2015

The Optimum Currency Area Theory: An Analysis of the Pacific Alliance

Andres Mira
University of Central Florida

Showcase of Text, Archives, Research & Scholarship

THE OPTIMUM CURRENCY AREA THEORY: AN ANALYSIS OF THE PACIFIC ALLIANCE

by

ANDRES FELIPE MIRA

A thesis submitted in partial fulfillment of the requirements for
the Honors in the Major Program in Economics
in the College of Business Administration
and in The Burnett Honors College
at the University of Central Florida
Orlando, Florida

Spring Term 2015

Thesis Chair: Dr. Uluc Aysun

ABSTRACT

This thesis is intended to consider whether the South American members of the trade bloc, the Pacific Alliance, namely Chile, Colombia, Peru, form an optimum currency area (OCA). An in-depth review into the progression of OCA theory is done to formulate a proper econometric analysis. An empirical investigation is conducted by using main macroeconomic indicators from the time period 2001 to the third quarter of 2014 to examine if the aforementioned countries are within the definition of an OCA. An ordinary least squares regression is done on three major economic indicators to test the causes of the deviation from one another. Evidence suggests the group is currently not an OCA and extensive integration efforts would be needed before the group is within the bounds of forming an OCA.

TABLE OF CONTENTS

LIST OF TABLES

TABLE OF FIGURES

1 INTRODUCTION

The goal of this thesis is to determine whether the trade bloc, the Pacific Alliance (PA) forms an Optimum Currency Area (OCA) and as such, a viable candidate for a monetary union. The following sections will give a brief history of the PA and why it was chosen as a potential candidate to be an OCA along with a historical overview of the progression of OCA theory. This paper shall only focus on the South American members – Chile, Colombia, and Peru. This thesis takes a different turn from current literature in the regression model using an ordinary least squares (OLS) model instead of the conventional vector-auto regression (VAR) models. The validation for using a different model is given in the upcoming sections.

1.1 The Pacific Alliance

The PA is a trade bloc formed by Chile, Colombia, Mexico, and Peru in 2011 for the purpose of deepening economic integration and forging stronger trading ties across the world, with a specific focus on Asia-Pacific countries. [1] Within the four years since its creation, the trade bloc has shown true promise in integrating their economies.

With respect to trade openness, the four members have eliminated 92% of tariffs between one another, and the remaining 8% will be gradually eliminated over a seven year period. This is in addition to having the lowest average applied most-favored-nation (AFN) tariffs and the highest number of free trade agreement (FTA) partners compared to other South American countries (Nolte 2013). A focus has also been placed on developing and integrating the region's capital markets, a weakness in many developing countries. This lead to the creation of the *Mercado Integrado Latinoamericano* (MILA), which integrates the countries stock exchanges

---

[1] For more information in regards to the Pacific Alliance see Website: http://alianzapacifico.net/en

and allows for easier movements of capital between each country. Mexico's stock exchange joined MILA in late 2014 making it Latin America's largest stock exchange. The next step in economic integration is the reduction of barriers for labor mobility. PA members have begun prioritizing the elimination of visa restrictions for business people and tourists.[2] This outward orientation towards regional integration and trade is in stark contrast to the historical nature of Latin American trade pacts which have traditionally been more inward oriented in nature (Villarreal 2014).

With the changes in PA member's economic policies during the past decade and further economic integration, it is an ideal time analyze whether these changes have moved them towards an OCA. The results from this analysis will let us conclude if a formation of a currency union would be beneficial for these three countries. Before we can empirically address this question we must have a better understanding of the role of money, what an OCA actually is, and why it would be more beneficial to create a monetary union if in fact they are an OCA.

1.2 The Role of Money and Exchange Rates

Economic theory has given three primary roles of money: a medium of exchange, store of value, and unit of account (Mankiw 2013). Money as a medium of exchange will be the primary focus with understanding an OCA. In the context of international trade dealing with multiple currencies leads to a number transaction costs from converting one currency to another to volatility in the foreign exchange markets. When a currency is stable with respect to its trading partners those transaction costs are minimal but will always be present. Flexible exchange regimes, which allow their currencies to float naturally, will have to deal with costs associated

---

[2] The Pacific Alliance, Movement of People: http://alianzapacifico.net/en.

with volatility. Those nations who decide to peg their currencies with another will nevertheless have transaction costs caused by the conversion of currencies in the global market. If these costs begin to rise to sufficiently high levels, they will begin to hinder trade and slow economic growth. As a unit of account, having a currency which does not cause large swings in the denomination of goods for transactions is crucial for the stability of the respective economy. This is especially the case in South America as it is known for its high inflation and spouts of hyperinflation, which cause currencies to be traded at hundreds to thousands to one against the U.S. dollar. This forced Peru to redenominate its currency in the 1990s and Chile in the 1970s.[3] Unlike their neighbors, the PA central banks have all managed to stabilize their respective currencies within the past several years, now having inflation within their inflation targets. The final role of money is a store of value. With fiat currencies being the norm, confidence in the national government and its central banks is crucial to ensuring stable internal economies. This is even more so for developing countries in South America who are prone to capital reversals and which lack credible central banks.

1.3 Definition of an Optimum Currency Area

Mongelli (2002) defines an OCA as "the optimal geographic domain of a single currency, or of several currencies, whose exchange rates are irrevocably pegged" (1). The domain is described as a region whose factors are mobile internally and immobile externally (Mundell 1961). OCA's have certain properties that can be looked for in a region and this paper will focus on three; synchronization of their business cycles, similarities in inflation rates and convergence of exchange rate movements. Within the next section, I will provide a more detailed definition of an OCA.

---

[3] Redenomination is the act by a government of reducing the face value used in circulating currency..

