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THE ANDEAN DOLLAR: AN ANALYSIS FOR THE MONETARY UNION OF A SET OF
COUNTRIES IN THE ANDEAN REGION

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Abstract

Recent legislations for human capital mobility as well as existing pacts for international cooperation and trade unions between a set of Latin American countries arises judgments of whether it would be beneficial a monetary union among Bolivia, Chile, Colombia, Ecuador and Peru. Data covering the period from 2005 to 2019 and the use of VAR techniques for a macroeconomic analysis indicates that macroeconomic shocks between this set of countries are symmetric enough to indicate that a monetary union between this countries should be further analyzed. The same analysis was done between the five Latin American countries and the United States for the option of a dollarization as a way of union, but in this case macroeconomic shocks were sufficiently asymmetric to rather not advise a dollarization of this countries.

Keywords:

Monetary union; Dollarization; Latin America; Bolivia; Colombia; Chile; Ecuador; Peru; Andean Community; Pacific Alliance; Andean Region

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Introduction

The tendency of economic cooperation between Latin American countries is a fact that is getting more relevance as restrictions between the nations fall apart, and is creating the basis for an economic union characterized by the free movement of capital and labor (O'keefe, 1996). The creation of the Andean Community in 1969 was the first step in creating an international entity for the cooperation of the north-western countries of Latin America, this community with Bolivia, Colombia, Ecuador and Peru as current members and with Chile and Venezuela as former members, was seeking the effective coordination of economic, political and social aspects within the member countries. This union has been achieving milestones from the moment of its creation such as the inception of a common jurisdiction for trials known as "The Court of Justice of the Andean Community" in 1979, liberalizing the air transport markets by the "open skies" policy in 1991, approving a common external tariff regime in 1994, among others (Baracaldo, 2019).

A more recent effort for improving cooperation was settled when the Pacific Alliance was created in 2011, this time the international entity has as members Chile, Colombia, Mexico and Peru, and its goals have been more noticeable and transcendent than the ones of the Andean community, some of them are the integration of the stock markets of the member countries in 2011 (Campa 2015), the elimination of the need of a visa nor passport for tourism in 2012, the establishment of common embassies and consulates to provide Alliance citizens with the necessary diplomatic services in 2013 and a very important one is the constant dialogue for consensus on trade policies and agreements between the member parties and Asia-Pacific countries (Bown, 2017).

With these agreements in place and taking into account the tendency of future further market integrations as well as other factors of culture, language, institutions, history and demographics

worth assessing, sufficient arguments are placed for exploring in depth the case of a monetary union between the mentioned Andean countries. A second part of the analysis was added by including the United States as a country in the model, this with the purpose of evaluating the monetary union with the USA through official dollarization as other countries from the region had went through this path (such as Ecuador from the year 2000) and also due to the large trade volumes that it sustains with the analyzed countries.

To proceed with the evaluation and reviewing the theoretical framework suggestions from the “Theory of Optimum Currency Areas” (Mundell, 1961) were considered, explicitly the statement that if a country suffers from long-lasting shocks that are highly positively correlated with those of its potential partners a basis for the case of a monetary union are set, on the other hand long-lasting disturbances in the macroeconomic scenario which are not highly positively correlated with the potential partners of the union weakens the idea of a monetary union. Taking this into account and also the idea of the main role of any central bank which has been scoped to be to maintain the inflation rates at recommended levels for sustained economic growth which is between 2% and 4% and react proactively to avoid long-lasting periods of economic recession, the macroeconomic model developed by Blanchard and Quah (1989) and extended by Bayoumi (1991), Bayoumi and Eichengreen (1992, 1993, 1994a,b), Bayoumi and Taylor (1995), and Hallwood, Marsh & Scheibe (2006) is the one found optimal for doing the analysis of a monetary union. The main idea is to identify macroeconomic shocks with the chosen set of countries measured through the output, which will be the real GDP, and the price levels, measured by the Consumer Price Index, and check how they correlate and in which magnitude with the ones of the peer countries. This will be done with a bivariate vector auto-regressive model where it can be also accounted for the duration of this shocks. After the model is ran a comparison on the results from the same

metrics between European Monetary Union members before German re-unification and the results can be a good starting point for recommendations. And since the assessment of Hallwood, Marsh & Scheibe (2006) does a similar exercise with another set of Latin American countries, including Argentina, Brazil, Chile, Uruguay and Venezuela, it serves as point of comparison of whether this different set of countries and within this period of growing integration builds a stronger case for a different monetary union but within the same region. The results on the macroeconomic econometric analysis shows a positive correlation on permanent shocks for the set of Andean countries maxing 40.7% of correlation between Colombia and Peru and just one negative correlation between Bolivia and Peru, this correlations are higher than the ones presented in the aforementioned research on Mercosur countries and also than the European Union members in 1989. Correlation on shocks between the studied countries and the United States is not highly positive enough and even negative to rather not recommend the option of monetary integration through official dollarization.

The work project will continue as following; in Section I, literature review is made emphasizing in the different consideration made in the Optimal Currency Areas Theory (OCA) in order to have an in depth view of current and future economic integration and implications of a common currency; in Section II a further explanation on the methodology and a data reviewing is going to be done; in Section III the results are going to be reported and; in Section IV conclusions are made:

- I. Literature review**
- II. Methodology and sampled data**
- III. Results**
- IV. Conclusions**

I. Literature Review

The strategy to cover the literature review is to bring to light the different considerations made by the OCA theory for monetary unions and check the impacts of a monetary union between Bolivia, Chile, Colombia, Ecuador and Peru, in that way we can disclose the positive and negative aspects of an economic integration, going from a broader view to a more country specific one. Following this logic, the first consideration reviewed was the one related to the trade patterns involving openness and integration, where we part from the statement that exchange rate variability is significantly reduced when different countries trade strongly with each other (Arize *et al*, 2000). Subsequently, the financial markets integration factor was considered departing from the idea that countries may benefit from the more efficient allocation of resources and the reduction of transaction costs when their financial markets are sufficiently integrated (Claessens, S, 2003). The next consideration to examine is the one related to the co-movement of the economic variables where we account for different mechanisms that composes the integration of the countries for the analysis and that are also the main focus of the quantitative and qualitative econometric methodology. To finalize the review of the different considerations mentioned by the OCA theory the political and institutional component is also analyzed considering that factors of central bank independence and monetary and fiscal discipline are necessary for common currency agreements and furthermore, that a common currency may serve a useful political catalyst to reach the mentioned factors (Kaelberer, 2004).

The first literature review done for the first consideration was the one related to trade patterns, having in mind two different components that structure it, which are the grade of openness for trade and the magnitude of the trade between the peer countries. Table 1 provides a summary for trade indication of exports and imports as percentage of the GDP and trade volumes with peer

countries as well as percentage of the GDP to capture relativeness of size of the different analyzed countries.

Table 1: Exports and imports as percentage of the GDP, 2019

From	United States		Bolivia		Chile	
	Exports	Imports	Exports	Imports	Exports	Imports
Total	11,750%	14,530%	14,960%	31,430%	28,030%	28,850%
USA	-	-	0,650%	0,838%	1,610%	2,362%
Bolivia	0,004%	0,002%	-	-	0,167%	0,016%
Chile	0,105%	0,048%	0,141%	1,810%	-	-
Colombia	0,107%	0,061%	0,571%	0,241%	0,108%	0,173%
Ecuador	0,036%	0,031%	0,330%	0,067%	0,075%	0,263%
Peru	0,069%	0,028%	0,579%	1,269%	0,296%	0,230%

From	Colombia		Ecuador		Peru	
	Exports	Imports	Exports	Imports	Exports	Imports
Total	15,850%	21,660%	23,040%	23,020%	23,890%	22,890%
USA	3,607%	3,149%	3,466%	2,609%	1,457%	2,573%
Bolivia	0,039%	0,089%	0,019%	0,125%	0,177%	0,115%
Chile	0,287%	0,150%	0,771%	0,253%	0,329%	0,517%
Colombia	-	-	0,438%	1,080%	0,200%	0,335%
Ecuador	0,568%	0,196%	-	-	0,201%	0,287%
Peru	0,336%	0,182%	0,510%	0,443%	-	-

Source: United Nations International Trade Statistics Database, 2021

From the table it is possible to see that the less open economy is the United States with relatively low volumes of trade coming from the Andean countries, but on the other side for the this countries the United States represents their largest commercial partner, implying that with this levels of trade exchange rate should not be as volatile for them, but it is not typically the case since for the United States the summatory of exports of the US to the Andean countries is around 0.3% of the GDP and for the imports it only account for 0.017% of the GDP, which are volumes that does not allow for the sufficient currency transfers needed to reach a point were volatility of exchange rate are reduced. In despite of this, there is another reason why trade intensities are important for monetary union agreements and is mentioned by Flandreau *et al* (2005) which is that a posteriori of a

monetary union trade start to rise within the members of the union, therefore the desirability for currency inflows and outflows must be as well contemplated.

Countries from Latin America may be considered as open economies exporting and importing goods and services that account in average for 25% of their GDP, whilst levels of openness of the euro area is around 46%. Trade openness is wishful for the case of monetary integration because this factor leads to more mobility of capital and even labor among the peer countries which may result in a convergence of income levels (Dowrick, 2004). The resulting effect from a convergence of income and price levels is the ease of choice for effective monetary policy, for instance if a country or group of countries have high unemployment, as it is common for Latin American economies, the central bank or central monetary institution will desire to print more currency in order to make products less expensive in world markets being adjusted by purchasing power parity, it makes this country a more attractive tourist destination, and also more attractive opportunity for foreign investors since they will be paying less in real terms for some opportunities, but on the other side countries with low unemployment rates will tend to print less currency to increase the people's purchasing power and keeping prices down. This set of conditions for opting a monetary policy can become more favorable or harmful to the countries in the common currency area ruled by a central entity when the set of conditions are not enough aligned between the members, an example can be made from the situation that the Greek economy is going through. That is why trade and its effects on the convergence of the income levels as well as other economic variables is an important metric to take into account when studying monetary unions. For that matter, it is a concern that trade intensities between the Andean countries are in most cases below 1% of the GDP. Meanwhile trade intensities of the Latin American countries and the United States exceed

the 3% of the GDP for various cases, suggesting the case for dollarization, especially for Chilean, Colombian and Ecuadorian economies.

For the Latin American economies trade partners are very diversified, it is true that they tend to have significant trade relationships with the United States as noted before and with Europe, but some of them also account for China and Asia Pacific countries to be its larger trade partner. This may cause a complication for the common currency and its regarding to fluctuation of exchange rate when the economies commercialize in different magnitude the different currencies coming from the cash inflows and outflows of exports and imports. The previous fact may cause rigidity on delivering a common currency but also provides additional channels for monetary policy such as the implementation of floating exchange rate which is much desirable in order to respond to trade shocks with proper adjustments in exchange rates and relative prices, but the adjustments from those shocks and for the common currency area must take into consideration the grade of correlation of this trade shocks on the different economies to deliver an optimal monetary response (Erceg *et al*, 2000).

Following on the second consideration regarding the grade of integration of financial markets to evaluate the efficiencies created from allocating resources and the reducing transaction costs it is found that for the set of Andean countries a program for the integration on Latin American stock markets, known as MILA (for its acronym in Spanish) was established in 2010 conformed for the moment by Chile, Colombia and Peru which has notable implications on monetary integration. The first implication of a joint stock market exchange is the diminishment on exchange rate volatility within the members which is explained through the mechanism of investment on different geographies, adducing to the investment on the different enterprises from a territory to other that may caught the attention of extraterritorial investor which will convert its domestic

currency to the one of the locality of its investment abroad at the moment of the purchase, allowing for major mobility of money and de-volatizing exchange rates at some extent.

That for the investment side, but on the borrowing side of financial markets there is also evidence that financial markets integration serves as a cushion for temporary adverse disturbances through capital inflows (Dorucci *et al*, 2004) in the way that when a country possess surplus of capital it can be viewed as attractive due to the low interest rate that it may have, and since there is integration, this capital may flow to the country or area in need for capital to expand its internal investments and a certain point create its own capital surplus. This mechanism would reduce interest rates difference within the integrated financial market area and make more easy the choice for monetary policy if this integrated area correspond to a common currency area.

It is also desirable to consider the literature from Hurrell (1992) which evidences the treatment of Latin America as one economic bloc, and the foreign investor attraction or pessimism towards Latin-American assets is viewed in a broader scope than just a country-specific one. That fact has implications on the co-movement of financial markets of the different countries that when treated as a whole they will react on monetary and exchange rate in a similar manner which arises arguments for appropriateness for a common currency area establishment.

In regards to the effects of integration with the financial markets of the United States, it can be stated that disturbances of this market are significant enough to refer to systematic risk, due to the grade of integration noted by Galindo *et al*. (2013), but that this effects are not different among emerging markets. Thus, it can be said that the grade of integration between the Latin American economies and the United States is not substantial enough taking into account the existence of a more deep integration with other markets different from the ones of the region, so accounting for the benefits of a financial market integration for the dollarization case is a mistake.

A third consideration has to be made when examining the case for a common currency area between a set of countries and is the co-movement of the different economic variables that are main point of attention of monetary policy makers. The challenge is imposed by the good addressment of macroeconomic factors, creating solutions through monetary policy but leveraging broad perspectives instead of specifiers of each country. One single central bank is going to be the one to handle the mechanisms that may serve to set inflation rates, interest rates to boost the output and employment by increasing the supply of money and with all the different combination of variables, it might be more or less effective to one economy or another, and it does need to aim for balance to create long-lasting welfare on the population of the area. For that matter and in order to check how feasible will it be for the central bank to have the desired effects on the economies throughout the use monetary policy Figure 1 and Figure 2 are provided to have visuals on the GDP growth and inflation rates respectively. From this information point it can be concluded that for this set of countries inflation is well controlled and kept on recommended levels of between 2%-4% in average and therefore the balance of monetary policy to prevent high levels of inflation should not be a main issue and that growth rates for the Andean countries are on similar levels to suggest possible effectiveness on contracyclical policy when needed to implement. The demonstration of correlation or uncorrelation for shocks on this variables is going to be the objective of the macroeconomic econometric study of this research.

Lastly, to cover the literature review on consideration taken by the OCA theory political and institutional considerations had been analyzed in order to have a clear panorama on aspects that are not merely economical. First point on this needs to be made on the independency on the central bank, Bolivia's, Chile's, Colombia's and Peru's central banks possesses total independence from the government and fiscal institutions, giving total autonomy for developing their monetary policy

without government intervention. This is crucial for a monetary union since what has occurred historically when central banks are not an independent institution was that usually leaders on duty used the mechanism of printing money as a way to gain popularity and favorability, usually near elections period, and take advantage of the short term effects of money printing, but this caused structural long-term issues by the generation of inflation and all the problems that this entails (Arnone *et al*, 2009). The autonomy of the central bank for all of the studied economies, except for Ecuador which is dollarized, is a hugely positive aspect since the implementation of a central institution can be directly imposed and this one does not have to bear into the request of presidents. Followed to that then it usually comes a convergence to reach fiscal discipline as governments cannot rely on seigniorage as a way of statal funding.

There is also a factor relying on institutions in this set of countries as they share many historical bases as well as a common language. The possibility of a common currency could be beneficial for economic growth and increasing trade because as demonstrated by Helliwell *et al*. (2001) in his study on trade for provinces in Canada and the US, enterprises and people are more keen to trade and made deal with others that share same currency, in despite that geographical distances. These economies do share similar governmental organization and statal functioning which may permit this countries to move forward in a harmonized way to achieve more advanced institutional stages as was the case for the European countries (Berg *et al*, 2002).

Political instability is a problem that has been constantly present in the region for many years and it still persists for some economies in the region. But a common currency will add in a certain degree the perception of stability in the region, a factor that is very well desired by countries that chose to dollarized. It is also proven from the European Union case that when a group of countries chose to have a common currency it is likely that countries from the same region, and that meet

the imposed standards for entrance, want to join the common currency area. This scenario looks very favorable to the Andean region because there are economies shadowed by bad policy makers but with a very high potential to become fast growing economies as it is the case for Venezuela and Argentina. This two countries were very good partners for countries in the Andean region, were decades ago they were growing at a rate of almost 6% annually and helping the development of the whole region. If this economies meet the imposed criteria and chose to join the Andean common currency area they would need to leave behind all faculties of monetary policy which is nowadays not independent, and it would mean the first step for economic recovery since prevention of inflation is going to be a main concern for the central bank and no longer subject of irresponsible politics of seigniorage and all the mentioned problems consequence of it.

Finally, the fact that the studied countries of the Andean region have similar levels of economic and financial development with ranges of GDP per capita adjusted by purchasing power parity of \$8,378 to \$14,565 for Bolivia and Colombia respectively, and Chile that is an outlier for this scenario with \$25,067 (World Bank Data, 2020) eases the process of setting up a currency union without engendering pressures for fiscal transfers or migration on a scale which is not sustainable for the receiving country and the one that is getting left without population. The United States is well above a reasonable range for applying this criteria to the dollarization case with a \$63,543 GDP per capita. An important call-out that many researchers make on regional integration and monetary unification is that it is a lengthy and complex process that requires a strong and sustained political commitment (Dorucci *et al*, 2004).

