The impact of monetary union on trade and business cycle: The case of the West African Economic and Monetary union (WAEMU)

Bachelor Thesis in Economics

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Acknowledgement

Our greatest gratitude goes to our supervisor Johan Lindén who has truly supported and directed us throughout the whole process. We would have not made it if it was not for his support and guidance. We would also like to thank our families, especially our parents for their thoughtfulness and encouragement. Finally our gratitude is extended to friends and classmates who have directly or indirectly supported us while doing this study.
Abstract

Course:

Bachelor thesis in economics 15hp

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Title:

The impact of monetary union on trade and business cycle: the case of WAEMU (West African Economic and Monetary Union)

Keyword:

Monetary union, exchange rate, trade, GDP volatility and growth rate.

Research question:

What effect does monetary union have on trade and GDP volatility.

Purpose of the research:

The purpose of this study is to see whether trade and business cycle improve with monetary union.

Methods:

This study will be based on literature reviews, articles, as well as internet sources. An empirical study will also be done to support it, where a comparison between two groups of countries will be done. One group is represented by WAEMU members and another “control” group is comprised by countries in the same region but outside the union.

Conclusion:

After the empirical study the assumption that trade increases more within the union was found to be true. However GDP was found to be less volatile within the union compared to the outside as opposed to the assumption.
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INTRODUCTION:

One of the most discussed topics among monetary economist is the impact of a monetary policy on the economy’s real variables, such as inflation, GDP per capita, unemployment rate, export, import etc. Another discussed subject amongst the economists is how the monetary policy effects are steered from monetary policy characteristics to real indicators of economic performance cited above. For this study, we have chosen to analyze the special case of WAEMU, which stands for West African economic and monetary union. A comparison based on WAEMU’s business cycle and trade performance against other countries in the region but which are not member of the union is undertaken. As they say: “unity is strength” but does this apply within the macroeconomic policies adopted by WAEMU countries? In this work, the aim is to study the consequences of the adhesion of a monetary union and the lost of a national independent monetary policy. More specifically, the research topic is: the impact of the WAEMU’s monetary union on its trade and business cycle. In the theory framework, the concept of different exchange rate regimes and analysis of their implications is also introduced and a description of how economic authorities should perform given what type of exchange rate they have established is presentend. This tudy’s analysis is based on comparing trade data for the countries before and after the adoption of the monetary union and a statistical regression of GDP is runed by using a linear trend analysis. By doing so, the below mentioned questions are examined in order to attain a reasonable conclusion. The question are formulated as follow:

- Does the monetary union ease trading?
- How is the business cycle of the union compared to that of the neighbor but non-member countries?
1.1 BACKGROUND

1.1.1 West African Monetary Union

The West African monetary union was established by a convention signed in Dakar, the capital of Senegal on the 10th January 1994. This convention was signed by the Governments of the 7 different countries which are Benin, Burkina Faso, Ivory Coast, Mali, Niger, Senegal and Togo. The convention became operative on the 11th August 1994. After ratification by the state members on 02 May 1997, Guinea-Bissau became the eighth member state of the Union.

WAEMU is symbolized by a logo representing growth, unity and solidarity between the countries. This union is defined by a set of institutional arrangements that determine fully their monetary policy. Its main feature is the fixed parity between their currency CFA franc and the Euro. Foreign exchange reserves are centralized by their central bank BCEAO and these reserves of the BCEAO are then deposited in an account opened by the French Treasury. The French Treasury in its turn agrees to make available to the BCEAO a certain amount of currency if needed. In return of the "insured system", France is a member of the executives and ministers board of the two bodies that represent the BCEAO policy. Each country has one vote in each of these two bodies.

1.1.2 CFA Franc: the Common Currency

CFA franc was created on the 26th /12/1945, at the time when France approved the Bretton Woods accord and applied its first statement parity with the International Monetary Fund (IMF). CFA initially stood for “French franc of African Colonies”. It then took the designation of the «African Financial Community franc », for the west African monetary union (WAEMU)

CFA franc system is established by four main basis.
1. The concentration of foreign exchange reserves in the French Treasury.
2. The fixed parity between the franc CFA and the euro
3. The free convertibility of the CFA franc to the euro.
4. The free capital mobility between France and countries within that zone.

These main fundamentals of this system add up the obvious omnipresent participation of France in most if not all of the governing bodies of these countries.

1.2 PROBLEM

In this study, the aim is to analyze the overall monetary union impact on the trade and business cycle of WEAMU. We want to investigate the advantage and disadvantage of adhering a monetary union and adopting a fixed exchange rate. Countries within a currency union lose their independent monetary policy in exchange for a more stable currency
behavior such as inflation. This is the reason why governments and policy makers, especially those of West Africa that are interested in joining the union would benefit from understanding this study. A clear comprehension of advantages and disadvantages of a monetary union would help them in their decision making process.

1.3 Purpose
The objective of this work is to analyze the effect of monetary union on WAEMU’s trade behavior, and economic activity fluctuations during a period of time. In other words, the principal matter of this work is to see how trade and the business cycle of these members have changed since they entered the union.

1.4 Limitation
One encountered challenge during this study is the difficulties with the accessibility of the data that were needed to run the empirical study. Many times databases and sources had to be changed because there would always be a country or two which were lacking data in the period needed. Because of that particular problem one country (Guinea Bissau), which is also a member of the WAEMU, had to be disregarded and only 7 out 8 countries were considered. In addition to this, we strongly believe that the volatility of the GDP and trade performance does not only depend on monetary policy ratified by the countries, but also on political, demographical and other strong economic factors. These factors have not been put in consideration since the time period that is set to accomplish this study is way smaller than the one needed to run a proper research of the topic as a whole. Regarding the part of the empirical study covering the growth rate, there has been a limitation because variables such as private, government consumption and Investment were needed to properly interpret and discuss the results observed. In addition to this, these variables were also to appropriately explain the reason behind the results of GDP volatility for the countries outside the union. Once again, because of the lack of time, these factors were disregarded and the “possible” reason behind the control group’s growth rate results is shortly and generally interpreted. The above cited factors could have given a more accurate and concrete conclusion for the study.

2 Method

2.1 Method Overview
The subsequent steps were followed to conduct the work: first the subject was chosen, we both were interested in the section that covered monetary policy while taking our macroeconomics courses. We then wanted our work to be focused on a particular monetary union rather than random countries and decided to choose the West African monetary union. We felt like it was going to be an interesting region to learn about and do a research
on, not only for us but also for our fellow classmates who may never have heard of it. After deciding our research area, we then started the information research and formulated it as: “the impact of monetary union on business cycle and trade”. This question was used to direct us to find important theories that have been the first step to understand more the area of interest. Moreover, formulating the research question helped us to have a better and clear picture of what the work could look like, the different section that needed to be pointed out and worked on in the empirical study, in order to make the work interesting to those who will read it. To find relevant theories and information that applies to the main question analysis, we have used mainly course literatures such as: macroeconomics (Nils Gottfries), (borjas 2008), google scholar, google books, journals and articles. Once we had a clear picture of what the problematic was, we read other studies that analyzed the same question and get inspired for our empirical study. To answer the question whether the adhesion of the union was beneficial for the union countries or not, we had to compare them with other countries with which they shared some similarities but were not in the union. Briefly, the work would be a comparison of a sample of countries. The countries that are outside the union, will be referred to as the “control group”. The control group is composed of 7 countries that are also in the West African region. These countries are Nigeria, Ghana; Sierra Leone; Liberia; Guinea Conakry, Mauritania and Gambia. Most of these countries are former British colonies, apart from Mauritania which is colonized by France and Liberia which is considered to not have been colonized. These countries have obtained their independence between 1955 and 1965. Most of the countries like Sierra Leone and Nigeria for example are rich in natural resources such as diamond, gold and oil. Nevertheless, these countries are still considered poor. In terms of monetary policy, all 7 countries have their independent currency with floating exchange rate

2.2 METHODS TO COLLECT DATA

The work was done using secondary data that we collected from internet databases.

