

# CAN FINANCIAL CONDITIONS INFLUENCE ECONOMIC ACTIVITY IN THE CFA ZONE? A CASE STUDY OF SENEGAL

By

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## **Abstract**

This paper investigates the extent to which changes in financial conditions affect macroeconomic outcomes in Senegal. Although financial conditions have been found to be a significant determinant of economic growth in developed countries, the relationship is less obvious in developing countries. In particular, the fact that Senegal's currency, the CFA, is pegged to the Euro raises a lot of questions about its financial independence. I first extract a common component of 15 bank interest rates to use as a financial conditions index. I then estimate a Vector Autoregressive (VAR) model for money growth and the financial conditions indicator to separately identify money supply and demand shocks. Lastly, I estimate the effects of these shocks on business activity and inflation to quantify by how much unexpected changes in money supply and demand shocks influence the country's economic growth and inflation. I find that a supply shock pushes inflation up by 0.2% after a month and stimulates business activity by 1.5% after two months, while demand shocks decrease inflation by less than 0.25% and business activity by about 1% after two months. These effects are less pronounced within the first month and start to dissipate one year after the shocks.

*Keywords:* economic activity, financial conditions, Senegal, monetary policy.

## **Acknowledgments**

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## **1. Introduction**

In the aftermath of the financial crisis, there has been renewed interest in the link between the financial sector and the real economy. While there is a lot of evidence on the positive relationship between financial conditions and economic outcomes for industrialized economies, much less attention has been paid to emerging countries. This is surprising because of the crucial role that financial conditions play for economic development and growth. Indeed, an inclusive, well-managed, and rich financial market has a critical role in the economic growth of a country (Bodie, Kane and Marcus, 2014). However, the impact of the financial institutions on expanding economic opportunity is limited in the developing world (Sutton and Jenkins, 2007). In fact, because of lack of information and infrastructure within the emerging financial markets and the size of the informal sector in developing economies, financial services are not widely used by the population and in revenge, companies' access to funding is limited. These limitations are exacerbated for Senegal because of the currency peg between the CFA and the Euro, which hampers the development of the financial sector. If the financial conditions created by the central and commercial banks in Senegal do not have much power to influence the course of the economy of the country, it may be because of the inability of the banking sector to promote financial inclusion and expansion which is key to stimulating economic activity. It is therefore critical to determine the strengths and weaknesses of the financial institutions in influencing the economic activity of the country, and most importantly, to uncover the areas for improvement for the central bank in creating a financial environment that supports the economic development of the country. Given the important role that the central bank has in promoting financial inclusion by determining the money supply and hence overall financial conditions in the country, this paper will also examine the extent to which Senegal's central bank has autonomy and power in conducting

monetary policy to boost financial activities and influence the economy of the country, which in turn will give us an idea about the conditions in other countries that are members of the West African Economic and Monetary Union (WAEMU).

Lately within the WAEMU, there have been region-wide uprisings and protests against the use of the CFA as the currency within the zone. After their independence in 1960, eight French West African States<sup>1</sup> formed a monetary union that uses as a common currency the Franc CFA, which is pegged to the Euro. This peg raises a lot of questions about the extent to which it weakens the financial markets of the member countries, and more broadly, the extent to which it limits the ability of the central bank of the union, the 'Banque Centrale des Etats de l'Afrique de l'Ouest' (BCEAO), to influence inflation and economic activity in the member states given the key role that financial markets and the banking system play in the transmission of monetary policy. In fact, the currency peg implies that the control of the BCEAO reserves is not entirely in the hands of the BCEAO but likely to be influenced by the European Union which means less financial power for the domestic institutions of the member countries. Although the governments of the member states support the peg and believe that it is in the best interest of their economies and some scholars have shown that the currency peg in no way hinders the economies of the member countries, other scholars and the general public argue that the main obstacle to the economic prospects of the West African Francophone countries is the use of the CFA. For instance, Ahmadou Al Aminou Lô, the National Director of the BCEAO for Senegal, defended in an interview that the CFA is a solution to the development of the countries in the zone, as it protects them against currency instability since their economies are mostly based on agricultural products, which are very sensitive to price fluctuations (Débat, 2017). Indeed, pegging the CFA to a currency issued by a central bank with a

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<sup>1</sup> The countries in the CFA zone are: Benin, Burkina Faso, Bissau-Guinea, Cote d'Ivoire, Mali, Niger, Senegal, and Togo.

good anti-inflationary reputation has the benefits of achieving low inflation rates and currency stability. On the other hand, some pan-Africanist scholars and activists argue that the CFA is the main reason for the lack of credit expansion in WAEMU countries and fosters competition favoring imported goods at the expense of locally produced ones (Sagna, 2017).

The goal of this paper is to analyze the efficiency of the monetary policy set by the BCEAO in affecting the economies of the member countries, taking Senegal as a case study. I adopt an indirect and partial way to analyze the efficiency of monetary policy by separating money demand from money supply effects. Since the BCEAO policies have an impact on commercial banks' interest rates, I will examine the effect of surprise changes in financial conditions of the country on the macroeconomy by quantifying how interest rate changes by commercial banks affect business activity and inflation. This research will shed light on the ability of the financial institutions in Senegal to influence macroeconomic outcomes and whether that impact is limited as a result of the currency peg.

I use the aggregate money in circulation and a range of commercial banks' interest rates to construct an indicator of financial conditions, and an index of business activity and consumer price inflation to measure macroeconomic conditions. My empirical analysis proceeds in three steps. I first extract a common factor of 15 different interest rates set by commercial banks, and then do a VAR analysis on the money growth rate and the common factor of interest rates to separate money supply and money demand shocks. In a third step, I estimate the effects of these shocks on inflation and real economic activity in Senegal. The results reveal that both money demand and supply shocks significantly affect the real economy. Specifically, supply shocks bring up inflation as high as 0.3% and intensify business activity by 2% after half a year. Conversely, demand shocks exert

a downward pressure on inflation by 0.2% and on business activity by 2% after the first half of the year.

The rest of the paper is structured as follows. Section 2 reviews the existing literature on the relationship between the financial sector and economic activity and provides an overview of the financial environment in Senegal. Section 3 introduces the methodology used to construct the financial conditions index. Section 4 describes the VAR model and the identification strategy that is used to decompose money demand and supply shocks. The results are presented in two ways: first, in the form of impulse responses to assess the quantitative changes in the impact of money supply and demand shocks on money growth and financial conditions, and second, with historical decompositions to analyze the relative contribution of these two shocks to the movements in money and interest rates. Section 5 quantifies the effects of these shocks on macroeconomic outcomes. I conclude in section 6.

## **2. Financial Conditions and Economic Activity**

Before elaborating on the specifics of the financial sector in Senegal, I will present the theoretical background and empirical evidence on the links between financial conditions and economic activity.

### **2.1 Theory**

Financial conditions are an important determinant of economic activity mainly because they constitute an important channel of transmission of monetary policy. In fact, monetary policy does not directly affect the economy but instead influences various aspects of the financial market such as interest rates and money market rates, which in turn affect economic activity (Hatzius et

al., 2010). Thus, understanding the ways in which monetary policy affects the real economy and inflation through financial mechanisms is fundamental in evaluating the efficiency of monetary policy. These channels of transmission have been classified by Boivin et al. (2009) into two main categories: the neoclassical and the non-neoclassical channels. The neoclassical channels involve conditions of perfect financial markets and include investment-, consumption-, and trade-based channels. On the other hand, the non-neoclassical channels operate through financial market imperfections. Thus, both channels involve financial conditions as captured by movements in interest rates but the mechanisms at work are different as described below.