The following section describes how the econometrical methodology serves the purposes of this research and how was it constructed and executed to analyze the hypothesis of a possible common currency area or dollarization.

II. Methodology and Sampled Data

The proposed model consists in a bivariate vector auto regression (VAR) model that seeks to measure shocks across price levels using as variable Consumer Price Index and output where the used variable is the real GDP, that in order to identify the degree of correlation between this shocks among the studied group of countries. This model developed by Blanchard and Quah (1989) and extended by Bayoumi (1991), Bayoumi and Eichengreen (1992, 1993, 1994a,b), Bayoumi and Taylor (1995) and Hallwood, Marsh & Scheibe (2006) represents an infinite moving average system of structural innovations through the evolution of the log first differences of real output (Y) and prices (P). The error terms resulting from the bivariate structural VAR can be decomposed and measure the grade of temporality of shocks, this due to the fact that error measurements on the output piece are reflected in a very short timeframe in the levels of GDP, meanwhile the second error surging from the price levels piece may reflect more permanently the shocks, this strong statement is corroborated by evidence from Gallagher & Taylor (2002) where they show that aggregate demand shocks have only temporary effects on real stock prices, while supply shocks may affect price levels permanently.

In vector notation the model can be viewed as following:

$$X_t = \begin{bmatrix} \Delta Y_t \\ \Delta P_t \end{bmatrix} = \sum_{m=0}^{\infty} L^m \begin{bmatrix} a_m^{11} & a_m^{12} \\ a_m^{21} & a_m^{22} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{temporal} \\ \varepsilon_t^{permanent} \end{bmatrix}$$

Where the authors of the model establish that L is the lag operator and the ε terms are unobservable structural shocks identified by their superscripts as of temporal or permanent. The previously mentioned papers where the model appears consider that structural disturbances are recovered from the reduced form of estimation and therefore they view as necessary two restrictions, first,

that the shocks are assumed to be orthogonal and second, that temporary shocks are so defined since they do not have permanent impacts in output, thus $\sum_{m=0}^{\infty} a_m^{11} = 0$ is a needed restriction.

This model is used for this type of analysis because is a small system capable of decomposing shocks between permanent and temporal as it is needed. It is capable of doing this without having to estimate a richly parametrized model which is convenient because of the relatively short period of data used (Hallwood *et al*, 2006). But on the other hand it has certain limitations worth mentioning, one of them in regards to the imposition of unidirectional relationships where the variables if they are wished to be forecasted they will be influenced by each other, which sometimes is desired but it is not the case for the purpose of this project because in that way the segregation between temporal and permanent shocks is possible. Another point made recurrently about VAR limitations is the omitted variable effects due to the different mechanisms that a country has for the different macroeconomic shocks, but the authors of the aforementioned paper respond to this by the focus they give to the shocks these economies have faced, and that they can be presumed to be policy invariant due to the endogenic factor of policy responses explained throughout the historical tendency of Latin American and US governments to follow very similar policy responses to a given shock. A great advantage of going towards the model used for similar analysis is that the results are easy comparable, and having in mind that in Hallwood, Marsh & Scheibe (2006) working paper they have as focus of analysis a set of countries also in Latin America this comparison is knowledge enriching.

In terms of sample selection, and before proceeding with the VAR analysis, first differentiated data of GDP and CPIs for the six different countries going from the first quarter of 2005 to the first quarter of 2019 was chosen for the analysis, this period was chosen on the basis of convenience for information quality (see Figure 1 and Figure 2). A limitation arises from this fact and it is that

it includes one period of very high volatility that is the economic recession of 2008 which could affect the results of the model by making the series non-stationary, that is why longer period of times are desired for analysis because they can include other periods of recession that could smooth the series and also, for making statistically accurate conclusions on the results is needed that this series are stationary. It is also worth mentioning that the CPI series, the GDP deflator series and the forex exchange rates has 2010 as base year for indexing this economic series.

The type of analysis usually done from a vector auto regression model is for forecasting purposes, but for the objective of the research is not to go into the direction of what should we expect for growth rates or inflation rates of this economies because this can be subject to the implementation of a central institution to regulate those aspects and will become endogenous to the future results of a monetary union, but rather focus on the grade of correlations of both temporal and permanent shocks to check correlations of them for the countries. Therefore it can be stated that the results from the VAR, although very useful to check previous events for each country in specific, should be only a mean to get to the main topic and is how does the different shocks of the variables correlate with the one of its peers. And for that reason attention should be upon the outcome of the evolution of the errors which note the grade of temporality of the shocks as mentioned before.

Before the stationarity test on the first differentiated data on GDP and CPIs is conducted as part of the conditions for the usage of Blanchard and Quah analysis it is worth mentioning that seasonally adjustment of the data was required because seasonal movements are often large enough that they mask other characteristics of the data that are of interest to analysts of current trends and cycles (US Census Bureau, 2012). For example, if each quarter has a different seasonal tendency toward high or low values, it can be difficult to detect the general direction of a time series' recent quarterly movement. Taking this into account, the data that was not already adjusted by seasonality from

the source the application of the X12 ARIMA methodology was used to de-seasonalize the data. Table 2 indicates data sources and to which of the series the X12 ARIMA methodology was applied to.

In Table 3 it can be found the results of the Dickey Fuller test and the augmented Dickey Fuller test which shows all of the series to be stationary but with different degrees of confidence. The 2008 economic recession seemed to cause high disturbances on the first differentiated data, with the major degree as expected to be in the USA economy and followed by the Bolivian economy, but the series are still stationary. In the augmented Dickey Fuller test the Ng-Perron criteria was the one used to select the number of lags for the tests, but often this lags were not significant, that is why following them was then opted to reduce the number of lags departing from the one of the criteria, then the equation is re-estimated until a significant lagged dependent variable is found, all this following the recommendation of Herzel's *et al* (2006) research. To add another level of assurance for non-stationarity variable trend is added to the test where it remains significant in order to capture the tendency of either upwards or downwards of the time series and in that way also help in the conclusion drawing. This leaves us with a robust data for the statistical analysis.

Table 3: Dickey–Fuller and augmented Dickey–Fuller unit-root tests on first differenced data

Country	Series	Period	Observations	DF-stats	ADF-stats	Trend
United States	GDP	05Q1-19Q1	57	-7.086***	-3.928** (lag7)	Yes
	CPI			-5.293***	-6.527*** (lag 1)	No
Bolivia	GDP	05Q1-19Q1	57	-6.401***	-3.144** (lag 2)	No
	CPI			-4.162***	-5.194*** (lag 8)	Yes
Chile	GDP	05Q1-19Q1	57	-5.439***	-5.161*** (lag 2)	No
	CPI			-4.674***	-3.528*** (lag 4)	No
Colombia	GDP	05Q1-19Q1	57	-5.306***	-5.201*** (lag 1)	No
	CPI			-5.682***	-2.654* (lag 4)	No
Ecuador	GDP	05Q1-19Q1	57	-4.563***	-4.563*** (lag 0)	No
	CPI			-3.877***	-3.364* (lag 3)	Yes
Peru	GDP	05Q1-19Q1	57	-5.099***	-4.053*** (lag 2)	No
	CPI			-4.372***	-4.415*** (lag 5)	No

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

Another important aspect to provide clarifications on is the need to reject endogeneity from the series in order to give a more solid foundation to the causal effect proposed on this research. Many scholars find endogeneity risks in the formation of common currency areas due to the fact of the likelihood of convergence of the macroeconomic shocks because common currency areas are propense to increasing trade intensities and therefore business cycle correlations (Silvestre, J. 2007). But this type of endogeneity is disassociated with this set of countries because they are particularly volatile and also can be classified as small countries which are partnered with a very large economy which is the United States or Europe in some cases, therefore the business correlations are more likely to be pegged to their largest partner regardless of the future effects of a monetary union. The statement and empirical evidence made by Krugman (1993) is still valid nowadays, he exposes the generation of specialization among individuals when a common currency area is imposed and that this specialization causes further diversification in the economic activities and therefore business cycles start to become more asymmetric as countries integrate. This strong finding and the use of simulations on currency unions for estimating no change in business cycle correlations rather than on trade intensities covers the endogeneity preoccupation for this research.

III. Results

Taking a look into the results of the bivariate VAR with 4 lags for each of the vectored variables In Table 4 it is not obvious any trend of the variables, but going further into detail of each of the countries we can check by the sign of the lagged and differentiated CPI, which is translated into the efforts of each country to fight inflation it can be said that for the studied period United States and Colombia where the most successful ones in this shore. And also that Ecuador and Peru where the more resilient countries when an exogenous macroeconomic shock disturbs their economy

during this period. The grade of significance of the differentiated GDP crossed with the grade of significance of the differentiated CPI tell us how does the evolution of the growth of GDP affects inflation rates and vice versa, but this does not mean that temporal or permanent shocks affect in the same way each other because this are captured by the error terms meaning no problem of autocorrelation is affecting the model. The path of going further into detail of the different results is not the focus and as mentioned in section II this will only provide us information for country specific matter which is not the objective. To do an analysis as a whole, both terms of errors of each country of must be checked for total randomness, and aspect that can be easily visualized in Figure 3 and Figure 4.

Table 4 A: Bivariate vector auto regression estimates

Variables	United States		Bolivia		Chile	
	ΔY_t	ΔP_t	ΔY_t	ΔP_t	ΔY_t	ΔP_t
ΔY_{t-1}	0.00277 (0.120)	1.261*** (0.350)	-0.724*** (0.233)	0.221* (0.130)	0.179 (0.141)	0.0449** (0.0206)
ΔY_{t-2}	0.197 (0.133)	-0.182 (0.388)	-0.492* (0.263)	0.0695 (0.147)	0.0552 (0.144)	0.0376* (0.0210)
ΔY_{t-3}	0.0854 (0.127)	0.110 (0.370)	0.0507 (0.267)	-0.119 (0.149)	-0.298** (0.145)	0.0286 (0.0212)
ΔY_{t-4}	0.358*** (0.116)	0.233 (0.338)	-0.515** (0.250)	-0.107 (0.140)	0.00386 (0.144)	-0.0155 (0.0210)
ΔP_{t-1}	0.0455 (0.0462)	0.441*** (0.135)	0.663** (0.266)	0.301** (0.148)	-2.292** (0.918)	0.520*** (0.134)
ΔP_{t-2}	-0.142*** (0.0483)	-0.653*** (0.141)	0.392 (0.274)	0.282* (0.153)	1.440 (1.047)	-0.181 (0.153)
ΔP_{t-3}	-0.0981* (0.0512)	0.260* (0.149)	0.293 (0.281)	-0.0896 (0.157)	-1.292 (1.040)	0.290* (0.152)
ΔP_{t-4}	-0.0780 (0.0479)	-0.218 (0.140)	0.369 (0.270)	-0.119 (0.151)	-0.670 (0.930)	0.0619 (0.136)
Constant	0.00285** (0.00119)	2.80e-05 (0.00347)	0.0169*** (0.00496)	0.00729*** (0.00277)	0.0280** (0.0125)	0.00207 (0.00182)
Observations	52	52	52	52	52	52

Standard errors in parentheses

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

Table 4 B: Bivariate vector auto regression estimates

Variables	Colombia		Ecuador		Peru	
	ΔY_t	ΔP_t	ΔY_t	ΔP_t	ΔY_t	ΔP_t
ΔY_{t-1}	0.368*** (0.130)	-0.0251* (0.0140)	0.363*** (0.141)	0.0982 (0.0845)	0.355*** (0.137)	0.00710 (0.0215)
ΔY_{t-2}	-0.0295 (0.141)	0.00977 (0.0152)	0.168 (0.142)	0.0557 (0.0856)	0.206 (0.142)	0.0361 (0.0223)
ΔY_{t-3}	-0.147 (0.139)	0.00416 (0.0149)	-0.102 (0.139)	0.0249 (0.0835)	-0.312** (0.143)	0.0175 (0.0224)
ΔY_{t-4}	0.0546 (0.131)	-0.0116 (0.0141)	-0.0574 (0.131)	-0.0118 (0.0787)	0.171 (0.139)	-0.0105 (0.0218)
ΔP_{t-1}	-0.125 (0.128)	0.417*** (0.128)	0.279 (0.225)	0.876*** (0.135)	-1.020 (0.859)	0.504*** (0.135)
ΔP_{t-2}	-1.575 (1.292)	-0.351** (0.138)	0.317 (0.265)	-0.673*** (0.159)	0.482 (0.947)	-0.0504 (0.148)
ΔP_{t-3}	-1.098 (1.350)	0.172 (0.145)	-0.455* (0.258)	0.625*** (0.155)	-0.917 (0.933)	-0.0260 (0.146)
ΔP_{t-4}	3.036** (1.197)	0.380*** (0.128)	-0.102 (0.230)	-0.221 (0.138)	0.257 (0.837)	0.0736 (0.131)
Constant	-0.000544 (0.0198)	0.00391* (0.00212)	0.00422* (0.00223)	0.00174 (0.00134)	0.0150 (0.00968)	0.00292* (0.00152)
Observations	52	52	52	52	52	52

Standard errors in parentheses

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

In the following figures it can be seen the time series plots of permanent shocks extracted from the structural VARs and the time series plots of the temporary shocks extracted from the structural VARs. This graphs denotes that there are no patterns followed by any economy in terms of the way that each of respective shocks affects the economies together, therefore making the conclusions of correlations to be made a very robust one. From the graph it can be noted the different structural effects captured by the error terms which are not only economical but also involve different aspects such as government elections, policy impositions and other different institutional factors. Again, the results on the plots are not subject of in depth interpretation, but rather taken as a verification layer to make robust conclusions, although it is presented in Table 7 the summary statistics of this shocks for making country-specific further analysis.

Figure 3: Time series plots of permanent shocks extracted from the structural VAR

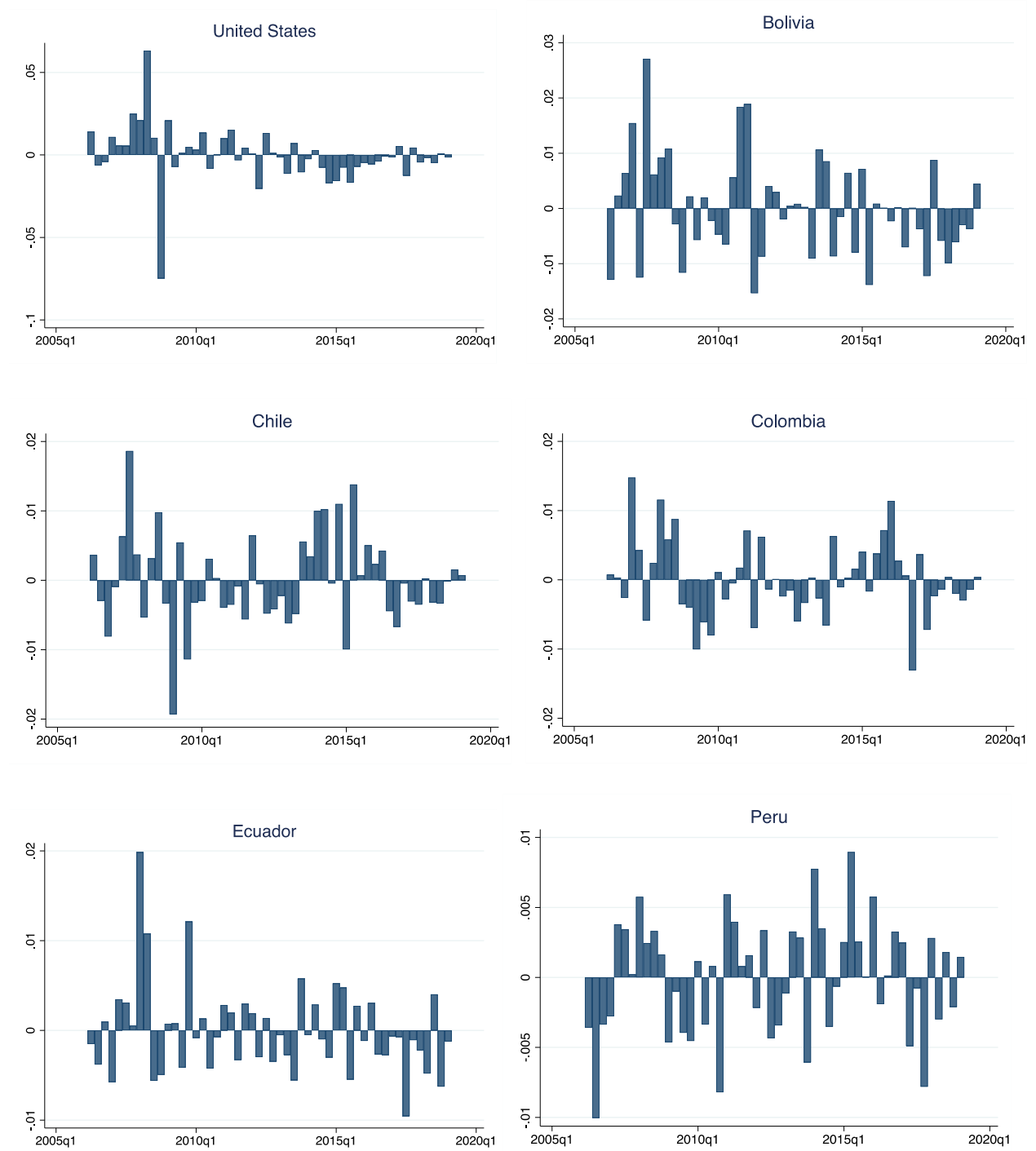


Figure 4: Time series plots of permanent shocks extracted from the structural VAR