It is important to note that Mundell, McKinnon, and Kenen (the three economist who helped develop the theory of OCA) centered their arguments on the fixed versus flexible exchange rate debate in the post-World War II era (Maes 1992). Maes (1992) also noted that early work on OCA theory "focused on the cost of giving up the exchange rate as an instrument of adjustment" (149). Later research efforts concentrated more on the benefits and costs of forming a monetary union, particularly during the formation of the European Monetary Union (EMU). These costs and benefits and the formation of the OCA arguments are given a more in depth look in the literature review section.

It should be noted than an OCA should not be confused with a currency union. Currency unions are, ideally, when countries forming an OCA abandon their national currencies for that of a regional currency. It is entirely possible to go the other direction and to have multiple optimum currency regions with in a single nation. This would suggest that a nation should have multiple currencies within its borders, though trends do not show this occurring, as it reduces the role of a currency as an adequate medium of exchange.

When a group of countries forms an OCA, it becomes economically more beneficial to create a monetary union than to maintain their own flexible exchange rate regimes or even fixing their exchange rates with one another. Although, any change in monetary policy nonetheless leads to various costs along with benefits. One of the most obvious costs is a country losing its monetary policy as such policies will then be conducted by a trans-national central bank. The farther away countries are from having OCA properties, the larger the costs that will arise from asymmetric internal and external shocks. The closer the countries are to an OCA, the lower this costs become and benefits of forming a monetary union rise. Those benefits are in the form of increased

macroeconomic stability and trade growth (Mongelli 2002). These costs and benefits are described in more detail in the next section.

2 LITERATURE REVIEW

Mundell's 1961 paper brought the topic of OCA into the spotlight and created the framework and foundation for the theory of the OCA. This study defines what an OCA is, specifically in the context of factor mobility and exchange rate regimes. Mundell made the case for a system of flexible exchange rates in the restriction that they are based on *regional* currencies and not on the standard national currencies. As stated previously he defined these regions as ones where factors of production are mobile internally and immobile externally and in which exchange rates are fixed internally. He emphasized labor mobility as a major factor to absorb shocks. Externally, exchange rates are variable as to correct any the balance of payments distortions. The main assumption in Mundell is that the exchange rate mechanism is an effective stabilization tool. This definition of Mundell, however only applies to the domain of a fairly small and homogenous OCA.

Although Mundell (1961) emphasized labor mobility as an important stabilizing mechanism and criteria for an OCA, this thesis will not be investigating labor mobility. This was a result of limitations in available labor mobility data for the region, as well as evidence from data available that current labor mobility within the region is minimal and current immigration patterns for the region are towards developed countries in North American and Europe.[4]

Mundell was also not clear if a currency area was based on a region of fixed exchange rates or if it was made up of a single monetary unit. He did though make the clear distinction

---

[4] The Migration Policy Institute provides immigration populations by country of origin and destination
http://www.migrationpolicy.org/

between the two in regards to their adjustment mechanisms. With this definition, viewing the exchange rate movements of a specific region internally and externally provides a basis for determining whether or not the area can be described as an OCA. By that, the areas' internal exchange rates should have low volatility and stable within a mean and external exchange rate should be floating against other currencies.

Mundell (1973) later provided a critique supporting monetary integration, later to be known as Mundell II. He argued that international risk sharing through portfolio diversification and financial integration is better attained in a single common currency area than labor mobility. This supports the argument for larger and more heterogeneous currency areas then his previous work backed. As such an arrangement of a larger OCA will allow for the spreading out of costs caused by asymmetric shocks to one area of the region. Therefore, an argument can be made that to discover a possible OCA; there will be a need for high levels of financial integration to allow for the mitigation of asymmetric shocks. McKinnon (2000) supported this view of portfolio diversification, especially as the positive effects from euro-denominated bonds and assets were beginning to emerge.

McKinnon (1963) agrees with Mundell's definition of an OCA, while expanding the theory with regards to trade and economic openness. McKinnon argued that a highly open economy will cause flexible exchange rates to be an ineffective tool. Flexible exchange rates will most likely cause negative consequences to price stability as any devaluation will cause domestic prices to rise. A very important component in McKinnon (1963) is the detailed focus on the liquidity of money. He made the argument that small currency areas will need to fix their exchange rates to enhance growth and maintain large capital movements. This gives support to the idea of monetary integration within a highly integrated region. From this we draw to the

6

conclusion that highly open economies with significant trade with each other constitute another criterion of an OCA and be better off forming a single currency area. Although PA countries are relatively open to the world compared to non-member Latin American countries, they have little intra-regional trade as they are primary resourced based economies.

Kenen (1969) expanded the ideas of McKinnon and Mundell by introducing the criterion of trade diversification as a better way of characterizing an OCA. He argued that a region with more diversified exports is more stable and less likely to experience external shocks. This diversification of trade will allow for flexible exchange rates as a tool to maintain external balances and allow it to fix its exchange rate with other diversified trading partners. This expanded definition of an OCA, though, favors monetary integration between only industrialized nations, such as a monetary union within Europe (Maes 1992). With regards to the PA members in South America who are still in a developing stage and not highly diversified, Kenen (1969) would argue against a currency area and for maintaining individual flexible exchange rates.

From the EMU experiment, McKinnon (2004) notes that nations who have unstable and weak public finances should not join in a monetary union as the costs of joining a monetary union would outweigh the benefits. This is caused by the fact that the fiscal irresponsibility of one member will hinder a new monetary currency from been credible worldwide, and as such not create the benefits from joining a union. Although fiscal positions are not analyzed in this thesis, it is important to note the general trends of debt to GDP ratios and budget deficits to GDP for the group. All countries are experiencing a downward trend with regards to Debt to GDP with all countries being below 31% by the end of 2013. Deficit to GDP ratios show a similar downward pattern. Colombia, with the largest budget deficits of the group, has seen considerable fiscal

constraint as its deficits decreased from 6.2% in 2001 to 2.4% in 2013. Interestingly, the group would satisfy the convergence criteria for the EMU with respect to fiscal responsibility.

The benefits resulting from trade have been documented by Rose (2000). Countries in monetary unions are more integrated, have more trade, and have less volatile exchange rates than with countries with their own national currencies. This is highly beneficial for developing countries as they are usually characterized by high volatility and export dependence.

