The Economic Research Guardian – Vol. 10(2)2020
Semi-annual Online Journal, www.ecrg.ro
ISSN: 2247-8531, ISSN-L: 2247-8531
Econ Res Guard 10(2): 83-96

Identification of risk-taking channel of monetary policy in Cameroon

Marcel Takoulac Kamta
University of Dschang, FSEG, Cameroon
E-mail: marcelk049@yahoo.fr

Arsène Aurelien Njamen Kengdo
University of Dschang, FSEG, Cameroon
E-mail: arsenekengdo@yahoo.fr

Alain Bertrand Ndzana Mekia
University of Dschang, FSEG, Cameroon
E-mail: ndzanaalain526@yahoo.com

Franklin Dongmo Tsobjio
University of Dschang, FSEG, Cameroon
E-mail: franklin.dongmo@migec.finance

Abstract
The objective of this research work is to identify the risk-taking channel of monetary policy in Cameroun. The credit risk is measure by the ratio of overdue debts on gross credit. The data used are those of 6 commercial banks collected from National Credit Council (CNC), within the period 2006-2016.The model is estimated with two methods: the Dynamic Ordinary Least Square and Fully Modify Ordinary Least Square. The Results show that the Central Bank's key interest rate (TIAO) negatively affects the level of overdue debts granted by commercial banks in Cameroon. However, its impact is not significant considering the hole period. Robustness check reveals that, risk-taking channel exist in Cameroon after recent financial crisis. It also appears that credit supply and inflation significantly enhance credit risk; while banking capital significantly harms credit risk. In addition, a reduction of interest rates increases banks risk-taking especially when Gross Domestic Product growth rate is feeble. Therefore, we recommend that the monetary authorities avoid practicing low key interest rates over a long period, because it is likely to increase bank risk-taking.

Keywords: Risk-taking channel, BEAC, Monetary policy, Overdue debts

JEL classification: E50, E51, E52, E58

Received: 19 August 2020; Received in revised form: 01 October 2020; Accepted: 08 December 2020

The Economic Research Guardian – Vol. 10(2)2020
Semi-annual Online Journal, www.ecrg.ro
ISSN: 2247-8531, ISSN-L: 2247-8531
Econ Res Guard 10(2): 83-96

1. Introduction

Risk-taking channel of monetary policy reflects the propensity of commercial banks to expose themselves to risk after a lasting decline of the central bank's interest rate (Borio and Zhu, 2012). In the Economic Community of Central African States (CEMAC), the key interest rate of the Bank of Central African States named interest rate on tenders (TIAO) decreases from 5.25% to 2.45% in the period 2006-2016 (COBAC, 2016). At the same time, we register an increase in the volume of credit supply and the part of overdue debt in total credit supply. In Cameroon, for instance, the growth rate of overdue debt rise from 2.5% to 17.9% within the period 2006-2016 (COBAC, 2016). These facts predict the presence of risk-taking channel in Cameroon.

In the recent literature, monetary policy decision is accused to increase the level of risk-taking by credit institutions (Linton, 2019). Angeloni et al. (2015), Roy and Kemme (2019) show for instance that, the lasting decline of the Federal Reserve (Fed) interest rate is one of the main causes of the financial crisis of 2007. This evidence is explained by the fact that, setting low interest rates by the Central Bank reduces the refinancing cost of commercial banks and, at the same time, improves economic activity. Therefore, credit institutions will increase their loans with greater tolerance of risk, hoping maximum profits. This situation will increase the risk level of their credit portfolio (Jimenez et al. 2014). If the increase of credit supply is followed by a recessive shock in economic activity, then there could be a systemic crisis (Jimenez et al. 2014).

The puzzle is visible in the stylized facts about TIAO, GDP and bank loan in Cameroon. It can be seen in table 1 below that, in Cameroon, the interest rate on tenders decreases from 2006 to 2016. This shows the will of the BEAC to implement an expansionary monetary policy. However, the expected effects of the drop in TIAO on GDP growth rate are not visible at all. In 2006 for example, with a TIAO of 5.25%, the growth rate of real GDP was 3.22%. In 2016, for the same indicators we recorded 2.45% and 4.5%, respectively. The TIAO fell by 2.8% while the GDP just increase by 1.28%. Even if the growth rate of the supply of bank loan is not regular, it can be noted that the volume of loans offered decreased in 2004, 2005 and 2009.

Table 1 - Evolution of the growth rates of TIAO, GDP and bank credit in Cameroon

Years	TIAO(%)	Gross credit**(%)**	GDP(%)
2006	5,25	31,72	3,22
2007	5,25	5,12	3,26
2008	5,25	25,03	2,88
2009	4,25	-1,15	1,93
2010	4,00	20,49	3,27
2013	3,25	16,02	5,56
2016	2,45	15,15	4,50

Source: authors using Credit National Council of Cameroon data (COBAC, 2016).

