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Dollarization in Ecuador and El Salvador

- its Impact on Fundamental Macroeconomic Variables

Authors
Carl-Fredrik Benoni
Susanna Lindahl

Supervisor
Charles Nadeau

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Abstract

This thesis examines the impact of dollarization in Ecuador and El Salvador. The variables studied are inflation, interest rate and GDP growth. We compare mean values and volatility before and after the implementation of the US dollar to analyze significant changes. Interest rates and inflation fell and stabilized in both countries after dollarization. The results regarding GDP growth are ambiguous which is explained by country specific factors. Furthermore, we analyze the impact of dollarization on trade by using a gravity regression model. Earlier empirical studies have shown equivocal results regarding the trade enhancing effect. Our findings provide no support of an increase in trade due to dollarization.

Keywords: Dollarization; Gravity Model; Trade; Ecuador; El Salvador

1 Introduction and Background

1.1 Introduction

In terms of exchange rates policies the last decades have been eventful. Transformations like the fall of the Soviet Union and the adoption of the Euro have forced many countries to rethink their choice of exchange rate policy. In addition, the years around the turn of the millennium were characterized by currency crises: Southeast Asia starting in 1997, Russia in 1998 and Argentina in 2001 to mention a few. The fact that many of the affected countries were emerging economies has fuelled the debate about the adequacy of different exchange rate regimes. At the same time, the capital markets have experienced a period of drastic deregulation and as a result adjustable pegs have lost in popularity (Salvatore, Dean & Willett, 2003). The world has developed a bipolar view where two extremes – hard pegs or freely floating exchange rates – are seen as the only prudent options (Eichengreen, 2003).

The most extreme peg – if it can still be called that – is a total abolishment of the national currency, a phenomenon called dollarization. This has been put into practice in several small countries or territories, among others in Panama in 1904. Much research has been done, but one major concern is the lack of data for most small countries. Since Ecuador and El Salvador dollarized just over a decade ago, the possibility to study the effects of dollarization has greatly improved.

Our study initially offers a general overview of how the most important macroeconomic aspects have been affected in Ecuador and El Salvador. The variables analyzed are inflation, interest rate and GDP growth. We compare the means and volatility in two time periods, before and after dollarization, to see if the variables have changed significantly. We observe significant decreases in inflation and interest rate which is in line with theory and previous research. Our results regarding changes in GDP growth rate are inconsistent: it increased in Ecuador after dollarization but decreased in El Salvador. Additionally, we examine the controversial question whether dollarization leads to increased trade within the dollar bloc. We use a gravity model to analyze bilateral trade flows and find no evidence of increased trade.

The rest of the thesis is organized as follows: the first section offers an introduction to the field of dollarization and provides an understanding for the time period prior to the dollarization in each country. Further, it elucidates the research questions and the

delimitations of the study. Section 2 contains a theory section and a literature review. Section 3 presents our data and methodology. In Section 4 results are presented and analyzed. Lastly, main conclusions are summarized in Section 5 together with an outlook for further research.

1.2 Background

Ecuador and El Salvador, the two countries studied in this thesis, adopted the US dollar for entirely different reasons. In Ecuador a severe banking and financial crisis led to the abandoning of the national currency Sucre in early 2000. A general lack of trust in the economic system and the currency led to very high levels of inflation during 1998 and 1999 (Abrego, Flores, Pivovarsky & Rother, 2006). Dollarization can be seen as a desperate measure to end the crisis and the US dollar was regarded as the only option credible enough. El Salvador, on the other hand, adopted the US dollar as part of a planned economic transformation. After a long civil war ending in 1992 the country undertook several measures to open up and stimulate the economy. Official dollarization proceeded with great speed in early 2001 (Swiston, 2011).

These two particular countries offer a good opportunity to study different reasons to choose dollarization. It also provides the possibility to observe what effects dollarization has had in the two economies. Compared with Panama, Ecuador and El Salvador adopted the US dollar much later which facilitates the data collection process in terms of availability and accuracy. Furthermore, more research has been done on the dollarization in Panama than in Ecuador and El Salvador.

1.2.1 Ecuador

Ecuador's economy underwent a troublesome time in the 1990s. The external debt amounted to 77% of the country's GDP and poverty was widespread and increasing[1]. The labor market experienced low mobility and the tax system lacked sufficient regulation and transparency. The banking system became weakened and did not recover due to weak control and supervision. In addition, the government focused on bailing out banks in trouble rather than solving the root causes. This fact and additional inappropriate political policies laid the foundation of an almost stagnant GDP growth per capita during the 1980s and 1990s (Offerdal et al., 2000). Furthermore, Ecuador's dependency on oil export made the country

[1] According to estimations by Offerdal et al. (2000) about 40% of the population lived in poverty in 1999.

vulnerable to fluctuations in world oil prices (CIA, 2013). A lack of trust in the economic system, the currency and the banking system caused inflation to reach dangerously high levels at the end of the 1990s (Jacome H, 2004). Altogether, this made the economy vulnerable to economic shocks.

Severe storms known as El Niño struck Ecuador in 1997 devastating much of the country's infrastructure and crops. The damages were estimated to about 13% of 1998 GDP and reduced total exports by 20%. Around this time, several drops in world oil prices following the Asian currency crisis damaged Ecuador's economy. Lastly, the Russian crisis in late 1998 caused instability on the international financial markets. As a result Ecuador's banking system experienced greater difficulties receiving loans from foreign banks (Offerdal et al., 2000).

In the late 1990s and early 2000 numerous measures were taken to deal with the ongoing crisis. The government launched a general bank restructuring strategy which turned out inadequate and thus aggravated factors such as liquidity, solvency and profitability. A severe depreciation of the Sucre followed and ultimately led to the implementation of the US dollar, officially announced on January 10th 2000. The conversion rate was set to 25 000 Sucre per US dollar, amounting to a depreciation by 460% compared to 1998[2] (Offerdal et al., 2000).

As a consequence of the financial and banking crisis 16 financial institutions were either put under government control or closed down. Non-performing loans had risen to 45% of total outstanding loans by January 2000 (Offerdal et al., 2000). An estimation by Quintyn and Hoelscher (2003) showed that the costs of the crisis amounted to almost 22% of GDP, putting the GDP per capita back to the level of 1977 (Jacome H, 2004).

1.2.2 El Salvador

The reasons for dollarizing in El Salvador differed considerably from those of Ecuador. In El Salvador a twelve-year-long civil war was ended with a peace agreement signed in 1992. Consequently, living conditions began to improve. Reforms of the pension system, a lowering of import tariffs and privatization of major sectors such as banking and telecommunication were implemented to open up the economy to attract foreign investments (U.S. Department of State, 2002). El Salvador grew steadily and had among the lowest interest rates in Latin America (Towers & Borzutzky, 2004). Another major difference compared with Ecuador was the inflation. In El Salvador it remained fairly stable during the 1990s, averaging at about 10%.

[2] Authors' calculations.

Since none of the more common reasons to dollarize (such as uncontrolled inflation or economic crisis) were present as in Ecuador and since there were no clear signs of economic distress, one might wonder why El Salvador decided to dollarize. The official reason given by the government was that dollarization would lead to lower interest rates, increases in foreign direct investments and lower transaction costs and hence stimulate economic growth (Towers & Borzutzky, 2004). A peg had been maintained since 1993 and the government argued that dollarization was the next rational step to take (Quispe-Agnoli & Whisler, 2006).

Approximately 1.5 million Salvadorans lived in the US at the time of dollarization. Remittances sent back to El Salvador amounted to more than 1.9 billion dollars, equivalent to about 15% of GDP in 2001 (Towers & Borzutzky, 2004). Additionally, trade with the US constituted the major part of El Salvador's export and import (U.S. Department of State, 2002). The elimination of currency risk and exchange transaction cost that remittances and trade were exposed to would surely benefit the population and the economy.

However, the government's arguments for dollarization have been questioned. Towers and Borzutzky (2004) claim that among wealthy and heavily influential groups an unofficial will to dollarize thrived as it would benefit themselves: "*Ultimately, the policy is simply a reflection of the nature of a political system which, although it is formally a democracy, continues to serve mostly the interest of a small oligarchy*" (Towers & Borzutzky, 2004, p. 30). Similar arguments about the skewed effects of dollarization in El Salvador can also be found in *Proceso*, a political newsmagazine printed in Mexico. About one year after dollarization they wrote, "*The most beneficiated sector from the dollarization process has been the financial system*" (Proceso, 2002).

In summary, the reasons for El Salvador to dollarize were not as obvious as for Ecuador. Arguments made by the government and the president indicate that a lowering of the interest rates and an increase in foreign investment were the purpose of dollarization. At the same time, one must be skeptical and critical in order to see if these were the only reasons or if there might have been some other personal interests that resulted in dollarization.

1.3 Purpose and Contribution

The purpose of this thesis is to study the impact of dollarization on a number of macroeconomic variables. We analyze Ecuador and El Salvador which both dollarized in the beginning of the 21st century but for entirely different reasons. The aim is to provide a comprehensible overview of the subject where Ecuador and El Salvador's individual

preconditions are thoroughly considered. Furthermore, we use a gravity model to analyze how trade flows within the dollar bloc are affected by dollarization. We focus on the field of dollarization since its body of research is much smaller than that of currency unions in general.

1.4 Research Questions and Hypotheses

The thesis contains two approaches. The first offers a macroeconomic overview of the consequences of dollarization. The variables investigated are inflation, interest rate and GDP growth (for detailed definitions see Section 3.2 and Appendix A). We assess whether the values of the variables have changed significantly after dollarization and evaluate changes in volatility for each variable. Thereafter, we study the correlation in business cycles between the dollarizer and the host country. In the second approach, we analyze bilateral trade flows within the dollar bloc using a gravity regression model. The research questions are summarized below.