Mongelli (2002) lists other main benefits of participating in a monetary union; of course this is when the currency union constitutes and OCA. He describes improvements in microeconomic efficiencies coming primarily from the "increased usefulness of money" (8). From a macroeconomic perspective, Mongelli (2002) noted that there was an improvement in the factors of price stability and more transparent financial markets. Another benefit noted earlier is lowering of transaction costs, due to the wider circulation of the new currency in the international markets.

More recent studies of whether certain regions constitute an OCA us econometric models, to test for symmetry between the economic shocks and the responses within the regions in those studies. This is due to the assumption that the more symmetric the shocks and responses are, the need for different political responses will no longer be needed, as one symmetric response would suffice for the entire region such as one central bank policy action. Bayoumi and Eichengreen (1994) were among the first to use a structural vector-auto regression analysis (VAR) with the theory of OCA to analyze these macroeconomic disturbances. They simulate supply and demand disturbances on output and inflation for a set of nations as a way to identify credible candidates for an OCA. From their analysis, no group of nations in North and South America was found to be a viable candidate for a currency union.

Beginning in the early 2000's, richer VAR models have been formulated to more rigorously analyze economic disturbances and give a better comparison of the country groups in question. This also allows for a better understanding of whether or not a region constitutes an OCA. Allegret and San-Zantman (2009), for example, examined external (real and financial) and internal shocks and finds that Latin American countries are all affected by external variables such as output of industrialized nations and commodity prices. However, some of their findings are inconclusive or contradictory to a large body of literature. Eichler and Karmann (2011) use an expanded VAR model by adding the endogenous variables real exchange rates and trade. The findings show that although South America as a whole does not constitute an OCA, some nations may be better off creating bilateral currency unions.

This literature survey demonstrates that the theory of OCA and monetary integration has become complex with just as many ways to answer the question of OCA and monetary integration. To see if a region is truly an OCA and if it would be beneficial to abandon each own national currency for that of a single, regional one, a detailed analysis of the region's economies must be conducted. Although most current analyses use VAR models, a direction away from a VAR model was taken as VAR models requires assumptions that may have weak economic foundations and problems with identifying where shocks are originating from. The purpose of the model of this thesis is to measure and identify where shocks that deviate the country's macroeconomic indicators from the regional averages are originating from and how the dimension of time is effecting the deviations; none of this questions can be answered with a VAR model. As such, this thesis took the route of estimating an OLS model with country and time fixed effects so as to better identify the origins of the external shocks that are leading to the countries deviating from the trade bloc average.

3   METHODOLODY

This thesis seeks to verify whether the South American members of the PA constitute an OCA. Three steps will be taken, first a look at two major macroeconomic indicators-output growth and inflation rates-to test if they are synchronized. Second, an In-depth look at exchange rate movements externally and internally. Finally, a least squares dummy variable (LSDV) regression to examine internal and external shocks on the deviation of these countries' three main economic variables from their respective arithmetic mean of the entire group.

3.1 Macroeconomic Indicators

For output growth, quarterly real gross domestic product (GDP) growth rates data were used to compute annual growth rates from 2001Q1 to 2014Q3. Annualized inflation rates were computed from the same sample period from quarterly data. Both indicators were gathered from Trading Economics[5]. For both indicators, correlations and summary statistics were calculated excluding Q2-Q4 of 2009.[6]

3.2 Exchange Rate Movements

As a characteristic of an OCA, countries of a possible OCA should be exhibiting similar exchange rate movements with respect the world. Their exchange rates with respect to one another should be fluctuating around a mean such as not to be appreciating nor depreciating against one another in the long run. Thus separate analyses on both internal and external exchange rate movements are conducted. While most papers on this topic tend to focus on real exchange rates, this paper has taken the route of using nominal exchange rates. This decision was

---

[5] More information on trading economics can be gathered at www.tradingeconomics.com
[6] This was done due to the global economic shock of the great recession during that time period.

taken as any policy decision towards the creation of a monetary union will likely focus on nominal exchange rates such as the European Union does with its Exchange Rate Mechanism II (ERM II).[7] Quarterly data on exchange rates was gathered from the Oanda Corporation from the period 2001 to the third quarter of 2014. To compute the values of exchange rates, the average of the bid and ask price of the quarters where taken. As the countries have a wide range in the numerical value of their exchange rates, data was transformed to have a base in quarter 1 of 2001 at a value of 100.

For simplicity, the exchange rate with respect to the U.S. dollar will be used as a measure of external exchange rate movements. This is done since the U.S. is the world reserve currency and most trade transactions are denominated in U.S. dollars, and the U.S. is a major trading partner with each of the sample countries. An analysis will comprise of investigating exchange rate movements against the US dollar as well as the movements of their volatility. Volatility in this case is measured as the standard deviation divided by the mean. For internal exchange rates, we examine the data to verify if the exchange rates are statistically deviating from one another (i.e. appreciating or depreciating) and at the volatility of their exchange rates over time. For internal exchange rates movements, three exchange rates are considered. These include the exchange rate movements of Chile-Colombia, Chile-Peru, and Peru-Colombia. For internal movements, a look at whether they are staying within a specific mean and their degree of validity is needed.

3.3 Least Squares Dummy Variable Model

In this section I build an OLS model with country and time fixed effects to analyze the causes of the member countries deviation from the trade bloc averages. Specifically, three

---

[7] The ERM has the potential members of the European Monetary Union (EMU) semi peg their exchange rates to the Euro. If those countries' currencies stay within a set margin, they are considered in entering the EMU.

regression models will be constructed as least squares dummy variable models (LSDV) and they will be estimated with panel data. The three variables were created by taking the absolute values of the difference between the country and the mean of the respective variable. The absolute values are taken due to only looking at the causes away from the center, not the direction of which way the deviations are occurring. Those three variables are, each country's output growth deviation from the mean of the trade group ($| Y_{it} - \overline{Y_t} |$) ,the deviation of the country's inflation rate from the average inflation rate of the group ($| I_{it} - \overline{I_t} |$) and lastly, the deviations of external exchange rates ($|Ex_{it} - \overline{Ex_t}|$) from the mean will conclude this regression. Observing what is causing shocks on a countries output growth, inflation and the exchange rates to the deviate the regional averages can help create a better understanding why these countries are either an OCA or not. As such information will allow concluding the symmetry of specific macroeconomic shocks. These three dependent variables will be regressed on a number of internal and external shocks.