Given that decreasing of the key central bank interest rate, it is advisable to check whether the evolution of bank credit risk responds. Credit risk is measured by the ratio of overdue debts on gross credit (COBAC, 2017; Brei et al. 2018). We can see through the figure 1 that the part of overdue debts in gross credits in Cameroon increased between 2008-2012; then, decrease between 2012-2016. While in table 1 above, interest rate falls within both periods.

The Economic Research Guardian – Vol. 10(2)2020
Semi-annual Online Journal, www.ecrg.ro
ISSN: 2247-8531, ISSN-L: 2247-8531
Econ Res Guard 10(2): 83-96

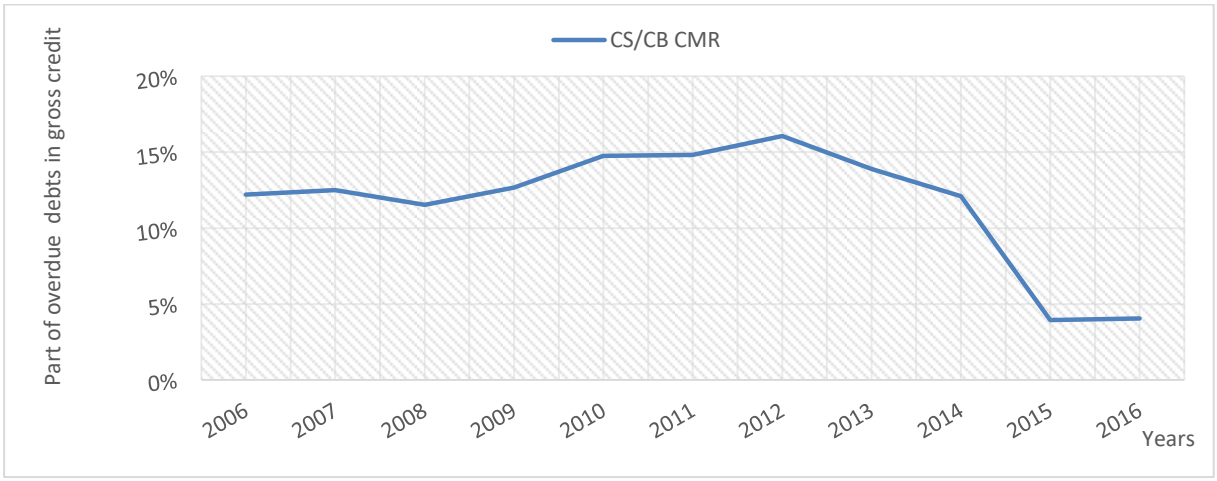

Figure 1 - Evolution of the share of overdue debts in gross credit in Cameroon

Note: CS/CB CMR= credit risk in Cameroon.
Source: authors using Credit National Council of Cameroon data (COBAC, 2016)

This study is relevant for at least two reasons. Firstly, to the best of our knowledge, this research work seems to be the first empirical study that attempts to examine the effect of monetary policy on commercial banks risk-taking in CEMAC zone through the case of Cameroon. Secondly, this study provides an additional literature on monetary policy transmission mechanism in Cameroon. Thus, the objective of this article is to identify the existence of risk-taking channel of monetary policy in Cameroon. According to the COBAC (2016) report, Cameroon has the most important and riskier banking system in CEMAC zone in term of total asset and overdue debt rate. That's why we particularly focus our attention on Cameroon.

The remainder of this paper is organised as follows. Existing literature review is presented in section two; Econometric strategy and data are developed in section three; Thereafter, finding will be exposed in section four. This paper will end by the mains conclusions presenting in section five.

2. Risk-taking channel: theoretical and empirical review

This section focuses on theoretical and empirical work related to risk-taking channel. The theoretical view of risk-taking channel of monetary policy is widely developed by Borio and Zhu (2012). According to them, risk-taking channel indicates the effect of the change in the monetary policy interest rate on banks' tolerance for risk. They show at least two ways by which this channel operates. The first way is through the impact of interest rate on the value of securities, income and cash flows. This is explained by the fact that a low interest rate increases assets value, income and guarantees. This leads to a reduction of risk perception and an increase in risk tolerance by commercial banks. The second way is the interaction between the market interest rate and the target rate of return. It's known that a reduction in the key interest rate of Central Bank increases the rate of return (Rajan, 2005). Therefore, commercial Banks will be temted to increase their tolerance to risk seeking maximum profit. In such a situation, for risk-taking channel to be operational, the spread between the market rate and the target rate of return must be small (Borio and Zhu, 2012). This theoretical evidence can be verify in some empirical works.