1.4.1 Average

1. Average Inflation
   H_0: Average rate of inflation *has not changed* after dollarization
   H_1: Average rate of inflation *is lower* after dollarization

2. Average Interest Rate
   H_0: Average interest rate *has not changed* after dollarization
   H_1: Average interest rate *is lower* after dollarization

3. Average GDP growth rate
   H_0: Average GDP growth rate *has not changed* after dollarization
   H_1: Average GDP growth rate *has changed* after dollarization

1.4.2 Volatility

4. Inflation volatility
   H_0: Inflation volatility *has not changed* after dollarization
   H_1: Inflation volatility *is lower* after dollarization

5. Interest Rate volatility
   H_0: Interest Rate volatility *has not changed* after dollarization
   H_1: Interest Rate volatility *has changed* after dollarization

6. GDP growth volatility
   H_0: GDP growth rate volatility *has not changed* after dollarization
   H_1: GDP growth rate volatility *is higher* after dollarization

1.4.3 Correlation

Earlier empirical studies on the business cycle correlation between a dollarized country and the host country have shown ambiguous results. We follow Engel and Rose (2000) and Swiston (2011) and expect the correlation to *increase* after dollarization. To study the correlation we use GDP growth rate as a proxy.

1.4.4 Trade

We investigate whether the bilateral trade patterns have changed due to dollarization. In theory, trade is expected to increase when a common currency is introduced and transaction costs decrease. Thus, trade between Ecuador and El Salvador and the dollar bloc is expected to *increase*.

1.5 Delimitations

Initially, focus lies on the dollarization process in two particular countries in Latin America. We do not examine dollarization in general. By focusing only on two countries more effort can be concentrated on examining the country-specific reasons for dollarizing and the arguments underlying the decision. No attempt is made to isolate the effect of dollarization due to the complex structure of the macroeconomic variables.

Thereafter, we use a static gravity model to evaluate trade flows. The model comprises the three largest dollarized countries in Latin America (Panama, Ecuador and El Salvador) and the US. Due to time and data limitations the very small dollarized countries in Latin America were not included.

The time period stretches from 1990 to 2013 with some exceptions. The frequency of the data is determined by the available data. Higher frequency data would have been preferable but is in many cases not accessible.

2 Theory and Literature Review

2.1 Dollarization and its Consequences

In the beginning of the 1960s the Canadian economist Robert Mundell introduced the theory of optimum currency areas. The theory ascertains under which conditions a region can be considered an optimum currency area. Too large differences within a currency union would cause difficulties in keeping the union together when exposed to shocks, since countries would be affected asymmetrically (Mundell, 1961, Fregert & Jonung, 2010).

Currency unions can be divided into two groups: those inventing a new currency or those adopting a foreign currency as their own. The latter is called dollarization. It is important to note that the foreign currency adopted does *not* need to be the US dollar. Other currencies used for this purpose are the Australian dollar, the Swiss franc and the Euro (Edwards, 2001, Schuler, 2005).

Generally, a distinction is made between unofficial (de facto) and official (de jure) dollarization. The first appears when residents in a country lose confidence in the national currency, often due to high inflation, and therefore choose to hold a foreign currency parallel with the national. In this case there is an often unknown amount of foreign currency in circulation even though it is not used as legal tender (Quispe-Agnoli & Whisler, 2006). Unofficial dollarization is widespread in Latin America and the foreign currency relied upon is mainly the US dollar. A common way to assess the degree of dollarization is to calculate the ratio of foreign currency deposits to total bank deposits. Naturally, the level of dollarization differs widely but some countries have had extremely high shares of foreign currency deposits; Bolivia and Paraguay reached 93% and 66% respectively before they managed to change this runaway trend in the first years of the 21st century. Other countries in the region have seen downward trends in the last decade as well, which might be an effect of lower inflation alongside improved economic and financial policies (Cartas, 2010).

Official dollarization is uncommon and occurs only when a country adopts a foreign currency as legal tender. Throughout this thesis we refer to official dollarization when discussing the concept. In this case the national currency is phased out and replaced by a foreign currency as the unit of account and means of payment (Quispe-Agnoli & Whisler, 2006). Panama underwent this procedure as early as 1904 and Ecuador and El Salvador followed suit about a century later. These two countries are considerably larger than many

other dollarizers and have more accurate and available data, which facilitates research regarding dollarization.

2.1.1 The Risk Premium

One immediate consequence of dollarization is the elimination of currency risk generated by depreciations or devaluations, and hence a lowering of interest rates (Berg & Borensztein, 2003). Countries with low creditworthiness often face considerably higher interest rates due to risk premiums than countries which are regarded as trustworthy. Investors need to be compensated for both currency risk and default risk. By adopting a foreign currency the interest rates converge to the rates in the host country. Dollarization also reduces inflation (see Section 2.1.4) which helps keep the interest rates low (Towers & Borzutzky, 2004).

However, even if dollarization eliminates currency risk, differences in interest rates between the dollarized country and the host country are likely to persist due to country specific factors. Dollarization does not solve the problem with default risk which varies from country to country. Hence, the risk premium on dollar denominated assets can be very different. Due to risk for political and/or fiscal instability investors might be unwilling to invest. This lowers the government's income and might cause financial problems. To lower the risk premium due to default risk and to be seen as a trustworthy place to invest, a country needs to do much more than to dollarize (Berg & Borensztein, 2003, Cooper, 2004). For a thorough discussion on currency and default risk see Goldfajn and Olivares (2000).

For the central bank of a dollarized country the possibility to independently set the repo rate to smooth business cycle fluctuations disappears. Hence, the cost of dollarization will be lower the higher the business cycle correlation is between the dollarizer and the host. However, it is also possible that the correlation increases after dollarization as a consequence of deeper economic integration (Alesina & Barro, 2001, Swiston, 2011). Similarly, Goldfajn and Olivares (2000) question whether lower domestic interest rates are in fact a result of dollarization or of other factors which make the banking system more competitive.

2.1.2 Economic Integration

Most official dollarizations have taken place in countries with an open economy and strong economic ties to the host country. A country that adopts the US dollar becomes per definition a part of the dollar bloc and benefits from lower costs for all transactions within the bloc.

Lower costs and deeper integration facilitate trade. Hence, trade with other dollar countries is expected to increase as a result of dollarization (Alesina & Barro, 2002, Cooper, 2004, Klein, 2005).

Dollarization is also likely to deepen financial integration and make the financial system more competitive. This is outside the scope of this thesis and for further discussion we refer to Quispe-Agnoli and Whisler (2006).

2.1.3 Growth

There are two different ways of arguing about dollarization and growth. On the one hand, a dollarized country could enjoy a higher growth rate in real GDP due to lower inflation and interest rates and increased investments and trade. On the other hand, it might become difficult to absorb external shocks when a smoothing monetary policy is absent. This could cause instability in a dollarized country and slow down the economic growth (Edwards & Magendzo, 2003). Since the theory is ambiguous it is necessary to turn to empirical studies (see Section 2.3).

Another risk of dollarization is that it could lead to greater fluctuations in GDP growth. If fiscal policy is not counter-cyclical enough and if the labor market is not very flexible, the country might need to adjust to external shocks through fluctuations in output and/or employment. In this case dollarization would cause GDP growth to be more volatile than in countries with a national currency (Goldfajn & Olivares, 2000).

2.1.4 Inflation

One common characteristic of dollarizers is the poor record of inflation targeting. With a lack of credibility for the national currency, both domestically and internationally, dollarization might be tempting. Dollarization is equivalent to delegating the responsibility for monetary and exchange rate policy to the central bank in the host country. A dollarized country has to accommodate to the host country's policies and acknowledge their own inability to stabilize the price level (Cooper, 2004). As long as inflation is low in the host country, it tends to be similar in the dollarized country (Towers & Borzutzky, 2004).

2.2 The Gravity Model

The gravity model was first introduced by the Dutch economist Jan Tinbergen in 1962. He had a background in theoretical physics from where the gravity model's name was inspired. The essential explanatory variables of a gravity model are distance and GDP. Tinbergen argued that larger economies trade more and that the transaction costs (proxied by distance) are higher for countries which are geographically far away from each other. Hence, bilateral trade is modeled as a positive function of two countries' combined income and a negative function of the distance between them. After Tinbergen's initial model, augmented versions of the gravity model have been widely used to investigate trade flows (De Benedictis & Taglioni, 2011).

2.3 Literature Review

In the field of dollarization all economists face one common problem, namely the lack of accessible data. Edwards (2001) lists a dozen countries which have experienced periods with official dollarization after 1970. The largest among them are Liberia and Panama with populations of about three million. The remaining countries are the size of Andorra, Liechtenstein or Micronesia. Edwards and Magendzo (2003, p. 5) write: "*…most strictly dollarized countries are very small and their data are not included in readily available data sets*". Despite this, economists have succeeded to realize a fairly large body of research about dollarization.

As mentioned above, interest rates are expected to decrease after dollarization, an effect on which most economists agree. Dornbusch (2001, p. 5) writes "*[f]irst and most obviously, there is a dramatic decline in interest rates*". For instance, Swiston (2011) tries to isolate the effects dollarization had on the interest rate in El Salvador. He uses an uncovered interest parity condition together with the Taylor rule and finds that the reduced currency risk lowered short term lending and deposit rates by 4 to 5 percentage points.

Another point which economists agree on is inflation. Empirical studies have shown unequivocal evidence: dollarization is an utmost effective measure against high inflation (Ghosh, Gulde, Ostry & Wolf, 1997, Goldfajn & Olivares, 2000). However, even if dollarization is a great help in reducing inflation it can in some cases take several years, as was the case for Ecuador (pointed out by Quispe-Agnoli and Whisler (2006)). Quispe-Agnoli and Whisler (2006) show that also inflation volatility was reduced in Ecuador after dollarization. This is in line with the findings of Ghosh et al. (1997) who find that countries

with fixed exchange rates have inflation rates of about 5 percentage points lower than others. Using an AR1 regression model they also find evidence of lower inflation volatility.

Regarding trade and economic integration, several empirical studies have shown that a common currency increases trade. Rose has argued in this direction together with several coauthors. Engel and Rose (2000) use a gravity model and estimate that trade is 285% higher between countries in a currency union than in countries with a national currency. One drawback of their data set is that only 16 of 146 of the observed transitions (countries entering or exiting a currency union) are entries. This raises the question whether their research can be applied to entries as well or if it only confirms a decreasing trade when a country exits a currency union.