The investment-based channels mainly comprise interest rates, which have an impact on the cost of capital, and thus determine the demand for capital by firms and hence their investment level. In particular, if the central bank raises its lending rate, the commercial banks will raise their interest rates which in turn will increase the cost of capital and decrease borrowing and investment. The consumption-based channels involve the consumers' wealth and their demand for stocks. An expansionary monetary policy will stimulate the demand for assets and thus increase consumption. The main channel related to trade is through the exchange rate. An expansionary monetary policy makes foreign assets more attractive, and that leads to an increase in demand for foreign assets which depreciates the currency. The currency depreciation leads to an increase in exports due to cheaper domestic goods.

The non-neoclassical channels of transmission are also called the credit view of monetary policy because they are characterized by market imperfections in the credit supply, mainly due to government intervention and asymmetric information. Indeed, government intervention, asymmetric information, and various other factors can give rise to uncertainty within the financial market and create information failure between lenders and borrowers, thus hampering the

effectiveness of the functioning of the financial markets. Monetary policy shocks, by causing changes in the borrowers' interest expenses or lenders' funds, can alter credit and affect real variables (Wang, 2013).

Based on these monetary policy transmission channels, we can see that the variables that create a ripple effect on economic activity from monetary policy are the financial conditions indicators. Understanding the behavior of monetary policy is not enough in knowing the ways in which it is reflected in the economy. To know the efficiency of monetary policy, it is crucial to analyze its intermediaries, namely the financial market variables, and quantify their effect on macroeconomic outcomes.

## **2.2 Empirical Evidence**

A lot of research has empirically shown that there exists a significant relationship between financial conditions and economic growth. The specific nature of the relationship has been investigated for different countries and time periods using a variety of models and ways to proxy for financial conditions. The main finding of this literature is that a positive and significant relationship between financial conditions and economic activity is found for developed countries, but there is a debate on the nature of that relationship in emerging countries; the evidence on the nature of that relationship is less clear-cut for emerging economies.

### **2.2.1 Developed Countries**

The 2007-09 financial crisis has renewed the interest in understanding the link between financial conditions and economic activity with a number of recent studies revisiting this question for advanced economies. Kim and Sánchez (2017) investigate the ways in which financial

conditions affect real economy in the US between 1990 and 2015 by establishing a relationship between the growth of different sectors faced with different financial conditions, good and bad, based on their dependence on external financing. The results show that financial conditions affect the real economy but the strength of this effect depends on the level of dependency of each industry on the financing conditions. In particular, industries that have a high dependence on external financing are more affected by economy-wide financing conditions compared to industries with less reliance on external sources for financing. When the country faces bad financial times, industries that rely more heavily on external financing suffer more losses compared to the ones that are not as dependent on financing conditions. Another study that explores the relationship between financial conditions and the real economy in the US is done by Swiston (2008), who finds that credit availability is a strong determinant of growth. Specifically, a tightening of lending standards leads to an economic slowdown, while an easing of lending standards which increases credit availability enhances GDP growth. These results are in line with the findings of Matheson (2011). He shows that financial conditions indexes are a good predictor of the evolution of economic activity in real time in the US and in the euro zone, through an out-of-sample forecasting model. Espinoza et al. (2009) also examine the predictive power of financial conditions on economic activity in the US and the euro zone between 1970 and 2007. They provide in-sample evidence that financial shocks predict real economy in the US and the euro zone, but, in contrast to the findings of Matheson (2011), they show that financial shocks do not predict future economic activity in the euro zone for out-of-sample forecasts.

Erdem and Tsatsaronis (2013) expand the exploration of the linkages between financial conditions and economic activity to a broader range of countries, including Canada, Germany and the UK in addition to the US. They find that financial variables contain predictive information on

the real economy, such as GDP and inflation, in all four countries. They further document that the predictive power of financial conditions is stronger for GDP than for inflation, and is weaker at longer horizon. In Greece as well, financial conditions have been proven to be an important determinant of economic activity by Balfoussia and Gibson (2015). They find that financial conditions have a positive and significant effect on economic activity, measured by industrial production, the volume of retail trade, and the Purchasing Managers' Index. As such, targeted longer-term refinancing operations (TLTRO) would boost the country's economy by improving financial conditions. Overall, there is a broad consensus on the positive and significant relationship between financial conditions and economic activity in developed countries.

### **2.2.2 Developing Countries**

While there is a lot of evidence on the positive relationship between financial conditions and macroeconomic outcomes for developed countries, evidence is scarce for developing countries. Compared to developed economies, emerging economies have weaker and less developed financial markets, which might explain why the evidence of a positive effect of financial conditions on the economy is more mixed. Allen and Ndikumana (2000) examine the relationship between financial development and economic growth on eight Southern African countries<sup>2</sup>. Using four different indicators of financial development, namely liquid liabilities of the financial system (M3), credit to the private sector, volume of credit provided by banks, and a broad index of financial development that combines the other three financial indicators cited above, they investigate whether these financial factors stimulate economic growth through real GDP per capita.

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<sup>2</sup> The eight Southern African countries are: Botswana, Lesotho, Mauritius, Malawi, Swaziland, South Africa, Zambia, and Zimbabwe.

They find that the size of the financial sector measured by liquid liabilities affects economic growth positively and significantly, with a stronger effect in the long-run. However, there is no significant relationship between economic growth and the volume of credit to the private sector or the volume of credit by banks. These results can be explained by the fact that “a more liquid financial system implies more resources to finance economic activity” (Allen and Ndikumana, 2000).

While a lot of existing studies show that monetary policy in developing countries has little to no effect on financial conditions which in turn implies no effect on the real economy, Abuka et al. (2017) challenge that conventional view. They make the case that monetary policy in developing countries alters financial conditions and hence, affects the economy. Using Uganda as a case study, they estimate the effect of changes in short-term rates on firms’ borrowing, while controlling for GDP growth and inflation, and find that monetary policy affects significantly financing conditions and economic activity. Specifically, a tightening of monetary policy represented by an increase in short-term interest rates reduces credit supply, which is tantamount to a worsening of financial conditions, which results in a decline of inflation and economic activity. As a result, financial development enhances the effectiveness of monetary policy on economic outcome.

Given that Senegal is a developing country like Uganda, it is conceivable that the results about the positive relationship between financial conditions and the real economy may also apply to Senegal. However, the financial environment in Senegal differs a lot from the other African countries for which empirical evidence on the link between financial conditions and growth exists. In particular, the currency peg and the passive monetary policy in Senegal may have implications on the extent to which financial conditions can affect economic activity and lead to different findings. The results for Senegal will also matter for the other member countries of the WAEMU

since they are subject to the same regulatory framework. To get a better sense of what sets Senegal apart from other African countries, I will provide an overview of its current financial environment next.

### **2.3 Financial environment in Senegal**

There has been a significant increase in the number of financial institutions in Senegal since 2000, which has ultimately led to a broader credit market. Imam and Kolerus (2013) analyze the structure of the banking sector in Senegal including commercial banks, insurance companies, and microfinance firms. They find that, based on the evolution of the financial services provided by these institutions, Senegal has significantly deepened its financial sector between 2001 and 2010. As a result, the main determinant of interest rates that commercial banks set is the increasing competition in the banking sector in Senegal, which makes them decrease their rates and improve their services to attract customers. Competition is thus a main determinant of the supply-side factors of the financial market. Given that it is hard to obtain quantitative measures of these supply-side factors, I conducted a field research in Senegal over the summer of 2017 to collect narrative evidence from banks about their credit supply decisions and their relationship with the central bank.