For simplicity, the three regressions will have the same variables. All variables will be transformed into the lag differences and will be labeled as the LD. in the equation. For internal variables we will be taking the lag difference of the deviation of output from the mean, of inflation rates from the mean, and of exchange rates from the mean. This is done to measure if any divergence from previous time period will cause the countries to diverge even farther. Other internal variables include unemployment (UE) and foreign exchange reserves (FXR). Foreign exchange reserves are used as a proxy for balance of payments as done in other papers (e.g. Allegret 2009) and due to lack of quarterly balance of payment data. External variables include annualized growth rates for US (USY) and annualized growth rates of China (CHINAY). Since China and the US make up the two largest trading partners for each country (Villarreal 2014) it

would be desired to see if any change in these countries affect the PA members differently. Another external variable was an energy price index (ENERGY). The energy index comprises of the crude oil, natural gas and coal price indices with a base year of 2005 and transformed to represent annualized changes in the index. Two other variables added are the spread between the countries benchmark interest rates and the mean benchmark interest rate of the group $(R_{It} - \overline{PAR_t})$ and the spread of countries benchmark rate with respect to the US federal reserve rate $(R_{It} - \overline{USR_t})$. To capture unobservable country specific and time specific effects a dummy variable for each was created; COUNTRY and TIME respectively. This leads us to equation (1).

$$|Y_{it} - \overline{Y_t}| = \text{ß} + \text{ß}1\,LD.|Y_{it} - \overline{Y_t}| + \text{ß}2LD.|I_{it} - \overline{I_t}| + \text{ß}3LD.|Ex_{it} - \overline{Ex_t}| + \text{ß}4LD.\,USY_t$$

$$+ \text{ß}5\,LD.\,CHINAY_t + \text{ß}5LD.\,UE_{it} + \text{ß}6LD.\,FXR_{it} + \text{ß}8LD.\,ENERGY_t + \text{ß}9LD.(R_{It} - \overline{USR_T})$$

$$+ \text{ß}10LD.(R_{It} - \overline{PAR_T}) + \text{ß}9COUNTRY_I + \text{ß}9TIME_t + U_{it} \tag{1}$$

Equation 1 will be replicated with $(|I_{it} - \overline{I_t}|)$ and $(|Ex_{it} - \overline{Ex_t}|)$ as dependent variables. It is important to add that as we are dealing with dummy variables and to prevent the dummy variable trap one from each has to be omitted for the regression and thus a time and country dummy where omitted. Specifically, Colombia and year 2001 were omitted for these regressions; as such the slope intercept is the average deviation Colombia is from the mean in the year 2001.

The statistical program STATA was used for the econometric analysis. Estimation was performed with STATA 13. All data for this regression is quarterly and collected from Trading Economics except the energy index which was collected from the International Monetary Fund (IMF).

4 RESULTS

4.1 Macroeconomic Indicators

Business Cycle. Unlike many of its South American neighbors, Chile, Colombia, and Peru have been experiencing strong and stable economic growth in the 21st century. This is also considerably different from the volatile past these countries experienced in the latter half of the 20th century. Output is measured as annualized quarterly real GDP growth rates from the beginning of 2001 to the third quarter of 2014. In estimating correlations in the business cycle between countries, the quarters effected by the global recession were removed. This was done to see how their economies have changed since the global recession.

Table 1: Correlation of GDP growth in Pacific Alliance

Q1 2001 - Q1 2009					
	CHILE	COLOMBIA	PERU	MEAN	STANDARD DEVIATION
CHILE	1.000			4.06	2.16
COLOMBIA	**0.522**	1.000		4.32	2.03
PERU	0.173	**0.569**	1.000	5.63	2.51
Q1 2010- Q3 2014					
	CHILE	COLOMBIA	PERU	MEAN	STANDARD DEVIATION
CHILE	1.000			4.80	2.07
COLOMBIA	-0.107	1.000		4.85	1.50
PERU	**0.767**	-0.042	1.000	6.06	2.18

Table 1 shows an interesting phenomenon occurring with regards to the business cycle of PA members. Peru and Chile's growth rates have become highly correlated since the global recession affected them in 2009. In contrast, Colombia's business cycle has seen a drastic change

with respect to the other two members of the PA to the extent that they are now negatively correlated after 2009. It may be important to note that Colombia was the only member of the PA to not have officially been in a recession as it did not experience a decrease in its yearly output levels. Growth rates on average increased and the volatility of the business cycle has seen a decrease since 2009. This may be due to the countries diversifying away from U.S. and Europe who continue to experience slow growth for nations such as China who require extensive natural resources to maintain strong growth levels.

Inflation. With regards to inflation, this is another economic indicator that deviates this trade bloc from the rest of South America. Inflation is measured with annualized quarterly data from the first quarter of 2001 to the third quarter of 2014. Inflation targeting policies of Chile, Colombia, and Peru have seemed to have performed well over the past decade bringing inflation to low and stable levels. Prices in those countries have stabilized in recent years and have converged since the 2008 Global recession as it can be seen in Figure 1.