Glick and Rose (2002) use another panel data set containing data for 200 countries over 50 years. They argue that a common currency nearly doubles the bilateral trade. They use both OLS and fixed effects and find significant increases in trade with both methods, even though the fixed effects estimator is smaller. Together with van Wincoop, Rose conducts robustness checks which strengthens the validity of his first results (Rose & Van Wincoop, 2001). However, Rose has been criticized by Edwards and Magendzo (2003) for treating all kinds of currency unions alike although there are big differences between them. They claim that there are "*important differences in terms of independence of monetary policy, seigniorage, and capacity to absorb external shocks*" (2003, p. 4). Moreover, the panel data set used by Rose and Van Wincoop (2001) and Glick and Rose (2002) contains data on very few dollarized countries. It is uncertain if these results can be ascribed to dollarized countries.

Edwards and Magendzo (2003) distinguish between officially dollarized countries and other currency unions in their research regarding inflation, volatility and growth. Unfortunately, their research does not include trade. Klein (2005) revisits the data set from Rose and Van Wincoop (2001) and Glick and Rose (2002) but focuses on dollarized countries in Latin America. Klein finds no evidence of increased trade due to dollarization and seriously questions the relevance of Rose's research for nations considering dollarization.

Another aspect of integration is the correlation between business cycles in different countries. Engel and Rose (2000) use panel data to compute correlation in output and find a slightly higher correlation between countries with shared currency than countries with their own currency. Further, Swiston (2011) compares the output in El Salvador and the US and argues that dollarization led to higher correlation in business cycles. On the other hand, Lindenberg and Westermann (2012) test for common serial correlation and find no evidence that confirms co-movements in the business cycles in Central America and the US.

The last effect of dollarization is GDP growth. Edwards and Magendzo (2001, 2003) analyze whether dollarized countries have experienced higher growth compared to countries maintaining a currency of their own. Edwards and Magendzo (2001) use a matching estimator technique and find that dollarized countries have lower growth than those with a national currency. Edwards and Magendzo (2003) use a treatment regression with a dollarization dummy included but they never obtain a significant coefficient for the dollarization dummy. The same result is found by Edwards and Magendzo (2006). Also according to Eichengreen (2003) it is uncertain whether dollarization increases growth.

The evidence is also ambiguous regarding growth volatility; Edwards and Magendzo (2001) find no evidence of higher volatility but Edwards and Magendzo (2003, 2006) do. Ghosh et al. (1997) use a large panel data set and thoroughly evaluate all different types of exchange rate regimes. Their conclusion is that countries with pegs have lower inflation at the cost of higher real volatility.

3 Methodology and Data

3.1 Methodology

In order to obtain a good overview and assess whether changes occurred in inflation, interest rate and GDP growth we test for differences in means and volatility between the period before dollarization (BD) and after dollarization (AD). Additionally, we compare the correlation in the business cycles between the dollarized country and the US. Thereafter, we use a gravity model to investigate whether dollarization led to an increase in trade within the dollar bloc.

3.1.1 Comparison of Means

To compare the mean of a variable before and after dollarization was realized and to identify significant changes, we use a comparison of means test. Observations of variables which experienced violent movements in the time period surrounding the dollarization moment were excluded from the calculations. This was done to avoid misleading results. The comparison of means test is calculated using equation (1) where $\bar{X}_i$ is the mean, σ_i^2 is the variance and n_i is the number of observations in time period *i* (BD and AD). Retrieved Z-values are compared to critical values found in a Z-table (see Appendix B).

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \quad (1)$$

3.1.2 Volatility

We follow Edwards and Magendzo (2003) and define volatility as the standard deviation of a variable. To test for changes in volatility we use equation (2) and an F-distribution (see Appendix B). The larger of the two variances is placed in the nominator and retrieved F-values are compared to critical values found in an F-table (see Appendix B).

$$F = \frac{\sigma_1^2}{\sigma_2^2} \quad (2)$$

3.1.3 Correlation

We use the GDP growth rate as proxy for business cycles as suggested by Lindenberg and Westermann (2012). Correlation in business cycles is calculated with equation (3) where $cov(X,Y)$ is the covariance between country X and Y and σ_i is the standard deviation of country i.

$$corr(X,Y) = \frac{cov(X,Y)}{\sigma_X \sigma_Y} \quad (3)$$

3.1.4 The Gravity Regression Model

In our regression we use a gravity model where trade is modeled proportionally to GDP and inverse proportionally to distance. To construct our model we follow Glick and Rose (2002). The main difference is that we focus only on dollarized countries and the US, whereas Glick and Rose study currency unions in general. Where they use a binary variable to indicate a currency union we use it to indicate an officially dollarized country. Due to our small data set we exclude a couple of the binary variables in Glick and Rose's model for which we would have had no variation[3].

Our data set consists of nominal variables since this is most common and for technical reasons more accurate than real values (De Benedictis & Taglioni, 2011). Trade is modeled as shown in equation (4). The model is a pooled OLS regression which contains both a cross sectional dimension (*i* and *j*) and a time dimension (*t*). A cross sectional approach would have answered the question *"Do dollarized countries trade more with countries within the dollar bloc than with countries outside?"* A panel data set offers an answer to the more interesting question whether dollarization, i.e. an entering into the dollar bloc, increases trade with other countries using the US dollar.

$$\begin{aligned} \ln(TRADE_{ijt}) = \beta_0 &+ \beta_1 \ln(GDP_i GDP_j)_t + \beta_2 \ln(Dist_{ij}) \\ &+ \beta_3 \ln(Area_i Area_j) + \beta_4 Com\ lang_{ij} + \beta_5 FTA_{ijt} \\ &+ \beta_6 Dollarized_{ijt} + \varepsilon_{ijt} \end{aligned} \quad (4)$$

The parameter of interest is β_6. *i* and *j* denote countries, *t* denotes time and the variables are defined as follows:

[3] Excluded are for instance binary variables describing the colonial past or if a country is an island or landlocked.

TRADE is the average[4] trade between country *i* and *j* at time *t*. Measured in nominal values and millions of US dollar.

GDP is nominal GDP measured in millions of US dollar.

Dist is the distance between country *i* and *j* measured in kilometers from middle to middle.

Com lang is a binary variable which is unity if country *i* and *j* have a common language.

FTA is a binary variable which is unity if country *i* and *j* have signed a free trade agreement at time *t*.

Dollarized is a binary variable which is unity if country *i* and *j* use the US dollar as legal tender at time *t*.

3.2 Data

As demonstrated in Section 2 dollarization influences a large number of fundamental macroeconomic variables.

Table 1. Variable description

Variable	Description	Interval and Frequency	Number of observations	Source
Ecuador				
GDP growth*	The % Growth Rate of Real GDP	Q1 1992 – Q4 2012 Quarterly	84	IFS
Interest Rate, Sucre**	The Lending Rate	Jan 1990 – Jul 2008 Monthly	223	IFS
Inflation*	CPI % change	Jan 1990 – Oct 2013 Monthly	286	IFS
El Salvador				
GDP growth*	The % Growth Rate of Real GDP	Q1 1991 – Q2 2013 Quarterly	90	BCR
Interest Rate, Colon***	The Lending Rate	Jan 1991 – Oct 2013 Monthly	274	BCR
Interest Rate, US dollar	The Lending Rate	Jan 1995 – Oct 2013 Monthly	226	BCR
Inflation*	CPI % change	Jan 1990 – Oct 2013 Monthly	286	IFS
United States				
GDP growth*	The % Growth Rate of Real GDP	Q1 1990 – Q3 2013 Quarterly	95	IFS
Interest Rate, US dollar	The Lending Rate	Jan 1990 – Oct 2013 Monthly	286	IFS
Inflation*	CPI % change	Jan 1990 – Sep 2013 Monthly	285	IFS

(*) Percentage changes are calculated as the change over the corresponding period of the previous year. The GDP growth rate for El Salvador has been calculated using real GDP values for El Salvador. (**) The Sucre interest rate for Ecuador ranges from 1990 until December 1998. After this date the rate is expressed in US dollar. (***) The Colon interest rate for El Salvador ranges from 1991 until January 2001. Thereafter the rate is expressed in US dollar and is for that reason the same as the US dollar rate. For a full explanation of the variables, see Appendix A.

[4] The average is calculated as the sum of country *i*'s reported export to and import from country *j* and country *j*'s reported export to and import from country *i,* divided by four.

In our first approach, which evaluates mean, volatility and correlation, we use the data presented in Table 1. The data set contains GDP growth, interest rates and inflation. The data is collected from the IMF's database International Financial Statistics (IFS) and from the Central Reserve Bank of El Salvador (BCR). The number of observations for each variable ranges from 84 to 286 on a quarterly or monthly basis. One missing value on the lending rate in Ecuador in August 2007 has been interpolated. Exact definitions of each variable are found in Appendix A.

In our second approach, we estimate the coefficients of the explanatory variables in the gravity model using a balanced panel data set with quarterly data for four countries: Ecuador and El Salvador as main foci, Panama because of its long history of being a dollarized country, and the US because of its role as host country. Mean and standard deviation for dollarized and non-dollarized observations are presented in Table 2. The time period stretches from 1991 to 2012. Values for GDP growth in Panama, which is only measured annually, have been interpolated.

Table 2. Descriptive statistics: regression

	Non-dollarized	Dollarized
Observations	192	336
$\ln(TRADE_{ijt})$	3.34 (2.28)	4.93 (1.56)
$\ln(GDP_iGDP_j)_t$	19.54 (3.56)	22.36 (3.59)
$\ln(DIST_{ij})$	7.60 (.54)	7.76 (.53)
$\ln(AREA_iAREA_j)$	24.36 (2.64)	24.24 (2.61)
Common language dummy, *com lang*	.60 (.49)	.44 (.50)
Free Trade Agreement dummy, *FTA*	0 (0)	.29 (.46)
Dollarization dummy, *dollarized*	0 (0)	1 (0)

Mean with standard deviation in parentheses.

3.3 Criticism of the Method

The main problem with the comparison of means test and the volatility test is that they are essentially developed for cross sectional approaches. The tests require independent and identically distributed (IID) variables. In time series the independent part is rarely fulfilled since the last period is likely to affect the current. Furthermore, if means and standard deviations are different in the two time periods, the assumption about identical distribution is violated. Therefore, the results should be interpreted with caution.