2.3 COLLECTION OF SECONDARY DATA

The secondary data consist of GDP, export and inflation data gathered from two different internet sources. The first data collected consist of GDP and export of the samples from the data center of UNCTADstad “united nation conference on trade and development”. Real GDP was chosen to do the regression measuring the volatility for both group of countries before and after the union and nominal GDP for measuring trade in % of GDP\(^1\). We also

acceded the Penn world table of the “Center of international comparison at the University of Pennsylvania” to collect inflation data for both group of countries. These materials will be portrayed in the empirical study.

3 THEORETICAL FRAMEWORKS

3.1 MONETARY UNION

In order to achieve greater economic overall benefits, two or more countries might decide to merge their economic activities and form a monetary union. Monetary union signifies that the countries that are members of the union, have one common central bank that sets their common monetary policy. Countries that adopt this policy have no longer different exchange rates against foreign currencies and each single economic decision is taken by the common central bank. In other words, these countries have a fixed exchange rate. There are benefits and drawbacks that are faced by the countries that have common currency.

The advantages and the disadvantages of the monetary union can be subdivided into micro and macroeconomic aspects. The microeconomic aspect refers to the factors that affect the efficiency and the trade among countries within and outside the union, while when looking at the macroeconomic level, we look at the economic stability of the countries.

Put in other words, most of the factors that are listed below (the advantages) play a considerable role in increasing trade while most of the disadvantages are the ones that causes the country’s GDP to fluctuate from the mean.

(Nils Gottfries p414-415)

3.1.1 Advantages of a Monetary Union

**The elimination of the transaction cost**: this is the most concrete and credible gain of changing from different currencies to a common currency. The fee that is usually paid during the exchange of currencies is no longer required. This elimination of transaction cost is a major

Access real GDP: unctadstdat-data center-economic trends-national accounts-Nominal and real GDP, total and per capita, annual, 1970-2013

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2 Penn world table-data and communication-PWT 7.0-data download-price level of consumption.
gain for the country because people who trade with currencies can now concentrate on increasing or improving the production and the services. In addition to this, it is true to say that the elimination of this fee increase trade since buyers and sellers of goods and services are no longer required to pay the exchange fee.

**Investment:** the lower transaction cost increases foreign investments since companies now are able to enter or exit any country of the union without incurring large costs. In other words the cross border investments increases, as the introduction of the common currency plays a big role in making the money market more integrated. The fact that the country becomes more open to foreign companies makes the competition tougher and this leads to a higher social welfare. In general, having a floating exchange rate decreases the net investment as the volatile exchange rate is correlated with risks. Moreover, the volatility of the rate has an impact on companies’ profitability and the risk increase. This is the reason why a country that wants to attract investors is better off entering a monetary union since the exchange rate is fixed and stable. This stability decreases the risk of loss for investors.

**The transparency of the prices:** when countries are using a common currency, the prices are expressed in the same currency and buyers do not need to translate or convert currencies in order to know the exact price of a good. This signifies that the customers can easily judge the price relationships. The new expression of the prices makes it easier for the buyers to compare and equalize the prices across borders.

**Workers can move freely:** the ability to have labor that can move freely plays a significant role in preventing asymmetric shocks that arises due inflation in one country and recession in another country of the union. The free mobility of workers eventually leads to increase in employment in the country that has a recession and the release in the inflation for the other. Another gain of joining the currency is that the country increases its overall income due to the expansion of its market. The act of merging the currency permits the movement of services and goods without any hinders. This is the reason why monetary union is vital, especially for countries that lack internal control. Considering the fact that the monetary union makes the countries interdepended on one another, it is reasonable to claim that peace is maintained between the countries. (Nils Gottfries p416-418)

### 3.1.2 Disadvantages of currency union

**The sovereignty of the country is lost:** the adoption of the common currency requires that the members surrender their monetary rights and decisions to the common central bank. The biggest inconvenience arises during crisis situations, especially when challenges faced by the countries are different and cannot be tackled in the same way. For example, one particular country might be facing a sudden increase in unemployment and this increase in its turn has to lead to the fall of government revenues, since the people are no longer able to pay taxes. To restore the situation the government might have no other choice than increasing taxes and this can clearly cause an even greater economic disaster. In brief, the countries are not capable of responding to shocks since they no longer have an independent monetary policy.

**It is costly to adopt a new currency:** it is true to say that countries adopting a new currency have to pay for such a system to take place: staff training, changing to new labels, educating
customers and introducing them to the changes. This is a clearly a huge cost to the county’s economy.

**Fiscal policy negative externalities from cross-border:** a country might have national expansionary fiscal policy that aims to increase savings, by increasing the long run return on savings and thereby weakening the investment. Since the monetary union is considered to be well integrated when it gets to capital market, the national expansion fiscal policy can be an impose since its effects can be spread to other countries. In addition to this, the national fiscal policy can cause the common currency to appreciate, and this weakens the competitiveness of the entire union. This is definately an unwanted externality for the other countries of the union.

Another great challenge to countries adopting a common currency, is the difference in languages which in its turn causes the fall in the mobility of labor. The Language becomes huge barrier to labor force movement and this leads to the creation of depressed areas in which people are not able to get jobs.

In brief, we expect an adoption of a monetary union to lead to a reduction of the cost of transaction, to improve competition within the union and thereby simplifying and increasing trade. Nevertheless, we expect the monetary union to also cause deviations in the GDP for individual countries within the union.

### 3.2 Macroeconomic Stability in the Case of a Monetary Union

Demand and supply shocks can sometimes strike a country. In this case, the strategy of changing the relative prices should be embraced if the country wants to maintain its original production. The change in the price or in the nominal exchange rate can be used to adjust the real exchange rate. As it is pointed out in the book macroeconomics by Nils Gottfries, the Mundell Fleming model affirms that the nominal exchange rate adjustment can help to modify the real exchange rate easily. However, a monetary union member does not have the power to manipulate the exchange rate. So, the country’s economy has to adjust depending on whether the shock is asymmetric or symmetric. An asymmetric shock implies that a shock is specific to only one country and therefore affects only that particular country of the union. On the other hand symmetric shock refers to those shocks that affect the union as a whole and in a similar way. According to Nils Gottfries in his book Macroeconomics, whenever the shock is symmetric, the common central bank regulates its interest rate, which in its turn affects the common currency’s exchange rate.

“The common central bank will react much like a national central bank would have done and the effect of the shock on the small open economy would be similar to what it would have been with a floating exchange rate”

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3 Nils Gottfries, macroeconomics page 419
Even though it is hard to imagine asymmetric shocks that affects only one country of the union and leaves out the others, it is still possible for the exogenous factor to strike only one country of the union. A particular country can face shocks due to many factors such as the change in the institutions and laws, structural changes or the evolution of the world market competition.

When an individual country is encountering such shocks, the exchange rate or the interest rate of the union can not be altered. The country responds to the shock through the adjustment of the wages and the price levels. A continual negative demand shock leads to a lower production level and a lower inflation in the country. Eventually the level of production can be improved due to the restoration of competitiveness and the increase in net exports. Nevertheless, the process of restoring the production and the competitiveness take a significant time since the prices and the wages do not change quickly.

A country facing asymmetric shocks can also tackle the situation through labor mobility. The country might be facing recession while another country of the union is in an economic boom. In this case, workers can leave the place and go to the other country to find jobs.