Figure 1: Annualized Inflation Rate in Pacific Alliance
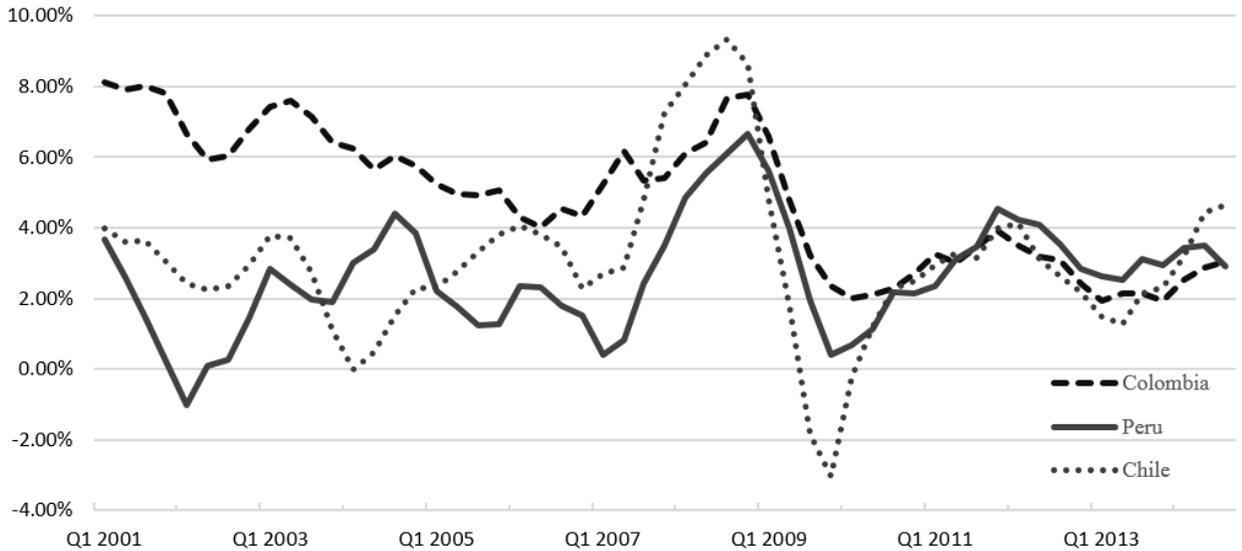
In the final quarters of 2014 inflation rates appear to be slightly diverging from one another again. Only time will tell if these countries central banks will be able to maintain their targeting levels in the long run or fall into the historical trends of Latin America with spouts of high inflation. Table 2 shows the correlation of annualized inflation rates along with a summary statistic, excluding the 2009 global recession such as done with output growth for the same reasons.

Table 2: Correlation of Inflation rate in the Pacific Alliance

Q1 2001 - Q1 2009					
	CHILE	COLOMBIA	PERU	MEAN	STANDARD DEVIATION
CHILE	1.000			3.72	2.45
COLOMBIA	0.225	1.000		6.17	1.04
PERU	**0.632**	0.236	1.000	2.51	1.88
Q1 2010 - Q3 2014					
	CHILE	COLOMBIA	PERU	MEAN	STANDARD DEVIATION
CHILE	1.000			2.66	1.22
COLOMBIA	0.431	1.000		2.71	0.60
PERU	**0.810**	0.596	1.000	2.91	0.97

Table 2 shows what is depicted in figure 1. Post 2009, volatility in all countries has seen a decreased compared to before the recession. Peru and Chile have experience a movement towards stronger correlation in their inflation rates. Colombia continues to have weak correlation with the other two members of the PA, though it experienced a drastic decrease in its average annualized inflation rate.

The low inflation and GDP correlation Colombia has with the other two members increases the suspicion that this region as a whole does not form an OCA. Although, a bilateral currency

union may be desired in the near future between Peru and Chile as their business and inflationary cycles appear to be converging (in the form of higher correlation) as it signifies that they are moving towards an OCA.

4.2 Exchange Rate Results

External Exchange Rates

Figure 2: Exchange Rate Movements with the U.S. Dollar
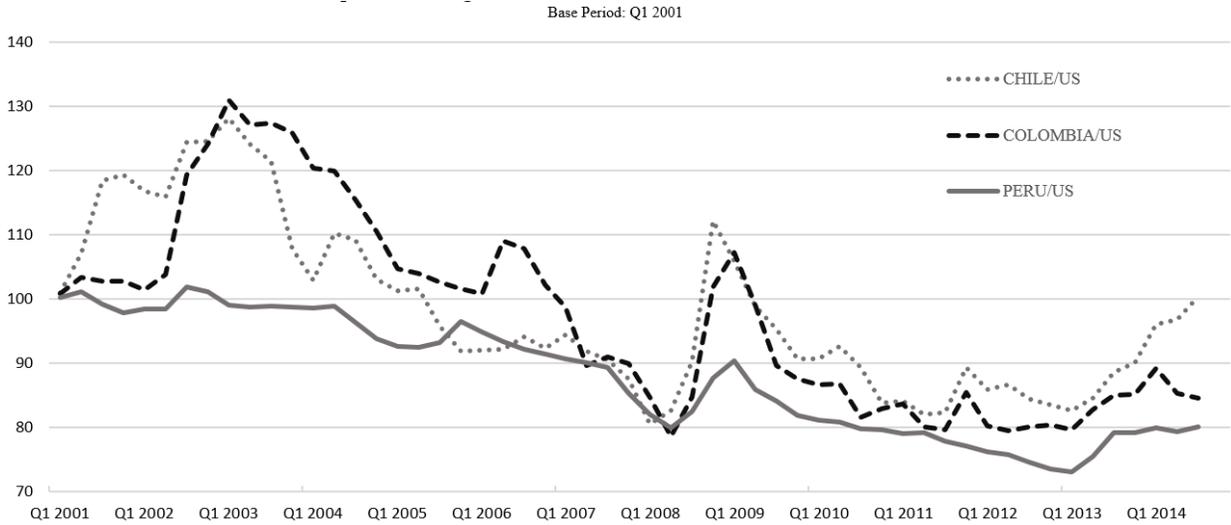
Tables 3 and 4 below give insights into these economies. We can make the assumption that Peru is involved more heavily in affecting the foreign exchange rate market, as volatility is relatively low compared to its peers during the period. All countries throughout the time frame have had an appreciating trend with respect to the United States (the papers substitute for external movements).