Likewise, the gravity model approach has its shortcomings. First, it assumes a linear relationship between distance and trading costs. There is no reason to believe that this holds in reality. Second, the gravity model is most commonly designed as a static model and so is ours. A static model only allows for contemporaneous effects even though economic arguments support the view of trade as a dynamic variable. This might cause a negative bias. The solution is to allow for lagged effects, which is outside the scope of this thesis due to time constraints. For the same reason, the fact that a shared time trend can cause spurious regression problems is not taken into account.

4 Results and Analysis

4.1 Macroeconomic Overview

In this section we present the results of the means and volatility tests and also correlations of business cycles. The results are found in Table 3. Average, volatility and correlation are calculated for Ecuador and El Salvador in the time periods BD and AD. Results for the US are

Table 3. Descriptive statistics: average, volatility and correlation

	Ecuador	El Salvador	US
CPI, %			
Average entire period	20.65	6.32	2.69
Average BD / AD	39.09 / 5.07	9.90 / 3.26	
Z-value	**29.13**	**9.83**	
Standard deviation entire period	19.07	6.29	1.26
Standard deviation BD / AD	12.45 / 3.22	7.47 / 2.30	
F-value	**14.94**	**10.51**	
LENDING RATE, NATIONAL CURRENCY, %			
Average entire period	30.57	11.64	6.38
Average BD / AD*	45.63 / 13.02	17.27 / 7.25	
Z-value	**28.30**	**44.76**	
Standard deviation entire period	18.67	5.27	2.23
Standard deviation BD / AD*	12.20 / 3.01	2.17 / 1.29	
F-value	**16.45**	**2.83**	
LENDING RATE, US DOLLARS, %			
Average entire period		8.48	
Average BD / AD*		11.12 / 7.25	
Z-value		**26.32**	
Standard deviation entire period		2.18	
Standard deviation BD / AD*		1.06 / 1.29	
F-value		1.22	
GDP GROWTH RATE, %			
Average entire period	3.90	3.12	2.47
Average BD / AD	2.79 / 4.49	4.63 / 1.91	
Z-value	**3.54**	**6.45**	
Standard deviation entire period	2.46	2.37	1.88
Standard deviation BD / AD	1.65 / 2.61	2.10 / 1.82	
F-value	**2.49**	1.33	
Correlation with US, entire period	.09	.54	
Correlation with US BD / AD	.12 / .31	-.09 / .77	

(*) Due to dollarization, these values for El Salvador are the same in the period after dollarization.
Bold indicates significance at 5%.

presented for the entire time period (1990-2013) as reference values. Table 4 summarizes answers to the hypotheses in Section 1.4.

Table 4. Answers to hypotheses

Hypothesis	Ecuador	El Salvador
1. Lower average inflation	confirmed	confirmed
2. Lower average interest rate; *domestic currency* *US dollar*	confirmed -	confirmed confirmed
3. Changed GDP growth rate	confirmed	confirmed
4. Lower inflation volatility	confirmed	confirmed
5. Changed interest rate volatility; *domestic currency* *US dollar*	confirmed -	confirmed not confirmed
6. Higher GDP growth rate volatility	confirmed	not confirmed
7. Increased business cycle correlation with the US	confirmed	confirmed
8. Increased trade	not confirmed	

4.1.1 Inflation

The comparison of means and volatility tests indicate significant decreases in mean and in volatility in both countries, i.e., the inflation rate and the inflation volatility were lower after dollarization than before. This confirms hypothesis one and four for both Ecuador and El Salvador.

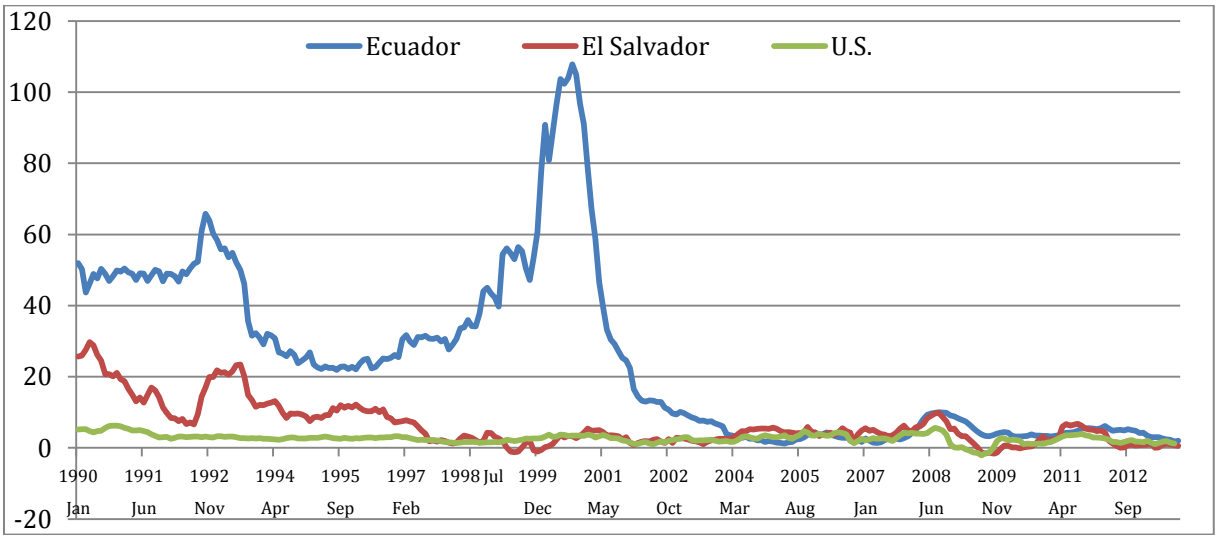

Figure 1. Inflation measured by CPI, %

From Table 3 and Figure 1 we see that Ecuador suffered from very high levels of inflation throughout the period before dollarization. It started out high and dropped in 1992-1993 which was mainly due to a stabilization program launched by the government to stimulate the economy and reduce inflation. The program used stable exchange rates as the major tool, together with fiscal policy restraints and structural reforms (Jacome H, 2004).

During the period of 1993-1997 the rate of inflation was fairly stable at around 20-25% but started to rise in 1998. During the financial crisis at the very end of the 1990s the inflation soared and in September 2000 it peaked at 108%. The extreme values between January 2000 and December 2001 (24 observations) have been excluded in the calculations since they do not reflect the general trend or level in the country at that time. Including these observations would cause an upward bias on the average rate of inflation after dollarization in January 2000.

When a country adopts another country's currency as legal tender, the rate of inflation is expected to be similar to the rate in the host country (Towers & Borzutzky, 2004). Dollarization caused the inflation in Ecuador to fall, even though an adjustment period was necessary to turn the upward trend and for the inflation to reach US levels. Inflation reached a one-digit number in November 2002 for the first time in our sample period. Quispe-Agnoli and Whisler (2006) study inflation in Ecuador and find that it reached single-digit numbers in 2003 for the first time since 1972. The small difference in findings is probably caused by disparities in the way of defining inflation. We use percentage change in CPI and in Quispe-Agnoli and Whisler's article no definition is given.

One possible explanation for the adjustment period is that inflation was still increasing in January 2000, the time of dollarization. It is plausible that it took some time to reverse the trend. This argument is stressed by Abrego et al. (2006). Another possible explanation is that prices are sticky and need time to adjust. In Ecuador, sticky prices could be due to for example price regulations or an inefficient labor market which is emphasized by Offerdal et al. (2000) as factors underlying the crisis in the Ecuadorian economy at this time. However, since 2004 the level of inflation has been roughly the same as in the US. Since the inflation lowering measures undertaken by the government were inadequate (see discussion in Section 1.2.1) no other likely explanation remains than that the new currency caused inflation to fall.

Inflation volatility decreased significantly in Ecuador; the standard deviation dropped from 12.5% before dollarization to only 3.2% after dollarization. This is in line with the findings of Abrego et al. (2006) among others. Our method does not isolate a causal effect but the drop in volatility could be explained by the increased trustworthiness following dollarization. The Sucre had lost its credibility and with the implementation of the US dollar the inflation and volatility rates converged towards those of the US.

El Salvador on the other hand never experienced levels of inflation as high as in Ecuador. Since the end of 1993, inflation was stable and decreasing, reaching US levels even before official dollarization in January 2001. Between April 1999 and December 2000 the inflation

in El Salvador was even lower than in the US. Around the time of dollarization it caught up and exceeded the US level and a time period with inflation higher than in the US followed. Towers and Borzutzky (2004) discuss the rounding up of prices as a possible contributor to this increase. In informal markets, where most poor citizens operate, rounding up was common. Since the exchange rate was 8.79 Colones to the dollar at the time of dollarization, the exchange rate was most likely rounded up to nine Colones to the dollar, either for simplicity or profit considerations.

The test regarding inflation volatility shows a significant decrease after dollarization, volatility dropped from 7.5% to 2.3%. However, both inflation and inflation volatility in El Salvador had downward trends even before dollarization. Therefore, the decreases cannot be assigned to dollarization only. Our method does not isolate any causal effects of dollarization and changes in inflation rate and volatility are affected by many other factors. For instance, the Salvadoran government implemented programs and reforms to promote and stabilize economic growth and improve the general economic situation. Hence, the effect of dollarization on inflation is not as clear in El Salvador as in Ecuador.

4.1.2 Interest Rate

The results regarding changes in lending rate are similar for both countries. The comparison of means and volatility tests turn out significant for the domestic currency lending rate, confirming hypothesis two and five for both Ecuador and El Salvador. Interest rate and volatility decreased in both countries.