Another adjustment mechanism for a country facing an asymmetric shock is fiscal policy. This refers to the alterations of government consumption and the change in taxes for the aggregate demand stabilization. Considering the fact that the countries lack their own monetary policy, fiscal policy is of a considerable importance in a monetary union.” In theory, an active fiscal policy can at least partially substitute for the absence of national monetary policy in a monetary union.”

The national fiscal policy is in this case the principal way to respond to asymmetric shocks. The government takes actions that have a significant impact on the economy stabilization such as increasing the economic activities. These activities in their turn raise the tax income, the social assistance and employment. To affect the competitiveness in the country, the government might use an internal devaluation policy. This policy is a package that is composed of an increase in the income tax or the value added taxes and a simultaneous payroll tax reduction. The internal devaluation restores the competitiveness in terms of exports since firms inside the country are not required to pay a value added tax. (Nils Gottfries p419-421)

“An internal devaluation shifts taxes from firms to consumers and it can be designed in such a way that the government budget balance remains roughly unaffected.”

3.3 EXCHANGE RATE REGIMES

With globalization and access to open market the question of stable and developed economy is an important element for the welfare of a nation. For stability purpose, monetary policy makers are interested in the behavior of exchange rate in the foreign market. There is a wide variety of exchange rate regimes, which is distributed between two extremes: fixed exchange rates and floating exchange rates. Recall that the two groups of the countries (union and non-union) that are compared in the results section of this study have chosen two diverging paths

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4 Nils Gottfries, Macroeconomics (2013) page 421
when establishing the exchange rates. As pointed out earlier, the union countries have a fixed exchange rate while the non-union countries have a floating exchange. A fixed exchange rate implies that the central bank sets a fixed level that the exchange rate cannot vary from. In an open exchange market, the agreement of a fixed exchange rate regime requires the central bank to intervene in the foreign exchange market, as soon as the exchange rate moves away from the parity established. This is initially done by purchasing the currency if it tends to devaluate on the foreign exchange market, and by selling it in the contrary case. Thus the central bank maintains a certain reserves of foreign currencies in order to intervene when necessary. It does so by injecting excess demand or taking up excess supply of the country’s currency. In a floating exchange rate regime in contrast, no commitment is made about the exchange rate. It floats freely depending on the supply and demand of a currency in the foreign exchange market, and the central bank does not participate in a currency market, in order to affect the value of the currency.

The economic growth theory and literature surveys on exchange rate regimes state that the type of exchange rate adopted by a country and its policy have eventually an impact on its growth. It can either have a direct effect after adjustments to different shocks or an indirect one through its impact on other important variables of economic growth such as investment, foreign trade and financial sector. On the other hand the differences between monetary and fiscal policies are also considered as a tool to influence the country’s economic activity and the roles they play given a particular type of exchange rate. A model explaining how and when one type of exchange rate is more appropriate than another is presented below. (Nils Gottfries p381 and p387)

3.4 MUNDELL-FLEMING MODEL AND EXCHANGE RATE.

3.4.1 The Mundell-Fleming Model
Robert Mundell and John Fleming conducted a research on economic policy in the early 1960's at a time when the dominant theory was that of Keynesianism. The Keynesianism theory supports the intervention of the government in the economy in particular when an expansionary policy is needed. Keynesianism is represented by the IS / LM model in the case of a closed economy. The model is comprised of a curve representing the market for goods and services (investments and savings IS) and LM curve representing the money supply (liquidity preference of money supply LM). Retaking the same model mundell and Fleming re-invented a new IS / LM model and assumed instead the case of an open economy.

3.4.2 The Market for Goods and Services
We have by definition \( Y = C + I + G + X - M \), where:
Y income, C consumption, I investment, G government expenses, X exports and M imports (to simplify note \( X-M = XN \), net export). We can express these differently where C depends on disposable income \( (Y-T) \), I on domestic interest rate \( (r) \) and \( XN \) on exchange rate \( (e) \)
\[ Y = C \ (Y-T) + I( r ) +G+XN(e) \]
(IS)
By assumption, we are in a small open economy with perfect capital mobility where domestic and foreign interest rate are equal:

\[ r = r^* \] (IP equation)

\[ e = \text{nominal exchange rate (foreign currency per unit domestic)} \]

- Consumption increases with respectively the increase in income and decrease of taxes.
- Investment increases and decreases with respect to an increase and decrease of the domestic interest rate.
- XN decreases when domestic currency appreciates, caused by an increase in exchange rate.

**Figure 1 IS curve-relationship between exchange rate and output**

As it is illustrated in the figure above, we can observe that there is an inverse relationship between output \((Y)\) and exchange rate \((e)\). When domestic currency depreciates (decrease of \(e\)), output \(Y\) increase and vice versa.

### 3.4.3 Money market

LM curve is normally upward sloping but, in the case of a capital mobility where we know \(r = r^*\) we assume that money supply do not depend on exchange rate and therefore LM is instead vertical.

\[
\frac{M_s}{P} = L(Y) \quad \text{(LM)}
\]
3.5 Fiscal and Monetary Policy: Floating and Fixed Exchange Rate

3.5.1 Fiscal Policy
Fiscal policy is represented by either an increase or decrease in government spending and taxes depending on the monetary policy undertaken, either expansionary or contractionary. Thus if we take the case of an expansionary policy, we observe that IS shifts to the right (increase in y, holding everything else constant): IS*1 to IS*2

- Let’s now see the effect of such a change in the two different exchange regime: floating and fixed

3.5.1.1 Fiscal Policy in Floating Exchange Rate
Assumed that we are in an open economy, when IS shifts to the right, interest rate goes up in the domestic market, that change will result in an inflow of foreign capital (interest rate is higher and so people outside will be willing to invest in the domestic country). That capital inflow, will demand a supply of the domestic currency which will increase in the foreign market. An increase in the demand of domestic currency will then in its turn causes the domestic currency to appreciate E1 to E2 which we know will lead to a negative reaction of net export (domestic goods are relatively too expensive so export falls). A fall of export will lead to general decrease of aggregate demand Y and so the changes observed with the expansionary fiscal policy is offset or canceled (there is no change at the end Y1=Y2). In floating exchange rate, fiscal policy is considered ineffective.
3.5.1.2 Fiscal Policy in Fixed Exchange Rate
When dealing with a fixed exchange rate, the consequences of an expansionary fiscal policy result in the same manner in the domestic market (increase in interest rate that causes currency appreciation) but as exchange are supposed to be fixed, any changes are not to occur. Thus to hold exchange rate unchanged the central bank intervenes by buying or selling foreign currencies in the open market until the domestic currency goes back to its original value.
In this case, when the domestic currency appreciates, the central bank sells foreign currencies and buys domestic currencies and injects it in the market. We then see a shift of the LM curve to the right. We have an unchanged exchange rate but Y has increased in general. In fixed exchange rate, fiscal policy is effective. (Nils Gottfries p391)

3.6 Monetary Policy
Monetary policy is the set of regulations where the monetary authorities mainly the central bank takes actions to regulate and adjust the extent and the growth rate of money supply. These different actions, in their turn affect the interest and the exchange rates. The monetary policy is upheld by changing the reserves of banks or by increasing /decreasing the interest rates. Central banks use monetary policy to control the money supply in the market. Regulating the money supply has a direct impact on the economy and mostly on interest rate
in the short run. If we assume again an expansionary monetary policy, money increases in the market and this causes interest rates decreases and Y increases. Interest rate changes in the domestic market results in changes exchange rates in the foreign market just like under a fiscal policy and so the market equilibrium is reached depending on whether we are on a floating or fixed exchange rate regime.