Volatility is decreasing across the entire period-except during the great recession. From here we can assume exchange rate movements with the world are stabilizing. As they are so

highly correlated in their movements with the US dollar, it can be assumed that a single currency would be more beneficial than having three national currencies.

Table 3: Correlation of External Exchange Rates

	Q1 2001 - Q3 2014		
	CHILE	COLOMBIA	PERU
CHILE	1.000		
COLOMBIA	**0.842**	1.000	
PERU	**0.810**	**0.890**	1.000

Table 4: Descriptive Statistics for External Exchange Rates

YEARS	CHILE/PERU		CHILE/COLOMBIA		COLOMBIA/PERU	
	MEAN	VOLATILITY	MEAN	VOLATILITY	MEAN	VOLATILITY
2001-2002	115.9	7.1%	107.3	8.5%	99.7	1.5%
2003-2004	113.4	8.6%	122.2	5.6%	97.8	1.9%
2005-2006	95.1	4.3%	104.1	2.9%	93.3	1.7%
2007-2008	91.2	10.6%	89.8	8.4%	85.9	4.8%
2009-2010	93.3	7.2%	90.1	9.6%	82.9	4.5%
2011-2012	84.7	2.9%	81.1	2.7%	76.6	2.7%
2013-2014	92.9	8.3%	85.8	85.8%	78.6	3.9%

Internal Exchange Rates

With respect to internal exchange rate movements, table 5 shows us some interesting results in regards to the movements of exchange rates within the trade bloc. Volatility for all pairs shows a downward trend, Colombia/Peru exchange rates showing the lowest level of volatility at 1.7% deviation from the mean. Another interesting observation is with the respect to the mean and volatility of 2001-02 and 2013-14. Looking at the mean and standard deviation (Table 5) it is clear that the means are statistically the same. That is, although the currencies have

appreciated and depreciated in between the time period, in the end they maintain a constant mean. Unfortunately, I cannot tell whether this is simply due to the time frame chosen for the paper or a pattern that will continue to be present over time.

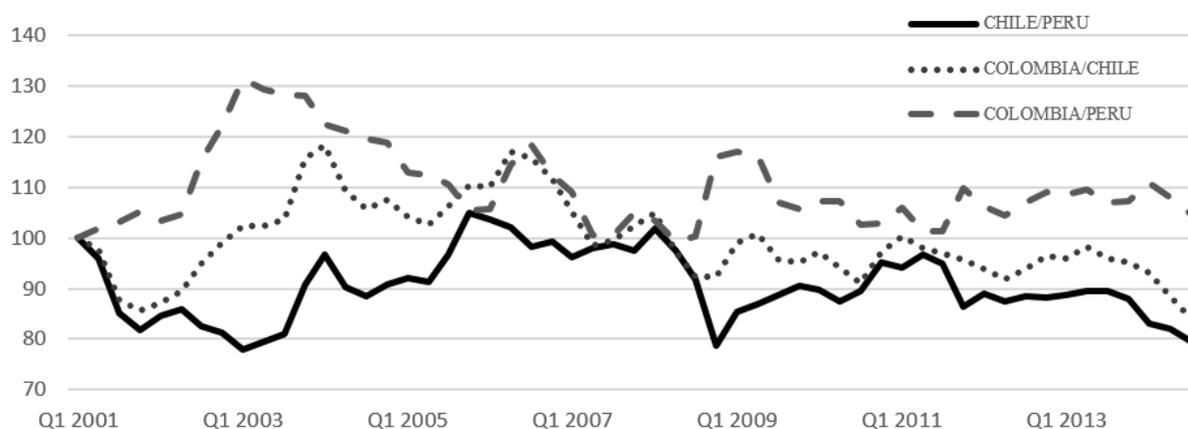Figure 3: Exchange rate Movements within the Pacific Alliance

Table 5: Descriptive Statistics for Internal Exchange Rates

YEARS	CHILE/PERU		CHILE/COLOMBIA		COLOMBIA/PERU	
	MEAN	VOLATILITY	MEAN	VOLATILITY	MEAN	VOLATILITY
2001-2002	87.1	8.0%	92.7	6.3%	107.0	7.2%
2003-2004	86.9	7.7%	108.1	5.6%	124.9	4.0%
2005-2006	98.5	5.2%	109.7	4.7%	111.5	3.9%
2007-2008	95.0	7.5%	99.0	5.0%	104.3	5.5%
2009-2010	89.2	3.3%	96.3	3.2%	108.3	5.1%
2011-2012	90.7	4.3%	95.9	2.8%	105.6	3.0%
2013-2014	85.8	4.7%	93.0	5.2%	108.0	1.8%

Support for an OCA can be made with the observed data on internal exchange rate movements as the respective exchange rates appear to be fluctuating from a mean with little to no appreciation (depreciation) in the long run. It can also be assumed that, as volatility is decreasing within the region, the countries exchange rates appear to be stabilizing. As volatility has reached low levels, it may be in fact more beneficial to fix their exchange rates or form a

currency union outright. Though, a more in-depth and broad analysis on their exchange rate movements and a much larger time period must be conducted prior to concluding that the patterns seen in this time span are representative of what is expected in the future or only an anomaly.

4.3 Regression Results

To be able to understand the results, it is important to reiterate that an OCA should not be having individual members deviating away from the mean of the main macroeconomic indicators to a large degree. This implies there are possibly internal and external shocks which are causing such movements. From these regressions, the main aspects to look at are the significance and the sign of the coefficients of the explanatory variables. For the lagged values of the dependent variable, a slope coefficient less than 1 signifies convergence while a value larger signifies divergence. A problem arises when the slope coefficients are negative since the dependent variable is in absolute terms. [8] For this thesis, a negative value is interpreted leading to the countries converging to the mean.