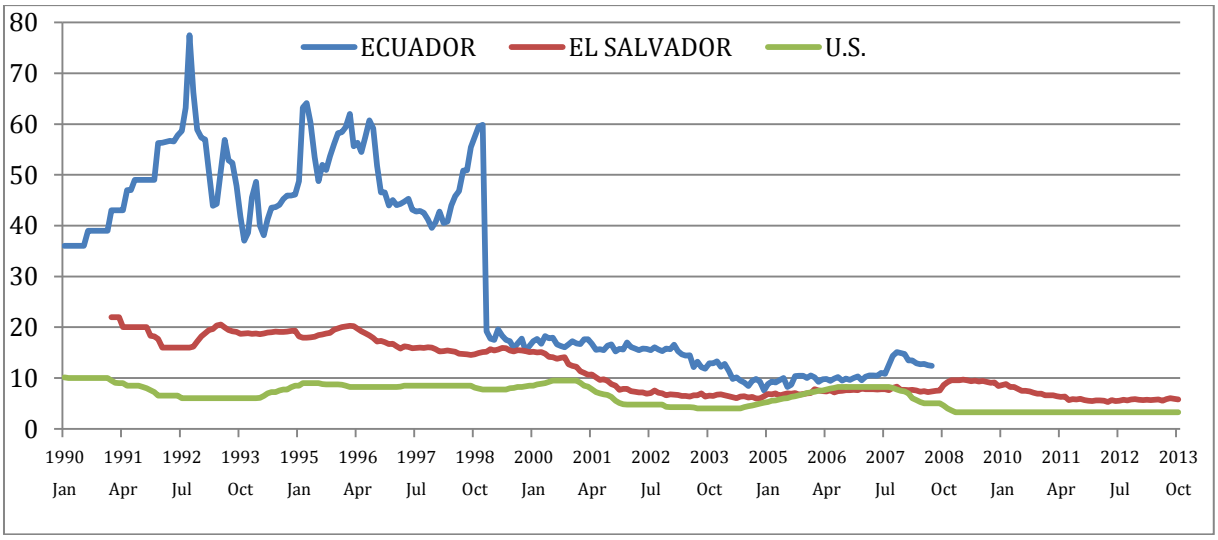

Figure 2. Lending rate, domestic currency, %

Ecuador's lending rate in Figure 2 is volatile in the period before dollarization and displays a remarkable drop in January 1999. This drop cannot be explained by dollarization which was not realized until January 2000, one year later. The drop is due to a change in the unit of measurement. Until December 1998 the interest rate refers to short loans in the national currency Sucre. From January 1999 and onward it refers to short loans issued in US dollar. Since we have been unable to find data on the US dollar rate in Ecuador before dollarization the results and analysis need to be based on this rate published by the IMF as "*domestic lending rate*" even though it in fact consists of two different currencies.

In the beginning of the 1990s the lending rate in Ecuador increased from about 35% to almost 80% in less than three years. The rate remains high and volatile until December 1998. Ecuador went through a troublesome time during the second part of the 1990s which caused very high interest rates. After the change in unit of measurement in January 1999 and after dollarization in January 2000 the rate is significantly lower and much less volatile. The standard deviation dropped from 12.2% to 3.0%. A decrease in volatility indicates that the interest rate became less sensitive to changes brought on by macroeconomic shocks or international events. Surely, being less sensitive to economic shocks is an advantage. However, the rate in Ecuador stayed higher than in the US, something the government in Ecuador tried to adjust with structural reform programs. The rate took some time to decrease to the level of the US. As discussed in Section 2.1.1 the adoption of the US dollar is an insufficient measure for reaching interest levels as low as in the US. Because of country specific factors such as country risk, lender's creditworthiness or supply and demand for loans, the US dollar rates in different countries are not identical.

In the case of El Salvador, Figure 2 shows the Colon rate until December 2000 and thereafter the US dollar rate (all in red). The lending rate was considerably lower than in Ecuador and less volatile. Since El Salvador did not experience high rates of inflation or other macroeconomic disturbances it is natural to see a lower lending rate. The interest rate in El Salvador decreased even before dollarization which makes it hard to draw any clear conclusions about the casual effect of dollarization. After dollarization, the lending rate reached a level close to that of the US.

However, even if lower lending rates are advantageous for individuals and companies, the comparison in Figure 2 is not just. Figure 2 shows the Sucre and Colon lending rates in the first half of the time period and the US dollar lending rate in the second half. Those currencies are inherently different. More interesting is Figure 3, which shows the US dollar lending rate in El Salvador for the entire time period. The rate expressed in dollars is about five to seven

percentage points lower than the rate expressed in Colones. Both lending rates decreased throughout the second half of the 1990s. As described in Section 1.2.2 El Salvador undertook several actions to improve the economic situation. As far as can be judged from the interest rate, these actions can be regarded as successful.

Although downward trending, both rates drop shortly after dollarization in January 2001. Our findings on El Salvador are in line with those of Swiston (2011) who estimates that dollarization caused lending and deposit rates to drop by about 4 to 5 percentage points. For the US dollar lending rate, the comparison of means test indicates a significant drop in the average lending rate. However, with our method we cannot be certain whether this drop is due to dollarization or other actions undertaken to improve the economic situation. The volatility test shows no significant results. This means that hypothesis two is confirmed but not hypothesis five.

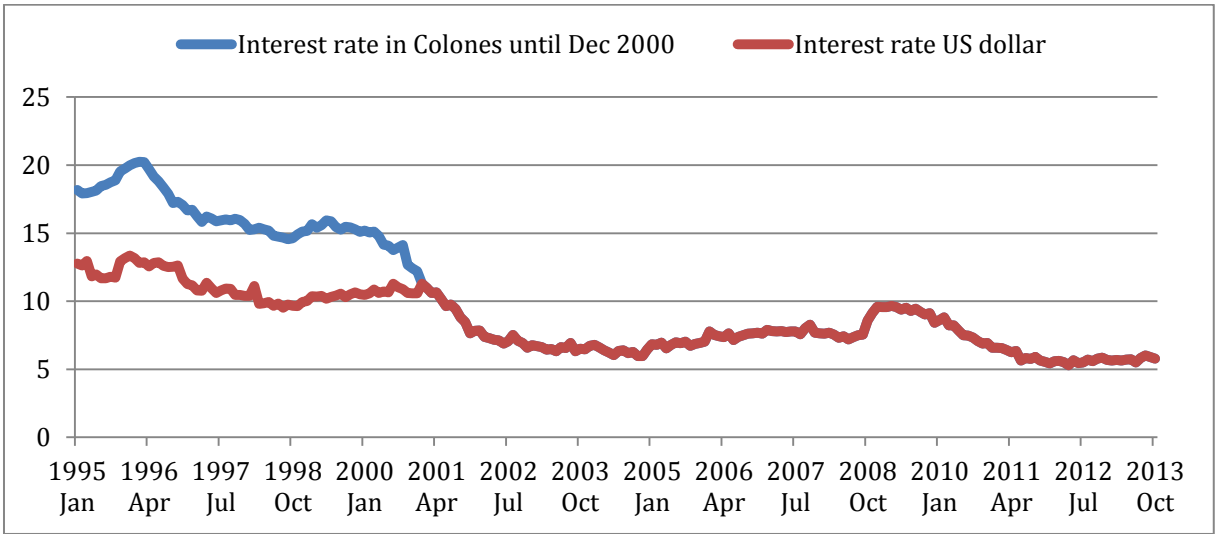

Figure 3. Lending rate, US dollars for El Salvador, %

If we would have had data on the US dollar lending rate in Ecuador for the time period prior to dollarization, our expectations and hypothesis would have been a lowering in average and a change in volatility. The US dollar lending rate in El Salvador decreased significantly but we do not find any significant change in volatility. In an unstable economy as Ecuador the difference between the two time periods was probably larger than in a stable economy like El Salvador. Therefore, we would most likely have seen a significant drop in average US dollar lending rate in Ecuador as well. Regarding interest rate volatility, it is hard to draw any conclusions since the results in El Salvador turned out insignificant.

4.1.3 GDP Growth

The results for Ecuador and El Salvador regarding real GDP growth and real growth volatility are contradictory. Ecuador experienced both higher average growth and growth volatility after dollarization. For El Salvador, the results are the opposite: both the average growth rate and the volatility decreased after dollarization. The comparison of means test shows significant results for both countries which confirms hypothesis three regarding a change in GDP growth. Hypothesis six assumes higher GDP growth volatility after dollarization and is confirmed in the case of Ecuador but not El Salvador. The business cycle correlation for Ecuador increased from 0.1 before dollarization to 0.3 after dollarization and for El Salvador from -0.1 to 0.8. Our findings regarding correlation are thus consistent with our expectations.

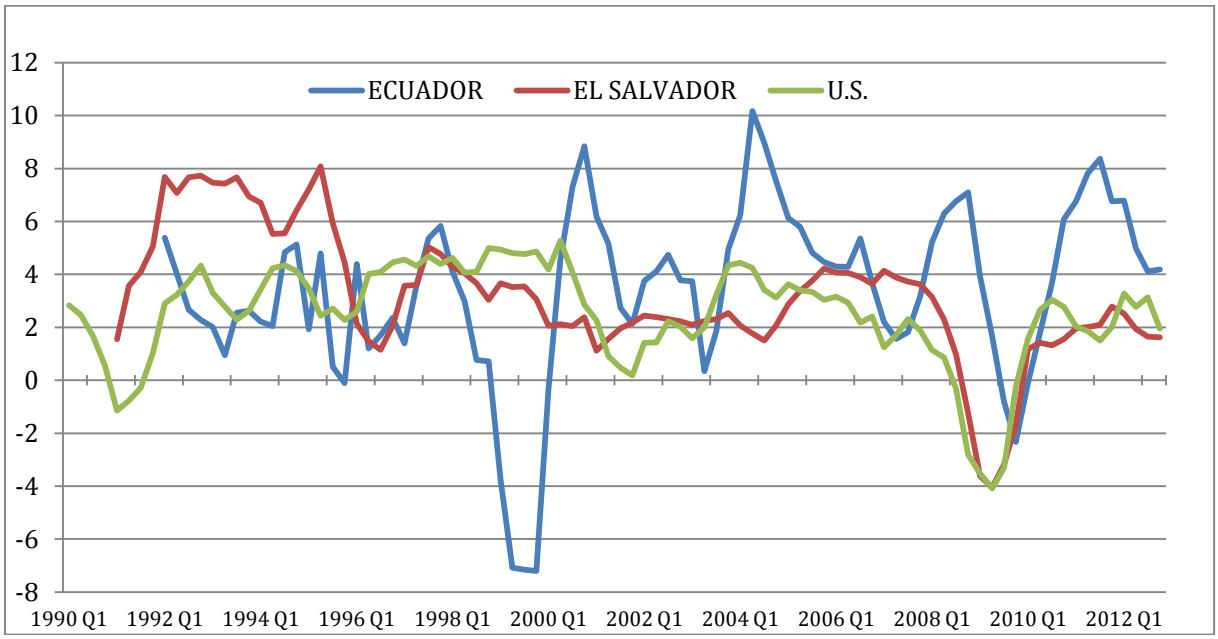

Figure 4. GDP growth rate, %

Ecuador experienced higher average growth after dollarization. It increased from 2.8% to 4.5%. Figure 4 displays a vast drop and a negative growth rate in 1999. This is due to the economic crisis described in earlier sections. A total of four observations in 1999 are excluded from the calculations because they constitute a unique event that cannot be considered representative of the GDP growth rate in Ecuador. Including them would lower the average growth rate for the period prior to dollarization and lead to even more significant results in the comparison of means test.