The link between the Central Bank interest rate and the level of risk incurred by commercial banks is addressed in the empirical literature. Using a micro data of Spain banks, Jimenez et al. (2014) find evidence of a risk-taking channel. Similar evidence has been found in Bolivia by Ionnadou et al. (2008). These results are in accordance with that of Dell'Ariccia and Marquez (2006) who shows that when there is information asymmetry, low interest rates can push banks to relax lending standards and increase their risk-taking. From a sample of 600 European banks, Altunbas et al. (2010) build the expected default frequencies to measure bank risk. The authors used a panel data regression model in which the expected default frequency is a dependent variable. The results suggest that a decrease of short term interest rates reduces overdue debts in short run but increases it in long run. Moreover, the paper of Angeloni et al. (2015) reveals that, monetary policy influences the average propensity of commercial banks to take risk. Specifically, commercial banks tend to increase the supply of risky credit as a result of expansionary monetary policy.

Using data on loan from Federal Reserve's Survey within the period 1997-2011, Dell'Ariccia et al. (2013) build an ex-ante measure of bank risk-taking. Their sample size is 400 US banks. They find that a low short run interest rate increases bank risk-taking. But, the result depends on bank capital level. The effect of interest rates on risk-taking is less pronounced for poorly capitalized banks. Following the same reasoning and measuring the credit risk by the gross rate of banks' portfolio deterioration, Trinnou and Igue (2015) show in their study in Monetary Union of West African States (UEMOA) that a drop in the main monetary policy interest rate leads to both an increase in credit supply and risky credit. However, from a threshold of 18.82% exposure to credit risk, banks become insensitive to monetary policy shocks. This reduces the effectiveness of monetary policy.

Sarkar and Sensarma (2019) examine the existence of risk-taking channel of monetary policy in India. Using annual panel data for 86 commercial bank of different ownership as public and private sectors banks, they find that risk-taking channel exist in India. According to them, an expansionary monetary policy can increase default risk for foreign banks and new private sector banks. They also show that a restrictive monetary policy can reduce bank's exposure to risk, especially liquidity and market risks. Even if Sarkar and Sensarma (2019) take into consideration bank ownership in their study, they neglected the fact that, the outcome may depend on the macroeconomic environment. While Trinnou and Igue (2015), Brei and al. (2018) argue that commercials banks appetite for risk increases with growth rate. Taking into consideration this literature, GDP is included in our model to account for macroeconomic conditions.

Several studies in United States of America (USA) revealed an inverse relationship between the Central Bank key interest rate and risk-taking by commercial banks (Sarkar and Sensarma, 2019). According to Delis et al. (2012), a long run decline of interest rate lead to higher bank risk. Moreover, the paper of Angeloni et al. (2015) reveals that, monetary policy influences the average propensity of commercial banks to take risk. Specifically, commercial banks tend to increase the supply of risky credit as a result of expansionary monetary policy.

Another category of work shows that the interest rate has no effect on the degree of tolerance of commercial banks to risk. It's the case of Clark and Berko (1997), Dewachter et al. (2006). Central bank interest rate may have an impact on risk-taking by commercial banks in some countries while in others it has no effect. The effect may also vary over time (Altumbas et al. 2009). This controversy arising from empirical work leads us to verify the existence of the risk-taking channel in the CEMAC zone across Cameroon.

The Economic Research Guardian – Vol. 10(2)2020
Semi-annual Online Journal, www.ecrg.ro
ISSN: 2247-8531, ISSN-L: 2247-8531
Econ Res Guard 10(2): 83-96

3. Methodology

3.1. Econometric specification and estimation method

We are conducting an empirical investigation using Panel data. The model used in this work is inspired by the work of Dell'Ariccia et al. (2013). The function of credit risk is given by equation1.

$$CR_{it} = a_1 CR_{it-1} + a_2 TIAO_{it} + a_3 K_{it} + a_4 L_{it} + a_5 INF_{it} + a_6 TIAO_{it} * GDP_{it} + E_{it} \quad (1)$$

Where dependent variable is the bank credit risk (CR). CR_{it-1} represents the bank Credit Risk lagged by one period. This variable is introduced into the model to account for the endogeneity. The independent variables are the Central Bank's interest rate (TIAO), the bank capital (K), the credit supply (L) and inflation rate (INF). With "i" the individual effect, "t" the time effect and E_{it} the error term. The specificity of this work is that it takes into account the possible interaction between Central Bank's interest rate and growth rate of GDP (TIAO*GDP). This is justified by Dell'Ariccia et al. (2013) which stipulate that the reductions in interest rates increase bank risk-taking especially when GDP growth rate is high. Monetary policy variable is captured by interest rate on tenders (TIAO). His coefficient is expected to be negative with respect to the risk-taking channel developed by Borio and Zhu (2012). Description and expected signs of variables are presented in Table 2 below.