3.6.1 Monetary Policy in Floating and Fixed Exchange Rate

In the case of an expansionary monetary policy, a shift of the lm curve to the right causes a decrease in the exchange rate in the foreign market and output Y increases. Thus monetary policy is appropriate for an economy with floating exchange rate. Notice in the same figure, if we were having an economy with fixed exchange rate, the exchange rate would not be allowed to change and so in this case the central bank would intervene by selling the domestic currency and buying foreign currencies in order for the money supply to decrease and go back to its origin before the change Y*2 to Y*1. Y increase is then canceled by this late policy. Thus monetary policy is not appropriate in a fixed exchange rate. (Nils Gottfries p390)

Figure 5 effect of monetary policy in floating exchange rate: Mundell-Fleming model

3.7 Theoretical Reviews

Several theoretical studies have been conducted regarding the effect of a monetary union. The most known study has been that of the optimal currency area (OCA) which refers to the union of different economic spaces that is either subject to a dominant monetary policy, either by the union having a single currency regime or the existence of a structure parity regime where exchange rates between the currencies of different economies are fixed. The exchange rates are fixed within this area and floating outside. The first theoretical analyst on the OCA is Robert Mundell (1961) who claims that regions using common currencies have everything to gain in terms of trade. According to him, the monetary union facilitates international trade as a unique currency cuts down the transaction cost. However, he states that a common currency can cause problems if there are asymmetric shocks and nominal rigidities in prices
and wages. Mundell concludes that the optimal currency area is in fact that in which labor factors are mobile. Then comes Mackinnon (1963) who puts forward the theory of the optimum currency area with the size of the economies and their openness. He argues that small economies are better off with a currency union because they tend to be much more open as they only produce a small amount of all their needs and thus need to trade with the rest of the world. According to him, larger economies only need to trade a small amount of their GDPs which implies that exchange rate only touches a very small part of their economy. So, his conclusion is that larger economies are better off with a floating exchange rate and being on their own.

Lastly one the most famous contributor of this theory is Kenen (1994). For him what it takes for a country to adhere in a monetary union is the ability of that country to produce diversified products. He means that if a country export one sort of product and that particular product faces a fall in demand, then the solution would be for that country to have a flexible exchange rate to adjust the economy and so a country without diversification would be worse off in a monetary union with fixed exchange rate. on the other hand if a country has a competitive advantage in many product and thus has a large diversified export sector (exports more than one sort of product) then it is likely that different industries will face different types of shocks and hopefully these shocks will not be interdependent and so many times, one shock in one sector will be cancelled out by another. This means that more diversified economies tolerate more a fixed exchange rate and can thus be part of a monetary union.

3.8 EMPIRICAL STUDIES REVIEWS

The most known research paper on the effect of monetary union on trade was that of Rose (2000). Rose did an empirical study on 186 countries with 330 observations where 2 countries where having a bilateral trade. He mention in his study that his sample consisted of countries that where small, poor or both. He used a gravity model of bilateral trade represented by 2 variables taking on a value of 1 or 0, 1 if both countries belong to the same monetary union or 0 if they did not. He then found that two countries that were together in the same monetary union and shared the same currency traded three times more than similar countries with different currencies.

Thereafter Rose result has received numerous criticisms, the one worth mentioning is that of Persson (2001). Persson thinks that Roses result is biased by what he calls the non-random phenomenon. For him the trade is not explained only by the fact that both countries are in the same monetary union but rather because they share several other geographical and cultural characteristics.

To correct this bias, Persson (2001) uses a method he calls "the matching method". This method consisted in finding a sample of countries within a monetary union and then find a "control" group of countries each with their own currency, but have almost similar characteristics of those in the monetary union and finally, estimating the effects of monetary union on trade using only countries in monetary union coupled with their control groups. He then observed that the effect of the monetary union on trade ranged from 13% to 65%.
4 EMPIRICAL STUDY

In this section an analysis of an empirical study is conducted to support and explain one advantage and disadvantage of monetary union. As mentioned earlier, adopting a common currency increases trade by cutting on transaction cost. Obviously, trade is the likely advantage that is going to be evaluated in this work. On the other hand it is also known that the fact that the union countries have no control on their exchange rate may lead to a highly volatile GDP and that of course is the disadvantage of the union. The objectif here is to see whether these two statements are applicable for the WAEMU members. To properly do that, an approach similar to that of Persson (2001) is applied. The 7 of the 8 countries inside the union are compared to the other 7 countries outside the union, which are considered to be control group. The control group outside the union share some similarities with the countries inside the union since the geographic distance between the two groups is minimal, some of them have the same export sector, they all are poor countries, former colonies, touched by many years of civil war, they have had their independence almost at the same time and they are all still at their early stage of development.

4.1 DIFFERENCE IN DIFFERENCE MODEL

The difference in difference model is utilized as a tool to evaluate and estimate the pre and post treatment (in our case the monetary union) results within the two groups of countries. In other words, the difference in this model can be seen, by comparing the performance of two groups in two states. In this case, one group is called the” control group” and the group that has been exposed to the treatement is called the “ treatment” group. Any study that uses this model requires a clear definition of the two mentioned groups. In addition to this, the control and the treatment group must have an identical pre-treatment situation. So, two periods of time are presumed where a comparison of the group’s performances before and after the treatment is conducted. The differences are then estimated provided that the ”control group” has continued to perform in the same manner as before. (Borjas 2008)

4.2 LINEAR TREND MODEL

Since this study’s aim is to estimate the monetary union’s effects on GDP fluctuations and growth rate, it is convenient to do a regression because it allows us to get the error term. When running the regression a linear trend model that is derived from the exponential model where $Y= Ae^{bt}$ is employed.

The linear trend model is then expressed as:

- $Y= a + bt + e$, where $Y$, the response variable= In GDP, and $a = \ln A$.

In the equation above, $a$ is a constant, $b$ is the coefficient that represent the GDP growth rate, the $t$ stands for the time and is the independent variable. The error term $e$ is the variable that we are mostly interested in because it represents the cycle. By using the model above, the GDP time series can be decomposed into trend and cycle.
By running this regression, one can be able to measure the volatility in $e$, which also is the GDP volatility. In brief: $1-R^2=$ volatility of GDP.

**Testing for the significance of the results**

After calculating the differences in trade, GDP volatility and growth rate, a $T$ test is runned where the main purpose is to test whether the means of the two samples are statistically significant or not. This test can help to come to a reasonable conclusion that answers the research question. A $T$ test result that is significant indicates whether the computed means are likely to reflect the actual situation or whether the difference in this means is due to some random choices of the observed variable. The main interest here is to see what happens to the trade, GDP volatility and growth rate after that the countries have joined the union. In this case, it is reasonable to run a $t$-test using the differences in means cross years and cross countries for the two groups. This helps to determine the effects of the monetary union for the countries after that sample 1 adopts a common currency. For the union, it can be argued that the picked sample is not a sample since almost all the countries that formed a union are picked. However, this is a sample considering the fact that only a sample of years from 1979-2008 is picked.

Recall that a $t$-test result that is statistically significant is the one that works in favor of the alternative hypothesis. The alternative hypothesis states that the variation between two groups is unlikely to have occurred by chance. As you already know it, Statistical significance is determined by 3 factors which are: the size of the sample, the samples standard deviation and the averages difference between the two samples. Practically, the larger the sample is the higher the chance of getting a statistical significant result is. With a larger sample, for example where $N= 100000$, the difference between the means would have a greater chance to be proven significant even when it is numerically small enough.

However, before running the $t$-test, it is vital to decide whether to use the pooled $t$-test or the unpooled $t$-test. Recall that the unpooled $t$-test assumes unequal variance while the pooled $t$-test presumes equal variance. To decide which test to use, an $F$ test is runned to test for the significance in the differences of the two samples’ variances. A 5% level of significance have been chosen in all tests that are runned in the impecrinal result section of this study. The decision of which $t$-test to run and present in the result is also to dependent on the $p$ values ranges, used to determine the significance of the calculated $F$ values.