After the drop in 1999, high levels of growth followed in 2000. It is plausible that the introduction of the US dollar triggered an overconfidence regarding investments and

spending. The citizens in Ecuador might have had high expectations in the US dollar and its potential to solve economic problems.

From 2000 and forward, Figure 4 shows a higher average growth rate but it is difficult to disentangle the effects of dollarization from the effects of the policy changes implemented around the time of dollarization in January 2000. These policy changes naturally needed some time to stimulate the economy. However, dollarization probably played an important part in turning a soaring rate of inflation and a negative growth rate into a high positive growth rate. As described in Section 2.1.3 the growth rate is affected by both inflation and interest rates. Hence, dollarization probably had an indirect positive effect on the growth rate.

The volatility of the GDP growth increased significantly in Ecuador. The standard deviation changed from 1.7% to 2.6%. As discussed in Section 2.1.3, without independent monetary policy, the fiscal policy and the labor market have to be countercyclical and flexible in order to smooth the business cycle. Since Ecuador had some difficulties with this, it might be an explanation to the increased volatility.

The financial crisis starting in the US in 2007 had, as depicted in Figure 4, a somewhat delayed effect on Ecuador. This delay may partially be explained by the low business cycle correlation with the US. The correlation was 0.1 before dollarization and 0.3 after dollarization. Even though it increased it was still low after dollarization and therefore the potential benefits of dollarization were lower for Ecuador than for El Salvador. The dollarized country loses the ability to conduct independent monetary policy and has to rely on the US for this matter. It cannot be expect that the US adjusts its monetary policy to the needs of the dollarized country. If the business cycles are not strongly correlated, the imported monetary policy may result in inappropriate actions to either stimulate or cool off the economy. Swiston (2011) highlights this fact. Perhaps the Ecuadorian business cycle has not been fully synchronized with that of the US, resulting in higher volatility of the business cycle after dollarization than before.

In El Salvador the average growth rate decreased significantly, dropping from 4.6% before to 1.9% after dollarization. The government's official reasons to adopt the US dollar were that it would lead to a higher economic growth rate, as discussed in Section 1.2.2. Clearly, this was not realized.

The volatility of GDP growth declined from 2.1% to 1.8% in El Salvador, although not significantly. Hypothesis six assumes an increase in volatility after dollarization. One explanation to the drop in volatility is that the US monetary policy contributed to cyclical stabilization. This point is also highlighted by Swiston (2011). A higher correlation in

business cycles is also a probable contributor. The curves for El Salvador and the US show great resemblances in the after period. The correlation changed from -0.1 to 0.8. Since the mid 1990s, the two lines have been fairly synchronized. Worth noting are the very close co-movements during the start of the recent financial crisis. Between mid 2008 and mid 2010 the lines are almost identical. The strong correlation with the US could be explained by the large share of trade that El Salvador has with the US. Of total exports in 2012, 47% was shipped to the US. The same number for Ecuador was 37%. Of total import, the shares were 35% and 28% respectively (CIA, 2013). This means that El Salvador had closer and more developed trade links with the US and was therefore more sensitive to changes in US supply and demand.

Furthermore, El Salvador and the US are both members of the free trade agreement CAFTA-DR since 2006 (CIA, 2013). This agreement aims at promoting trade and investments among the participants. Additionally, El Salvador is one of few countries in the world to participate in a program together with the US aimed at reducing crime and insecurity and promoting productivity, the Partnership for Growth Initiative. Working along with the US, several goals have been set in order to deal with these issues (U.S. Department of State, 2002). Both these agreements with the US might help explain why El Salvador and the US have a stronger correlation in business cycles and tend to trade more, compared to Ecuador.

Another possible explanation for the high correlation is the remittances sent back to families by Salvadorans working in the US. As mentioned in Section 1.2.2, the remittances amounted to about 15% of GDP in 2001 (Towers & Borzutzky, 2004). This share increased to 17% of GDP in 2011 (CIA, 2013). This is a considerable portion of El Salvador's GDP and the ties with the US have become even stronger. The size of the remittances sent to El Salvador depends on the business cycle and unemployment rate in the US. Since the US economy has grown mildly during the start of the millennia, and with the global recession starting in 2007, El Salvador also experienced a decrease in average growth.

Finally, some additional events contributed to dampen growth in El Salvador in the period after dollarization. In 2001, two earthquakes coincided with an increase in oil prices and a decline in international coffee prices (Quispe-Agnoli & Whisler, 2006). None of these events were beneficial for the country's growth rate.

4.2 Regression Results

Our results from the gravity model do not support the theory of increasing trade due to a common currency for dollarized nations. The regression results are presented in Table 5. Column 1 includes only *GDP* and *distance*, the cornerstones in a gravity model. Both variables have expected signs (*GDP* is positive and *distance* negative) and are highly significant. This holds throughout all our regressions.

Table 5. Regression output

	$\ln(TRADE_{ij})$				
	(1)	(2)	(3)	(4)	(5)
$\ln(GDP_iGDP_j)_t$	.585*** (.016) [.027]	.574*** (.018) [.026]	.419*** (.025) [.025]	.699*** (.053) [.060]	.710*** (.055) [.066]
$\ln(DIST_{ij})$	-.966*** (.114) [.162]	-.917*** (.119) [.160]	-1.639*** (.140) [.183]	-1.185*** (.156) [.175]	-1.192*** (.156) [.176]
Dollar dummy		.116* (.081) [.062]	.349*** (.081) [.063]	-.099 (.109) [.090]	-.094 (.110) [.090]
$\ln(AREA_iAREA_j)$			.361*** (.042) [.027]	.296*** (.042) [.031]	.281*** (.047) [.039]
Common language				2.161*** (.367) [.352]	2.159*** (.367) [.348]
Free Trade Agreement					-.076 (.108) [.103]

Obs=528, R-squared= 0.87 for main regression in column 5. Standard deviation in parentheses, robust standard deviations in brackets. Due to heteroskedasticity the significance level is calculated on robust standard deviations. (*) significant at 10%, (**) significant at 5%, (***) significant at 1%.

Recall from Section 2.3 that Engel and Rose (2000), Rose and Van Wincoop (2001) and Glick and Rose (2002) argue that bilateral trade at least doubles when two countries are members of the same currency union. Our dollarization dummy is included in column 2 and its point estimate is very small, at least compared with the findings of Rose and his coauthors, and becomes insignificant when further control variables are included (column 4 and 5). Column 3 adds *area* which has a positive and significant point estimate as expected. Column 4 includes a dummy for common language and column 5 a dummy for free trade agreement. As seen in column 5, a 1% increase in the combined GDP would *increase* bilateral trade by approximately 0.7%. Equally, a 1% increase in the combined area would *increase* trade by approximately 0.3%. Finally, a 1% increase in distance would *decrease* trade by approximately 1.2%. These results are not only statistically significant but economically

significant as well. It is clear that trade patterns to a certain extent are determined by distance, GDP and country size.

The only insignificant variables in column 5 are the FTA dummy and the dollarization dummy. A free trade agreement would lower trade by approximately 7.6%. This result is unexpected and should be interpreted with caution for two reasons. First, this dummy equals unity in only 18.5% of our observations. Second, differences in agreements are not taken into consideration. A reliable estimate of the effect of a free trade agreement on trade would need to consider the conditions of each agreement carefully.

Worth noting is the very high point estimate for the common language dummy. According to this estimate a common language would increase trade by 766%[5]. This is most likely an overestimate due to omitted variable bias. Most importantly, the period of colonialism greatly influenced the political, economic and cultural spheres in the colony which all affect a country's trade pattern. We assume that unobserved factors related to the colonial heritage from Spain are positively correlated with both the common language dummy and the bilateral trade between Ecuador, El Salvador and Panama. This gives the point estimate for *common language* an upward bias. However, without a detailed data set we cannot disentangle the effect on trade of these aspects from the effect of a common language.

Glick and Rose (2002) use several control variables in their model for which we would have no variation. Therefore, these variables have been excluded. There is one though, which would have been possible for us to control for, namely the *GDP per capita.* This variable is expected to have a positive point estimate but turned out negative and significant and has therefore been excluded. The unexpected sign was most likely due to multicollinearity and a relatively small sample size. A certain degree of multicollinearity cannot be avoided since it is an inherent property of many macroeconomic variables to share an upward trend over time and hence be positively correlated (Gujarati & Porter, 2009). This is the case for variables such as *population, GDP* and *trade*. Multicollinearity does not need to be a problem as long as there is no (near) perfect linear relationship but it can result in variables obtaining the incorrect sign (O'brien, 2007). However, the point estimate for the dollarization dummy is very small and insignificant regardless of whether the *GDP per capita* is included or not. The gist of our results is that a common currency might not have a trade enhancing effect in the case of dollarized countries.

[5] $100\ (e^{2.159} - 1) = 766$

The key argument behind the theory of increasing trade due to a common currency is lower transaction costs. However, in a world with well developed derivative markets, the legitimacy of this argument must be questioned. There is an abundance of ways to hedge against currency risk and a common currency might only make a very small difference after all. Furthermore, it is plausible that trade would increase between countries with a fixed exchange rate. Different types of pegged currencies reduce transaction costs. El Salvador maintained a peg many years prior to dollarization which might have had an effect on trade. Dollarization per se might not make any difference in a situation like this.