Table 2 - Description of variables

Variables	Description	Expected signs	Justifications
CR	Ratio of overdue debts on gross credit		COBAC (2017); Brei et al. (2018)
CR_{it-1}	CR lagged by one period	-	Tobias et al. (2010)
TIAO	Central Bank's interest rate on tenders in percent	-	Borio and Zhu (2012)
K	Bank capital in XAF	+	Altunbas et al. (2010)
L	Credit supply in XAF	+	Popov (2016)
INF	Inflation rate in percent	+	Stigliz and Weiss (1981)
TIAO*GDP	Interaction between the Central Bank's interest rate and the growth rate of GDP	-	Dell'Ariccia et al. (2013)

Source: authors, starting from a review of the literature.

The equation 1 coefficients are estimated using the cointegration approach of the Fully Modified Ordinary Least Square (FMOLS) and the Dynamic Ordinary Least Square (DOLS). FMOLS automatically correct heteroskedasticity, autocorrelation and endogeneity problems. Moreover, it gives unbiased estimators when the individual size is less than the time period (Roodman, 2009). Kao and Chiang (2000) show that DOLS method is more efficient that FMOLS.

The Economic Research Guardian – Vol. 10(2)2020
Semi-annual Online Journal, www.ecrg.ro
ISSN: 2247-8531, ISSN-L: 2247-8531
Econ Res Guard 10(2): 83-96

3.2. Data

This research uses two categories of data: macro and micro data. The macroeconomic data are GDP growth rate, inflation and TIAO. Concerning microeconomics data, we have bank capital, credit supply and credit risk. Using Micro data in this research enable us to take into account the heterogeneity of bank behavior. We solve the problem of scale by dividing micro data by total asset of banks' balance sheets. Our study period is 2006-2016 with 6 individuals (Banks).This work use secondary data gotten from the Credit National Council of Cameroon (COBAC, 2016). The study period and number of Bank choice depends on the availability of data. Descriptive statistics are given in Table 3 below.

Table 3 - Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
CR	66	0.132	0.0142	0.115	0.161
TIAO	66	3.918	1.014	2.450	5.250
K	66	9.250e+09	3.350e+09	3.000e+09	1.580e+10
L	66	1.890e+11	1.420e+11	3.060e+10	4.490e+11
INF	66	2.618	1.374	0.921	5.338
TIAOGDP	66	16.37	4.167	9.344	25.74

Source: authors using Stata.

4. Results

4.1. Baseline results

We have to take into account cross-sectional dependence when implementing the estimations due to common shocks that affect commercial banks (Carrera et al. 2020). This test will allow us to choose either first generation or second-generation panel unit root test. According to Hoechle (2007), the first generation panel unit root test can lead to biased result in the presence of cross-sectional dependence. In order to avoid making such a mistake, we implement on each variable included in equation 1 the test of weak cross-sectional dependence (WCsD) developed by Pesaran (2015). The results of the test are recorded in table 4.

Table 4 - Test of cross-sectional dependence

Variables	Test name	Test stat	P-value	Corr	abs(corr)
CR	WCsD	12.85	0.000***	1.000	1.000
TIAO	WCsD	12.85	0.000***	1.000	1.000
K	WCsD	10.36	0.000***	0.806	0.806
L	WCsD	10.20	0.000***	0.794	0.794
INF	WCsD	12.85	0.000***	1.000	1.000
TIAO*GDP	WCsD	12.85	0.000***	1.000	1.000
Ê	Breusch-Pagan LM test	11.30	0.0457**		
$\hat{e}^2$	Cs Correlation test	10.674	0.0223**		

Notes: *** p<0.01, ** p<0.05.
Source: authors using Stata.

The Economic Research Guardian – Vol. 10(2)2020
Semi-annual Online Journal, www.ecrg.ro
ISSN: 2247-8531, ISSN-L: 2247-8531
Econ Res Guard 10(2): 83-96

The results presented in Table 4 confirm the strong inter-bank dependence in the sample. Furthermore, our model suffers from heteroskedasticity and cross-sectional correlation of residuals. The Covariate Augmented Dickey-Fuller (CADF) test was used to test the unit root null hypothesis in a heterogeneous panel, in presence of cross-sectional dependence (Pesaran, 2007). CADF is a Second generation unit root test developed by Pesaran (2007). The results are presented in the table 5.

Table 5 - Pesaran's unit root test

Variables	In level		In difference	
	Z[t-bar]	P-value	Z[t-bar]	P-value
CR	-1.6480	0.2282	-3.5079	0.0004***
TIAO	-0.3367	0.9992	-3.3263	0.0007***
K	-0.6226	0.9861	-3.2343	0.0014***
L	-0.7028	0.9748	-3.1415	0.0016***
INF	-5.4380	0.000***		
TIAO*GDP	-1.5818	0.2776	-2.2632	0.0277**

Notes: *** p<0.01, ** p<0.05.
Source: authors using Stata.