**Table 1 Test for significance**

<table>
<thead>
<tr>
<th>P value</th>
<th>F test significance</th>
<th>T-test to be used</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P&gt;10%$</td>
<td>Insignificant</td>
<td>Pooled t test</td>
</tr>
<tr>
<td>$P&lt;5%$</td>
<td>Significant</td>
<td>Unpooled t test</td>
</tr>
<tr>
<td>$5% &lt;P&lt;10%$</td>
<td>Insignificant but closed to significant</td>
<td>Pooled and unpooled t test</td>
</tr>
</tbody>
</table>

---

6 The table below summarizes the fundamentals of this study’s $t$-test decision making.
4.3 EFFECT ON TRADE

The aim here is to see whether, in terms of trade, monetary union is more favorable for the countries inside the union as opposed to those outside the union. If yes, is this increase due to the fact that the countries adopted the currency union or is it just a random increase due to other economic factors. To answer this, as mentioned earlier, the two groups of countries are going to be compared in order to see the trade evolution within the union and outside it before and after the union creation. Trade is then measured by calculating the average exports as a fraction of GDP \( X/Y \) cross countries both inside and outside the union. In this case, \( X \) stands for exports and \( Y \) stands for GDP.

This approach provides the ability to determine whether the statement of increase in trade is in fact more important inside the union than outside. If this is proven to be true, all the credits are to be given to the monetary union formation. On the other hand, if the very same statement of significant increase in trade can also be observed for the countries that are outside the union, the conclusion is going to be that the countries of the union can also be better off without a monetary union. But what if the two groups of countries experience an increase in trade? Well, in this case, the conclusion is going to be drawn based on the amount by which trade has increased for the two groups of the countries. The results of this study are presented in the tables below:

**Data for trade inside and outside the union**

<table>
<thead>
<tr>
<th>countries</th>
<th>average(X/Y)1979-1993</th>
<th>Average(X/Y)1994-2008</th>
<th>% point difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>27,37389%</td>
<td>23,84389%</td>
<td>-3,52996183%</td>
</tr>
<tr>
<td>Burkina-faso</td>
<td>9,8575%</td>
<td>10,74683%</td>
<td>0,88934513%</td>
</tr>
<tr>
<td>Ivory coast</td>
<td>34,6022%</td>
<td>43,98215%</td>
<td>9,379957135%</td>
</tr>
<tr>
<td>Mali</td>
<td>17,07127%</td>
<td>24,12134%</td>
<td>7,050064978%</td>
</tr>
<tr>
<td>Niger</td>
<td>19,75452%</td>
<td>17,75824%</td>
<td>-1,996284856%</td>
</tr>
<tr>
<td>Senegal</td>
<td>24,77948%</td>
<td>27,3348%</td>
<td>2,555326462%</td>
</tr>
<tr>
<td>Togo</td>
<td>36,43207%</td>
<td>34,72213%</td>
<td>-1,709944824%</td>
</tr>
<tr>
<td>average</td>
<td>24,26728%</td>
<td>26,07277%</td>
<td>1,805493889%</td>
</tr>
<tr>
<td>Stdv</td>
<td>9,5262%</td>
<td>10,8777%</td>
<td>4,8572781%</td>
</tr>
</tbody>
</table>

The tables include export as % of GDP for the countries inside and outside the union, for the two periods of 1979-1993 and 1994-2008 and the point increase in these two.
### Table 3: Countries outside the Union: Trade

<table>
<thead>
<tr>
<th>Countries</th>
<th>Average (X/Y) 1979-1993</th>
<th>Average (X/Y) 1994-2008</th>
<th>% Point Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gambia</td>
<td>42,29206%</td>
<td>29,02111%</td>
<td>-13,2709491%</td>
</tr>
<tr>
<td>Ghana</td>
<td>8,194882%</td>
<td>21,97056%</td>
<td>13,77568164%</td>
</tr>
<tr>
<td>Guinea</td>
<td>24,53779%</td>
<td>23,67303%</td>
<td>-0,864756911%</td>
</tr>
<tr>
<td>Liberia</td>
<td>43,10266%</td>
<td>32,79262%</td>
<td>-10,31003131%</td>
</tr>
<tr>
<td>Mauritania</td>
<td>26,66956%</td>
<td>36,79781%</td>
<td>10,12824661%</td>
</tr>
<tr>
<td>Nigeria</td>
<td>16,76339%</td>
<td>15,78912%</td>
<td>-0,974265997%</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>28,29274%</td>
<td>32,48631%</td>
<td>4,193574349%</td>
</tr>
<tr>
<td>Average</td>
<td>27,12187%</td>
<td>27,50437%</td>
<td>0,382499896%</td>
</tr>
<tr>
<td>Stdv</td>
<td>12,6445%</td>
<td>7,3485%</td>
<td>9,9417012%</td>
</tr>
</tbody>
</table>

### 4.3.1 Result of the empirical description: trade

Starting with the countries inside the union it can be seen that 4 of the 7 countries have achieved an increase in export proportion of GDP while the 3 other countries have experienced a drop in the export as a fraction of GDP. As we can see it, the cross-country average \(X/Y\) has increased from 24.27% to 26.07% implying an average increase of approximately 1.81%. After joining the union, Ivory Coast and Mali have experienced a considerable increase in trade since their increases in \(X/Y\) are 9.38% and 7.05% respectively. On the other hand, Benin and Niger have experienced the largest fall in trade compared to other counties in the union. For Benin, the trade decreased by 3.53% while Niger’s trade dropped by almost 2%.

For the countries that are not in the union, we can also see a significant increase for some countries like Ghana, Mauritania and Sierra Leone, where the trade rise is 13.78%, 10.13% and 4.19 respectively. However, for countries like Gambia, and Liberia we can see a considerable fall in the export as fraction of GDP. Gambia’s export fell by 13.27% while Liberia’s export dropped by 10.31% for the period 1994 to 2008. Jointly, the countries that are outside the union have a 0.38% increase in trade while the ones that are in the union have jointly achieved a 1.81% increase. As we expected the countries within the monetary union have achieved a higher trade increase, since their trade increase is almost five times larger than the increase outside the union.

### 4.3.2 F and t test for Trade

As mentioned earlier, an F and a t test are going to be done, to see whether the difference computed above are statistically significant.
Table 4 trade: sample size, mean and standard deviation differences

<table>
<thead>
<tr>
<th>samples</th>
<th>Sample size(N)</th>
<th>Mean difference</th>
<th>Standard deviation of differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside the union</td>
<td>7</td>
<td>1,8055%</td>
<td>4,8573%</td>
</tr>
<tr>
<td>Outside the union</td>
<td>7</td>
<td>0,3825%</td>
<td>9,94171%§</td>
</tr>
</tbody>
</table>

To compute the value of F, the following formula is going to be used

**Formula A**

\[ F = \frac{S_1^2}{S_2^2} \]

\( S_1 \) stands for the standard deviation of the countries outside the union while \( S_2 \) is the standard for the countries inside the union.

The degrees of freedom in the numerator = \( N_1 - 1 = 6 \)

The degrees of freedom in the denominator = \( N_2 - 1 = 6 \)

The hypothesis will then be formulated as:

- \( H_0 \): the variances are equal
- \( H_a \): the variances are not equal

Using the formula A above presented above, F value can be calculated as: \( \frac{(9,9417012\%^2)}{[(4,8572781\%^2)]} = 4,18924 \).

The critical F value at 5 % level of significance is 4,28 and the p value is 0.05247157 at \( F=4,18924 \).