Another important aspect is *simultaneity*, i.e., the distinction between the cause and the effect. Countries with extensive trade with the US are probably more prone to adopt the US dollar as legal tender. In the year prior to dollarization the export to the US as share of total export amounted to 65% for El Salvador and 37% for Ecuador and the import to 50% and 32% respectively[6]. Well established trade patterns might be a contributor to dollarization rather than a consequence of it. Simultaneity is related to another important point raised by Klein (2005), namely that the effect of dollarization on trade might depend on the distance between the dollarizer and the host country. It is plausible that countries in Latin America trade with the US to a large extent regardless of the currency. Including dollarized countries in other parts of the world might give other results. A way to find out whether the magnitude of the point estimate for the dollarization dummy depends on distance would be to include an interaction term between the logarithm of distance and the dollarization dummy. This however leads us back to the problem with the insufficiency of data. Klein's results indicate that dollarization might have a larger effect on trade with the US for countries that are distant from the US. However, the only country outside Latin America included in his data set is Liberia. Not many general conclusions can be drawn from the experiences of one single country.

It is furthermore difficult to draw applicable conclusions for all countries from our results. The US is distinctly different from the dollarized countries regarding size, population and GDP. The gravity model requires the variables to take absolute values. Hence, a large percentage change in a small country might have a limited impact on the outcome. Similarly, a small percentage change in the US might have an unproportionately large effect on the outcome.

[6] Authors' calculations based on data from IFS.

Another difficulty is the bias that might arise from self-selection. As seen in Table 2 there are differences in mean values between dollarized and non-dollarized observations. There is a risk of endogeneity if the dollarized countries share a characteristic which is not controlled for and if this characteristic is correlated with an independent variable. One possible way to solve or at least mitigate the problem with this omitted variable bias is to control for more variables and to do this, a larger data sample than ours is required. However, there is no guarantee that the problem disappears in an enlarged data set. The original data set used by Rose and his coauthors (see for instance Glick and Rose (2002)) and his critics like Klein (2005) contains hundreds of thousands of observations and still shows differences between countries with a national currency and countries in a currency union. Persson (2001) scrutinizes these differences and argues that they are likely to cause biased estimates. Advanced methods have been developed to deal with the self-selection problem, see for example Persson (2001) or Lin and Ye (2010) .

The OLS estimator is the norm when modeling bilateral trade with a gravity model. A crucial assumption for unbiasedness of the OLS estimator is that the error term is uncorrelated with the explanatory variables. In our case, trade is probably affected by unobserved factors, for instance fluctuations in exchange rates (prior to dollarization) or political environment. One way to avoid this bias is to use the fixed effects estimator instead of the OLS which allows unobserved, time-constant factors to be correlated with the explanatory variables (Wooldridge, 2009). Both Rose and Van Wincoop (2001) and Glick and Rose (2002) estimate the effect of dollarization on trade using both OLS and fixed effects. The fixed effects method results in smaller point estimates than OLS. The fixed effects estimator is most reliable since it is "*least demanding in terms of heroic econometric assumptions*" (Glick & Rose, 2002 p. 1135). Our coefficient for the dollarization dummy, -.094, is estimated with OLS and might be biased upwards due to the same omitted variable bias as in Rose's papers. The true values would even less support increases in trade due to dollarization. On the other hand, our estimates along with those of Klein and Rose might all be underestimated due to the use of a static model. Neither Rose nor Klein discusses the design of their models even though trade is likely to be a dynamic variable. The lagged effects might need to be taken into account to obtain unbiased estimators.

The bottom line is that our findings do not support the theory that dollarization increases trade within the dollar bloc. Rose and his coauthors investigate currency unions in general whereas our findings along with Klein's concern dollarization in particular. Even though we use the same method as Rose we obtain completely different results. This indicates that there

are inherent differences between dollarized countries and countries in a currency union in general. Therefore, it would be inappropriate to apply results regarding currency unions in general to countries considering dollarization. More research is needed on dollarized countries in specific to support countries considering dollarization in their decision.

5 Conclusions and Outlook

The purpose of this thesis was to study if and how the realization of official dollarization has affected a number of fundamental macroeconomic variables: inflation, interest rate, GDP growth, business cycle correlation and trade. Focus lay on Ecuador and El Salvador which adopted the US dollar in 2000 and 2001 respectively. We used a comparison of means test and found significant decreases in the average rate of inflation and interest rate for both countries. This is in line with theory and our hypotheses. Regarding the effect on GDP growth the theory is ambiguous, and so were our results. The GDP growth rate increased in Ecuador after dollarization and decreased in El Salvador.

We tested for changes in volatility in each variable. Inflation volatility and domestic lending rate volatility decreased in both countries. The US dollar rate in El Salvador decreased in average but not in volatility. GDP volatility increased significantly in Ecuador but not in El Salvador. In line with theory, the correlation in business cycles with the US increased for both Ecuador and El Salvador. Additionally, in order to study the impact of dollarization on trade we used a gravity regression model. The results offer no clear signs of a trade enhancing effect of dollarization.

The main conclusion from our research is that dollarization is an utmost effective measure for lowering inflation. Its positive impact on interest rates is also well-recognized. These effects have been observed in several countries and empirical studies have shown unequivocal results. Regarding the effect of dollarization on GDP growth rate, economists have found ambiguous results since country specific properties dominate the effect of dollarization. Dollarization per se does not lead to a higher growth rate but is likely to have an indirect effect through lower inflation and interest rates.

The main part of the existing research on exchange rate systems regards currency unions in general. Policy recommendations to countries considering the adoption of another country's currency as legal tender must be based on experiences from dollarized countries in particular. Hence, more research is required on dollarized countries. This thesis focused on a small number of countries in Latin America which have adopted the US dollar. Extensive research could preferably include a larger variety of countries and currencies in other parts of the world. Additionally, it could examine changes in investments due to dollarization. For

instance, the El Salvadoran government wished to attract more investments by adopting the US dollar. Due to time constraints and especially lack of appropriate data our thesis left this dimension unexplored. Lastly, it would be interesting to study if any dollarized country is considering abandoning the US dollar in favor of another currency due to the economic difficulties experienced in the US since the start of the recent financial crisis.

References

Printed Sources

ABREGO, L., FLORES, E., PIVOVARSKY, A. & ROTHER, B. 2006. Ecuador: Selected Issues. Washington, D.C.: IMF.

ALESINA, A. & BARRO, R. J. 2001. Dollarization. *American Economic Review,* 91**,** 381-385.

ALESINA, A. & BARRO, R. J. 2002. Currency Unions. *Quarterly Journal of Economics,* 117**,** 409-436.

BERG, A. & BORENSZTEIN, E. R. 2003. The Pros and Cons of Full Dollarization. *In:* SALVATORE, D., DEAN, J. W. & WILLETT, T. D. (eds.) *The dollarization debate.* Oxford and New York: Oxford University Press.

CARTAS, J. M. 2010. Dollarization Declines in Latin America. *Finance & Development.* IMF.

COOPER, J. C. B. 2004. Dollarisation in Theory and Practice. *World Economics,* 5**,** 79-89.

DE BENEDICTIS, L. & TAGLIONI, D. 2011. The Gravity Model in International Trade. *In:* DE BENEDICTIS, L. & SALVATICI, L. (eds.) *The Trade Impact of European Union Preferential Policies: An Analysis through Gravity Models.* New York and Heidelberg: Springer.

DORNBUSCH, R. 2001. Fewer Monies, Better Monies. *American Economic Review,* 91**,** 238-242.

EDWARDS, S. 2001. Dollarization Myths and realities. *Journal of Policy Modeling,* 23**,** 249.

EDWARDS, S. & MAGENDZO, I. 2003. A Currency of One's Own? An Empirical Investigation on Dollarization and Independent Currency Unions. National Bureau of Economic Research, Inc, NBER Working Papers: 9514.

EDWARDS, S. & MAGENDZO, I. I. 2001. Dollarization, Inflation and Growth. National Bureau of Economic Research, Inc, NBER Working Papers: 8671.

EDWARDS, S. & MAGENDZO, I. I. 2006. Strict Dollarization and Economic Performance: An Empirical Investigation. *Journal of Money, Credit, and Banking,* 38**,** 269-282.

EICHENGREEN, B. 2003. What Problems Can Dollarization Solve? *In:* SALVATORE, D., DEAN, J. W. & WILLETT, T. D. (eds.) *The dollarization debate.* Oxford and New York: Oxford University Press.

ENGEL, C. & ROSE, A. Dollarization and integration. Conference on Currency Unions, organized by Alberto Alesina and Robert Barro, Hoover Institution, Stanford University, May, 2000. 19-20.

FREGERT, K. & JONUNG, L. 2010. *Makroekonomi : teori, politik och institutioner,* Lund, Studentlitteratur.

GHOSH, A. R., GULDE, A.-M., OSTRY, J. D. & WOLF, H. C. 1997. Does the Nominal Exchange Rate Regime Matter? : National Bureau of Economic Research, Inc, NBER Working Papers: 5874.

GLICK, R. & ROSE, A. K. 2002. Does a currency union affect trade? The time-series evidence. *European Economic Review,* 46**,** 1125-1151.

GOLDFAJN, I. & OLIVARES, G. 2000. Is adopting Full Dollarization the solution? Looking at the evidence. Department of Economics PUC-Rio (Brazil).

GUJARATI, D. N. & PORTER, D. C. 2009. *Basic econometrics,* Boston, McGrawHill.

JACOME H, L. I. 2004. The Late 1990s Financial Crisis in Ecuador: Institutional Weaknesses, Fiscal Rigidities, and Financial Dollarization at Work. International Monetary Fund, IMF Working Papers: 04/12.

KLEIN, M. W. 2005. Dollarization and Trade. *Journal of International Money and Finance,* 24**,** 935-943.

LIN, S. & YE, H. 2010. Dollarization does promote trade. *Journal of International Money & Finance,* 29**,** 1124-1130.

LINDENBERG, N. & WESTERMANN, F. 2012. How Strong Is the Case for Dollarization in Central America? An Empirical Analysis of Business Cycles, Credit Market Imperfections and the Exchange Rate. *International Journal of Finance and Economics,* 17**,** 147-166.

MUNDELL, R. A. 1961. A theory of optimum currency areas. *American Economic Review,* 51**,** 657-665.