I interviewed five commercial banks of different types: a microfinance firm, a mortgage bank, an international one, a pan-African one, and an entrepreneurship bank for SMEs. They all mentioned that competition is the main determinant of the rates they set, as they all tend to decrease their interest rates due to increased competition in the banking sector in Senegal. The BCEAO has also imposed free access to some banking services, in order to encourage more people to use banking services. That represents a challenge for the commercial banks as it cuts their profit margins and makes them more vulnerable, but it is a way for the BCEAO to combat the low

number of people who use banking, which is a main obstacle to an efficient financial sector. Moreover, the commercial banks mentioned that the policies that the BCEAO took during and after the financial crisis, in order to minimize risks and protect lenders, greatly affected their lending decisions. Indeed, the BCEAO adopted the Basel norms II and III that impose minimum capital requirements to ensure that commercial banks have enough funds to repay debts. Consequently, the banks have become more reluctant to lend, more risk-averse and they assess every loan application much more carefully. They also indicated that the BCEAO can indeed influence the interest rates they set through its policy rate, which is their main reference in determining their individual interest rates. Thus, the two key determinants of credit availability and loan supply are the degree of competition in the banking sector and the policy interventions of the BCEAO. A report by the IMF (2005) also identified excess liquidity to be the main obstacle to the expansion of the financial market. Indeed, because of large excess bank reserves, banks compete to lend to corporations which leads to low credit cost and weaker bank portfolios.

Despite the stability and the depth of its financial system, the country still faces a weak financial market with low accessibility to financial services and high financial illiteracy compared to countries such as Morocco and Cote d'Ivoire. The country still has a lot of areas of improvements for a deeper financial inclusion, according to Imam and Kolerus (2013). Moreover, a study conducted by the World Bank (2016), revealed that only 13% of the population in Senegal have a bank account and only half has an average understanding of the functioning of the financial system. This highlights the weaknesses on the demand side in the financial sector. Regardless of the increasing number of banks in Senegal, if their services are still inaccessible to most of the population and most importantly to businesses, changes in interest rates, or financial conditions more broadly, will have little to no effect on economic activity and hence, growth. This lack of

accessibility to financial services may be one of the reasons there is a weaker relationship between financial conditions and economic activity in developing countries. For financial intermediaries to influence the real economy, their services need to be widely used and accessible. For instance, if people do not rely on bank loans as much, then an alteration of interest rates will have little to no effect on consumer spending, and thus on inflation and business activity. As such, the link between financial conditions and the real economy is potentially weakened in emerging economies because for the most part, financial services are not widely used by the population.

From existing studies as well as the field research I conducted in Senegal, we have a broad understanding of the factors that drive the supply and demand sides of the financial market. However, there remains the need to know the relative importance of these demand- and supply-side factors and the ways in which they may influence economic activity and inflation differently. That is the main reason why it is imperative to dissociate money demand and supply in my empirical analysis in order to separately identify the effects of money demand and supply shocks on the economy.

In sum, there is a considerable amount of evidence on the link between financial conditions and economic activity in the developed world, and there is a consensus on a positive effect of financing conditions on the real economy. However, the conventional view about emerging economies is that monetary policy and financial conditions are weak determinants of economic activity. Despite that conventional view, Abuka et al. (2017) and Allen and Ndikumana (2000) find that in different countries in Africa, monetary policy changes and financial conditions can significantly affect economic growth, especially if the financial market is liquid. The countries in Africa where they have done research are very different from Senegal though, in terms of currency control and monetary policy dynamics, and therefore, the results they found do not necessarily

hold for the case of Senegal. This is where my research comes in. Senegal, as a developing country and part of the WAEMU, will provide new information reflecting the dynamics between financial conditions and economic activity in the member countries of the union. I focus on Senegal as a representative country because it is the second largest economy in the union after Cote d'Ivoire. Given that the latter was hit by a severe political crisis in 2011, Senegal is better suited for a case study since it has been the most stable country in the union. This will make the analysis more reliable since there are fewer confounding factors that could potentially have affected the general trend of the economy.

### **3. Construction of a Financial Conditions Index**

The first step of the empirical analysis consists of constructing a measure that allows us to gauge financial conditions since such a time series is not readily available for Senegal. For this purpose, I use the Principal Component Analysis (PCA) to extract a common factor from the 15 different commercial banks' interest rates along the lines of Hatzius et al. (2010). The principle component analysis is used to collapse a large number of correlated and interrelated variables into a single indicator that captures the common variations in the original data set but gets rid of idiosyncratic noise. It does so by obtaining the least-squares best fit line through the original dataset (Shlens, 2003; Richardson, 2009; Jolliffe, 2002).

In my analysis, I use a set of 15 distinct commercial banks' interest rates<sup>3</sup> obtained from the BCEAO website, that differ based on the type of borrower (e.g. loan to individuals vs credit to

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<sup>3</sup> The 15 interest rates used are: Interest Rates on credit to individuals (medium run), Interest Rates on credit to private companies of the productive sector, Interest Rates on credit to individual companies, Interest Rates on credit to village cooperatives, Interest Rates on mortgage credit, Interest Rates on credit for physical assets, Interest Rates on credit for consumption, Less than 1 month Interest Rates, 1-3 month Interest Rates, 3-6 month Interest Rates, 6-

companies), the period of maturity, and the purpose of the loans (e.g. credit on consumption vs credit on mortgage). I use monthly series that cover the period from February 2005 through July 2017. It is not possible to use all these interest rate series individually in the analysis because that would create redundancy. Indeed, the interest rates series co-move for the most part, but some are more volatile than others. That hints that there are factors that affect all the interest rates, while each rate also has an idiosyncratic component. In order to account for the common movement and to exclude idiosyncratic shocks, I extract one common factor and obtain a new variable, which constitutes the financial conditions index, that is included in the next step of the empirical analysis. To do so, I first standardize the data to have a zero mean and a unit variance. The common factor is then modeled with an OLS regression as follows:

$$r_{it} = \lambda_i f_t + e_{it}$$

where  $r_{it}$  is the set of standardized interest rates,  $f_t$  is the common factor that affects all interest rates,  $\lambda_i$  are the factor loadings that measure the effect of the common factor on each interest rate, and  $e_{it}$  is a vector of idiosyncratic factors (Delle Chiaie, Ferrara and Giannone, 2017). The common factor  $f_t$  is the best-fitted line through the data of interest rate variables and captures most of the variance in the variables. It is obtained by first finding the variance-covariance matrix of the interest rates and then computing the eigenvector of the highest eigenvalue of the variance-covariance matrix. The eigenvector of the highest eigenvalue captures the most variance of the dataset and is thus retained as the common factor.