- The results above show that the calculated F value is less than the critical value, and this signifies the failure of rejecting the null hypothesis. However the calculated F value with a p value that is slightly higher than 5 % is really close to the critical. This indicates the use of a pooled T test, when testing for the significance of the results, but also the use of the unpooled t test since the standard deviations are not significantly different from each other. The two t-tests are presented below

### 4.3.2.1 POOLED t-test

To calculate the pooled samples standard deviation, the following formula is used and the \( S_p \) stands for the pooled standard deviation.

**Formula B**

\[ S_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}} \]

To compute the pooled t value we use the following equation:

**Formula C**
We are running a two sided t-test and the critical value of t shall be computed at 5% as mentioned earlier. So the null hypothesis is as follows:

Ho: mean 1 = mean 2
Ha: mean 1 ≠ mean 2

The degrees of for a pooled t-test is computed as: \( N_1 + N_2 - 2 = 14 - 2 = 12 \) and critical value of t when DF is 12 is equal to ±2.179

So, our Sp value will be \( \sqrt{[(6x0.0485727812) + (6x0.0994170122)]/12} = 0.07824 \)

The t-value = \( \frac{1.805493889 - 0.382499896}{0.07824\sqrt{1/7 + 1/7}} = -0.34 \)

As we can see it, the value of T is really low and is insignificant at any level. This result affirms that the means’ difference in the two samples is due to luck, so, the null hypothesis is not rejected.

4.3.2.2 Unpooled test

Recall that the general t-test is used whenever, the variances are not similar. In this test, the degrees of freedom are reduced and this implies that the calculated t values have to be large in order to be significant. In other words, the chance of rejecting the null hypothesis is lower when using the unpooled t-test than when utilizing the poled t test, due to the fact that the degrees of freedom are adjusted downwards.

The degrees of freedom are computed as follows:

**Formula D**

\[
DF = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{1}{n_1 - 1} \left(\frac{s_1^2}{n_1}\right)^2 + \frac{1}{n_2 - 1} \left(\frac{s_2^2}{n_2}\right)^2}
\]

And the t value is calculated using:

**Formula E**

\[
t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}
\]

S1: standard deviation of the non union countries.
S_2: standard deviation of the union countries.

N_1: N_2: size of samples.

\( \bar{x}_1, \bar{x}_2 \): difference in means for each sample, Inside and outside respectively.

Using the formula DF and the values that we have in the table 3 we get:

\[
DF = \frac{17.49^2}{33.22 + 1.89} = 8.71 = 8
\]

\[
T = \frac{0.3825 - 1.8055 - 1.423}{\sqrt{14.12 + 3.34}} = 0.34
\]

The T test is still low to be significant so the two t test results affirm that the difference of the trade means is random.

4.4 EFFECT ON GDP VOLATILITY

DATA FOR GDP VOLATILITY

Table 5 countries inside the union: GDP volatility

<table>
<thead>
<tr>
<th>Countries</th>
<th>GDP Volatility 1979-1993</th>
<th>GDP Volatility 1994-2008</th>
<th>Difference in the two periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>0.08</td>
<td>0.0104</td>
<td>-0.0696</td>
</tr>
<tr>
<td>Burkinafaso</td>
<td>0.0913</td>
<td>0.0054</td>
<td>-0.0859</td>
</tr>
<tr>
<td>Ivory coast</td>
<td>0.5518</td>
<td>0.4435</td>
<td>-0.1083</td>
</tr>
<tr>
<td>Mali</td>
<td>0.0767</td>
<td>0.0074</td>
<td>-0.1083</td>
</tr>
<tr>
<td>Niger</td>
<td>0.6001</td>
<td>0.0245</td>
<td>-0.0693</td>
</tr>
<tr>
<td>Senegal</td>
<td>0.0984</td>
<td>0.0036</td>
<td>-0.0948</td>
</tr>
<tr>
<td>Togo</td>
<td>0.7651</td>
<td>0.1784</td>
<td>-0.5867</td>
</tr>
<tr>
<td>Average</td>
<td>0.323343</td>
<td>0.096171429</td>
<td>-0.227171429</td>
</tr>
<tr>
<td>Stdv</td>
<td>0.302332</td>
<td>0.165621</td>
<td>0.242220848</td>
</tr>
</tbody>
</table>

\( ^8 \) The tables include GDP volatilities for the countries inside and outside the union for the two periods of 1973-1993 and 1994-2008 and the difference in these two.
Table 6 countries outside the union: GDP volatility

<table>
<thead>
<tr>
<th>Countries</th>
<th>GDP volatility 1979-1993</th>
<th>GDP volatility 1994-2008</th>
<th>Difference in the two periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gambia</td>
<td>0.0529</td>
<td>0.0222</td>
<td>-0.0307</td>
</tr>
<tr>
<td>Ghana</td>
<td>0.224</td>
<td>0.0058</td>
<td>-0.2182</td>
</tr>
<tr>
<td>guinea</td>
<td>0.029</td>
<td>0.0263</td>
<td>-0.0027</td>
</tr>
<tr>
<td>Liberia</td>
<td>0.382</td>
<td>0.3764</td>
<td>-0.0056</td>
</tr>
<tr>
<td>Mauritania</td>
<td>0.2193</td>
<td>0.1163</td>
<td>-0.103</td>
</tr>
<tr>
<td>Nigeria</td>
<td>0.9854</td>
<td>0.0548</td>
<td>-0.9306</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>0.532</td>
<td>0.732</td>
<td>0.2</td>
</tr>
<tr>
<td>average</td>
<td>0.346371</td>
<td>0.190543</td>
<td>-0.155828571</td>
</tr>
<tr>
<td>Stdv</td>
<td>0.3321789</td>
<td>0.2711401</td>
<td>0.3640604</td>
</tr>
</tbody>
</table>

4.4.1 Result of Empirical Study: GDP Volatility
(For a graphical illustration of all the values that are presented in the tables of growth rate and GDP volatility, please check appendix). (On the X-axis of the graphs we have time, while we have the GDP on the y-axis of graphs)

In general, as it can be seen in the tables, there has been an overall decrease in the variations of GDP for all countries. We can see a significant decrease in the countries that are outside the union, such as Nigeria and Ghana, since they have achieved a fall of 93.06% and 21.82% respectively. All the countries that are outside the union have experienced a more or less decrease in fluctuations of GDP apart from Sierra Leone whose GDP fluctuations increased by 2%. The “control” group has jointly achieved a fall of 15.58% in the volatility. Nevertheless, the countries that are inside the union have achieved a greater decrease since they have jointly attained a decrease of 22.72%. The difference in the decreases in GDP volatility for the two countries is 7.14%. In other words, the countries inside the union managed to decrease their GDP variability by 7.14 percentage units more than the countries outside the union. Unlike the countries outside the union, all the union countries have achieved a decrease in the fluctuations. In the union, Togo has achieved the most outstanding results since its GDP volatility decrease is over 50%.