---

[8] An augmented Dickie-Fuller unit root test completed for the model. The test shows that the panel data does contain a unit root. This implies that the casual effects in the regression may be biased.

Table 6: Regression Results

EXPLENATORY VARIABLES	DEPENDENT VARIABLES		
	Y-MEAN	I-MEAN	EX-MEAN
LD.Y-MEAN	**0.126**	0.030	-0.354
	(0.069)*	(0.056)	(.218)
LD.I-MEAN	0.028	**0.632**	**-1.228**
	(0.154)	**(0.123)***	**(0.485)**
LD.EX-MEAN	0.043	0.017	**0.399**
	(0.035)	(0.028)	**(0.112)**
LD.USY	0.056	0.055	0.379
	(.125)	(0.101)	(0.395)
LD.CHINAY	**-0.182**	0.062	-0.111
	(0.101)*	(0.082)	(0.320)
LD.UE	-0.042	0.006	0.174
	(0.066)	(0.053)	(0.209)
LD.FXR	0.010	0.005	-0.026
	(0.006)	(0.005)	(0.019)
LD.ENERGY	0.595	0.163	-2.206
	(0.559)	(0.449)	(1.761)
LD.USSPREAD	0.278	-0.019	-0.750
	(0.172)	(0.138)	(.543)
LD.PASPREAD	**-0.432**	-0.163	**1.572**
	(0.224)*	(0.180)	**(.707)**
PERU-D	0.169	**-0.311**	**2.631**
	(0.173)	**(0.139)**	**(.546)**
CHILE –D	0.141	**-0.511**	0.575
	(0.173)	**(0.139)***	(.544)
2002	0.648	-0.299	1.089
	(0.495)	(0.398)	(1.562)
2003	0.46	-0.508	**4.822**
	(0.483)	(0.388)	**(1.523)***
2004	0.16	**-0.751**	0.802
	(0.484)	**(0.389)***	(1.526)
2005	0.417	**-1.165**	**-2.603**
	(0.485)	**(0.390)***	**(1.529)***
2006	0.752	**-1.581**	-1.786
	(0.485)	**(0.390)***	(1.527)
2007	**1.007**	**-1.09**	**-4.075**
	(0.503)	**(0.405)***	**(1.587)**
2008	**1.247**	**-1.466**	-1.697
	(0.511)	**(0.411)***	(1.610)

2009	**1.107** **(0.527)****	**-1.14** **(0.423)*****	-2.892 (1.660)
2010	0.79 (0.562)	**-2.02** **(0.452)*****	**-3.892** **(1.771)****
2011	0.078 (0.488)	**-2.359** **(0.393)*****	**-3.056** **(1.539)****
2012	0.118 (.495)	**-2.282** **(0.398)*****	**-3.276** **(1.559)****
2013	0.281 (0.475)	**-2.177** **(0.382)*****	**-2.923** **(1.498)***
2014	0.557 (0.495)	**-2.006** **(0.398)*****	-0.485 (1.559)
CONSTANT	0.465 (0.412)	**2.776** **(0.332)*****	**5.762** **(1.300)*****
N	158	158	158
Adj. R^2	.1997	.5503	.5496

* Significant at 10%   ** Significant at 5%   *** Significant at 1%

(standard errors in parentheses)

Regression 1: Deviations of country's output from the mean of the PA.

From the results, a 1 percent change in the previous quarter's deviation away from the PA average growth rate will only lead to the country's growth rate to be .126% away from the mean in the current time period at a 10% statistically significant rate. This is what you would expect from a a region that constitutes a OCA as any country that begins to diverge from the rest of the region will ultimately converge back to the average and this is exactly what is happening. An interesting result that is difficult to explain is that a positive change in China's annualized growth rates in the previous quarter leads to a convergence in output at a 10% significant level. This is fascinating as it also means a decrease in China's growth rates will cause the countries to deviate from the mean of the region. What this implies is that, as China's economy begins to slow down, the consumption of each country's natural recourses is affected at different enough rates to cause their economies to deviate. The fact that it is significant and that China is expected to continue to

have a decelerating growth rates for the foreseeable future is something that should continue to be observed. Another variable that was statistically significant was the interest rate spread between a country and the average of the PA. As the spread increases in previous quarter, output growth of that country is expected to converge to the regional average. A possible cause of this result is the central bank raising interest rates to slow down an overheated economy. Though, as the dependent variables are in absolute values, this direction cannot be confirmed. The time period coinciding with the global recession of 2008-2009 had a significant impact with countries experiencing a deviation of 1% to 1.2% in GDP growth rates away from the mean. Although external shocks coming from the United States or energy prices did not cause a statistically significant deviation, it appears that external shocks in the global scale will affect these countries in a manner that does not constitute them been part of an OCA.

Regression 2: Deviations of the country's inflation from the mean of the PA.

Time was the most significant variable in this regression. Every year after 2003 was statistically significant and negative. This shows that as time passes, all countries are converging to the mean of the pacific alliance. This was seen in graph 1 and explained previously as we noticed the three countries inflation rates converging with one another in the previous years since the great recession. Peru and Chile dummy variable was statistically significant and negative. This informs as that both countries inflation rate are closer to the average than that of Colombia's inflation rate. With respect to the effect of lagged changes in inflation rates, as a country's previous period's inflation deviates by 1% away from the PA average rate of inflation, we see that inflation will only be diverging in the current time period by 0.632 percent. For clarification, this signifies that a deviation of inflation in previous periods will lead naturally converge back to

23

the average of the region, although at a slower pace than what was observed with deviations of output.

Regression 3: Deviations of the country's external exchange rates from the mean of the PA.