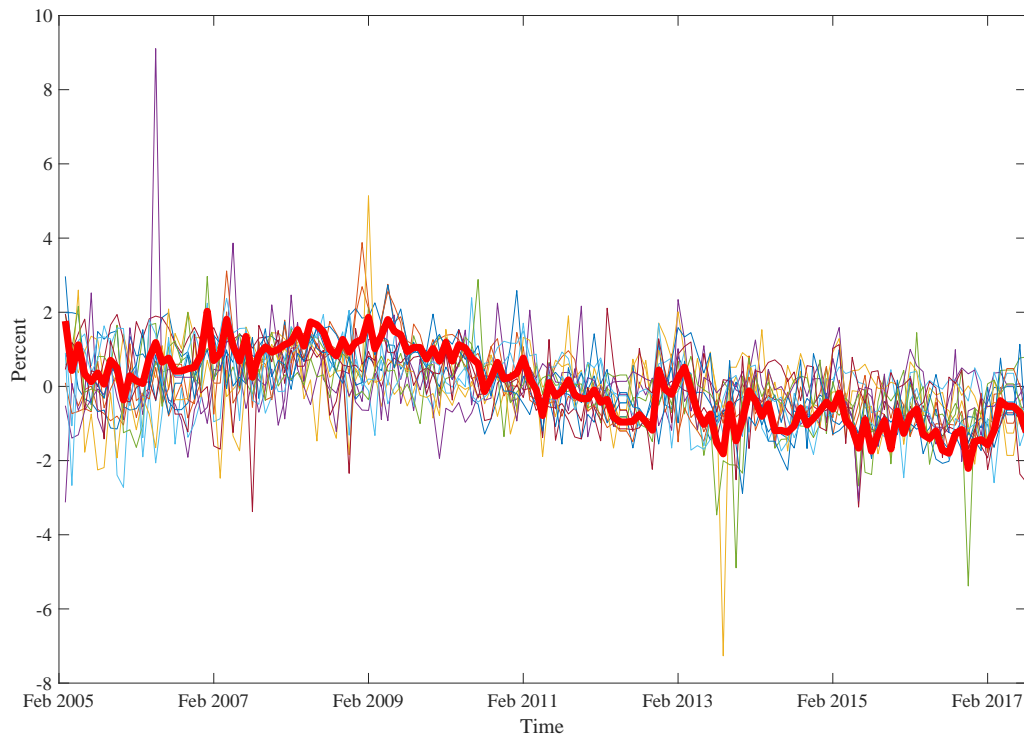
Figure 1 plots the different interest rates underlying the common factor (red bold line) for the entire sample period. The financial conditions index tracks the movements of the interest rate series closely. Given that there seems to be a slight downward trend in this indicator, I linearly

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12 month Interest Rates, 1-2 year Interest Rates, 2-5 year Interest Rates, 5-10 month Interest Rates, more than 10 year Interest Rates

detrend the series before incorporating it into the empirical model used to disentangle supply-side factors from demand-side factors which is presented in the next section.

*Figure 1: Financial Conditions Index (FCI)*



Notes: Bold red line represents the common factor extracted from 15 bank interest rates, and the other lines the 15 interest rates used. They are all standardized with mean 0 and standard deviation 1. Source: BCEAO

#### **4. What Drives Financial Conditions?**

In order to quantify the relationship between financial conditions and economic activity, it is important to distinguish between forces that influence financial conditions from the supply side and the demand side because they might induce different economic responses. To this end, I estimate a Vector Autoregressive (VAR) model since it allows me to quantify the responses of

specific variables of interest to structural one-time shocks and to determine the relative contribution of different structural shocks to actual fluctuations in the data via historical decompositions (Hashimzade and Thornton, 2013). Section 4.1 discusses the basic model and the data used in the estimation of the VAR. The restrictions imposed to identify the underlying structural shocks are described in section 4.2.

The VAR model is used to capture the dynamic relationships between different variables and quantify the impulse responses of specific variables of interest to structural one-time shocks (Hashimzade and Thornton, 2013). VAR is widely used in macroeconomic data analysis given that standard regression analysis does not account for the underlying challenges of macroeconomic measurements and estimation. To do so, a reduced form VAR regresses each variable on its own lagged variables, all the other variables in the analysis, and an idiosyncratic error term. The error terms are the surprise movements in the variables and the weighted average of the underlying structural shocks (Stock and Watson, 2001). Since the variables are likely to be correlated, the errors terms are correlated across the equations, and thus they need to be decomposed to extract the structural shocks. A relationship is established between the structural shocks and the residuals using a variance-covariance matrix.

#### **4.1 Estimation of the Reduced-Form VAR Model**

I consider the following VAR ( $p$ ) model:

$$Y_t = c + B_1 Y_{t-1} + B_2 Y_{t-2} + \dots + B_p Y_{t-p} + \epsilon_t$$

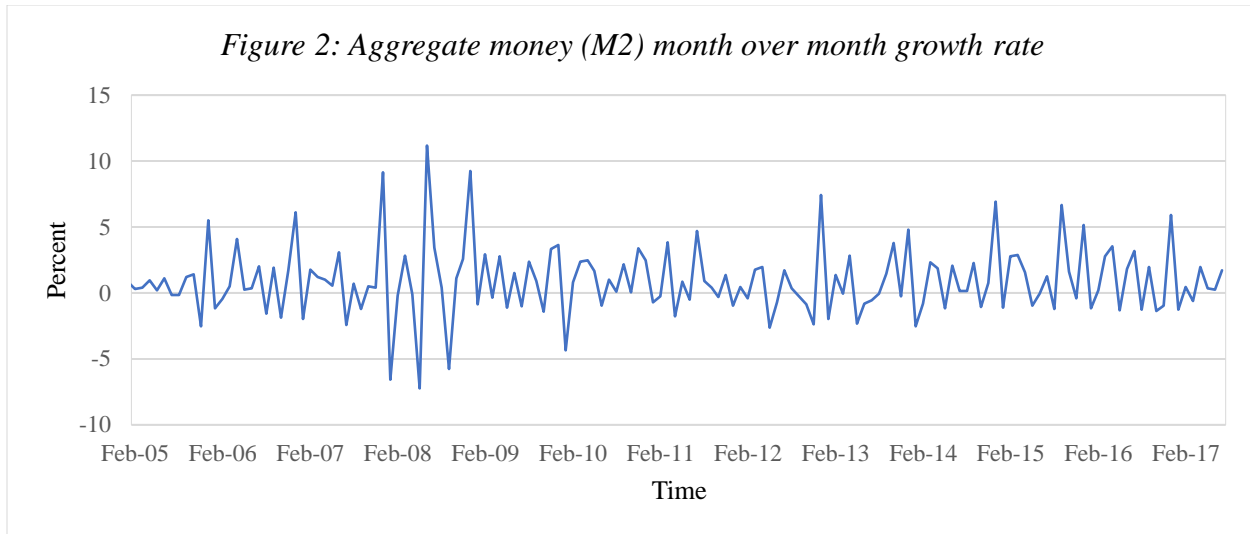
where  $Y_t$  is an  $n \times 1$  vector of endogenous variables,  $c$  is an  $n \times 1$  vector that contains the constant terms,  $B_i$  are  $n \times n$  matrices of lagged coefficients up to order  $p$  that capture the dynamic

relationships between the variables, and  $\epsilon_t$  is a serially uncorrelated white noise error, with mean zero and variance-covariance matrix  $\Omega$ .

I estimate a monthly bi-variate VAR which includes the financial conditions index and a broad aggregate of money to describe the money market following Chadha, Corrado, and Sun (2010). There exist four main measures of the quantity of money balances: M1, M2, bank deposits and treasury deposits.<sup>4</sup> M1 measures the liquid and physical money in circulation, such as coins and notes, as well as checking accounts. Bank deposits measure the money held by the banks in consumers' short-term accounts, and treasury deposits are long-term deposits. M2 includes cash, checking deposits, savings deposits, money market securities, and other short-term and liquid deposits. The latter measure represents the aggregate money in circulation, and is thus the broadest measure for liquidity which is why I chose it for my analysis. Figure 2 displays the month-over-month growth rate of M2. The sample runs from February 2005 to July 2017. Given that the sample period is relatively short, the lag length is set to  $p = 3$  which strikes a good balance between parsimony while allowing for sufficient dynamics of the system.

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<sup>4</sup> These data are available on the BCEAO website.



Notes: Aggregate money in circulation in Senegal. Growth rate in percentage. Source: BCEAO

## 4.2 Structural Analysis

The goal is to isolate the effects of money supply and money demand on the financial conditions index and money growth. This requires decomposing the reduced-form residuals  $\epsilon_t$  into structural shocks  $u_t$  where the two are related as follows:

$$\epsilon_t = A u_t$$

with  $A$  being a  $2 \times 2$  matrix that captures the contemporaneous structural relationship between variables. The error terms are the surprise movements in the variables and the weighted average of the underlying structural shocks (Stock and Watson, 2001). Since the variables are likely to be correlated, the errors terms are correlated across the equations, and thus they need to be decomposed to extract the structural shocks. The problem is that there is not enough information in the data to uniquely determine  $A$ . Therefore, additional assumptions need to be made about the structure of the economy to achieve identification. Put differently, there exist infinitely many

possible decompositions for the reduced-form variance-covariance matrix  $\Omega$  that are all compatible with the data.