It can be seen in table 5 above that amongst the variable chooses, only *INF* is stationary in level; the variables *CR*, *TIAO*, *K*, *L* and *TIAO*GDP* are stationary in difference. To account for this properties, we adopt a cointegration approach on the variables stationary in difference. The results are showing in the following subsection.

4.2. Economic interpretation of results

We perform the Westerlund (2007) second generation panel cointegration test without constant and trend. We also consider that the robust P-values are obtained after bootstrapping using 400 replicates. The results of cointegration test are presented in table 6.

Table 6 - Results of the Westerlund panel cointegration test

Statistic	Value	Z-value	P-value	Robust P-value
Gt	-0.615	3.248	0.999	0.555
Ga	-0.571	3.206	0.999	0.283
Pt	-1.111	2.249	0.988	0.672
Pa	-0.415	1.909	0.972	0.423

Notes: we use *xtwest* to test cointegration. Bootstrapping critical values under H0.
Source: authors using Stata.

The alternative hypothesis of the existence of cointegration is accepted (P>0.05) for the hole sample (Persyn and Westerlund, 2008; Yaobin, 2013). Owing to the existence of cointegration, the presence of heteroskedasticity and cross-sectional autocorrelation, we use FMOLS and DOLS as estimations methods. The table 7 summarizes the different results of the estimations obtain from FMOLS and DOLS estimators.

This table shows a R-squared of 0.8719 and 0.9227, respectively. This means that the variables selected significantly explain the bank risk taking in this panel.

The Economic Research Guardian – Vol. 10(2)2020
Semi-annual Online Journal, www.ecrg.ro
ISSN: 2247-8531, ISSN-L: 2247-8531
Econ Res Guard 10(2): 83-96

Table 7 - Summary of the results of risk-taking channel in Cameroon

	FMOLS	DOLS
CR_{it-1}	-0.146220	-0.208343
	(0.107193)	(0.141498)
TIAO	-0.017346	-0.030325
	(0.033158)	(0.043770)
K	-0.297866***	-0.244972*
	(0.105870)	(0.139752)
L	0.012421***	0.013037***
	(0.003316)	(0.004378)
INF	0.023871**	0.031718**
	(0.009780)	(0.012910)
TIAO*GDP	1.311918***	1.257285***
	(0.172661)	(0.227918)
Observations	60	60
Number of banks	6	6
R-squared	0.871956	0.922708
Adjusted R-squared	0.811490	0.873327

Note: standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: authors using Eviews.

It can be notice from the table 7 that the estimated coefficients have the same signs, and the difference between them from one method to another is not significant. Bank credit risk lagged by one period (CR_{it-1}) has a deleterious effect on bank risk-taking in Cameroon. But its impact is not significant. Despites non-significant, this predictable result is in line with Tobias et al. (2010) which states that a bank's overdue debt at period t-1 is considered as a sign of deterioration of its portfolio. Therefore, banks will tighten the conditions for granting loans, this will lead to a reduction in overdue debts and credit risk in period t.

The key interest rate of the central bank (*TIAO*) negatively affects bank credit risk in Cameroon. This result corroborates Jimenez et al. (2014) and the risk-taking theory of Borio and Zhu (2012). This result can be explained by the fact that, a lasting drop in the bank interest rate leads to a reduction in the refinancing cost of commercial banks. This signal is perceived by commercial banks as an increase in their financing capacity. Then they will soften credit conditions in order to generate greater demand for credit from investors and consumers in order to maximize their profit. Credit supply will increase. However, if we admit that as soon as a bank has agreed to grant loans it has indirectly agreed to expose itself to credit risk, then the level of risk will increase. As the bank interest rate coefficient is not significant, we will say that the risk-taking channel does not exist in Cameroon. This result is consistent with Clark and Berko (1997), Dewachter et al. (2006) which also found that the bank interest rate has no effect on the commercial bank credit risk.

Regarding bank capital (*K),* an increase in bank capital leads to a decrease in bank credit risk. This significant result is in conformity with Altunbas et al. (2010). This is explained by the fact that an increase in bank capital in order to strengthen the risk coverage rate comes at the detriment of the credit supply. Consequently, the credit supply will decrease in favor of the constitution of capital and the credit risk with.

Credit supply (*L*) positively and significantly affects bank credit risk in Cameroon. This result is in line with Popov (2016). In fact, lax monetary conditions increase bank credit in general and bank credit to ex-ante risky firms in particular, especially for banks with lower capital ratio.

Inflation (*INF*) significantly enhance bank credit risk in Cameroon. This result is consistent with Stigliz and Weiss (1981). According to him, the practice of high interest rates is more attractive to entrepreneurs who have the riskiest projects, because they are more willing to pay the higher interest rates than others. So, by increasing the loan interest rate, the bank will choose the riskiest projects. This increases the bank's credit risk. However, if a negative shock occurs in the economy, banks will accumulate bad (or toxic) debts that can generate a systemic crisis like the international financial crisis of 2008.