4.4.2 Effect on Growth rate
Data table of growth rate

---

9 The tables below include the growth rate of the countries inside and outside the union for the two periods of 1979-1993 and 1994-2008 and the point increase in these two periods.
### Table 7: Countries inside the union: growth rate

<table>
<thead>
<tr>
<th>countries</th>
<th>Growth rate 1979-1993</th>
<th>Growth rate 1994-2008</th>
<th>% points difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>3.23%</td>
<td>4.5%</td>
<td>1.27%</td>
</tr>
<tr>
<td>Burkinafaso</td>
<td>2.66%</td>
<td>5.85%</td>
<td>3.19%</td>
</tr>
<tr>
<td>Ivory coast</td>
<td>1.01%</td>
<td>1.26%</td>
<td>0.25%</td>
</tr>
<tr>
<td>Mali</td>
<td>3.58%</td>
<td>4.95%</td>
<td>1.37%</td>
</tr>
<tr>
<td>Niger</td>
<td>-1.06%</td>
<td>3.9%</td>
<td>4.96%</td>
</tr>
<tr>
<td>Senegal</td>
<td>2.45%</td>
<td>4.4%</td>
<td>1.95%</td>
</tr>
<tr>
<td>Togo</td>
<td>1.01%</td>
<td>1.63%</td>
<td>0.62%</td>
</tr>
<tr>
<td>Average</td>
<td>1.84%</td>
<td>3.784285%</td>
<td>1.9443%</td>
</tr>
<tr>
<td>Stdv</td>
<td>1.6223%</td>
<td>1.7100%</td>
<td>1.6358%</td>
</tr>
</tbody>
</table>

### Table 8: Countries outside the union: growth rate

<table>
<thead>
<tr>
<th>countries</th>
<th>Gdp growth rate 1979-93</th>
<th>Gdp growth rate 1994-2008</th>
<th>%points difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gambia</td>
<td>3.5%</td>
<td>3.6%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Ghana</td>
<td>3.07%</td>
<td>4.84%</td>
<td>1.77%</td>
</tr>
<tr>
<td>Guinea</td>
<td>3.17%</td>
<td>3.56%</td>
<td>0.39%</td>
</tr>
<tr>
<td>Liberia</td>
<td>-9.79%</td>
<td>10%</td>
<td>19.79%</td>
</tr>
<tr>
<td>Mauritania</td>
<td>1.65%</td>
<td>4.06%</td>
<td>2.41%</td>
</tr>
<tr>
<td>Nigeria</td>
<td>-0.25%</td>
<td>6.96%</td>
<td>7.21%</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>1.31%</td>
<td>3.26%</td>
<td>1.95%</td>
</tr>
<tr>
<td>Average</td>
<td>0.38%</td>
<td>5.182857143%</td>
<td>4.8028%</td>
</tr>
<tr>
<td>Stdv</td>
<td>4.6736531%</td>
<td>2.4690735%</td>
<td>7.0126284%</td>
</tr>
</tbody>
</table>

#### 4.4.3 Results: Empirical Study: Growth Rate
When looking at the growth rate of GDP in the tables above; we can see that the countries that are outside the union have experienced a higher GDP growth rate compared to those in the union. For the countries that are outside the union, From 1979 to 1993, the average GDP growth rate was 0.38% and increased to 5.18% from 1994-2008. This average GDP growth has increased by 4.8%. As it can be seen, Liberia has experienced a 19.19% increase in growth rate. By looking at this increase it is true to say that Liberia has achieved the highest rate compared to the rest of the countries both inside and outside the union. From the tables presented above, we can see that the countries of the union had a higher average GDP growth before entering the union. The growth rate was 1.84% and increased to 3.78% after joining the union. By comparing the increase in the growth rate we can see that countries outside the union achieve an increase that is more than twice the increase of the union’s country.

4.4.4 F and T test for GDP Growth Rate and Volatility

As it has been done in the previous section, the significance in the growth rate means difference as well as the GDP volatility is going to be tested. An F test is once again going to be runned in order to decide which t test to use. The tables bellow consists of factors needed to run the tests: sample size, means and standard deviation differences.

<table>
<thead>
<tr>
<th>samples</th>
<th>Sample size</th>
<th>Mean difference</th>
<th>Standard deviation of the differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside the union</td>
<td>7</td>
<td>1.9443%</td>
<td>1.6328%</td>
</tr>
<tr>
<td>Outside the union</td>
<td>7</td>
<td>4.8028%</td>
<td>7.01263%</td>
</tr>
</tbody>
</table>

For the F test, the hypothesis are expressed as:

H₀: the variances are equal
Hₐ: the variances are not equal

The degrees of freedom here are still 6 in the nominator as well as in the denominator and the critical value is still equal to: 4.28.

The F value for GDP growth is then \( F = \frac{7,01263^2}{1,6328^2} = 18.44 \) and the p value is equal to 0.001257.

The calculated F value is considerably greater than the critical value. In addition to this the p value is much smaller than 5%. This means that is appropriate to use only the unpooled t test where the variances are assumed to be significanitly different from each other. Once again the formulas D and E are used to compute the degrees of freedom and the unpooled t value.

\[
DF = \frac{7.4061^2}{8.225 + 0.0241} = 6, 64 = 6, 51 \\
T value = \frac{4.8028 - 1.9443}{\sqrt{(7.01263^2 + 1.6328^2)/7}} = 1.05
\]

The critical value equals 2.447 when DF is 6 and the level of significance is 5%.
As we can see the t value is still too low to be considered statistically significant. Here again the means differences are affirmed to be random and the null hypothesis is rejected.

Table 10 GDP volatility: sample size, mean and standard deviation differences.

<table>
<thead>
<tr>
<th>samples</th>
<th>Sample size(N)</th>
<th>Mean difference</th>
<th>Standard deviation of the differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside the union</td>
<td>7</td>
<td>−0,2272</td>
<td>0,2422</td>
</tr>
<tr>
<td>Outside the union</td>
<td>7</td>
<td>−0,1558</td>
<td>0,3641</td>
</tr>
</tbody>
</table>

The F value for GDP volatility = $\frac{0,3641^2}{0,2422^2}$ = 2, 2590 and the p value is equal to 0, 1722

The p value is clearly greater than 10% indicating the use of the pooled t test, where the variances are assumed to be equal.

Using again formula B and C above we get:

$S_p$ = 0,3092 and

$T$ value = $\frac{0,0692}{0,1652}$ = 0,43

- As we can see for the GDP growth and GDP volatility, the t values are 1, 05 and 0, 43 respectively, while the critical values are ±2,179 and 2,447 respectively. This indicates that the null hypothesis is not to be rejected again. Recall that the null hypothesis holds for the 3 cases presented above (trade, GDP growth and GDP volatility). Put in other words, all differences computed in the three cases are affirmed to be random. However, this is not surprising considering the fact that the sample size is considerably small, thereby diminishing the chance of proving the significance of any results.

The next section of this study is composed by the discussions of the results and the conclusions.

**4.5 Empirical Result Analysis**

4.5.1 Trade

When it gets to trade, the results of this study are similar to Robert Mundell (1961) study’s results, where trade has been proven to increase as results of combined currency.

In this study, trade was found to have been increased in both groups after the union, but the increase has been more important in the union compared to the control group and this result is consistent with the theory. The increase in trade for the union countries might be due to the fact that a common currency facilitates trade within the union but also simplifies trade outside the union, since the importers and exporters from outside only have one currency to consider. In addition to this, the elimination of transaction cost that is achieved through monetary union formation plays a significant role in increasing trade. This holds true because buyers and sellers are encouraged to trade any amount of goods and services without paying any exchange fee.
Since all the countries are neighbors and have all been colonized by France, their official language is French and there is no language barrier. Presumably they have a well-integrated labor market as well, where people can move freely to other union’s countries. This can also be seen as a factor that increases trade.

As it was pointed out earlier, the trade t-test results affirm that the differences in means are not important. However, the probability of getting a significant result when the number of countries in each sample is only 7 is really low. This strengthens the fact that the sample size has a considerable impact on the significance of the results. So, the t-test results are going to be disregarded when drawing the conclusion. In this case, the differences in the means for the two samples are the ultimate factors that are going to be considered when concluding.

By looking at the trade increase for the two groups of country, we can see that the increase in trade inside the union is almost 5 times as large as the one outside the union. This difference is large enough to support the statement that trade increases as currency union is adopted. This is why we also argue that trade has increased more in the union compared to the outside.