The most common approach to identification is the Choleski factorization where  $A$  is lower triangular implying that an innovation in the first variable is allowed to influence both variables contemporaneously but shocks to the second variables have no immediate effect on the first variable. With this recursive identification scheme, one risks to ignore substantial instantaneous effects of a shock on a variable, thereby underestimating the impact of certain shocks. Moreover, this rather mechanical procedure of imposing zero restrictions on the contemporaneous impact matrix lacks economic interpretation and is merely justified by the assumption that certain variables affect others only with a lag. This belief is reflected in the ordering of the variables.

To overcome these shortcomings of traditional zero restrictions, my identification strategy is based on sign restrictions. The signs imposed on the response of variables are derived from what conventional wisdom tells us about the reaction of certain variables after a certain shock. Allowing for an immediate reaction of all the variables after all structural shocks is particularly important in the market model considered below. However, while the Choleski factorization leads to a unique decomposition, with sign restrictions all possible contemporaneous impact matrices are computed but only those compatible with the signs placed on the impulse response functions are kept. To summarize the information of this set of impulse responses, below I report the median and the 16<sup>th</sup> and 84<sup>th</sup> percentiles.

Following Chadha et al. (2010), I apply the Choleski decomposition to the variance-covariance matrix  $\Omega$  to make the errors uncorrelated with each other. I then generate a rotation matrix  $Q$  by applying the  $QR$  decomposition to a matrix of standard random normal variables that I use to rotate the Choleski factor in order to get rid of the zero that arose from its lower triangular

structure. Using the contemporaneous impact matrices obtained from rotations of the different elements of the VAR, I compute impulse response functions and check for compliance with the postulated sign restrictions. The draw is kept when it fulfills all the sign conditions.<sup>5</sup>

The sign restrictions are derived from a standard money market model as illustrated in Figure 3. A positive money supply shock which results in a downward shift of the money supply curve will increase money in circulation and improve financial conditions by lowering interest rates across the board. An unexpected increase in money demand will lead to an upward shift of the money demand curve which means that M2 increases and financial conditions tighten which is equivalent to an overall increase in interest rates.

Thus, the identifying restrictions take the following form:

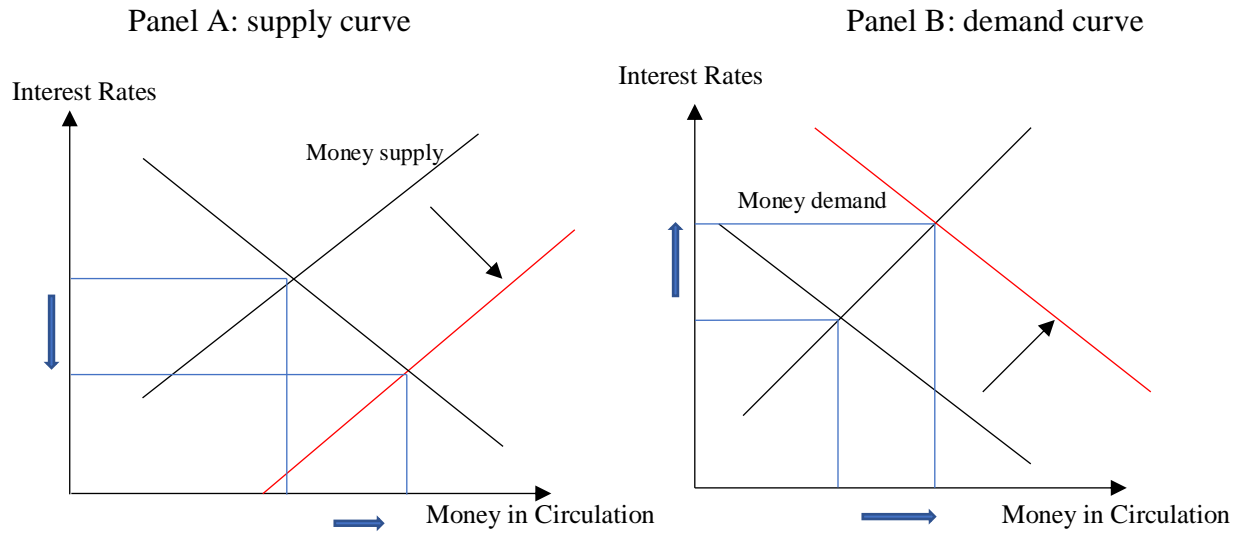
$$B = \begin{array}{|c|c|} \hline + & + \\ \hline - & + \\ \hline \end{array}$$

the first column being the supply shocks and the second the demand shocks, with money supply on the first row and interest rate on the second row (Hashimzade and Thornton, 2013; Chadha, Corrado, and Sun, 2010).

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<sup>5</sup> I generate 5000 draws for  $Q$  and of those 5000 draws, only the matrices that fit the sign restrictions are retained.

Figure 3: Money demand and supply curves

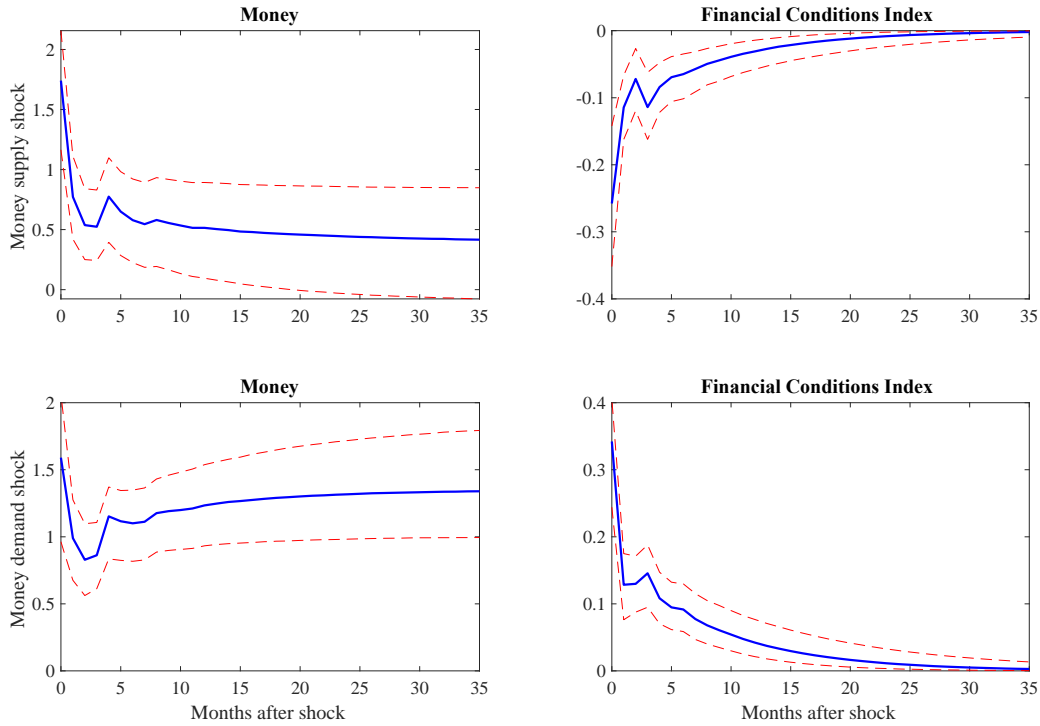


### 4.3 Empirical Evidence

Figure 4 shows the median impulse responses to one-time shocks of money supply and demand over three years together with 16<sup>th</sup> and 84<sup>th</sup> percentile error bands. Overall, both money demand and supply shocks affect significantly financial conditions and the level of money in circulation. Specifically, we can see that a one-standard-deviation supply shock increases the amount of money in circulation by about 1.75% on impact. The quantity of M2 drops to 0.5% over the next three months and stays at that level thereafter after briefly picking up again to 0.8% in the fourth month. This means that after a positive money supply shock the amount of money in circulation is permanently higher. The same money supply shock eases financial conditions by about 0.25% but the impact effect dissipates by more than half after the first month with financial conditions going back to their pre-shock level after two years and a half. The responses of the variables to money supply shocks are very similar to the results obtained by Chadha et al. (2010), who also found considerable impact effects of money supply shocks on money in circulation and