The multiplicative variable between the Central Bank's interest rate and the growth rate of GDP (*TLAO*PIB*) positively and significantly affect bank credit risk. This means that a reduction of interest rates increase bank risk taking especially when GDP growth rate is weak. This outcome is in contradiction with Minsky (1977), Dell'Ariccia et al. (2013). Indeed, when economy is in recession, the investors can increase their credit demand in order to sustain investment. Commercial banks will respond by increasing their supply of new loans seeking more profit while Central Banks' interest rate is low. In a rapidly expanding economy, we are witnessing a boom in financial investments through excessive borrowing because banks are in a euphoric situation. Several authors such as Ramskogler (2015), Farboodi (2017), Brei et al. (2018), Roy and Kemme (2019), Sarkar and Sensarma (2019), draw the attention of commercial banks on the excessive lending when the GDP growth rate is higher and the bank interest rate is lower. The nature of the above results, especially the non-significance of most variables of interest, requires robustness test using alternative methods.

4.3. Robustness checks

We test the robustness of the results presented above through alternative methods using Driscoll-Kraay standard errors estimator and the Generalized Method of Moments (GMM). Concerning Driscoll and Kraay's estimator, it gives the ability to control all time-invariant differences between the individuals in the study, thereby eliminating large potential sources of bias. The error structure is assumed to be heteroscedastic, autocorrelated up to some lag; and standard errors are well calibrated when cross-sectional dependence is present (Hoechle, 2007). This method can be applied on both balanced and unbalanced panels and it is capable to handle missing values. Nevertheless, one should be cautious in applying this estimator to panels which contain a large cross-section but only a very short time dimension (Driscoll and Kraay, 1998). This is why we perform the fixed effects and the random effects Driscoll and Kraay's regressions, and the Hausman test to choose which is more robust. The results are presented in table 8.

The results in table 8 show that the signs obtained and the levels of significance are the same for both regressions. Howerver the Hausman test recommends the use of the random effect model (Prob>chi2 is greater than 5%). The results obtained are globally robust, with overall R-squared of 0.7227 and p-values associated with the Wald statistic less than 1%. The bank Credit Risk lagged by one period (CR_{it-1}) and the Central Bank's key interest rate (*TLAO*) significantly enhances bank risk-taking; while inflation (*INF*) and the multiplicative variable between the

Central Bank's interest rate and the growth rate of GDP (*TIAO*PIB*) has a significantly harmful effect on bank risk-taking.

Table 8 - Effect of TIAO on bank credit risk using Driscoll and Kraay's estimator

Regressions with Driscoll-Kraay standard errors		
Variables	Fixed-effects regression	Random-effects GLS regression
L.CR	0.891***	0.904***
	(0.190)	(0.197)
TIAO	1.413***	1.374***
	(0.398)	(0.372)
K	1.085	0.660
	(0.666)	(0.482)
L	-0.415	-0.123
	(0.227)	(0.119)
INF	-0.775***	-0.771***
	(0.100)	(0.0940)
TIAO*GDP	-0.250***	-0.249***
	(0.0453)	(0.0458)
Constant	-12.26	-10.06
	(12.22)	(8.608)
Observations	60	60
Number of banks	6	6
F-statistic	49.01	
Prob> F	0.0000	
Wald chi2(6)		271.6
Prob> chi2		0.0000
within R-squared	0.734	
overall R-squared		0.727
Hausman test	chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 1.09	
	Prob>chi2 = 0.9822	

Note: standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

This result can hide important disparities due to the fall of TIAO after the financial crisis. It is important to take into consideration this event using the Generalized Method of Moments (GMM).This method has the advantage of correcting the problem of endogeneity that may arise in the estimates due to the fact that the lagged bank Credit Risk is taken into account as an independent variable (Hansen, 1999). The validity of the results obtained is based on two main tests: the absence of 2nd order autocorrelation and the validity of the Sargan (1958) over identification test. To apply the Generalized Method of Moments (GMM) in system (GMMs), the number of individuals must be greater than the length of the study period. This results in convergent and efficient coefficients (Roodman, 2009). We test the sensitivity of the result with respect to the choices of period of study by carrying out two regressions before and after 2012 in order to take into account the effects of the 2008-2009 global financial crisis (data shows that the effects of the financial crisis will be felt after 2011). This is presented in table 9.

