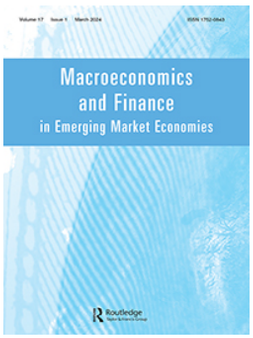

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Monetary policy, prudential regulations and bank lending behaviour in Africa

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ABSTRACT

The study examines the effect of monetary policy and prudential regulations on bank lending behaviour in Africa. This study employs the Two-Stage Least Square (2SLS) estimation technique for a panel dataset of 54 African countries over the period, 2004–2021. The study finds that monetary policy and prudential regulations reduce bank lending and the impact is better in countries with a strong institutional environment. It provides evidence to affirm that monetary policy and prudential regulations provide a complementarity effect in yielding a desirable outcome for bank lending.

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1. Introduction

In response to the Global Financial Crisis (GFC) and the recent pandemic, the central bank and financial regulators in most countries have employed different sets of regulatory policy framework to strengthen the stability and resilience of the banking system (Aiyar, Calomiris, and Wieladek 2015). For instance, policymakers continue to use monetary policy as a means of achieving price stability (Lubis, Alexiou, and Nellis 2019); macro-prudential regulations predominantly focus on financial stability (Cehajic and Kosak 2021), whereas micro-prudential regulation targets the safety and soundness of individual financial institutions (Lubis, Alexiou, and Nellis 2019). Alternative to the measures of prudential regulation (i.e. micro- and macro-prudential), that is intended to limit the risky behaviours of individual financial institutions (Aikman, Nelson, and Tanaka 2015), the anti-money laundering/combating the financing of terrorism (AML/CFT) regulations have been established to protect financial institutions from the risk of money laundering and the financing of terrorism (Chong and Lopez-De-Silanes 2015; Loayza, Villa, and Misas 2017). While there is widespread agreement that banks play a key part in the transmission of monetary policy and prudential policy actions to the entire financial and economic system, there is considerable controversy over the exact role that banks play. At the heart of this debate is the question of whether monetary and regulatory policy transmission mechanisms play a role in bank lending behaviour. We contribute to this debate in the

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literature by examining the dynamic effects of monetary and prudential policy actions on bank lending behaviour in a developing economy such as Africa.

The motivation for this study is threefold: First, in principle, the lending channel of monetary policy suggested by Coimbra and Rey (2017) shows that monetary policy influences agents' risk-taking behaviour, thereby increasing the credit supply during periods of easing (Albrizio et al. 2020). However, monetary policy actions do not always have the same effect on bank lending in the domestic and international contexts (see Argimon et al. 2019; Dell'Ariccia et al. 2017). Second, the bank lending mechanism by which prudential policies are transmitted to the real economy remains an interesting debate in the literature. For instance, the argument made in the model of Igan and Kang (2011) highlights that macro-prudential tools could, in principle, be used to moderate the risk-taking incentives arising from monetary policy decisions. They explained that the impact of a tightening of monetary policy on defaults can be contained by having in place stringent macro-prudential measures – hence leading to sound adjustments in bank balance sheets and leverage conditions, and, in turn, shapes bank lending behaviours. In addition, as emerging markets open up their economies and financial markets, they become increasingly appropriate targets for money laundering activities, which in turn, creates unpredictable changes in money demand and money supply, undermines the integrity of the financial system, channels resources to less efficient sectors and increases reputation risks (Beyer et al. 2017). This calls for sound micro-prudential policies that limit the probability of the misallocation of funds or money laundering that poses severe problems in emerging markets. Third, monetary policy and prudential policies (macro- and micro-policies) pursue different objectives and use different instruments to achieve them. However, changes in various instruments may be transmitted through similar channels to affect bank intermediation, and therefore, these policies (macro- and micro-policies), within an emerging market context, are likely to interact with monetary policy in a dampening or amplifying manner (Beyer et al. 2017).

Given the above theoretical background, the aim of this current study is to examine the impact of monetary policy and prudential regulations on bank lending behaviour in Africa. Studies examine whether bank lending is constrained by monetary policy in emerging markets (Altunbas, Binici, and Gambacorta 2018; Chibba 2008) and emerging economies of sub-Saharan Africa (Modugu and Dempere 2022); and others often discover that attempts to curb excessive credit booms through macro-prudential regulation are successful (Altunbas et al. 2018, Araujo, Guimaraes, and Rodrigues 2020; Cehajic and Kosak 2021). In addition, previous studies have shown the importance of regulatory policy in reducing systemic risk (Akinci and Olmstead-Rumsey 2018; Jimenez et al. 2017; Meuleman and Vander Vennet 2020). However, these studies focused on only one policy measure and how the respective measure impacts bank loans. Further, even though, extant literature focused on a single measure of regulatory framework, less attention had been given to how prudential regulations including macro-prudential and AML regulations affect bank lending behaviour.

Although alternative or different sets of regulations have often been used independently for almost a decade, there is a substantial gap in our knowledge of how they interact and complement to influence bank lending (see Auer et al. 2019; Cubillas and

Suarez 2018). Given that these regulatory policies have an impact on the availability of credit and the real economy as a whole (Claessens, Ghosh, and Mihet 2013), the lack of empirical research in developing economies is significant. It will also be relevant to policymakers and financial regulators in understanding whether these regulatory policy measures should complement or substitute each other in yielding a desirable outcome in the transmission channel.