4.5.2 GDP volatility
For the volatility of GDP, as we can see it from the graphs and the tables above, countries inside the union have a less volatile GDP compared to those that are outside the union. By looking at the results, we can see that they contradict our expectations. Normally countries outside the union should have had a less diverging GDP due to the fact that they can use their independent monetary policy to adjust their economy. On the other hand, countries in the union should have had a higher volatility because they are not capable of altering their exchange rate in order to properly respond to macroeconomic shocks. Considering the fact the countries outside the union have an adjustable exchange rate, it is rational to say that these countries have not been as competent as the ones in the union when using their economic policy to stabilize their economy.

The fall in GDP variability for the countries inside the union might be a result of the countries’ fiscal policy effectiveness when managing the rate of inflation, but also the central bank’s capability to monitor the exchange rate. One of the advantages of monetary union is for it to allow lower price fluctuations and a balanced exchange rate. This signifies that the GDP variability reduction might be due to the fact that the countries have a considerable reduction in uncertainties and a more balanced inflation rate that determines stability of the country’s economic environment. Lower inflation may also be related to more predictable demand patterns, which again causes lower GDP volatility. However, the extent to which the variability can be determined by a monetary union is still not clear.
Inflation inside and outside the union

Table 11 inflation: countries inside the union

<table>
<thead>
<tr>
<th>period</th>
<th>Togo</th>
<th>Senegal</th>
<th>Niger</th>
<th>Mali</th>
<th>ivorycoast</th>
<th>Burkina</th>
<th>Benin</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979-93</td>
<td>2.38%</td>
<td>0.73%</td>
<td>-2.72%</td>
<td>0.86%</td>
<td>-1.64%</td>
<td>-0.47%</td>
<td>-0.21%</td>
<td>-0.15%</td>
</tr>
<tr>
<td>1994-08</td>
<td>0.41%</td>
<td>-0.78%</td>
<td>-1.02%</td>
<td>0.803%</td>
<td>0.15%</td>
<td>-7.75%</td>
<td>0.1%</td>
<td>-1.36%</td>
</tr>
</tbody>
</table>

Table 12 inflation: countries outside the union

<table>
<thead>
<tr>
<th>period</th>
<th>Guinea</th>
<th>Mauritani</th>
<th>Liberia</th>
<th>Gambia</th>
<th>Nigeria</th>
<th>Sierra Leone</th>
<th>Ghana</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979-93</td>
<td>-1.17%</td>
<td>-0.567%</td>
<td>0.26%</td>
<td>38.48%</td>
<td>73.66%</td>
<td>-2.03%</td>
<td>-4.44%</td>
<td>14.88%</td>
</tr>
<tr>
<td>1994-08</td>
<td>-2.29%</td>
<td>-0.18%</td>
<td>1.25%</td>
<td>-3.12%</td>
<td>12.82%</td>
<td>2.41%</td>
<td>-0.76%</td>
<td>1.73%</td>
</tr>
</tbody>
</table>

The cross-country average inflation in the union went from -0.15% to -1.36% while the one outside the union went from 14.88% to 1.73%. Obviously, there has been a fall in inflation for the two groups, especially for the countries that are outside the union. However, we can still see that the inflation in the union is lower than the inflation outside the union. This might be the reason behind the unexpected results of the fall in GDP variability inside the union. Recall that the t-test results were insignificant for the GDP volatility, and that the union countries’ fall in GDP fluctuation was 7.14 percentage units more than the one outside the union. Even though the results are not justified by the theory or the t-test, the difference in the decrease is rather large enough to support the statement that the union countries have achieved a higher fall in GDP variability. This difference is a strong evidence we base our conclusion on. As conclusion, we believe that the volatility has decreased more in the union compared to the outside.

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10 The tables above show the inflation data for the two groups of countries inside and outside the union for the two period of 1979-1993 and 1994-2008
4.5.3 Growth rate

As mentioned earlier in the limitation section of this study, we will not be able to discuss properly the growth result observe because of the lack of variables that we have not considered in this research. Only possible and general reasons that usually affect the growth rate of economy for any country are going to be discussed to explain the results revealed in this study.

Several factors affects the rate at which a countries economy grows at but investment is probably the ultimate element that lies behind the higher increase in the growth rates for the countries that are outside the union. The non-union countries might have been able to invest more in the 3 sectors mentioned below.

**Investment in human Capital.** Investment in the human capital involves devoting the countries’ efforts in increasing the levels of the education as well as training and improving the motivation levels of the workers in the country. This investment improves efficiency in the countries and is directly linked to increased productivity and economic growth.

**Investment in technology.** The development of a country’s technology is a vital tool to increase productivity and workers motivation. This is clearly related to higher economic growth since with a more advanced technology, production is done faster and more efficiently.

**Investment in infrastructure.** When a country is dedicated to enhance and improve the mode of transport and communication, it can save firms from incurring large cost of production and thereby enhancing their competitiveness in the international markets. Once again, this investment is one of the key factors that increase production.
5 CONCLUSION

The purpose of this study was to examine the effects of monetary union on trade and business cycle. The case of 7 countries of West African economic and monetary union (WAEMU) was studied and compared to the “control group” which was composed by 7 West African countries which are not in the union. The two groups of countries are similar in many different ways since they all are in the same region, the majority of them are former colonies and they have been afflicted by civil wars. By using the difference in difference and the linear trend model we have been able to compare the two groups’ performance in terms trade and GDP volatility. In conclusion, we found that the increase in trade was much greater inside the union compared to the outside. This is consistent with the theory, because it affirms that trade increases as a result of currency union. On the other hand, we found that the countries of the union have experienced a larger decrease in GDP variability, compared to the outside and this contradicts the theory. As it was pointed out, the GDP volatility should have increased inside the union, considering the fact that the union countries have not an independent monetary policy, where they can adjust to different shocks. For countries outside the union, the growth rate comparison results revealed that these countries have jointly achieved a much higher growth rate compared to the ones in the union. The imaginable factor that might be behind this result was assumed to be the investement in human capital, technology and infrastructure.
6 REFERENCES

- West African Economic and Monetary Union. (Wikipedia).


• Borjas, J Geoerge (2008): Labour economics.

• Lind, A Douglas;Marchal G William;Wathen A Samuel: statistical techniques in Business &economics


• Penn word table: “center for international comparisons at the university of Pennsylvania” https://pwt.sas.upenn.edu/php_site/pwt_index.php

• http://www.danielsoper.com/statcalc3/calc.aspx?id=7(p (value calculator)

7 APPENDIX

Inside the union countries

Benin before

\[ y = 0.0323x + 7.3422 \]
\[ R^2 = 0.92 \]

Benin after

\[ y = 0.045x + 7.177 \]
\[ R^2 = 0.9896 \]

Burkina Faso before

\[ y = 0.0266x + 7.4959 \]
\[ R^2 = 0.9087 \]

Burkina Faso after

\[ y = 0.0585x + 7.0183 \]
\[ R^2 = 0.9946 \]

Ivory Coast before

\[ y = 0.0101x + 9.3409 \]
\[ R^2 = 0.4482 \]

Ivory Coast after

\[ y = 0.0126x + 9.4231 \]
\[ R^2 = 0.5565 \]
Outside the union countries
nigeria before

\[ y = -0.0025x + 10.874 \]
\[ R^2 = 0.0146 \]

nigeria after

\[ y = 0.0696x + 9.701 \]
\[ R^2 = 0.9452 \]

sierra leone before

\[ y = 0.0131x + 7.3406 \]
\[ R^2 = 0.468 \]

sierra leone after

\[ y = 0.0326x + 6.45 \]
\[ R^2 = 0.267 \]