Table 9 shows that the bank Credit Risk lagged by one period (CR_{it-1}) significantly enhances bank risk-taking. This result is in line with the theory of convergence (Barro, 1990). It means that the level of bank risk-taking tends to be closer together over time. Furthermore, the negative effect of the Central Bank's key interest rate (*TIAO*) on bank credit risk will be felt only after the

financial crisis due to the structural disruption caused by the lowering of the BEAC's key interest rate starting in 2012. This result allows the identification of the bank risk-taking channel in Cameroon after the crisis. Moreover, the negative and significant effect of inflation (*INF*) on bank credit risk prior to the crisis can be observed due to the high inflation rate, which has a direct negative effect on the profitability of investments, ceteris paribus, hence the contraction of future investments leading to a decrease in the credit risk of commercials banks

Table 9 - Effect of TIAO on bank credit risk using GMM, before and after the financial crisis

Variables	Before Financial Crisis	After Financial Crisis
CR_{it-1}	1.676***	0.0956***
	(0.179)	(6.10e-11)
TIAO	2.555***	-0.344***
	(0.492)	(1.01e-09)
K	-1.398	-1.72e-11 *
	(1.183)	(9.49e-12)
L	4.430**	3.17e-11*
	(2.084)	(1.63e-11)
INF	-0.973***	8.481***
	(0.0775)	(2.03e-09)
TIAO*GDP	-0.316***	3.20e-10**
	(0.0203)	(1.31e-10)
Observations	30	30
Nber of banks	6	6
Prob> chi2	0.000	0.000
P-value Sargan test	0.121	0.0895
Nber of instruments	28	22

Note: standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

One of the remarking variables in these two regressions is the multiplicative variable between the Central Bank's interest rate and the growth rate of GDP (*TIAO*PIB*) which is negative before the 2008 financial crisis and positive after this crisis. TIAO*PIB's negative sign observed before the crisis means that the relatively high level of the key interest rate until 2012 reduces the ability of commercial banks to refinance themselves with the central bank, in a context of weak economic growth. This situation leads commercials banks to tighten lending conditions, leading to the excess liquidity observed during this period (Fouda, 2009). The decline in demand for credit, due to tighter supply conditions, occurs in a context of inflationary pressures leading to a decline in bank credit risk. The rest of the variables despite being non-significant conserve their signs in all the regressions.

5. Conclusion and Policy implications

The purpose of this study was to identify the risk-taking channel of monetary policy in Cameroon. Using cointegrated panel estimation techniques (FMOLS and DOLS), we estimated a linear regression model. The study focuses on data from a sample of 6 banks over the period 2006-2016. This analysis shows that the BEAC's key interest rate negatively affects the level of overdue debts granted by commercial banks in Cameroon. However, its impact is not significant if we consider the hole period. But robustness analyses reveal the existence of risk-taking channel

of monetary policy in Cameroon after financial crisis with negative and significant effect of TIAO on bank credit risk. In addition, credit supply and inflation significantly enhance credit risk; while bank capital significantly harms credit risk in Cameroon. It also appears, through the interaction between the Central Bank's interest rate and the growth rate of GDP that a reduction of interest rates increases bank risk-taking especially when GDP growth rate is feeble. Based on these results, we recommend that the monetary authorities avoid practicing low key interest rates over a long period. Because, if the business climate and credit conditions improve in Cameroon, we could see an explosion of bad debt that are likely to increase credit risk and lead to unsustainable situations.

References

Abbate A, Thaler D (2019). Monetary Policy and the Asset Risk-Taking Channel. *Journal of Money, Credit and Banking*. Doi: 10.1111/jmcb.12621.

Altumbas Y, Gambacorta L, Marqués-Ibanez D (2010). Does monetary policy affect bank risk-taking? *European Central Bank Working Paper* 1166. 41p.

Angeloni I, Faia E, Duca L M. (2015). Monetary Policy and Risk Taking. *Journal of Economic Dynamics and Control*. 52 (C): 287-305.

Barro R. J (1990). Government Spending in a Simple Model of Endogenous Growth. *The Journal of Political Economy*. 5 (98): 103-125.

Borio C, Zhu H (2012). Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism? *Journal of Financial Stability*. 8 (4): 236-251.

Brei M, Jacolin L, Noah A (2018). Credit risk and bank competition in Sub-Saharan Africa. *Working Paper 664*. Banque de France.

Carrera J, Gnimassoun B, Mignon V, Restout R (2020). Currency Misalignelents and exchange rate regimes in Latin American countries: A trade-off issue. *CEPII Working Paper*.

Clark J, Berko E (1997). Foreign investment fluctuations and emerging market stock returns: The case of Mexico. *Federal Reserve Bank of New York Staff Report* 24.

COBAC (2014). Rapport annuel 2014. Commission Bancaire de l'Afrique Centrale.

COBAC (2016). Bulletin N°19 de la Commission Bancaire de l'Afrique Centrale.

COBAC (2017). Rapport annuel 2017. Commission Bancaire de l'Afrique Centrale.

Delis M., Hasan I., Mylonidis, N. (2012). The risk-taking channel of monetary policy in the USA: Evidence from micro-level data. *MPRA Paper* (34084*), University Library of Munich.*

Dell'Ariccia G, Laeven L, Suarez G (2013). Bank Leverage and Monetary Policy's Risk-Taking Channel: Evidence from the United States. *International Monetary Fund Working Paper*.