O'BRIEN, R. 2007. A Caution Regarding Rules of Thumb for Variance Inflation Factors. *Quality & Quantity: International Journal of Methodology,* 41**,** 673-690.

OFFERDAL, E., CORTÉS, M., ZERMEÑO, M., HILAIRE, A., INCHAUSTE, G., DELGADO, F., PANCORBO, A. & KELLER, W. 2000. Ecuador: Selected Issues and Statistical Annex. Washington, D.C.: IMF.

PERSSON, T. 2001. Currency Unions and Trade: How Large Is the Treatment Effect? *Economic Policy,* 16**,** 435-448.

QUINTYN, M. G. & HOELSCHER, D. S. 2003. Managing Systemic Banking Crises. International Monetary Fund IMF Occasional Papers: 224.

QUISPE-AGNOLI, M. & WHISLER, E. 2006. Official Dollarization and the Banking System in Ecuador and El Salvador. *Federal Reserve Bank of Atlanta Economic Review,* 91**,** 55-71.

ROSE, A. K. & VAN WINCOOP, E. 2001. National Money as a Barrier to International Trade: The Real Case for Currency Union. *American Economic Review,* 91**,** 386-390.

SALVATORE, D., DEAN, J. W. & WILLETT, T. D. 2003. Introduction. *In:* SALVATORE, D., DEAN, J. W. & WILLETT, T. D. (eds.) *The dollarization debate.* Oxford and New York: Oxford University Press.

SCHULER, K. 2005. SOME THEORY AND HISTORY OF DOLLARIZATION. *CATO Journal,* 25**,** 115-125.

SWISTON, A. 2011. Official Dollarization as a Monetary Regime: Its Effects on El Salvador. International Monetary Fund, IMF Working Papers: 11/129.

TOWERS, M. & BORZUTZKY, S. 2004. The Socioeconomic Implications of Dollarization in El Salvador. *Latin American Politics and Society,* 46**,** 29-54.

WOOLDRIDGE, J. M. 2009. *INTRODUCTORY ECONOMETRICS: A Modern Approach,* Canada, South-Western Cengage Lerning.

Electronic Sources

CIA (2013) *The World Factbook*.
https://www.cia.gov/library/publications/the-world-factbook/ Retrieved 2013-12-04

U.S. Department of State (2002) *Background Notes.*
http://www.state.gov/outofdate/bgn/elsalvador/23899.htm Retrieved 2013-11-29

Proceso (2002) *Weekly News Bulletin* No. 986 February 6
http://www.uca.edu.sv/publica/proceso/proci986.html Retrieved 2013-11-20

Appendix A. Variable Definition

Consumer Prices Ecuador defined by IMF. Source: Central Bank of Ecuador.
Weights Reference Period: 2004; Geographical Coverage: covering eight cities with a population of more than 20,000; Number of Items in the Basket: 299 items; Basis for Calculation: Survey of Incomes and Expenses of Urban Homes, conducted during the period from February 2003 to January 2004.

Consumer Prices El Salvador defined by IMF. Source: Central Reserve Bank of El Salvador.
Weights Reference Period: August 2005- September 2006; Geographical Coverage: Six departments of the country (Sonsonate, Santa Ana, La Libertad, San Salvador, La Paz y San Miguel); Number of Items in Basket: 238; Basis for Calculation: The weights are derived from the ENIGH, which covers the period from August to September 2006.

Domestic Lending Rate Ecuador defined by IMF
Weighted average rate charged by private banks on 92- to 172-day loans in national currency. Beginning in January 1999, weighted average rate charged by private banks on 92- to 172-day loans in U.S. dollars. Nominal interest rates published from January 1999 to July 2007 were recalculated and expressed as annual effective rates. Beginning in September 2007, weighted average of the annual effective rates charged by all other depository corporations on 121- to 180-day loans in U.S. dollars.

Domestic Lending Rate El Salvador defined by Central Reserve Bank of El Salvador.
Loans one year or less

US dollar Lending Rate El Salvador defined by Central Reserve Bank of El Salvador.
Loans one year or less

Appendix B. Statistical Tables

Z- table

P (%)	z	P (%)	z
50	0,0000	2,3	1,9954
45	0,1257	2,2	2,0141
40	0,2533	2,1	2,0335
35	0,3853	2,0	2,0537
30	0,5244	1,9	2,0749
25	0,6745	1,8	2,0969
20	0,8416	1,7	2,1201
15	1,0364	1,6	2,1444
12	1,1750	1,5	2,1701
10	1,2816	1,4	2,1973
9	1,3408	1,3	2,2262
8	1,4051	1,2	2,2571
7	1,4758	1,1	2,2904
6	1,5548	1,0	2,3263
5	1,6449	0,9	2,3656
4,8	1,6646	0,8	2,4089
4,6	1,6849	0,7	2,4573
4,4	1,7060	0,6	2,5121
4,2	1,7279	0,5	2,5758
4,0	1,7507	0,4	2,6521
3,8	1,7744	0,3	2,7478
3,6	1,7991	0,2	2,8782
3,4	1,8250	0,1	3,0903
3,2	1,8522	0,05	3,2906
3,0	1,8808	0,01	3,7191
2,9	1,8957	0,005	3,8907
2,8	1,9110	0,001	4,2650
2,7	1,9268	0,0005	4,4174
2,6	1,9431	0,0001	4,7537
2,5	1,9600	0,00005	4,8919
2,4	1,9774	0,00001	5,1997

F- table

		ν_1											
ν_2	p	11	12	13	14	15	20	25	30	40	60	120	∞
11	0,05	2,82	2,79	2,76	2,74	2,72	2,65	2,60	2,57	2,53	2,49	2,45	2,40
	0,025	3,47	3,43	3,39	3,36	3,33	3,23	3,16	3,12	3,06	3,00	2,94	2,88
	0,01	4,46	4,40	4,34	4,29	4,25	4,10	4,01	3,94	3,86	3,78	3,69	3,60
12	0,05	2,72	2,69	2,66	2,64	2,62	2,54	2,50	2,47	2,43	2,38	2,34	2,30
	0,025	3,32	3,28	3,24	3,21	3,18	3,07	3,01	2,96	2,91	2,85	2,79	2,73
	0,01	4,22	4,16	4,10	4,05	4,01	3,86	3,76	3,70	3,62	3,54	3,45	3,36
13	0,05	2,63	2,60	2,58	2,55	2,53	2,46	2,41	2,38	2,34	2,30	2,25	2,21
	0,025	3,20	3,15	3,12	3,08	3,05	2,95	2,88	2,84	2,78	2,72	2,66	2,60
	0,01	4,02	3,96	3,91	3,86	3,82	3,66	3,57	3,51	3,43	3,34	3,25	3,17
14	0,05	2,57	2,53	2,51	2,48	2,46	2,39	2,34	2,31	2,27	2,22	2,18	2,13
	0,025	3,09	3,05	3,01	2,98	2,95	2,84	2,78	2,73	2,67	2,61	2,55	2,49
	0,01	3,86	3,80	3,75	3,70	3,66	3,51	3,41	3,35	3,27	3,18	3,09	3,00
15	0,05	2,51	2,48	2,45	2,42	2,40	2,33	2,28	2,25	2,20	2,16	2,11	2,07
	0,025	3,01	2,96	2,92	2,89	2,86	2,76	2,69	2,64	2,59	2,52	2,46	2,40
	0,01	3,73	3,67	3,61	3,56	3,52	3,37	3,28	3,21	3,13	3,05	2,96	2,87
20	0,05	2,31	2,28	2,25	2,22	2,20	2,12	2,07	2,04	1,99	1,95	1,90	1,84
	0,025	2,72	2,68	2,64	2,60	2,57	2,46	2,40	2,35	2,29	2,22	2,16	2,09
	0,01	3,29	3,23	3,18	3,13	3,09	2,94	2,84	2,78	2,69	2,61	2,52	2,42
25	0,05	2,20	2,16	2,14	2,11	2,09	2,01	1,96	1,92	1,87	1,82	1,77	1,71
	0,025	2,56	2,51	2,48	2,44	2,41	2,30	2,23	2,18	2,12	2,05	1,98	1,91
	0,01	3,06	2,99	2,94	2,89	2,85	2,70	2,60	2,54	2,45	2,36	2,27	2,17
30	0,05	2,13	2,09	2,06	2,04	2,01	1,93	1,88	1,84	1,79	1,74	1,68	1,62
	0,025	2,46	2,41	2,37	2,34	2,31	2,20	2,12	2,07	2,01	1,94	1,87	1,79
	0,01	2,91	2,84	2,79	2,74	2,70	2,55	2,45	2,39	2,30	2,21	2,11	2,01
40	0,05	2,04	2,00	1,97	1,95	1,92	1,84	1,78	1,74	1,69	1,64	1,58	1,51
	0,025	2,33	2,29	2,25	2,21	2,18	2,07	1,99	1,94	1,88	1,80	1,72	1,64
	0,01	2,73	2,66	2,61	2,56	2,52	2,37	2,27	2,20	2,11	2,02	1,92	1,80
60	0,05	1,95	1,92	1,89	1,86	1,84	1,75	1,69	1,65	1,59	1,53	1,47	1,39
	0,025	2,22	2,17	2,13	2,09	2,06	1,94	1,87	1,82	1,74	1,67	1,58	1,48
	0,01	2,56	2,50	2,44	2,39	2,35	2,20	2,10	2,03	1,94	1,84	1,73	1,60
120	0,05	1,87	1,83	1,80	1,78	1,75	1,66	1,60	1,55	1,50	1,43	1,35	1,25
	0,025	2,10	2,05	2,01	1,98	1,94	1,82	1,75	1,69	1,61	1,53	1,43	1,31
	0,01	2,40	2,34	2,28	2,23	2,19	2,03	1,93	1,86	1,76	1,66	1,53	1,38
∞	0,05	1,79	1,75	1,72	1,69	1,67	1,57	1,51	1,46	1,39	1,32	1,22	1,01
	0,025	1,99	1,94	1,90	1,87	1,83	1,71	1,63	1,57	1,48	1,39	1,27	1,01
	0,01	2,25	2,18	2,13	2,08	2,04	1,88	1,77	1,70	1,59	1,47	1,32	1,01