi2(df)</td>
</tr>
<tr>
<td>Standard</td>
<td>714.239</td>
<td>0.0000</td>
<td>807.957</td>
</tr>
<tr>
<td>Augmented A</td>
<td>735.627</td>
<td>0.0000</td>
<td>772.437</td>
</tr>
<tr>
<td>Augmented B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We reject the null hypothesis. There is evidence of contemporaneous correlation for the equations.