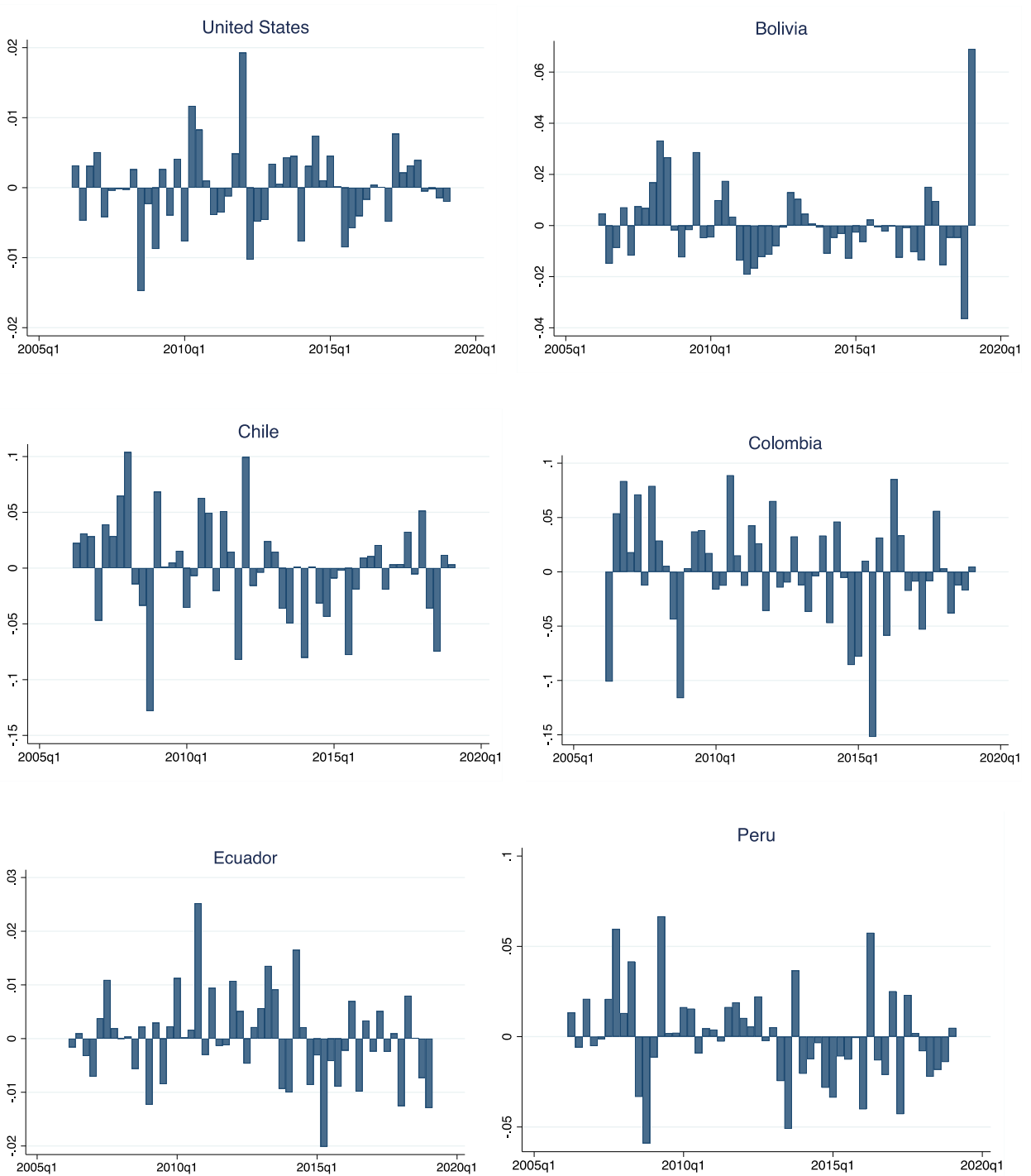


Table 5: Matrix of correlations of permanent shocks

Variables	United States	United States ($t-1$)	United States ($t-2$)	United States ($t-3$)	United States ($t-4$)	Bolivia	Chile	Colombia	Ecuador
Bolivia	0.277	-0.011	0.074	0.066	-0.007	1.000			
Chile	0.036	0.347	-0.154	-0.088	-0.042	0.024	1.000		
Colombia	0.154	0.171	0.155	0.029	-0.091	0.102	0.139	1.000	
Ecuador	0.434	0.047	-0.085	0.176	-0.183	0.202	0.078	0.177	1.000
Peru	-0.032	0.218	-0.039	-0.001	0.051	-0.104	0.352	0.407	0.134

Table 6: Matrix of correlations of temporal shocks

Variables	United States	United States ($t-1$)	United States ($t-2$)	United States ($t-3$)	United States ($t-4$)	Bolivia	Chile	Colombia	Ecuador
Bolivia	-0.042	0.008	-0.114	-0.089	-0.050	1.000			
Chile	0.261	0.145	-0.232	0.040	0.046	0.048	1.000		
Colombia	0.254	0.091	-0.227	-0.006	-0.067	0.102	0.672	1.000	
Ecuador	0.240	0.014	0.146	-0.234	0.046	-0.058	0.094	0.148	1.000
Peru	0.096	-0.017	-0.073	-0.143	0.036	0.166	0.375	0.554	0.061

In Table 5 it can be found the different correlations of the studied countries for the longer temporality of the macroeconomic shocks, classified as permanent, this are the ones that the ones which the results are going to be drawn upon, since correlation on long-lasting shocks were the base of the finding of Mundell (1961) on the basis for setting a common currency area when this shocks were highly positive enough. Before going into detail on the results and comparing them with other exercises and cases of currency unification it must be clarified that there were added to the correlation matrix four more lags of the United States case due to the fact that the United States is the largest trade partner or most of the other studied countries and is the largest economy of the data set, having said that it will be accounted for the base of analysis of systematic risk as it shock in macroeconomic disturbances may be sizeable enough to still have some effects even 4 periods (one year) on the smaller and open economies as recommended from Kleinow *et al.* (2017) study. Having this into consideration it is proceed to state that correlation of shocks of the United States and Ecuador is exceeding the 30% correlation threshold that is the one recommended from literature as the point where basis start to be considerable enough to recommend a monetary union,

this also occurs with Chile and the first lagged version of the United States temporal shocks. But this is not the case for the majority of the other scenarios with other countries and the different lagged versions of the United States permanent shocks, where it can be even found negatively correlated shocks. This result means that a monetary integration of the Latin American countries with the United States would remain rather not advisable in despite of the large trade volumes of the Hispanic countries and the United States. On Hallwood, Marsh & Scheibe (2006) paper a similar conclusion was made upon dollarization when they found that none of the South American countries (Argentina, Brazil, Chile, Uruguay and Venezuela) have shock correlations with contemporaneous or lagged US shocks that exceed 30% at best and that most correlations are close to zero or negative.

Now directing the attention on the results on correlation between the set of Andean countries it becomes noticeable the high correlation of shocks between Peru and Chile and Peru and Colombia, exceeding the 30% correlation threshold, and it is cardinal because these three economies account for the 84.28% of the GDP of the studied countries in the region. It is also noticeable that there is a positive correlation between every other combination of the Latin American countries of the study, except for the one of Peru and Bolivia. The matrix of correlation of temporal shocks is similar to the permanent shocks one and does not provide very different results of the ones already mentioned.

Now, these results compared against the correlation of shocks of members of the European Union before German unification in 1989 were they ranged between 0.2 and 0.5 this set of countries is doing well, and some of the sample countries does arise judgements for obvious monetary union. A second level of comparison has to be made with the results from Hallwood's, Marsh's & Scheibe's (2006) assessment for the monetary union of Argentina, Brazil, Chile, Uruguay and

Venezuela where they found positive shocks between Argentina, Brazil, Chile and Uruguay but all of the cross correlations with Venezuela are negative. Although they found this positives correlations and strong basis to consider a regional Latin American union between members of the Mercosur and Chile as solution for monetary integration, the magnitude of the correlations found for the Andean Community members and Chile is even larger, meaning that a common currency between Bolivia, Chile, Colombia, Ecuador and Peru is more recommended. It is also valid to take into account that the correlation on temporal shocks for the case of Argentina, Brazil, Chile, Uruguay and Venezuela is in most of the cross iterations negative meanwhile for the case of correlation of temporal shocks between Bolivia, Chile, Colombia, Ecuador and Peru every cross iteration is positive except for the one of Ecuador and Bolivia.

Table 7 and Table 8 correspond to the summary statistics of the shock segmented by grade of temporality. These tables does not correspond to a cross checked analysis but rather to have a comparable notion of each of the magnitude of the specified shock for each country in particular. It can be concluded that the dispersion of the set of values for the United States was the most aggressive, explained by the 2008 economic recession, but we it is not found any similar grade of dispersion among the other countries meaning that they had few or none highly stressful permanent shocks and that the one of the United States was not overlapped to the Latin American Economies. Another different story is told by the summary statistics of temporary shocks where there is high volatility for the Latin American countries and very few for the one of the United States, this may be due to a variety of reasons but a more explanatory one is the measurement in U.S. Dollars of the GDP and exchange rate variability affects the Latin American countries in the short term but it does not cause the shock to be permanently affecting macro-economic issues.

Table 7: Summary statistics of permanent shocks in percentages

	SD	Min	Max
United States	1.688	-7.479	6.318

Bolivia	.898	-1.536	2.71
Chile	.661	-1.931	1.864
Colombia	.55	-1.306	1.478
Ecuador	.498	-.954	1.985
Peru	.409	-1.004	.896

Table 8: Summary statistics of temporary shocks in percentages

	SD	Min	Max
United States	.579	-1.473	1.929
Bolivia	1.606	-3.65	6.903
Chile	4.528	-12.813	10.378
Colombia	5.132	-15.194	8.893
Ecuador	.829	-2.014	2.52
Peru	2.61	-5.907	6.668

IV. Conclusions

Through the desegregation of macroeconomic shocks on permanent and temporal by the use of a bivariate vector autoregressive model it has been found that long-lasting shocks between Bolivia, Chile, Colombia, Ecuador and Peru are positively correlated and symmetric enough to set the basis for a monetary union between these set of countries. By comparing the results with the ones of European Union members and Mercosur members, the set of countries chosen for the study appears to be in a better shape to establish a common currency area than the previously mentioned group of countries. On the other hand, it would not be recommended to these countries to integrate monetarily with the United States through official dollarization as shocks do not correlate positively or significantly enough with the set of countries of the Andean Region. Apart from that it is recommended that this project is stated as one for the long term as projects of the Andean Community and the Pacific Alliance continue more, continuing the trend of increasing integration, and that it may have more desired effects once macroeconomics are more harmonized. In the short term it will be good for these countries to consider to start a sandbox project on a central bank digital currency. Finally, efforts for increasing trade between Andean countries must continue the path it has been taking to ensure significant benefits from a monetary integration.

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Appendix

Data sources

Country	GDP	Seasonal Adjustment	CPI
United States	IMF-IFS, 2005Q1-2019Q1	X12 ARIMA	IMF-IFS, 2005Q1-2019Q1
Bolivia	IMF-IFS, 2005Q1-2019Q1	X12 ARIMA	IMF-IFS, 2005Q1-2019Q1
Chile	IMF-IFS, 2005Q1-2019Q1	Already adjusted from source	IMF-IFS, 2005Q1-2019Q1
Colombia	IMF-IFS, 2005Q1-2019Q1	Already adjusted from source	IMF-IFS, 2005Q1-2019Q1
Ecuador	IMF-IFS, 2005Q1-2019Q1	Already adjusted from source	IMF-IFS, 2005Q1-2019Q1
Peru	IMF-IFS, 2005Q1-2019Q1	X12 ARIMA	IMF-IFS, 2005Q1-2019Q1

Figure 1: GDP growth by country

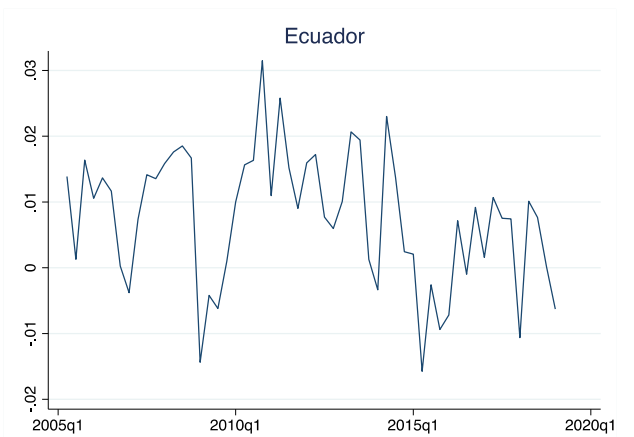
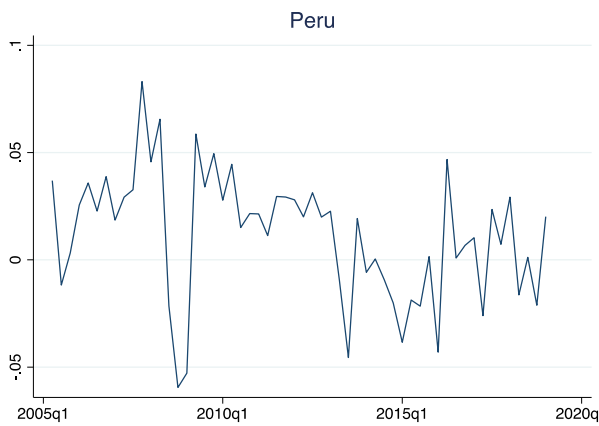
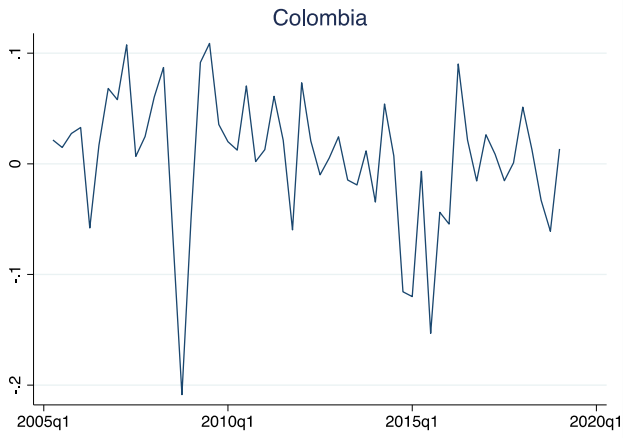
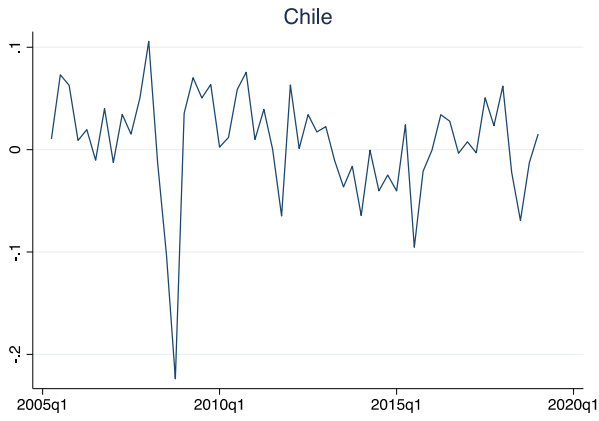
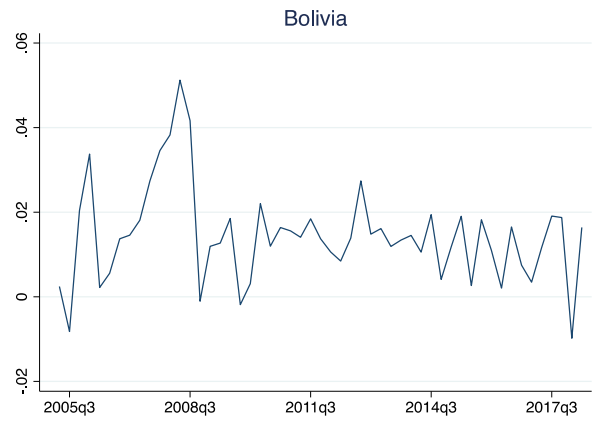
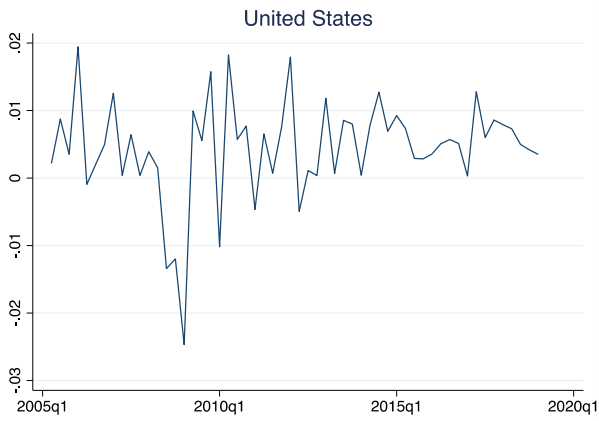