the external finance premium in the US, which however decreases by more than 50% in the months following the shock. For money demand, a one-standard-deviation shock increases the amount of broad money by about 1.5% on impact and tightens financial conditions with the overall level of interest rates rising by 0.35%. M2 temporarily decreases to below 1% but then gradually rises and stabilizes around 1.3% in the longer run. The persistence of this effect is somewhat surprising as demand shocks are expected not to have long-term effects on the amount of money in circulation. Financial conditions rapidly ease with the common interest rate factor dropping by more than half in the first two months after the shock. The effect of the shock disappears completely after two and a half years. Similarly, Chadha et al. (2010) find that financial conditions in the US ease a few months after a demand shock as the external finance premium drops by half. However, the level of aggregate money maintains a stable level without any significant decrease after the shock, contrary to the results in my analysis.

Figure 4: Impulse Responses



Notes: VAR impulse responses of money growth and financial conditions index to money demand and supply shocks, with sign restrictions. Sign restrictions are imposed over the first 6 months. Blue solid lines: the median impulse responses. Red dashed lines form the 84<sup>th</sup> and 16<sup>th</sup> percentile error bands.

While we know, from these impulse responses, the ways in which financial conditions and aggregate money respond to money demand and supply shocks, we do not know to what extent changes in each of these variables are due to money demand or supply shocks. In particular, it is interesting to look at the relative contribution of money demand and supply shocks to historical changes in financial conditions and aggregate money. To do so, I compute a historical decomposition which quantifies the cumulative contributions of each structural shock to fluctuations in both variables over the sample period.

Figure 5 shows the historical decompositions for the financial conditions index and the growth rate of the broad monetary aggregate. Money growth rates are influenced relatively more

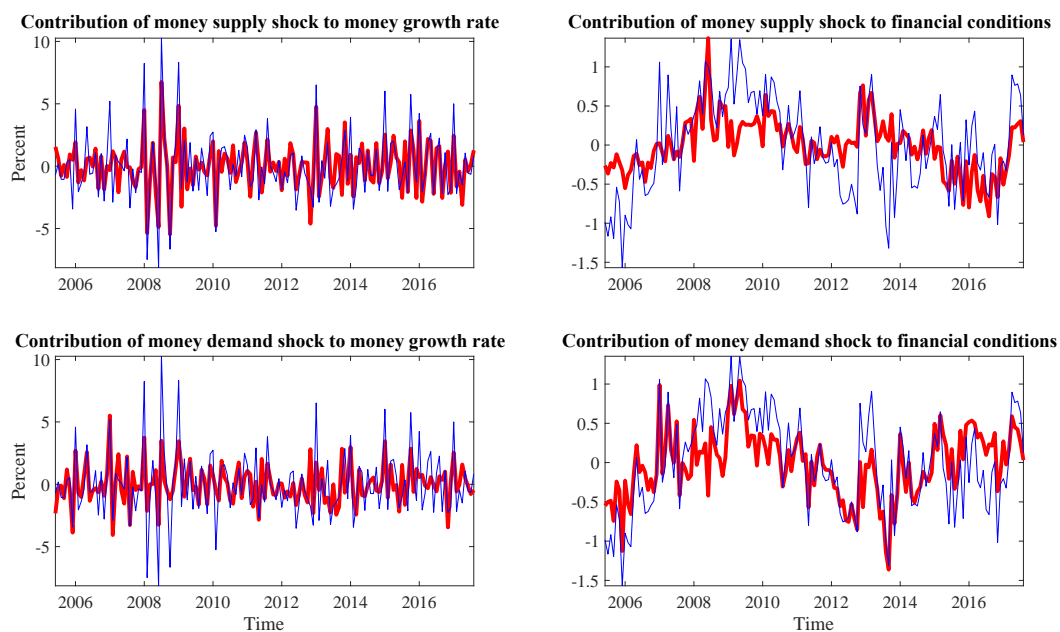
by money supply shocks throughout the whole period, while money demand shocks dominate the evolution of financial conditions for the most part. For instance, between 2008 and 2009, Senegal experienced huge fluctuations in the aggregate level of M2, which are mostly explained by money supply shocks. At the beginning of 2008, there was a significant increase in the amount of money in circulation, for which supply shocks accounted for more than half. In the subsequent month, the money growth rate decelerated significantly, and money supply shocks accounted for 75% of that decrease. These fluctuations in the amount of money in circulation in 2008 can be explained by the regulations and restrictions that the BCEAO set for commercial banks in order to minimize risk. Indeed, the BCEAO put a lot of restrictions on commercial banks by imposing minimum capital requirements, and as a result, the credit supply from commercial banks dropped. This explains the significant decreases in the aggregate money in circulation. At the same time, banks increased their excess reserves to enhance their resilience and competitive advantage and thus, had more money to lend to corporations, which is why there were hikes in the level of money. These two overlapping conditions in the financial market in Senegal explain the fluctuations of the money growth rate between 2008 and 2009. Later in 2013, aggregate money growth increased by over 6%, and supply shocks explain over 80% of that change. There are some periods, such as January 2010, in which money supply shocks explain the whole change in aggregate money. In sum, the growth rate of money in circulation in the economy is mostly affected by supply-side factors, while money demand shocks have a lesser and sometimes no impact on the changes in the monetary aggregate. This shows that the central bank which administers the supply side detains the most power to influence the circulation of money in the economy, while consumers' demand has little to no power. The lack of accessibility to financial services and the low literacy are likely to explain why consumers' demand for money does not have much influence on the money growth rate.

These results are also in line with the findings of Chadha et al. (2010) who document that in the US money supply shocks strongly determined money growth between 1987 and 2009.

On the other hand, changes in financial conditions are mostly driven by shocks to money demand, although money supply shocks dominate in a few periods. Before 2008, money demand shocks explained almost all of the changes in the overall level of interest rates. For example, in 2006, interest rates dropped by more than 1.5% and money demand shocks contributed about 4/5 to this decrease while supply shocks accounted for only 1/5. Throughout 2007, there were a few spikes in the financial conditions index, almost 95% of which were explained by money demand shocks. However, between 2008 and 2009 which coincides with the beginning of the financial crisis, the dynamics changed and money supply shocks became more important in determining financial conditions. For instance, around June 2008, the overall level of interest rates increased by 1% completely driven by money supply shocks while the contribution of demand shocks was negative. This exception in 2008 is probably due to the regulations of the BCEAO during the financial crisis, which restrained banks' supply of loans and thus led to the hike in interest rates. Specifically, during the crisis, the BCEAO increased the minimum required bank reserves, which translates to less money for the commercial banks to lend. Consequently, the banks became more reluctant to lend in order to minimize the risk. The financial crisis therefore had an influence on the dynamics of the changes in interest rates and the factors that influence them. In 2009, the situation reverts back to the normal condition, with demand shocks impacting financial conditions more strongly. Another historical episode during which money supply shocks dominated is 2013, where most of the increase in interest rates can be attributed to supply shocks. But shortly after those spikes, financial conditions eased mostly due to negative demand shocks. Chadha et al. (2010) found similar results for the US, where demand shocks dominate changes in the external

finance premium apart from the years 2002 and 2008. Therefore, consumers' demand for money is the main factor that influenced financial conditions in Senegal between 2005 and 2017, except in 2008 and 2013. These results prove the speculations of the commercial banks' directors whom I interviewed and who stated that competition within the banking system in Senegal is the main factor that affects the interest rates they set even though the BCEAO regulations and policies during the crisis affected their decisions.