To begin, one can see that lagged deviations of a countries exchange rate away from the mean of the time period will see their exchange rates converging back at a significant level. . The lagged difference of inflation rates also had a negatively significant effect on exchange rate deviations. This result appears to be contradictory to economic theory as one should expect deviations of inflation from a group to cause exchange rates to deviate in the same direction. The spread of a country's interest rates and the average of the PA interest rates have a significant and positive effect on exchange rates deviation. This is expected as, for example, an increase in the spread of interest rates with respect to the PA will lead to an influx of capital into the country and cause an appreciation (deviation from the mean of the region). Since all three countries are of similar risk levels to investors since they are all developing countries, such change of interest rate spread will lead to investors moving from one country to another. While on the other hand, the interest rate spread with respect to U.S. Federal Reserve rate does not cause a deviation from the mean as the countries are treated similarly from a risk standpoint compared to the developed U.S. economy. Time was a factor that was statistically leading the countries to converge in respect to external exchange rates.

U.S. GDP growth and had little effect on the deviation of all three regressions. This shows that all countries are affected in similar ways by shocks from the United States. Surprisingly, energy prices did not statistically effect the deviation of the countries of any of the three main macroeconomic indicators. This is a positive sign showing that the economies of the three PA countries are affected in similar ways by external shocks to their main commodity

industries. Another surprising result from the observatory variables was that no statistical significant deviations where caused by Unemployment levels or Foreign exchange rate reserves. This is a positive sign that these countries may form an OCA as current shocks to their Unemployment or balance of payments will not cause the country to deviate from the region.

Another regression was done eliminating the absolute values from the model. As such, regressions on the three same macroeconomic variables were done regressed on the lag of those variables and all else the same. The results were slightly different than those of the regression of the thesis with all but the lagged values of the dependent variable been statistically significant. The lagged values of the dependent variable for all three regressions had a slope coefficient between -1 and 1 which signifies as the current model that any divergence will result the values converging slightly in present time.

5   CONCLUSION

Evidence from this paper suggests that the South American members of the PA do not form an OCA. Although from the LSDV regression we see that various shocks do not cause significant deviations from the three main economic indicators, the countries do not satisfy enough criteria to form the conclusion that they form an OCA. We see little trade diversification and minimal intra-regional trade, which is used to protect and spread out any asymmetric shocks that an OCA may still have. Although great strides have come in integrating their financial markets, further efforts are needed to strengthen what will constitute still weak financial and capital markets. Minimal levels of internal factor mobility, especially in terms of labor mobility across the entire region, needs to be addressed prior to being recognized as an OCA. So far, the countries seem to be using their own national currencies as an effective monetary policy as should remain with their respective currencies for the foreseeable future. Although the data suggest that the PA as a whole is not an OCA, in the long term, if the countries of Peru and Chile continue on their current path, a bilateral currency union may be beneficial, though more in-depth analysis of their economies will be needed for such a statement to be confirmed. If the PA continues its path of further integrating their economies at the rate they are, an OCA may very well be likely. Although for now, the countries should maintain their independent flexible exchange rate regimes.

6 REFERENCES

Allegret, J.P. and Sand-Zantman, A. (2009). "Does a Monetary Union protect again foreign shocks?   An assessment of Latin American integration" *Journal of Policy Modeling*, Vol. 31, pp. 102-118.

Bayoumi, T. and Eichengreen, B. (1994). "One money or many? Analyzing the Prospects for Monetary Unification in Various Parts of the World*." Princeton Studies in International Finance*, 76.

Eichler, S. and Karmann, A. (2011). "Optimum Currency Areas in Emerging Market Regions: Evidence Based on the Symmetry of Economic Shocks." *Open Economies Review*, 22, pp. 935-954.

Fritz, B. and Muhlich, L. (2006) "Regional Monetary Integration Among Developing Countries: New Opportunities for Macroeconomic Stability Beyond the Theory of Optimum Currency Areas?" *GIGA Working Papers, No. 38.*

Kenen, Peter B. (1969). "The Theory of Optimal Currency Areas: An Eclectic View." In Mundell and Swoboda, eds., *Monetary Problems in the International Economy,* Chicago: University of chicago Press.

Maes, I. (1992). "Optimum Currency Area Theory and European Monetary Integration" *Tijdschrift voor Economie en Management*, Vol. 37, No. 2, pp. 137-152.

Mankiw, N. Gregory. Principles of Macroeconomics. 8th Edition, New York: WorthPublishers, 2013. Print.

McKinnon, Ronald I. (1963). "Optimal Currency Area." *American Economic Review,* 53, September, pp. 717-724.

McKinnon, Ronald I. (2000). "Mundell, the Euro, and Optimum Currency Areas", *Working Paper*, No. 00009, Stanford University Department of Economics, Palo Alto, CA.

McKinnon, Ronald I. (2004). "Optimum Currency Areas and Key Currencies: Mundell I versus Mundell II," *Journal of Common Market Studies,* 83, pp. 151-159.

Mongelli, Francesco P. (2002). "New views on the optimum currency area theory: What is EMU telling us? (2002).

Mongelli, F. P. (2008). "European Economic and Monetary Integration and the Optimum Currency Area Theory." *Economic Papers 302.* European Commission. February.

Mundell, Robert A. (1961). "A Theory of Optimum Currency Areas." *American Economic Review,* 51, September, pp. 657-664.

Mundell, Robert A. (1973). "Uncommon Arguments for Common Currencies." In Johnson, H.G. and Swoboda, A.K. (eds). *The Economics of Common Currencies: Proceedings of the Madrid Conference on Optimum Currency Areas*, George Allen & Unwin, London, pp. 114-132.

Nolte, Detlef, and Leslie Wehner (2013). "The Pacific Alliance Casts Its Cloud over Latin America." *GIGAFocus. (Consultado el 2 de noviembre de 2013).*

Rose, A and Engel, C. (2000). "Currency Unions and International Integration." *National Bureau of Economic Research Working Paper No. 7872*, September

Scandizzo, Stefania (2003). "Options for Monetary Integration in the Andean Community," *Revista Venezolana de analisis de Coyuntura,* 6, pp. 65-105.

Villarreal, Angeles M. (2014). "The Pacific Alliance: A Trade Integration Initiative in Latin America." *Congressional Research Service,* October.