Figure 2: Inflation rates throughout time by country



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tsset date

gen trend = _n

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gen ln_USA_CPI = ln(USA_CPI)
gen ln_COLOMBIA_realGDPUSD = ln(COLOMBIA_realGDPUSD)
gen ln_COLOMBIA_CPI = ln(COLOMBIA_CPI)
gen ln_CHILE_realGDPUSD = ln(CHILE_realGDPUSD)
gen ln_CHILE_CPI = ln(CHILE_CPI)
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gen ln_PERU_realGDPUSDAdjusted = ln(PERU_realGDPUSDAdjusted)
gen ln_PERU_CPI = ln(PERU_CPI)
tsline D.ln_PERU_realGDPUSDAdjusted
gen ln_ECUADOR_realGDPUSD = ln(ECUADOR_realGDPUSD)
gen ln_ECUADOR_CPI = ln(ECUADOR_CPI)
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* Test of DF over first differenciated series:
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dfuller D.ln_USA_realGDPAdjusted
dfgls D.ln_USA_realGDPAdjusted
dfuller D.ln_USA_realGDPAdjusted , regress lag(7) trend

dfuller D.ln_USA_CPI
dfgls D.ln_USA_CPI
dfuller D.ln_USA_CPI, regress lag(1)
tsline D.ln_COLOMBIA_realGDPUSD

dfuller D.ln_COLOMBIA_realGDPUSD
dfgls D.ln_COLOMBIA_realGDPUSD
dfuller D.ln_COLOMBIA_realGDPUSD , regress lag(1)
*recomendado un lag pero el ultimo no es significativo al 10%
dfuller D.ln_COLOMBIA_CPI
dfgls D.ln_COLOMBIA_CPI
dfuller D.ln_COLOMBIA_CPI , regress lag(4)
*significativo al 10%

*DF CHILE
dfuller D.ln_CHILE_realGDPUSD
dfgls D.ln_CHILE_realGDPUSD
dfuller D.ln_CHILE_realGDPUSD , regress lag(2)
*recomendado 7 pero significativo con 2
dfuller D.ln_CHILE_CPI
dfgls D.ln_CHILE_CPI
dfuller D.ln_CHILE_CPI, regress lag(4)

*DF PERU
dfuller D.ln_PERU_realGDPUSDAadjusted
dfgls D.ln_PERU_realGDPUSDAadjusted
dfuller D.ln_PERU_realGDPUSDAadjusted , regress lag(2)

dfuller D.ln_PERU_CPI

```

```

dfgls D.ln_PERU_CPI
dfuller D.ln_PERU_CPI, regress lag(5)
*DF ECUADOR

dfuller D.ln_ECUADOR_realGDPUSD
dfgls D.ln_ECUADOR_realGDPUSD
dfuller D.ln_ECUADOR_realGDPUSD , regress
*Baje lags de 7 recomendados a 0

dfuller D.ln_ECUADOR_CPI
dfgls D.ln_ECUADOR_CPI
dfuller D.ln_ECUADOR_CPI, regress lag(3) trend
*baje lags. de 3 recomendados a 1
*DF BOLIVIA
dfuller D.ln_BOLIVIA_realGDPUSDAdjusted
dfgls D.ln_BOLIVIA_realGDPUSDAdjusted
dfuller D.ln_BOLIVIA_realGDPUSDAdjusted , regress lag(2)

dfuller D.ln_BOLIVIA_CPI
dfgls D.ln_BOLIVIA_CPI
dfuller D.ln_BOLIVIA_CPI, regress lag(8) trend
*baje lags. de 9 recomendados a 8 con trend

* Regressions Colombia:
var D.ln_COLOMBIA_realGDPUSD D.ln_COLOMBIA_CPI, lags(1/4)
outreg2 using "Outreg/varColombia.xls", replace
predict resid_D_ln_COLOMBIA_realGDPUSD, residuals
equation(D_ln_COLOMBIA_realGDPUSD)
predict resid_D_ln_COLOMBIA_CPI, residuals equation(D_ln_COLOMBIA_CPI)
twoway bar resid_D_ln_COLOMBIA_realGDPUSD date, title(Colombia)
name(TemporalColombia, replace) ytitle("") xtitle("")
graphregion(color(white))
twoway bar resid_D_ln_COLOMBIA_CPI date, title(Colombia)
name(PermanentColombia, replace) ytitle("") xtitle("")
graphregion(color(white))

*Regressions USA

var D.ln_USA_realGDPAdjusted D.ln_USA_CPI, lags(1/4),
outreg2 using "Outreg/varUnitedStates.xls", replace
predict resid_D_ln_USA_realGDPAdjusted, residuals
equation(D_ln_USA_realGDPAdjusted)
predict resid_D_ln_USA_CPI, residuals equation(D_ln_USA_CPI)
twoway bar resid_D_ln_USA_realGDPAdjusted date, title(United States)
name(TemporalUnitedStates, replace) ytitle("") xtitle("")
graphregion(color(white))
twoway bar resid_D_ln_USA_CPI date, title(United States)
name(PermanentUnitedStates, replace) ytitle("") xtitle("")
graphregion(color(white))

*Regressions Chile

var D.ln_CHILE_realGDPUSD D.ln_CHILE_CPI, lags(1/4)
outreg2 using "Outreg/varChile.xls", replace
predict resid_D_ln_CHILE_realGDPUSD, residuals equation(D_ln_CHILE_realGDPUSD)
predict resid_D_ln_CHILE_CPI, residuals equation(D_ln_CHILE_CPI)

```

```

twoway bar resid_D_ln_CHILE_realGDPUSD date, title(Chile) name(TemporalChile,
replace) ytitle("") xtitle("") graphregion(color(white))
twoway bar resid_D_ln_CHILE_CPI date, title(Chile) name(PermanentChile,
replace) ytitle("") xtitle("") graphregion(color(white))

```

**Regressions Peru*

```

var D_ln_PERU_realGDPUSDAadjusted D_ln_PERU_CPI, lags(1/4)
outreg2 using "Outreg/varPeru.xls", replace
predict          resid_D_ln_PERU_realGDP,          residuals
equation(D_ln_PERU_realGDPUSDAadjusted)
predict resid_D_ln_PERU_CPI, residuals equation(D_ln_PERU_CPI)
twoway bar resid_D_ln_PERU_realGDP date, title(Peru) name(TemporalPeru,
replace) ytitle("") xtitle("") graphregion(color(white))
twoway bar resid_D_ln_PERU_CPI date, title(Peru) name(PermanentPeru, replace)
ytitle("") xtitle("") graphregion(color(white))

```

**Regressions Ecuador*

```

var D_ln_ECUADOR_realGDPUSD D_ln_ECUADOR_CPI, lags(1/4)
outreg2 using "Outreg/varEcuador.xls", replace
predict          resid_D_ln_ECUADOR_realGDPUSD,          residuals
equation(D_ln_ECUADOR_realGDPUSD)
predict resid_D_ln_ECUADOR_CPI, residuals equation(D_ln_ECUADOR_CPI)
twoway bar resid_D_ln_ECUADOR_realGDPUSD date, title(Ecuador)
name(TemporalEcuador, replace) ytitle("") xtitle("") graphregion(color(white))
twoway bar resid_D_ln_ECUADOR_CPI date, title(Ecuador) name(PermanentEcuador,
replace) ytitle("") xtitle("") graphregion(color(white))

```

**Regressions Bolivia*

```

var D_ln_BOLIVIA_realGDPUSDAadjusted D_ln_BOLIVIA_CPI, lags(1/4)
outreg2 using "Outreg/varBolivia.xls", replace
predict          resid_D_ln_BOLIVIA_realGDP,          residuals
equation(D_ln_BOLIVIA_realGDPUSDAadjusted)
predict resid_D_ln_BOLIVIA_CPI, residuals equation(D_ln_BOLIVIA_CPI)
twoway bar resid_D_ln_BOLIVIA_realGDP date, title(Bolivia)
name(TemporalBolivia, replace) ytitle("") xtitle("") graphregion(color(white))
twoway bar resid_D_ln_BOLIVIA_CPI date, title(Bolivia) name(PermanentBolivia,
replace) ytitle("") xtitle("") graphregion(color(white))

```

```

graph combine TemporalUnitedStates TemporalBolivia , cols(2)
graph combine TemporalChile TemporalColombia , cols(2)
graph combine TemporalEcuador TemporalPeru , cols(2)
graph combine PermanentUnitedStates PermanentBolivia , cols(2)
graph combine PermanentChile PermanentColombia , cols(2)
graph combine PermanentEcuador PermanentPeru , cols(2)

```

```

graph display TemporalUnitedStates
graph display TemporalBolivia
graph display TemporalChile
graph display TemporalColombia
graph display TemporalEcuador
graph display TemporalPeru
graph display PermanentUnitedStates
graph display PermanentBolivia
graph display PermanentChile

```

```
graph display PermanentColombia
graph display PermanentEcuador
graph display PermanentPeru
```

```
* Correlations
```

```
* Permanent:
```

```
label variable resid_D_ln_USA_CPI "United States"
label variable resid_D_ln_COLOMBIA_CPI "Colombia"
label variable resid_D_ln_CHILE_CPI "Chile"
label variable resid_D_ln_PERU_CPI "Peru"
label variable resid_D_ln_ECUADOR_CPI "Ecuador"
label variable resid_D_ln_BOLIVIA_CPI "Bolivia"
```

```
asdoc cor resid_D_ln_USA_CPI L.resid_D_ln_USA_CPI L2.resid_D_ln_USA_CPI
L3.resid_D_ln_USA_CPI L4.resid_D_ln_USA_CPI resid_D_ln_BOLIVIA_CPI
resid_D_ln_CHILE_CPI resid_D_ln_COLOMBIA_CPI resid_D_ln_ECUADOR_CPI
resid_D_ln_PERU_CPI, save(Outreg/corr_permanent.doc) replace label dec(3)
```

```
* Temporal
```

```
label variable resid_D_ln_COLOMBIA_realGDPUSD "Colombia"
label variable resid_D_ln_CHILE_realGDPUSD "Chile"
label variable resid_D_ln_ECUADOR_realGDPUSD "Ecuador"
label variable resid_D_ln_BOLIVIA_realGDP "Bolivia"
label variable resid_D_ln_PERU_realGDP "Peru"
label variable resid_D_ln_USA_realGDPAdjusted "United States"
```

```
asdoc cor resid_D_ln_USA_realGDPAdjusted L.resid_D_ln_USA_realGDPAdjusted
L2.resid_D_ln_USA_realGDPAdjusted L3.resid_D_ln_USA_realGDPAdjusted
L4.resid_D_ln_USA_realGDPAdjusted resid_D_ln_BOLIVIA_realGDP
resid_D_ln_CHILE_realGDPUSD resid_D_ln_COLOMBIA_realGDPUSD
resid_D_ln_ECUADOR_realGDPUSD resid_D_ln_PERU_realGDP,
save(Outreg/corr_temporal.doc) replace label dec(3)
```

```
*In percentage
```

```
gen p_resid_D_ln_COLOMBIA_realGDPUSD = resid_D_ln_COLOMBIA_realGDPUSD *100
gen p_resid_D_ln_CHILE_realGDPUSD = resid_D_ln_CHILE_realGDPUSD*100
gen p_resid_D_ln_ECUADOR_realGDPUSD = resid_D_ln_ECUADOR_realGDPUSD*100
gen p_resid_D_ln_BOLIVIA_realGDP = resid_D_ln_BOLIVIA_realGDP*100
gen p_resid_D_ln_PERU_realGDP = resid_D_ln_PERU_realGDP*100
gen p_resid_D_ln_USA_realGDPAdjusted = resid_D_ln_USA_realGDPAdjusted*100
```

```
* Labelling each country
```

```
label variable p_resid_D_ln_COLOMBIA_realGDPUSD "Colombia"
label variable p_resid_D_ln_CHILE_realGDPUSD "Chile"
label variable p_resid_D_ln_ECUADOR_realGDPUSD "Ecuador"
label variable p_resid_D_ln_BOLIVIA_realGDP "Bolivia"
label variable p_resid_D_ln_PERU_realGDP "Peru"
label variable p_resid_D_ln_USA_realGDPAdjusted "United States"
```

```
asdoc sum p_resid_D_ln_USA_realGDPAdjusted p_resid_D_ln_BOLIVIA_realGDP
p_resid_D_ln_CHILE_realGDPUSD p_resid_D_ln_COLOMBIA_realGDPUSD
p_resid_D_ln_ECUADOR_realGDPUSD p_resid_D_ln_PERU_realGDP, stat(sd min max)
replace dec(3) label save(Outreg/sum_temporal.doc)
```

** In percentage*

```
gen p_resid_D_ln_USA_CPI = resid_D_ln_USA_CPI*100
gen p_resid_D_ln_COLOMBIA_CPI = resid_D_ln_COLOMBIA_CPI*100
gen p_resid_D_ln_CHILE_CPI = resid_D_ln_CHILE_CPI *100
gen p_resid_D_ln_PERU_CPI = resid_D_ln_PERU_CPI*100
gen p_resid_D_ln_ECUADOR_CPI = resid_D_ln_ECUADOR_CPI*100
gen p_resid_D_ln_BOLIVIA_CPI = resid_D_ln_BOLIVIA_CPI*100
```

**labels*

```
label variable p_resid_D_ln_USA_CPI "United States"
label variable p_resid_D_ln_COLOMBIA_CPI "Colombia"
label variable p_resid_D_ln_CHILE_CPI "Chile"
label variable p_resid_D_ln_PERU_CPI "Peru"
label variable p_resid_D_ln_ECUADOR_CPI "Ecuador"
label variable p_resid_D_ln_BOLIVIA_CPI "Bolivia"
```