*Figure 5: Historical Decomposition*

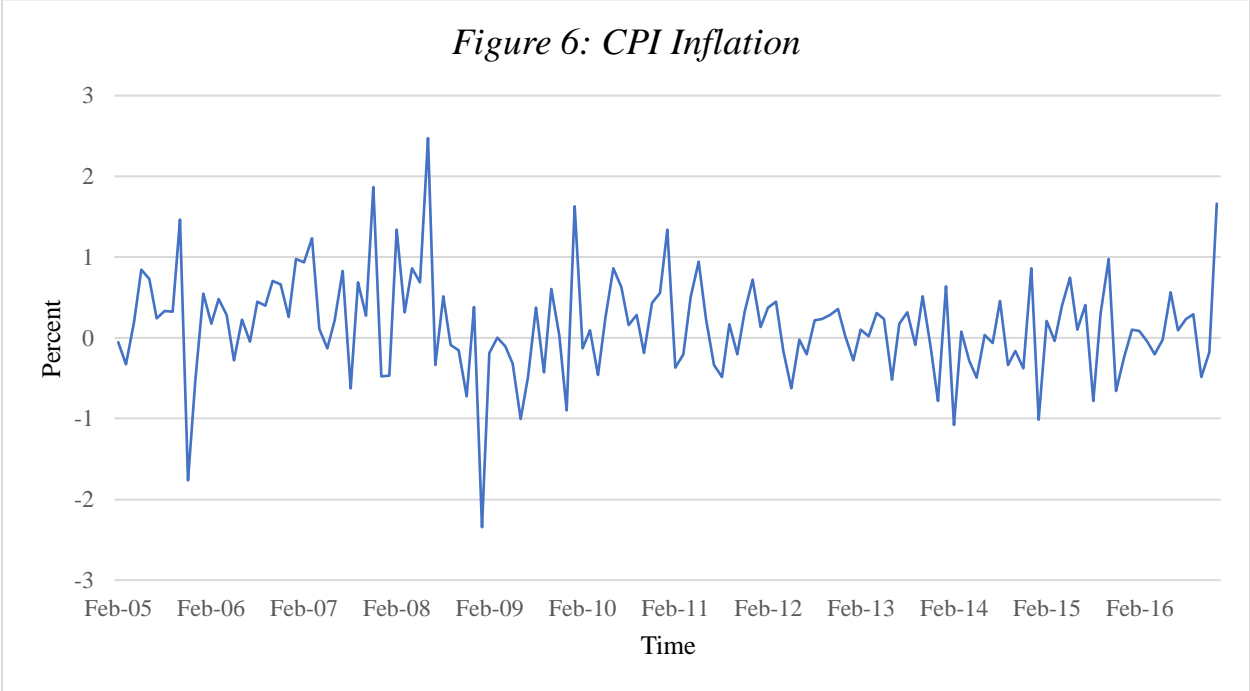


Notes: Blue line is original data series. Red bold line is the contribution of money demand and supply shocks to variables.

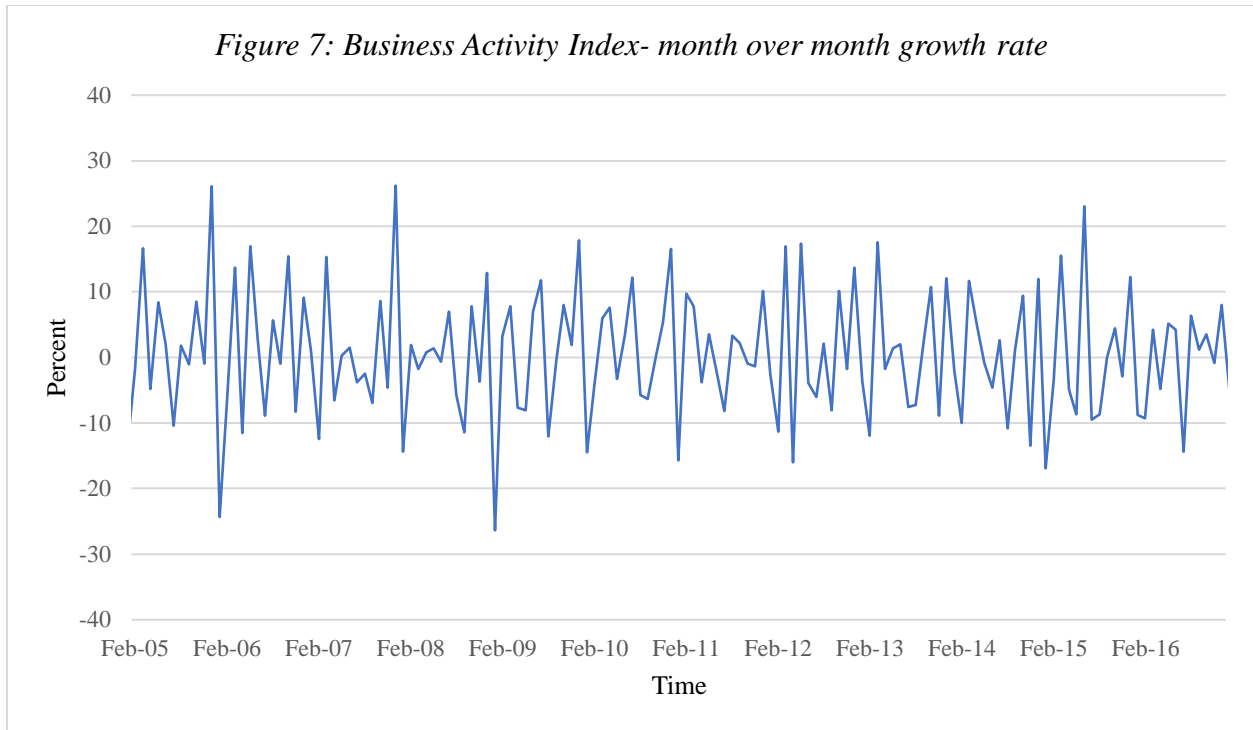
## 5. The Macroeconomic Effects of Money Supply and Demand Shocks

In the last step of the empirical analysis, I quantify the impact that money supply and demand shocks have on the real economy. To that end, I regress inflation and business activity growth rate on the structural shocks obtained from the VAR model in the second step. The monthly

consumer price index is obtained from the Global Economic monitor database of the World Bank. Figure 6 shows the inflation rate which is computed as the percentage change of the price index. Figure 7 reports the month-on-month growth rate of the Business Activity Index obtained from the BCEAO database which is used as a measure of real economic activity.



Source: World Bank



Source: BCEAO

## 5.1 Regression Analysis Model

The regression model is adopted from Kilian (2009), in which the impulse response coefficients are at a specific time horizon, set to twelve months in my analysis. Therefore, the model is as follows:

$$\pi_t = \alpha_j + \sum_{i=0}^{12} \beta_{ji} shock_{jt-i} + \mu_{jt}$$

$$y_t = \theta_j + \sum_{i=0}^{12} \varphi_{ji} shock_{jt-i} + \delta_{jt}$$

for j=1, 2

where  $\pi_t$  is the CPI inflation,  $y_t$  is business activity index growth rate, *shock* is the money supply shock for j=1 and the money demand shock for j=2, and  $\mu$  and  $\delta$  are potentially serially correlated

errors. The coefficients  $\beta$  and  $\varphi$  correspond to the responses of inflation and business activity to the money supply and demand shocks, at a horizon of twelve months.