Dell'Ariccia G, Marquez (2006). Lending booms and lending standards. *Journal of Finance*. 61 : 2511-2546.

Dewachter H, Lyrio M, Maes K (2006). A joint model for the term structure of interest rates and the macroeconomy. *Journal of Applied Econometrics*. 21 (4): 439-62.

Driscoll J C, Kraay A C.(1998). Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data. *Review of Economics and Statistics*. 80: 549-560.

Farboodi M (2017). Intermediation and Voluntary Exposure to Counterparty Risk. *Paris school of economics*.

Fouda O J P (2009). La convergence des politiques économiques dans la zone Franc : où en est-on 15 ans après ? *L'Actualité économique*. 85 (3): 319-354.

Hansen B E (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics*. 56: 345-368.

Hoechle D (2007). Robust Standard Errors for Panel Regressions with Cross-Sectional Dependence. *The Stata Journal*. 7 (3): 281-312.

Hoechle D. (2007). Robust Standard Errors for Panel Regressions with Cross-Sectional Dependence. *The Stata Journal*.3(7): 281-312.

Ionnadou V P, Ongena S, Peydro J L (2008). Monetary policy, risk-taking and pricing: evidence from a quasi-natural experiment. Paper presented at the 9th Jacques Polak Annual Research Conference, IMF, Washington D C. 13-14.

Jimenez G, Ongena S, Peydro J L, Saurina J (2014). Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking? *Econometrica*. 82 (2): 463-505.

Linton G (2019). Innovativeness, risk-taking, and proactiveness in startups: a case study and conceptual development. *Journal of Global Entrepreneurship Research*. 9 (20): 1-21. Doi: 10.1186/s40497-019-0147-5.

Minsky H P (1977). Banking and fragile financial environment. *Journal of Portfolio Management*. 3 (4): 16-22.

Neuenkirch M, Nöckel M (2018). The risk-taking channel of monetary policy transmission in the Euro area. *Journal of Banking and Finance*. Doi :10.1016/j.jbankfin.2018.06.003.

Persyn D, Westerlund L (2008). Error-correction-based cointegration test for panel data. *The Stata journal*. 8 (2): 232-241.

Pesaran H M (2007). A panel Unit Root Test in the Presence of Cross-Sectional Dependence. *Journal of Applied Econometrics*. 22 (2): 265-312.

Pesaran H M (2015). Testing Weak Cross-Sectional Dependence in Large Panels. *Econometric Reviews*. 34 (6-10): 1089-1117.

Popov A (2016). Monetary policy, bank capital, and credit supply: A role for discouraged and informally rejected firms. *International Journal of Central Banking*. 12 (1): 95-141.

Rajan R G (2005). Has financial development made the world riskier? Paper presented at "*TheGreenspan Era: Lessons For the Future*" – A symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming. 25-27.

Ramskogler P (2015). Tracing the origins of the financial crisis. *OECD Journal: Financial Market Trends*. 2014/2: 47-61. Doi: 10.1787/fmt-2014-5js3dqmsl4br.

Roodman D (2009). How to do xtabond2: An Introduction to Difference and System GMM in Stata. *The Stata Journal*. 9 (1): 86-136

Roodman D (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*. 9(1): 86-136.

Roy S, Kemme D M (2019). The run-up to the global financial crisis: A longer historical view of financial liberalization, capital inflows, and asset bubbles. *International Review of Financial Analysis*. Doi: 10.1016/j.irfa.2019.101377.

Sargan J D (1958). The estimation of economic relationships using instrumental variables. *Econometrica*. 26 : 393-415.

Sarkar S, Sensarma R (2019). Risk-taking Channel of Monetary Policy: Evidence from Indian Banking. *The Journal of Applied Economic Research*. 13 (1): 1-20. Doi: 10.1177/0973801018800088.

Stigliz J, Weiss A (1981). Credit Rationing in Markets with Imperfect Information. *American Economic Review*. 71 (3): 393-410.

Tobias A, Moench E, Hyun S (2010). Macro risk premium and intermediary balance sheet quantities. *Staff Report 28*. Federal Reserve Bank of New York.

Trinnou G M, Igue B C (2015). Risque de crédit bancaire et politique monétaire dans l'Union Economique et Monétaire Ouest Africaine. *Revue Economique et Monétaire*.18 (14): 49-76

WDI (2018). World Development Indicators Data. www.worldbank.org/data.

Westerlund J (2007). Testing for Error Correction in Panel Data. *Oxford Bulletin of Economics and Statistics*. 69(6): 709-748.

Yaobin L (2013). Energy production and regional economic growth in china: a more comprehensive analysis using panel model. *Energies*. 6: 1409-1420. Doi: 10.3390/en6031409.