```
asdoc sum p_resid_D_ln_USA_CPI p_resid_D_ln_BOLIVIA_CPI p_resid_D_ln_CHILE_CPI
p_resid_D_ln_COLOMBIA_CPI p_resid_D_ln_ECUADOR_CPI p_resid_D_ln_PERU_CPI,
stat(sd min max) replace dec(3) label save(Outreg/sum_permanent.doc)
```

THE ANDEAN DOLLAR: AN ANALYSIS FOR THE MONETARY UNION OF A SET OF COUNTRIES IN THE ANDEAN REGION

THESIS DEFENCE

David Alejandro Gómez Carrillo

Introduction

POSSIBILITY OF A MONETARY UNION DUE TO RECENT EFFORTS FOR INTEGRATION

I want to understand whether it would be beneficial a monetary union between Bolivia, Chile, Colombia, Ecuador and Peru to create a new currency or to officially dollarize.

The Andean community

From march 2022 citizens from member countries can reside and work without visa constraints. Including automatic validity recognition of academic and professional titles

The Pacific Alliance

Free trade and common tariff for Asia Pacific countries has been a main concern since the creation of the entity. Integration of stock market it's the highest in America.

Links with the United States

Largest trade partner for most of the chosen economies and with major stakeholders in terms of direct and indirect investment

Table of contents

I. Literature review

II. Methodology and sampled data

III. Results

IV. Conclusions

V. Appendix

Literature Review

CONSIDERATIONS FROM THE OPTIMAL CURRENCY AREA THEORY FROM MUNDELL (1961)

Trade Patterns

Evaluating openness and integration between the set of countries

- Exchange rate variability is significantly reduced when different countries trade strongly with each other (Arize et al, 2000)

Financial Market Integration

Levels of integration for more capital flows

- Countries may benefit from the more efficient allocation of resources and the reduction of transaction costs when their financial markets are sufficiently integrated (Claessens, S, 2003)

Economic variables co-movements

Different mechanism that balance macro aspects of the chosen region

- The creation of stability through the coordination of the monetary policy between the peer countries must be a possibility for successful integration (Mundell, 1961)

Politics and institutions

Determinants of monetary freedom and long-term commitment

- Central bank independence and monetary and fiscal discipline are necessary for common currency agreements and furthermore (Kaelberer, 2004)