## 5.2 Empirical Results

Figure 8 shows the point estimates of the effects of money supply and demand shocks on inflation and business activity together with one- and two-standard-deviation error bands. Overall, the responses of inflation and real activity to money demand and supply shocks are in line with economic theory. A money supply shock exerts positive effects on both inflation and business activity. Specifically, a money supply shock does not have much effect on inflation in the first couple of months, but raises it by 0.2% after two months. The effect stays at around that level for the following nine months, and starts to dissipate after a year. The positive link between the money supply shock and inflation in Senegal makes sense because the more money there is in the economy the higher inflation will be because of a higher demand for goods. Indeed, as people possess more money, their demand for goods and services increases which leads to a demand-pull inflation. These effects are also reflected in the response of business activity to money supply shocks, which have a negative effect on business activity at first but the effect becomes positive after a month. Indeed, a positive money supply shock decreases business activity by 1% on impact, and this change increases to eventually be positive after the first month. Business activity keeps increasing steadily until it reaches a maximum of 2% after about half a year before starting to decrease. Overall though, the positive effect of money supply shock on business activity dominates its negative effect, which is in accordance with economic theory. A positive money supply shock translates to more favorable financing conditions and as a result, firms borrow more money to invest more in the economy in anticipation to increasing consumer demand. This result is

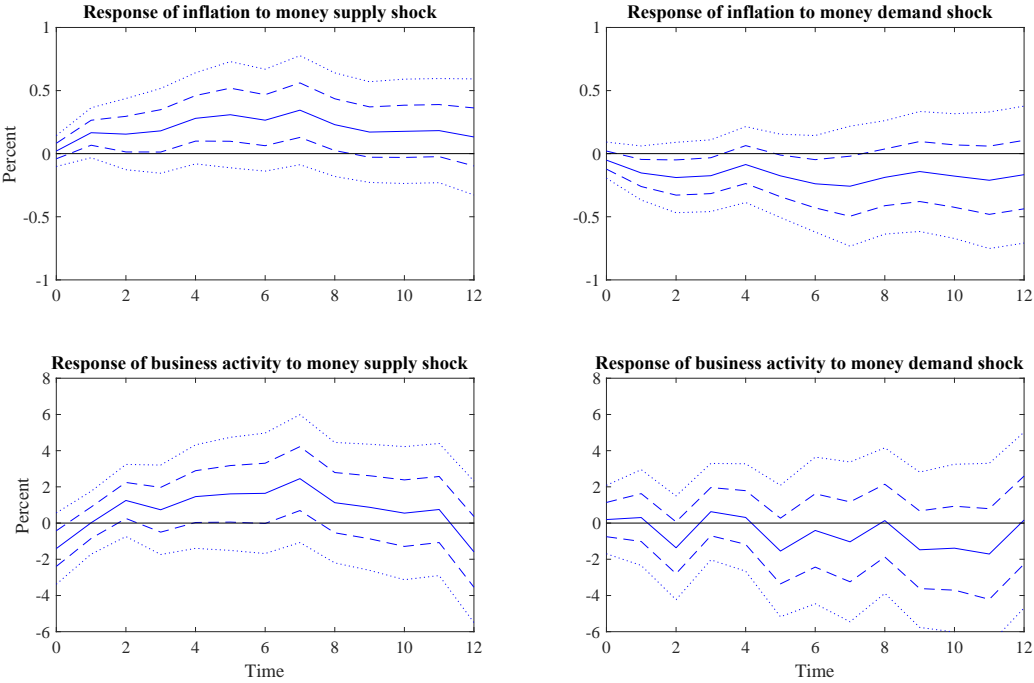
comparable to Swiston's (2008) findings in the US, that an easing of lending standards, equivalent to a positive money supply shock, increases GDP growth. The positive response of business activity to money supply shock is delayed because the effects of investment takes time to be reflected in the economy.

Contrarily to the supply shock, the money demand shock decreases inflation slightly by 0.05% on impact. The effect gets bigger as time goes by and reaches -0.2% after two months. The change in inflation due to a positive money demand shock fluctuates between -0.05 and -0.2 for the next 10 months. Unlike inflation, the response of business activity to money demand shocks is not clear-cut. Indeed, business activity fluctuates between -2% and 0.5% after a supply shock, but there is a negative trend in the effect overall. The negative responses of inflation and business activity to positive money demand shocks is due to the fact that a positive money demand shock leads to a shortage of money in the economy and as a result, people have less spending money. This decrease in consumption leads to a drop of the price level. As prices fall, firms invest less and reduce their supply, which dampens economic activity. Again, the initial positive response of business activity to money demand shocks is explained by the fact that it takes time for investors to realize the change in demand for their goods and services and adjust their supply.

Overall, inflation significantly responds to both money demand and supply shocks. The price level in Senegal is driven by supply-side factors as much as demand-side ones. However, the economic activity is more influenced by supply-side factors, which stimulate it in the medium-run, while money demand shocks have no significant effect on it. These results are in line with the findings of Abuka et al. (2017) for Uganda, where an expansionary monetary policy increases credit supply and consequently has a positive effect on inflation and the real economy. The expansionary monetary policy is analogous to positive money supply shocks, which in our results

for Senegal also increase inflation and business activity. However, from Abuka et al.'s (2017) research, we cannot determine the specific channel of transmission of the loose monetary policy, whether it affects inflation and the real economy in Uganda through demand or supply factors. That is the reason why it is important to separate supply and demand shocks. Moreover, given the opposing effects of money supply and demand shocks on each economic outcome, the overall effect of financial conditions potentially cancels out if demand and supply are not distinguished. That is probably the case in Allen and Ndikumana's (2000) research, who found no significant effect of the volume of credit on economic growth.

Figure 8: Regression Results



Notes: Estimates of regression model. Solid blue line represents the point estimate, dashed and dotted lines are the one and two standard error bands.

## 6. Conclusion

In an attempt to understand the monetary policy framework of the BCEAO and assess its effect on the real economy in Senegal, this paper adopted an indirect way of quantifying the effects of money supply and demand shocks on business activity and inflation. After running a VAR model of the financial conditions index and the aggregate money growth to separately identify supply and demand shocks of money, I estimate the effect of these shocks for inflation and business activity. I find that money supply shocks have a positive effect on inflation and business activity, while money demand shocks have a negative effect on inflation and no clear effect on economic activity. These results suggest that monetary policy in Senegal, to the extent that it influences the amount of money in circulation through supply-side factors, can significantly affect the real economy. This effect is weakened by regulations and restrictions the BCEAO imposes on commercial banks. On the other hand, demand-side factors, despite their significant effect on inflation, remain weak in influencing economic activity due to the lack of accessibility of the population to financial services. Therefore, for monetary policy to positively influence the real economy, the BCEAO should minimize regulations in order to increase money supply and in turn stimulate business activity, while encouraging competition. There is also a need to increase incentives for people to access and use financial services in order to stimulate money demand and strengthen the effect of the demand-side factors of the financial conditions on the economy.

This research could be expanded to the other member states of the WAEMU, to investigate the extent to which internal factors of the economy, such as fiscal policy and the size of the financial market, are important in assessing the effect of financial conditions on economic activity. Although Senegal represents a good case study for the countries in the CFA zone, it does not necessarily reflect the realities of financial development and economic activity in all the member

countries because, beside the common currency and central bank that they share, they have very different domestic policies.

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