Methodology

HYPOTHESIS TO TEST AND MODEL

- Main premise to test is the one based on the OCA theory which states **that if a country suffers from long-lasting shocks that are highly positively correlated with those of its potential partners a basis for the case of a monetary union are set.**
- This shocks are going to be measure by two variables **Consumer Price Index** (CPI) which will measure shocks across price levels and **real Gross Domestic Product** (GDP) which will measure shocks on output.
- Error terms will be decomposed and measure the temporality of the shocks.

Methodology

DATA

- 6 countries
- Timeframe: 2005 Q1 – 2019 Q1
- Adjusted by seasonality when required using the X12 ARIMA from the US Census Bureau
- Used first differentiated data
- Tested stationarity using the Dicky-Fuller and Augmented Dicky-Fuller tests

Country	GDP	Seasonal Adjustment	CPI
United States	IMF-IFS, 2005Q1-2019Q1	X12 ARIMA	IMF-IFS, 2005Q1-2019Q1
Bolivia	IMF-IFS, 2005Q1-2019Q1	X12 ARIMA	IMF-IFS, 2005Q1-2019Q1
Chile	IMF-IFS, 2005Q1-2019Q1	Already adjusted from source	IMF-IFS, 2005Q1-2019Q1
Colombia	IMF-IFS, 2005Q1-2019Q1	Already adjusted from source	IMF-IFS, 2005Q1-2019Q1
Ecuador	IMF-IFS, 2005Q1-2019Q1	Already adjusted from source	IMF-IFS, 2005Q1-2019Q1
Peru	IMF-IFS, 2005Q1-2019Q1	X12 ARIMA	IMF-IFS, 2005Q1-2019Q1

Methodology

BI-VARIATE VECTOR AUTOREGRESSIVE MODEL

$$X_t = \begin{bmatrix} \Delta Y_t \\ \Delta P_t \end{bmatrix} = \sum_{m=0}^{\infty} L^m \begin{bmatrix} a_m^{11} & a_m^{12} \\ a_m^{21} & a_m^{22} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{temporal} \\ \varepsilon_t^{permanent} \end{bmatrix}$$

- This model represents an infinite moving average system of structural innovations through the evolution of the log first differences of real output (Y) and prices (P)
- Error terms are segregated between temporal and permanent, to focus our attention on the permanent ones.
- L is the lag operator for the regression
- $\sum_{m=0}^{\infty} a_m^{11} = 0$ as a necessary restriction for not having permanent impacts on output from temporary shocks
- Limitations arises on endogeneity and need for stationarity

Results



Variables	United States	United States ($t - 1$)	United States ($t - 2$)	United States ($t - 3$)	United States ($t - 4$)	Bolivia	Chile	Colombia	Ecuador
Bolivia	0.277	-0.011	0.074	0.066	-0.007	1.000			
Chile	0.036	0.347	-0.154	-0.088	-0.042	0.024	1.000		
Colombia	0.154	0.171	0.155	0.029	-0.091	0.102	0.139	1.000	
Ecuador	0.434	0.047	-0.085	0.176	-0.183	0.202	0.078	0.177	1.000
Peru	-0.032	0.218	-0.039	-0.001	0.051	-0.104	0.352	0.407	0.134

With Respect to the union with the United States through official dollarization

- Inclusion of lagged US terms accounting for systematic risk
- Positive and significant correlation with the Andean countries is not the case for most of the other scenarios with other countries and the different lagged versions of the United States permanent shocks, where it can be even found negatively correlated shocks.
- Monetary integration is rather not advisable in despite of the large trade volumes of the Hispanic countries and the United States

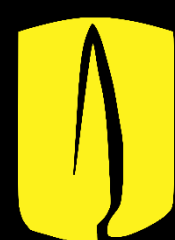
With Respect to the union between the Andean countries

- There is high and positive correlation of the permanent shocks between most of the combinations of this set of Latin American countries
- First comparison of this results and the correlation of shocks of members of the European Union before German unification in 1989 were they ranged between 0.2 and 0.5 is looking promising
- A second comparison with the results from Hallwood's, Marsh's & Scheibe's (2006) assessment for the monetary union of Argentina, Brazil, Chile, Uruguay and Venezuela where they found positive shocks between Argentina, Brazil, Chile and Uruguay but the Andean countries posses more highly significant correlation.

Conclusions

- Long-lasting shocks between Bolivia, Chile, Colombia, Ecuador and Peru **are positively correlated and symmetric enough** to set the basis for a monetary union between these set of countries
- By comparing the results with the ones of European Union members and Mercosur members, **the set of countries chosen for the study appears to be in a better shape** to establish a common currency area than the previously mentioned group of countries.
- It would **not be recommended to these countries to integrate monetarily with the United States through official dollarization** as shocks do not correlate positively or significantly enough with the set of countries of the Andean Region.
- Efforts for **increasing trade** between Andean countries must continue the path it has been taking to ensure significant benefits from a monetary integration **as well as effort for integration** delivered by the Pacific Alliance.

Thank you



Appendix



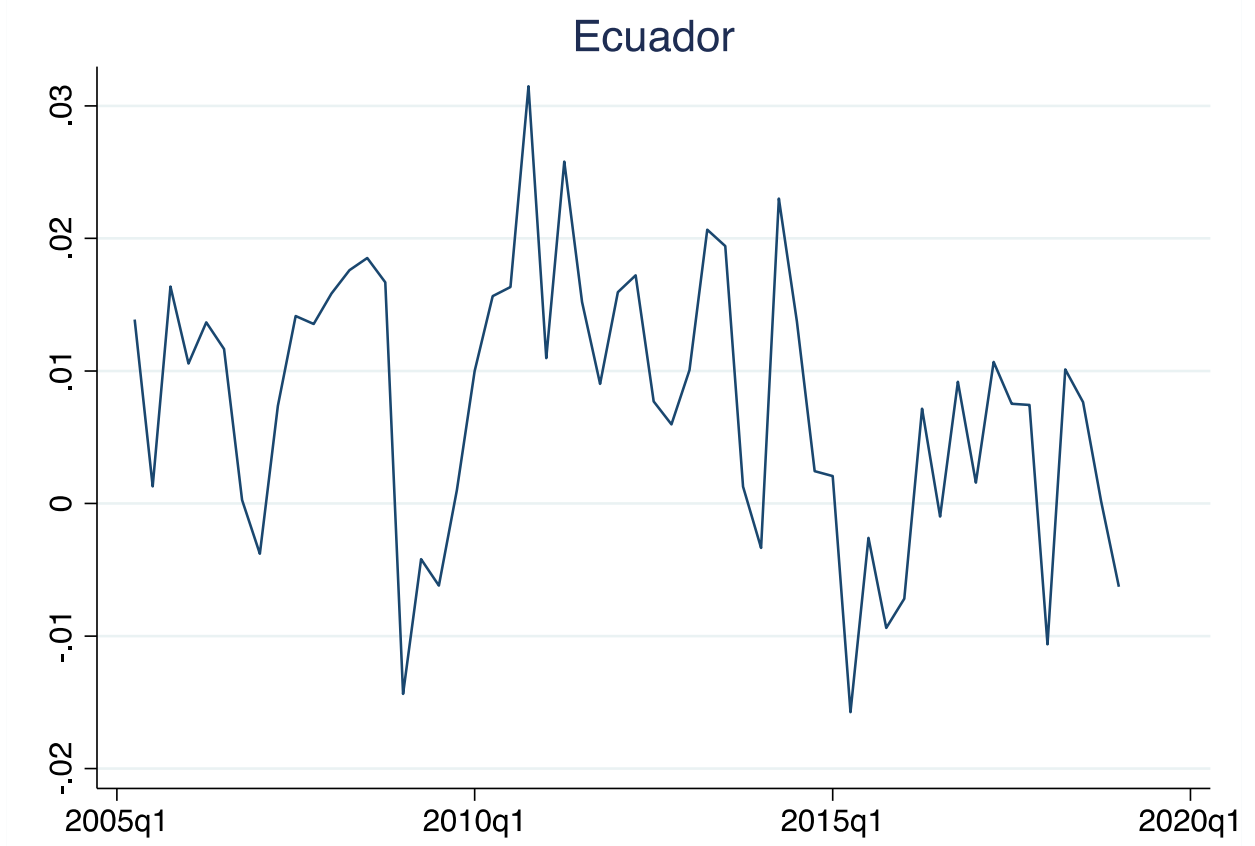
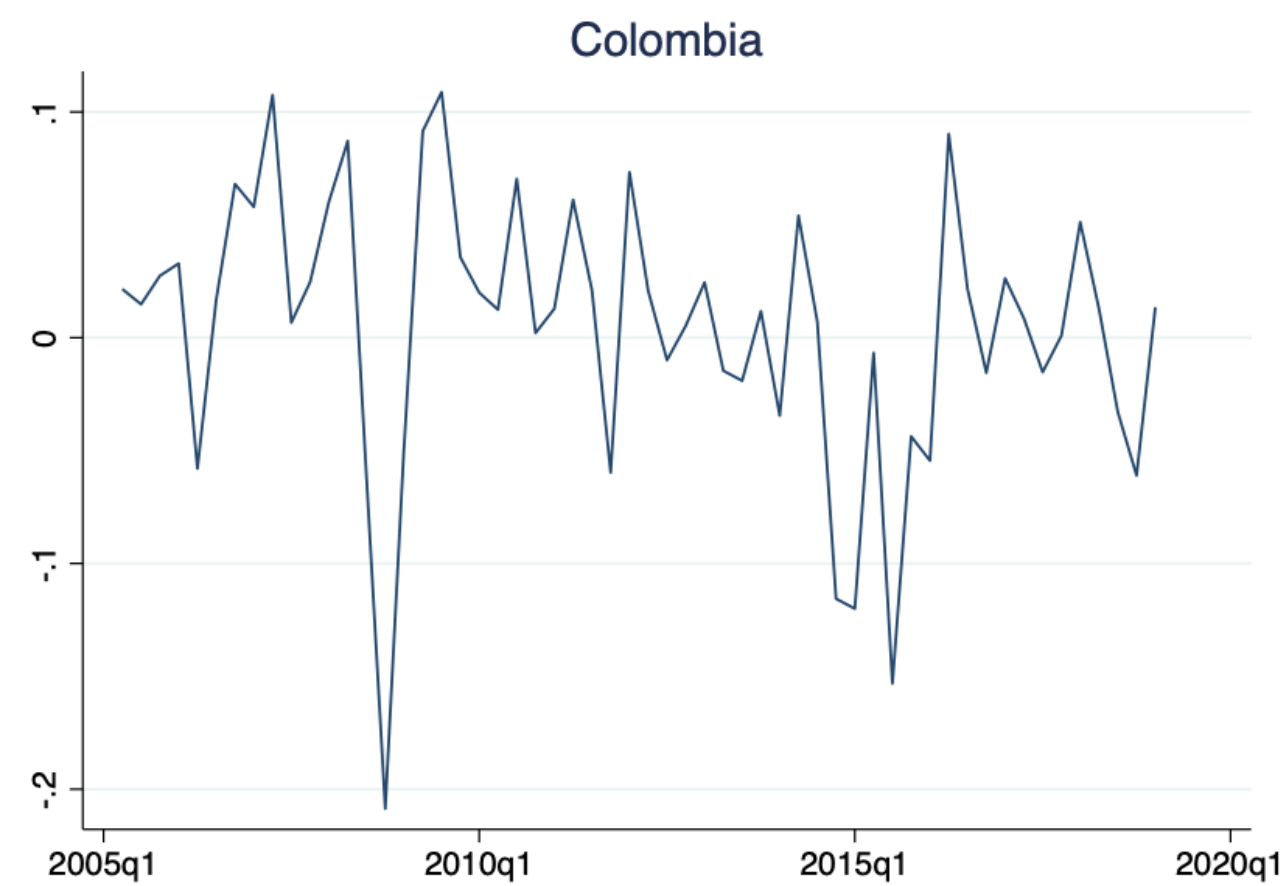
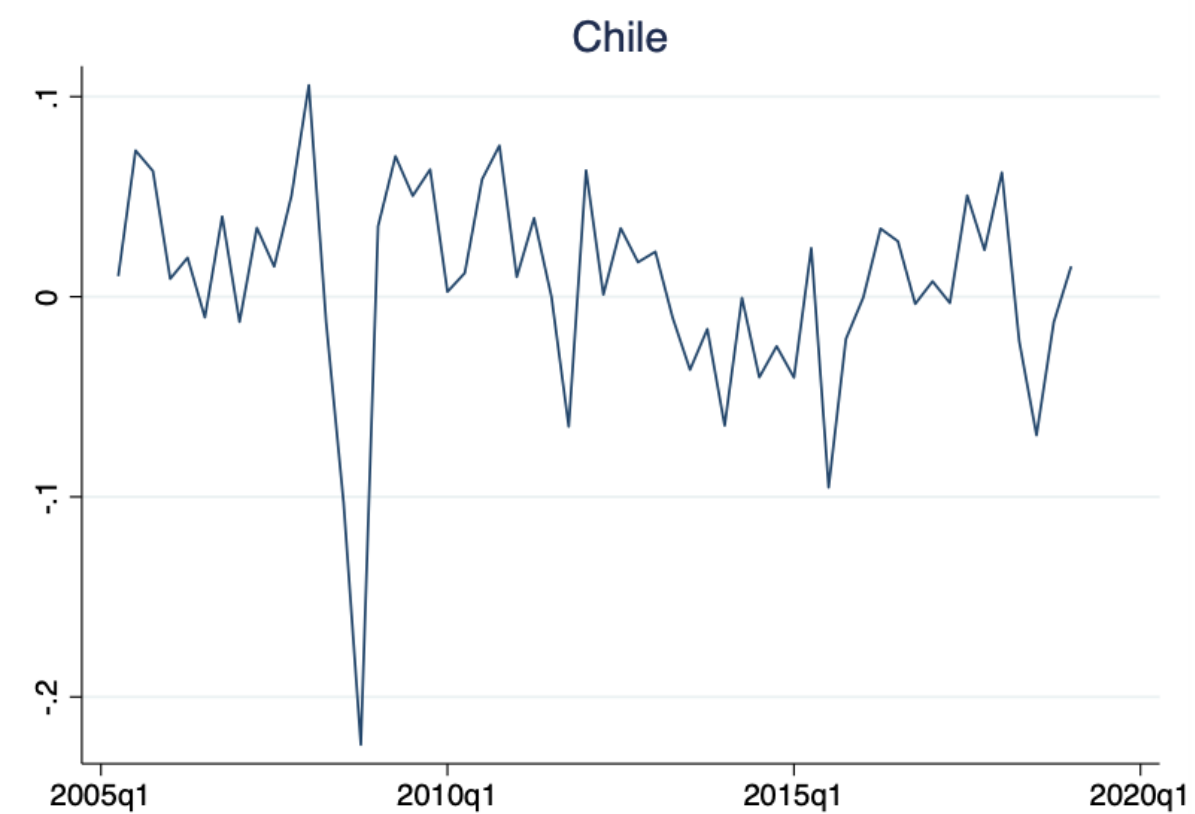
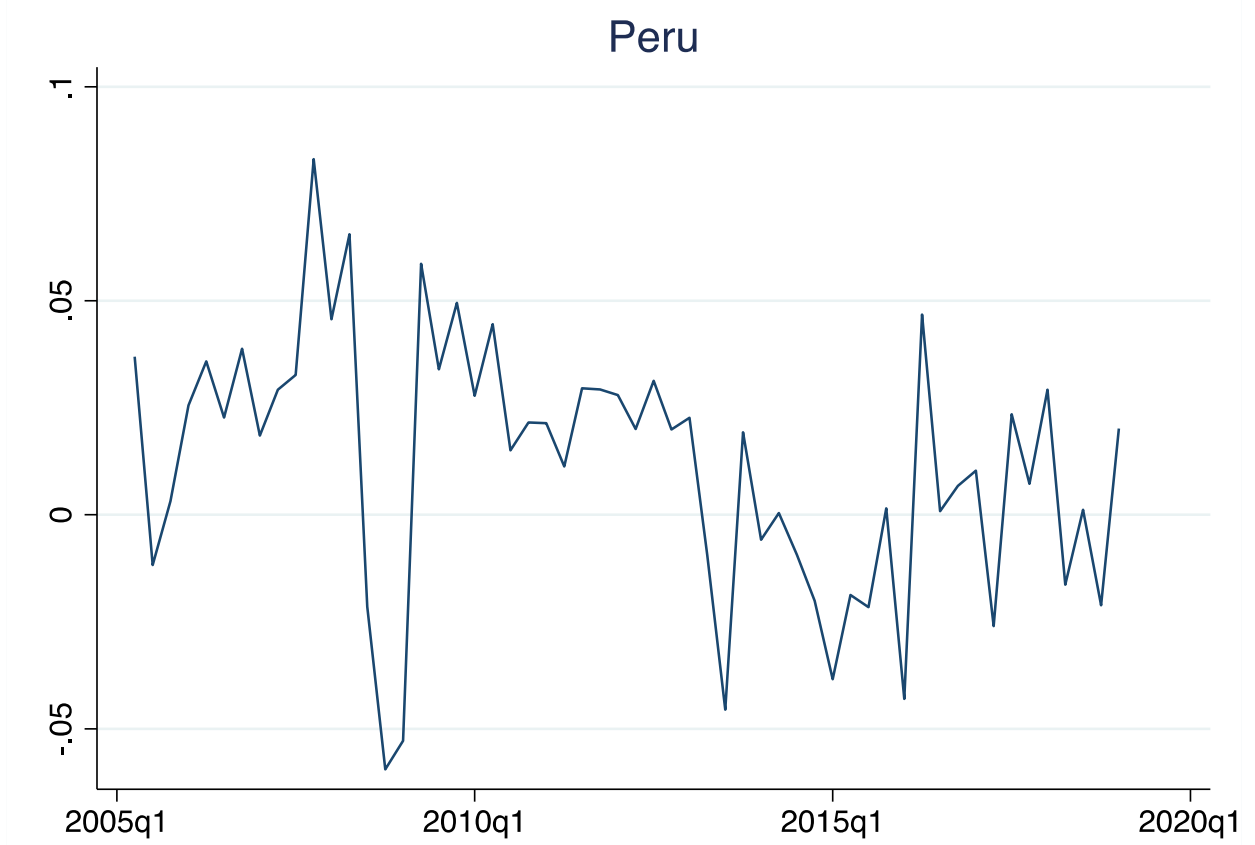
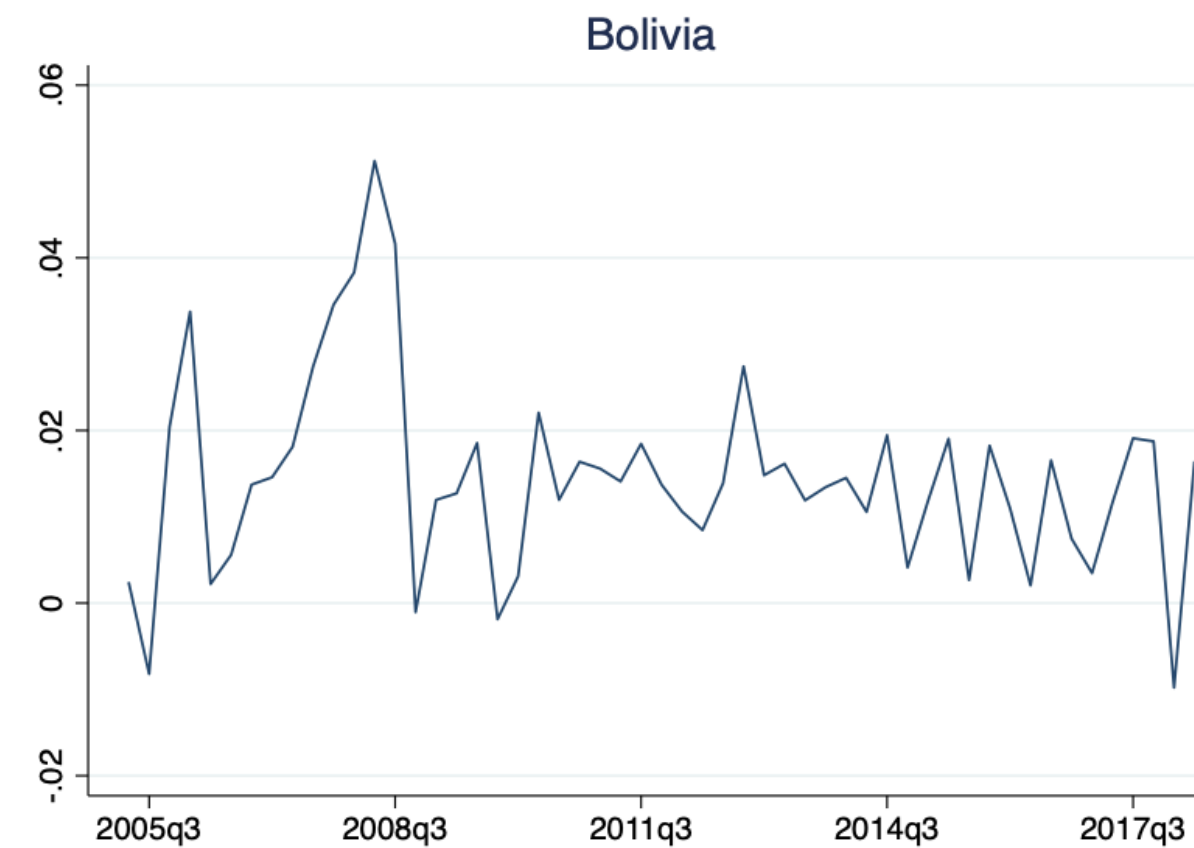
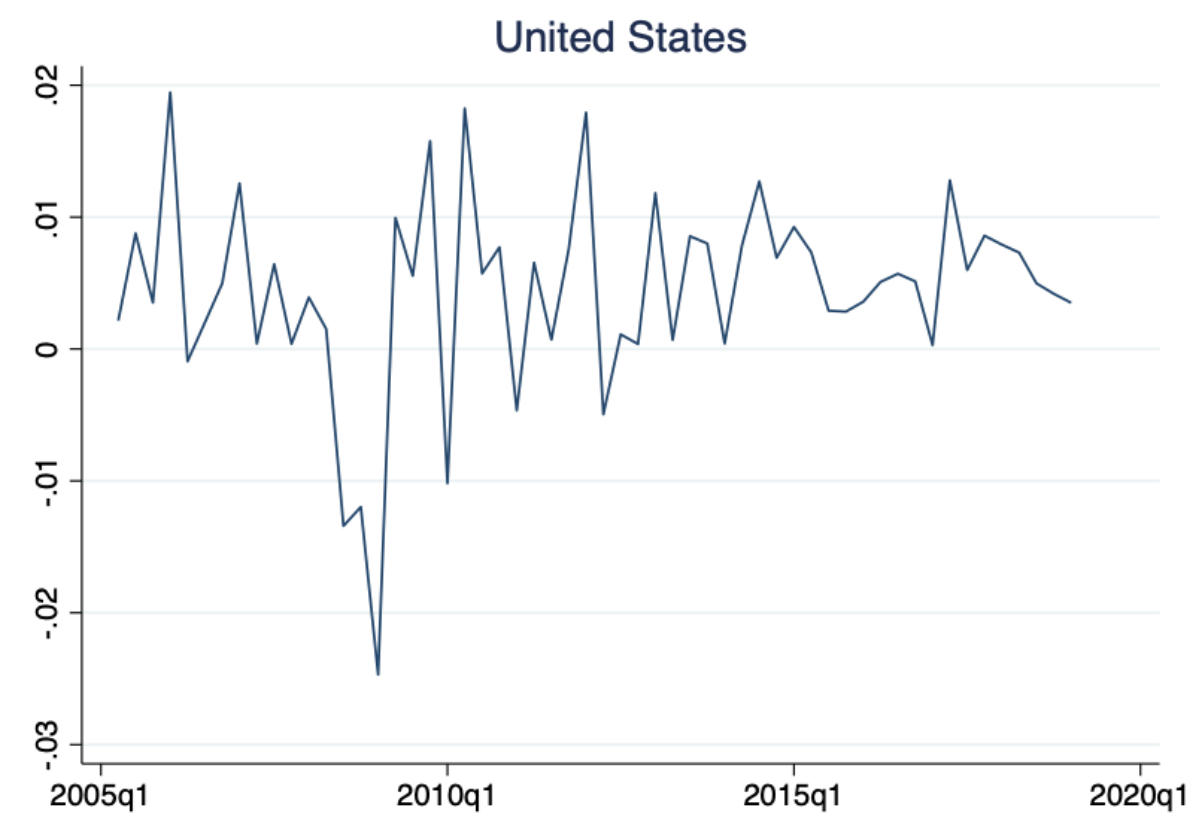
Literature Review

TRADE INTENSITIES

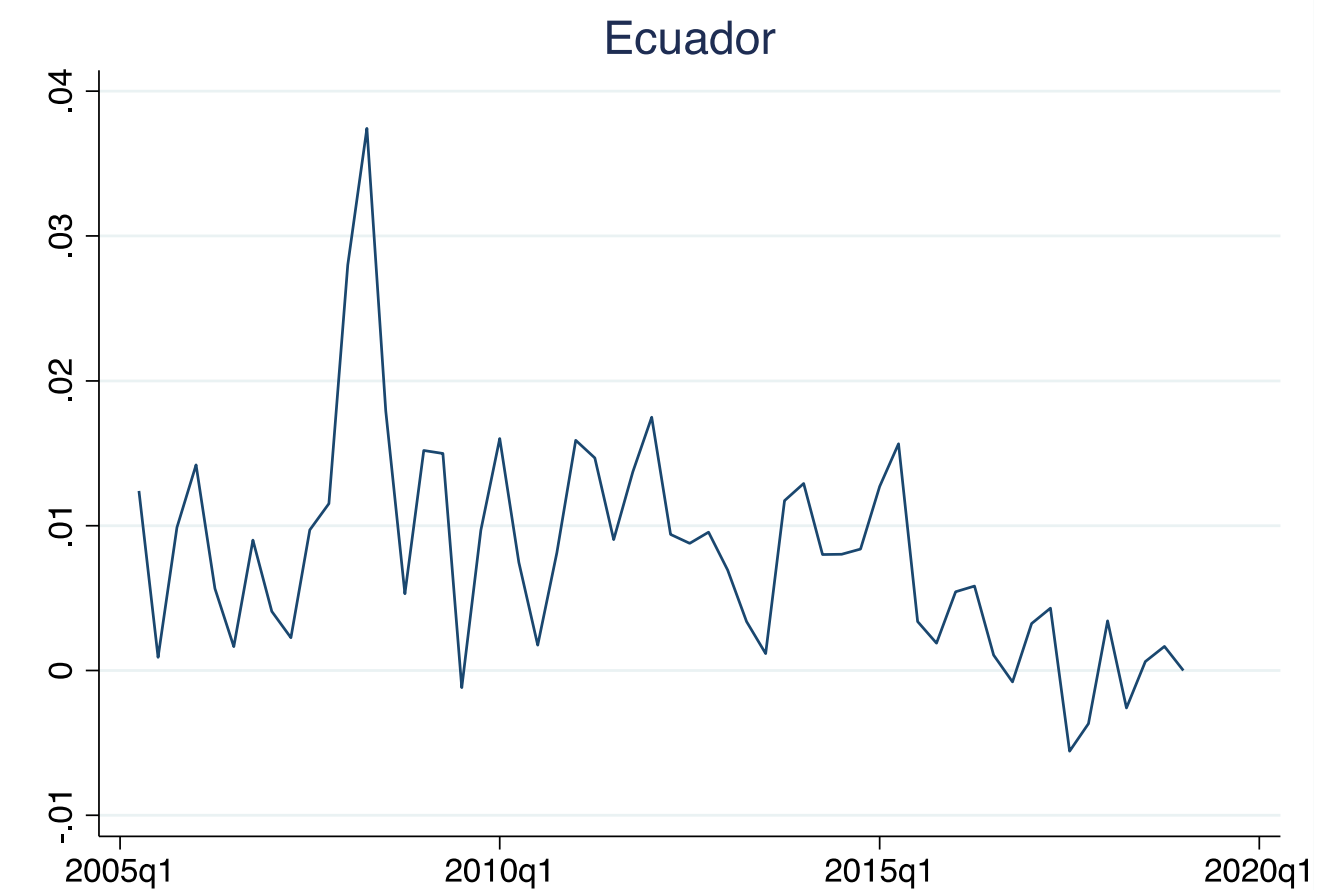
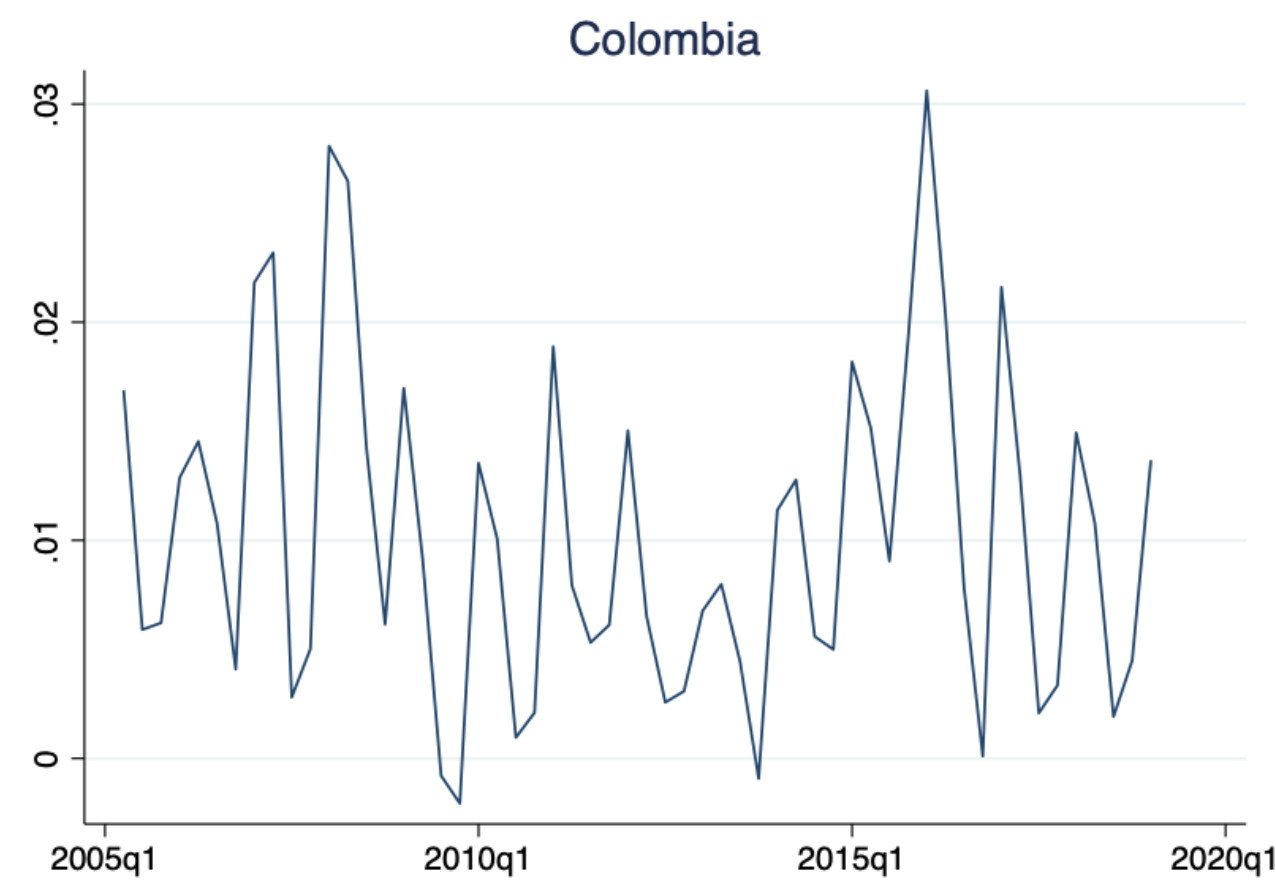
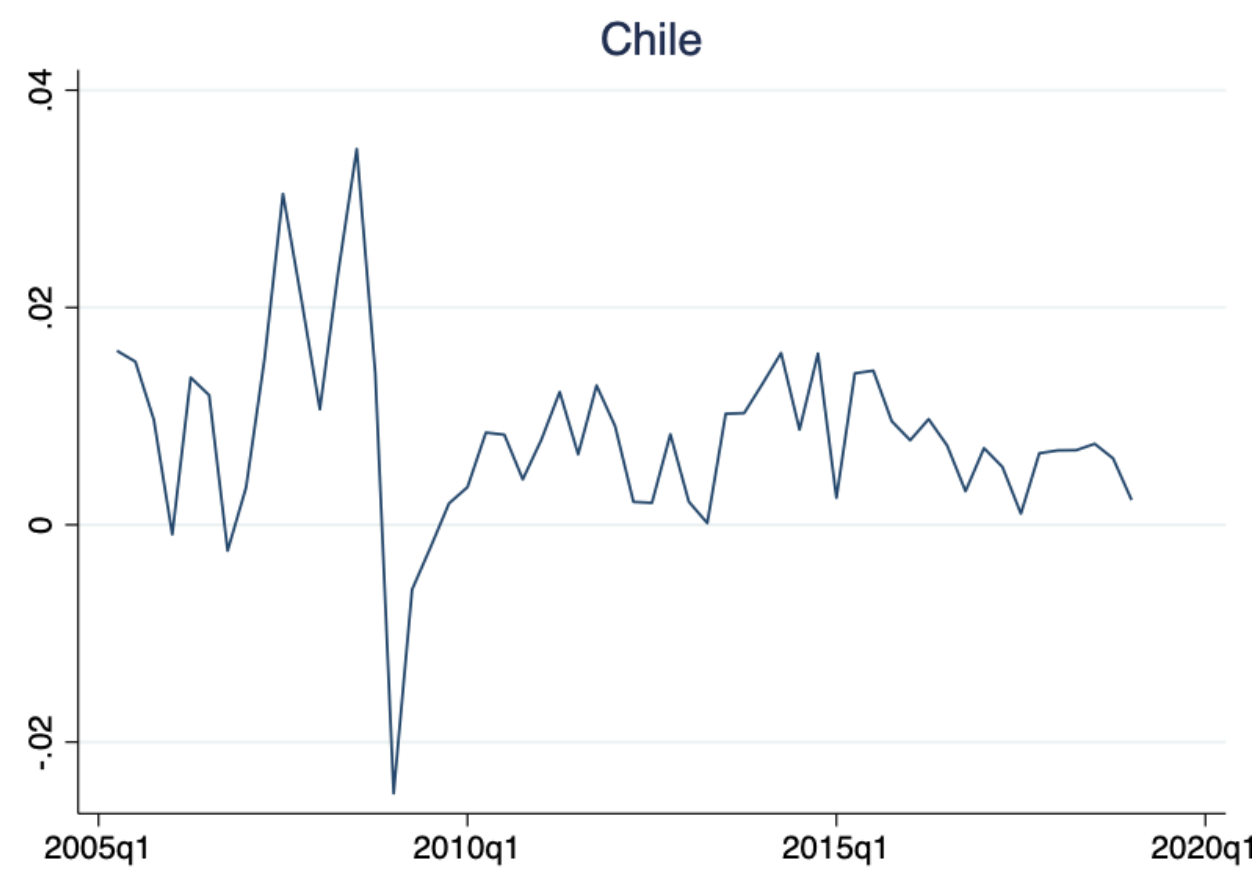
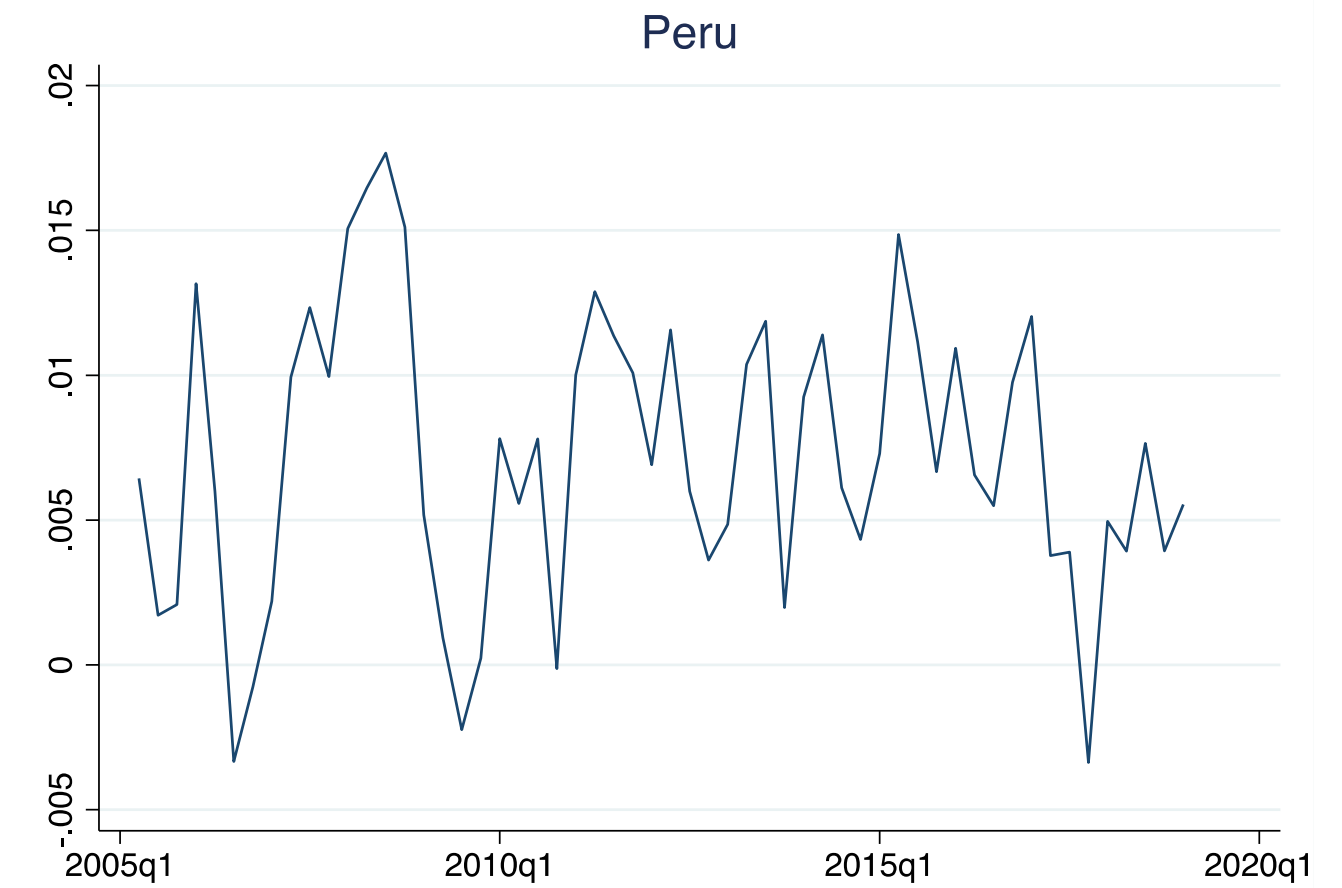
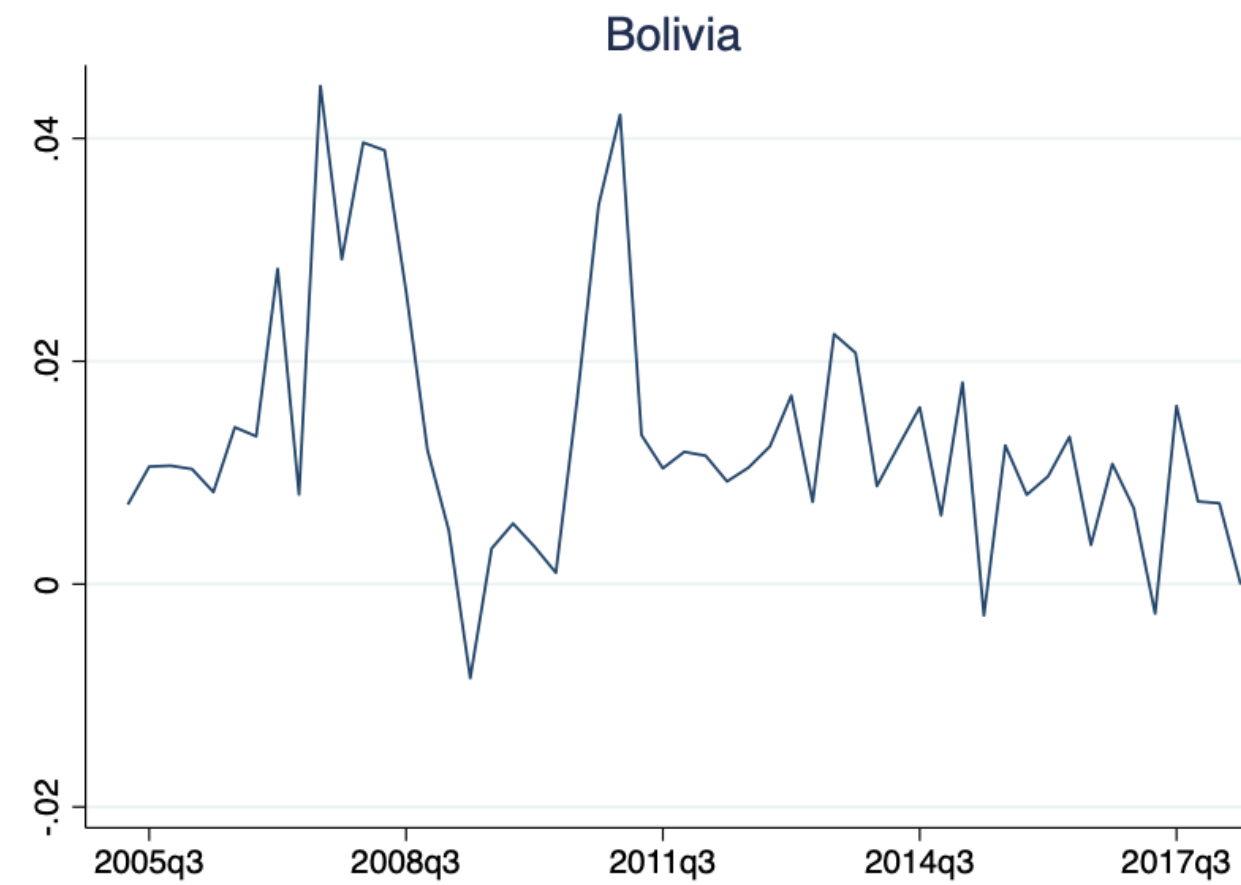
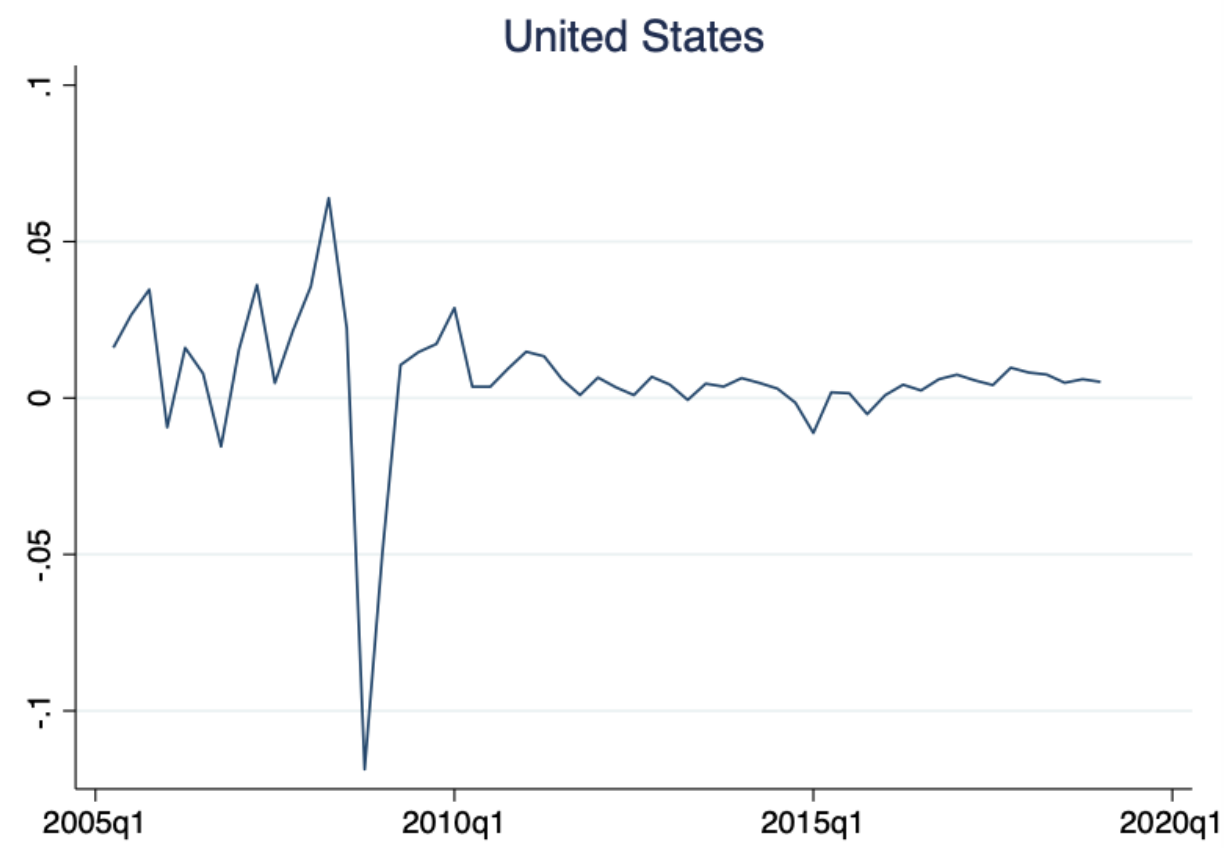
From	United States		Bolivia		Chile		From	Colombia		Ecuador		Peru	
	Exports	Imports	Exports	Imports	Exports	Imports		To	Exports	Imports	Exports	Imports	Exports
Total	11,750%	14,530%	14,960%	31,430%	28,030%	28,850%	Total	15,850%	21,660%	23,040%	23,020%	23,890%	22,890%
USA	-	-	0,650%	0,838%	1,610%	2,362%	USA	3,607%	3,149%	3,466%	2,609%	1,457%	2,573%
Bolivia	0,004%	0,002%	-	-	0,167%	0,016%	Bolivia	0,039%	0,089%	0,019%	0,125%	0,177%	0,115%
Chile	0,105%	0,048%	0,141%	1,810%	-	-	Chile	0,287%	0,150%	0,771%	0,253%	0,329%	0,517%
Colombia	0,107%	0,061%	0,571%	0,241%	0,108%	0,173%	Colombia	-	-	0,438%	1,080%	0,200%	0,335%
Ecuador	0,036%	0,031%	0,330%	0,067%	0,075%	0,263%	Ecuador	0,568%	0,196%	-	-	0,201%	0,287%
Peru	0,069%	0,028%	0,579%	1,269%	0,296%	0,230%	Peru	0,336%	0,182%	0,510%	0,443%	-	-

Source: United Nations International Trade Statistics Database, 2021

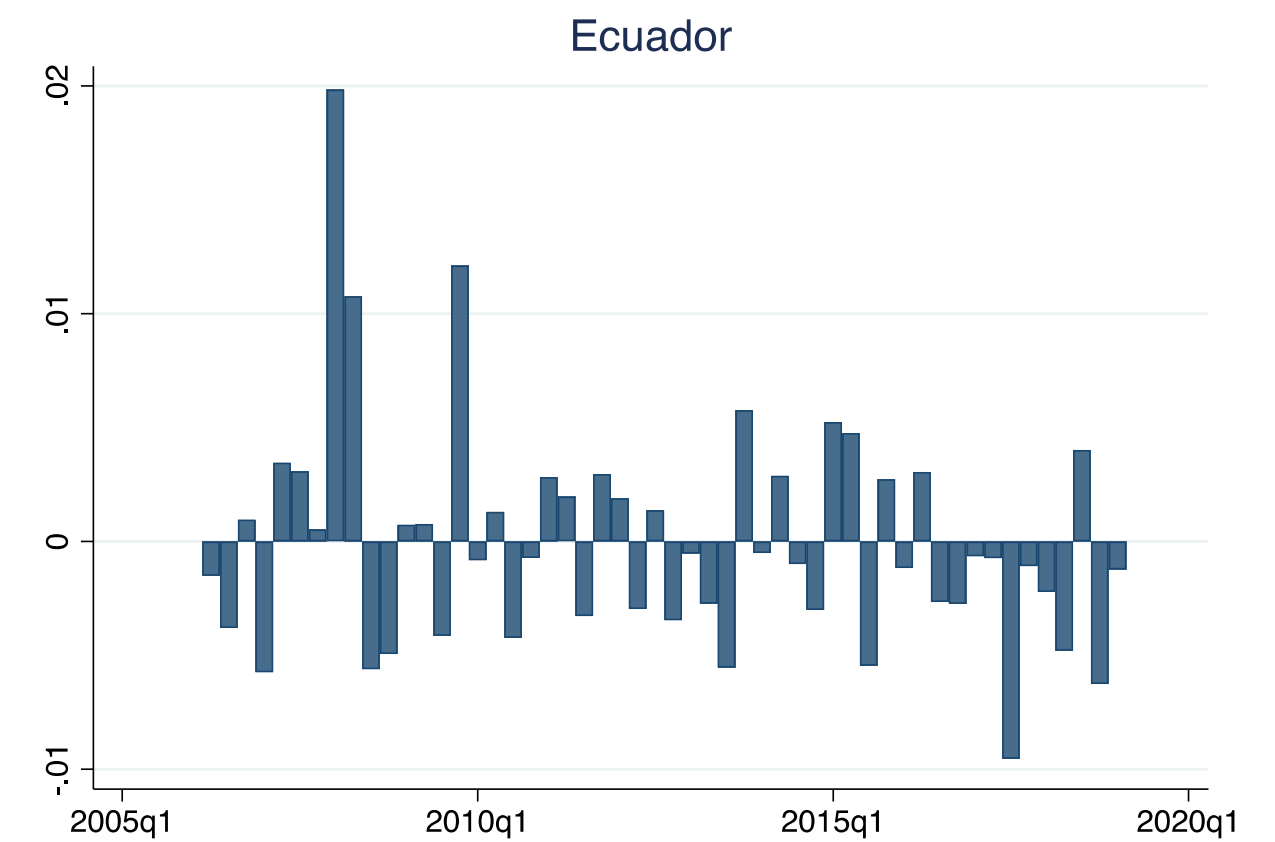
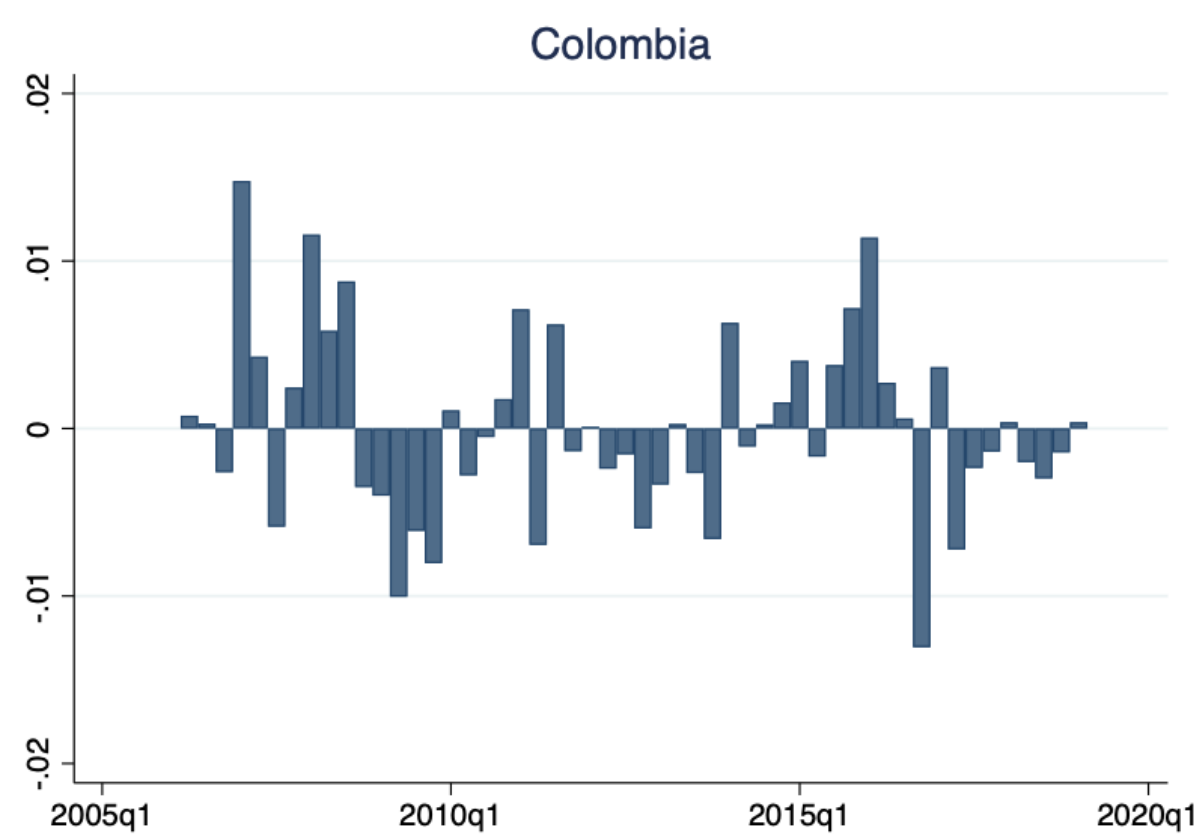
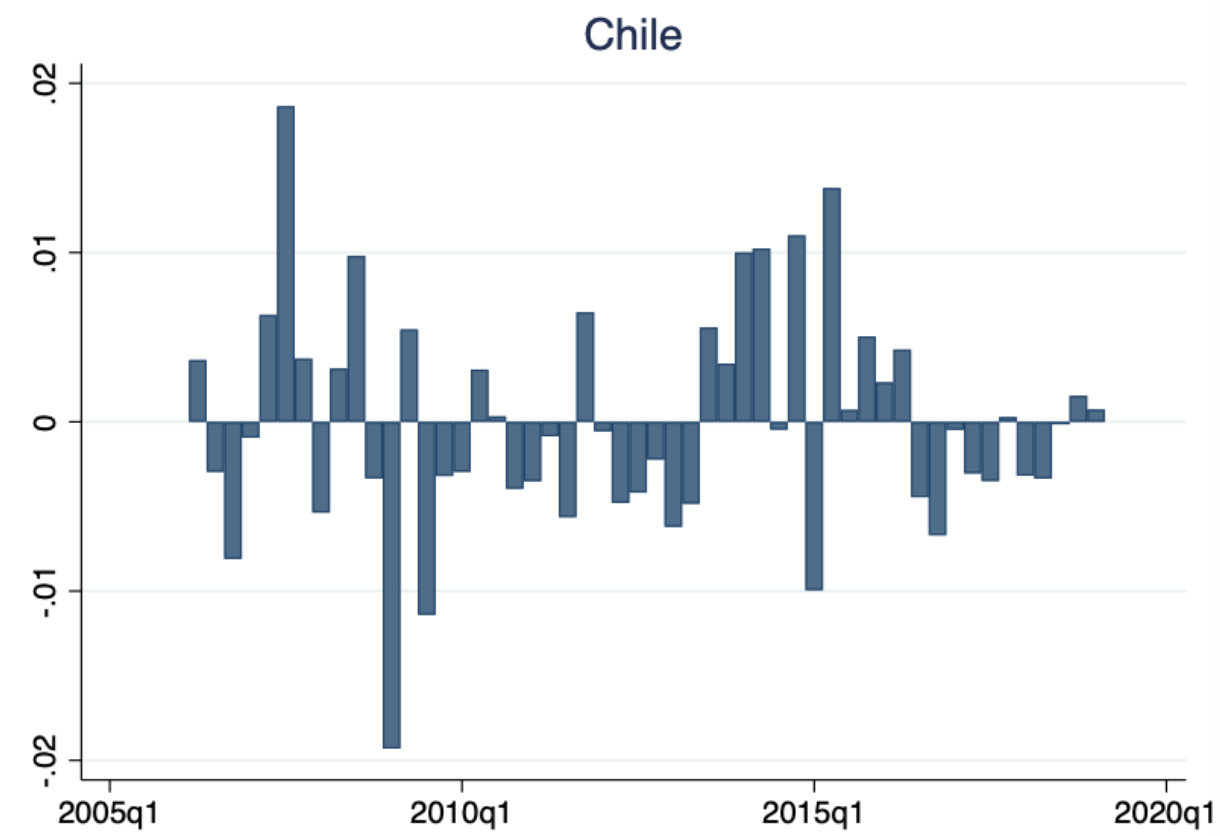
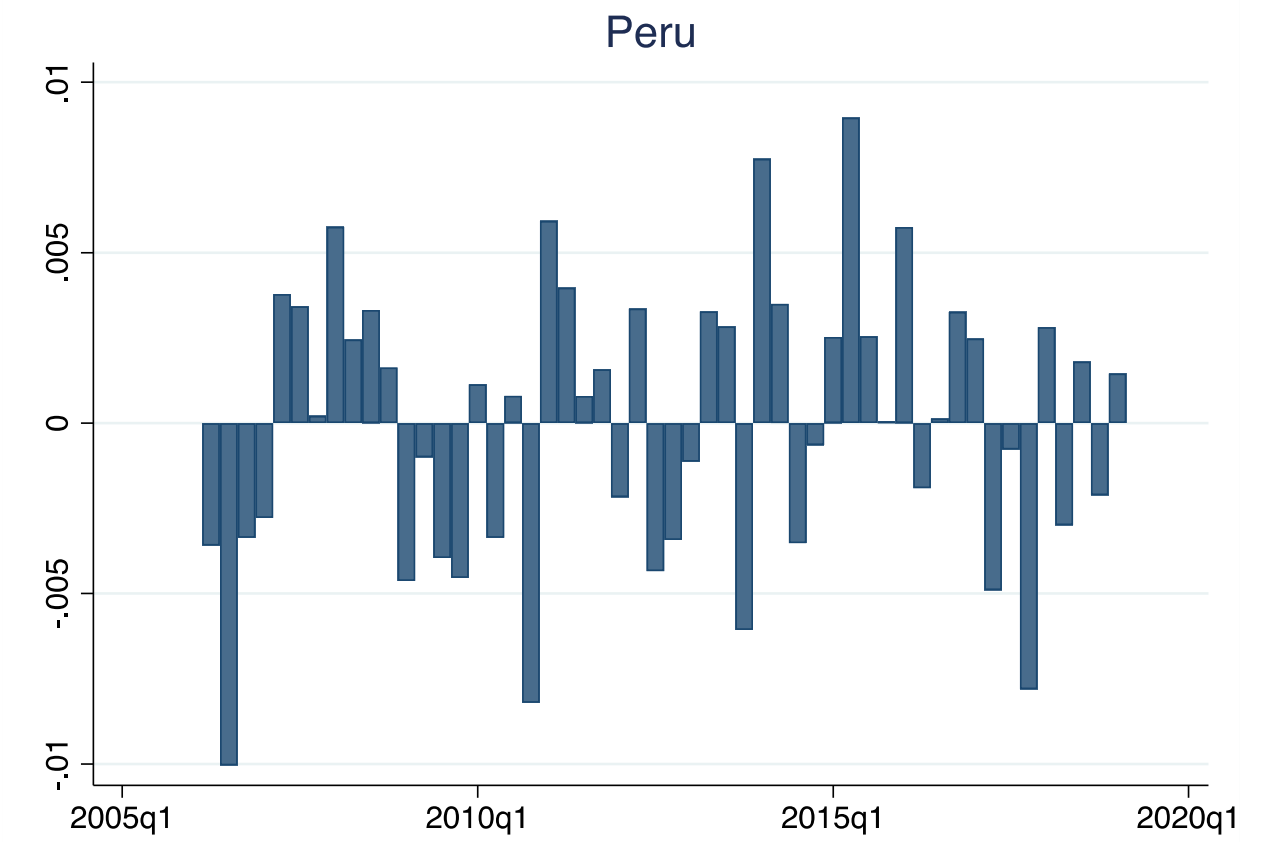
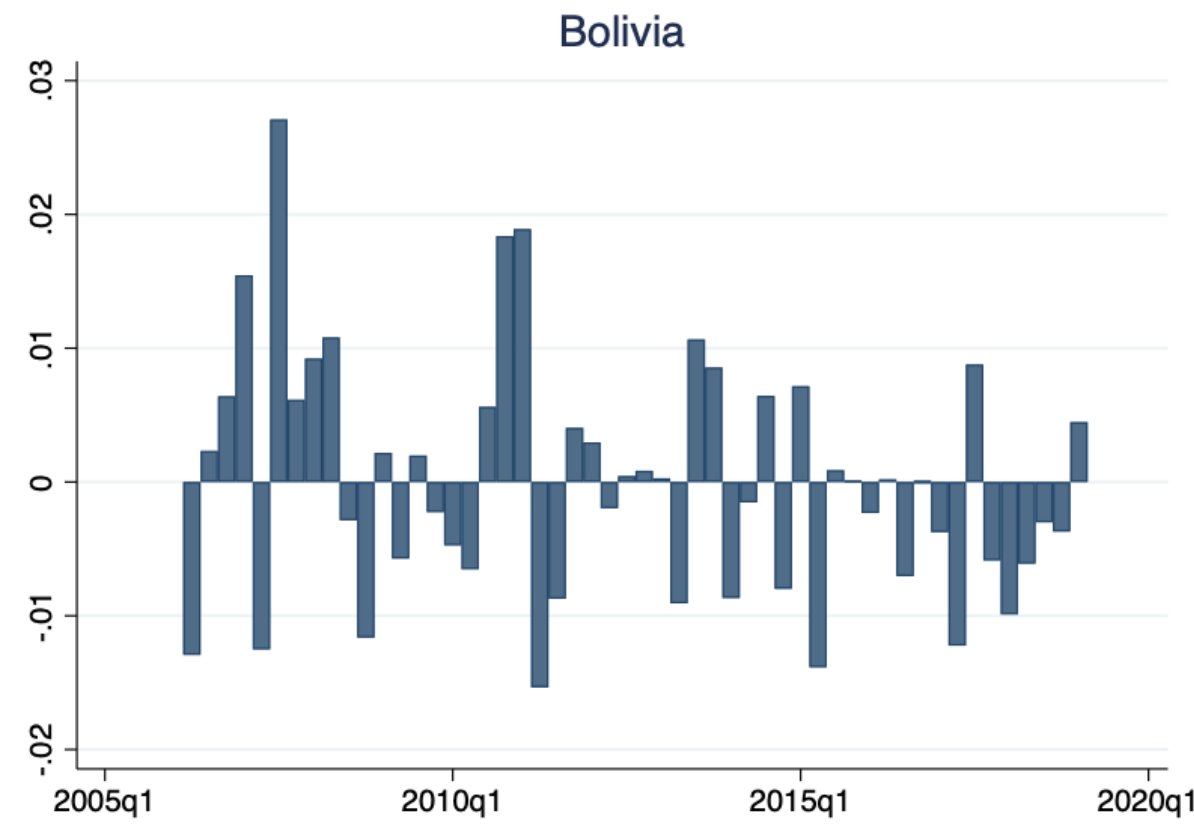
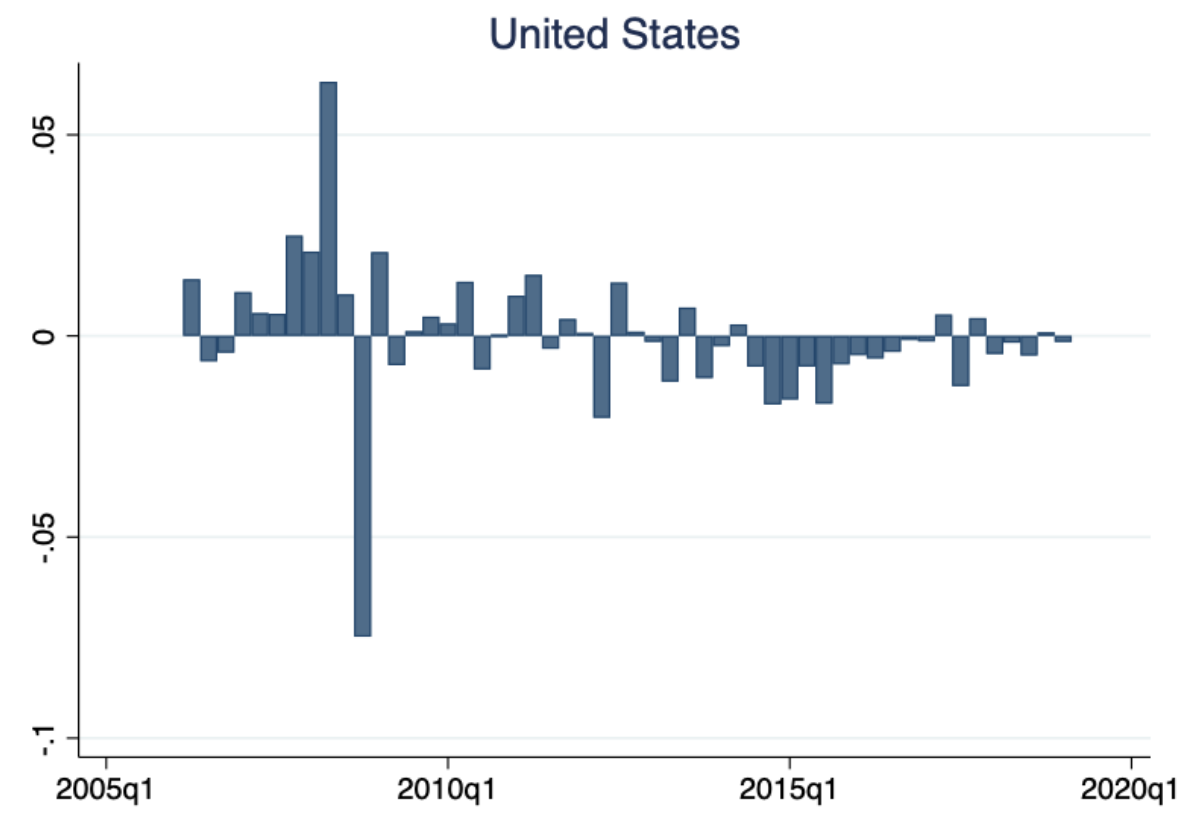
GDP GROWTH BY COUNTRY



INFLATION RATE BY COUNTRY



TIME SERIES PLOTS OF PERMANENT SHOCKS EXTRACTED FROM THE STRUCTURAL VAR



Summary Statistics from the VAR

Table 7: Summary statistics of permanent shocks in percentages

	SD	Min	Max
United States	1.688	-7.479	6.318
Bolivia	.898	-1.536	2.71
Chile	.661	-1.931	1.864
Colombia	.55	-1.306	1.478
Ecuador	.498	-.954	1.985
Peru	.409	-1.004	.896

Table 8: Summary statistics of temporary shocks in percentages

	SD	Min	Max
United States	.579	-1.473	1.929
Bolivia	1.606	-3.65	6.903
Chile	4.528	-12.813	10.378
Colombia	5.132	-15.194	8.893
Ecuador	.829	-2.014	2.52
Peru	2.61	-5.907	6.668