The current study makes novel contributions to the literature by empirically examining the interactions between monetary policy and the prudential regulations (macro-prudential and AML) and testing the complementarity and marginal effects of the regulatory policies in determining bank lending behaviours in Africa. The lack of resources needed to expand the real sector of the economy in Africa, as well as the combination of weak system stability, monetary policy changes, and a misalignment between the fiscal and monetary policies, and prudential regulations, has created a huge gap in the African credit market. This study contributes to the literature on African financial regulation and financial intermediation in several ways. The study first looks at how individual monetary policy and prudential regulations (macro-prudential and AML) affect bank lending behaviour in Africa. Second, given the information on the regulatory transmission channels, we show that the impact of these regulations on bank lending differs across different institutional regimes. Third, we are able to analyse the interaction effects of these regulatory policies on bank lending behaviour and observe their complementarity effect on bank lending. Finally, we provide empirical evidence to show that monetary policy and prudential regulations jointly influence bank lending behaviour through conditional marginal effects.

The rest of the paper is structured as follows: Section 2 presents the overview of monetary policy, prudential regulations and bank lending across different set-ups. The available literature on the subject is discussed in Section 3. The data and methodology used for the investigation are described in Section 4. The empirical findings of the study are discussed in Section 5. Section 6 brings the analysis to a close with a few policy implications.

2. Monetary policy, prudential regulations and bank lending: an overview

The section shows (1) the average values of bank lending (bank credit to GDP), monetary policy rates, macro-prudential action index, AML regulations across developed countries in the 2004–2021 period, developing countries and African countries. It also shows the average values of the variables for countries with weak and strong central bank independence and institutions across Africa.

In Figure 1(a), we see that the average bank lending in Africa over the 2004–2021 period is lower than countries in developing and developed regions. This means that banks in Africa have relatively less capacity to lend compared to countries in other regions. In terms of regulations, we observe in Figure 1(b) that the average monetary policy rates for countries in Africa, over the period 2004–2021, are relatively higher compared to developing and developed countries. Similarly, the average prudential regulations (macro-prudential and AML) for countries in Africa are relatively higher compared to those in the developing and

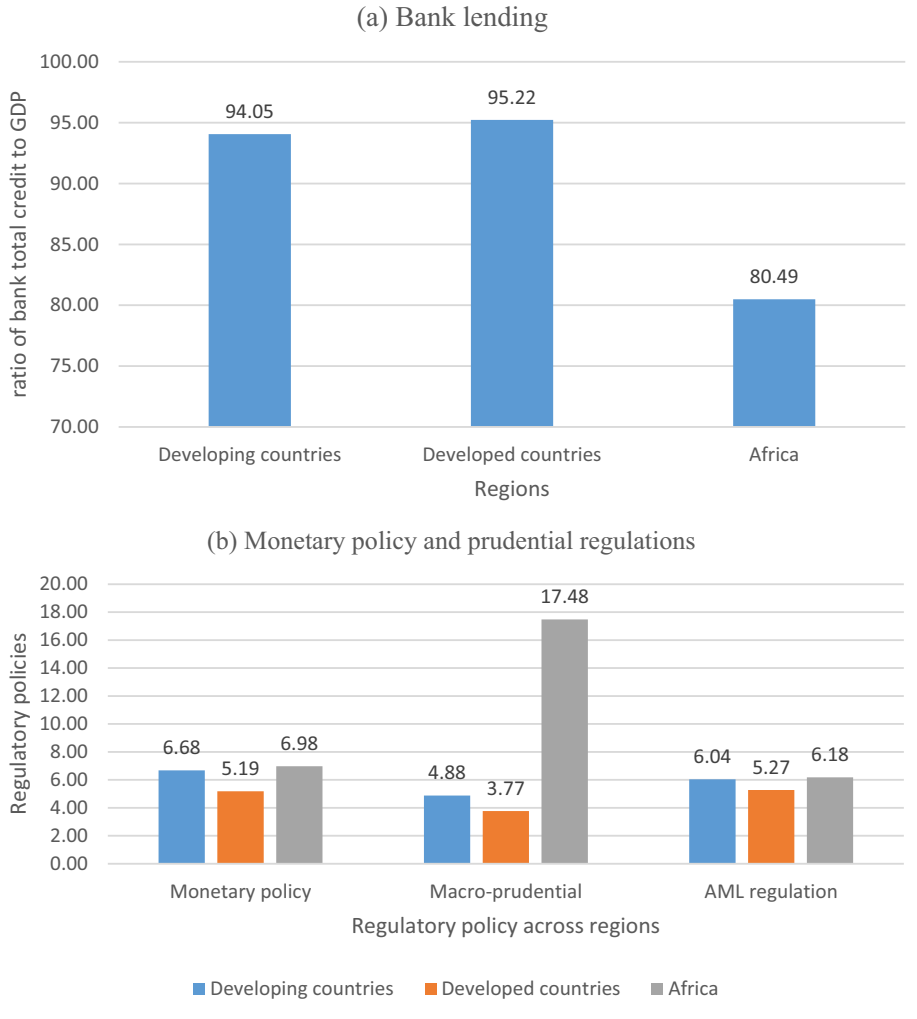

Figure 1. Monetary policy, prudential regulations and bank lending across different regions. Authors' construction and data analysis based on data from the World Bank, IMF, Alam et al. (2021) databases.

developed countries, over the same period. This suggests that countries in Africa relatively operate in a tight regulatory policy environment compared with countries in other regions. While bank lending is relatively low in Africa compared to regions, regulatory policies are high in Africa compared to other regions.

In Figure 2, banking lending in countries with weak CBI is higher than those with strong CBI, while bank lending in countries with strong institutional quality is greater than those with weak institutional quality. In terms of the measures of regulations, the average monetary policy rate (macro-prudential regulation) in countries with weak (strong) CBI is relatively greater (lower) than those in strong (weak) CBI. In addition, the average monetary policy rate and macro-prudential regulation in countries with weak institutional quality are relatively greater than those with strong institutional quality (see Figure 2(b)).

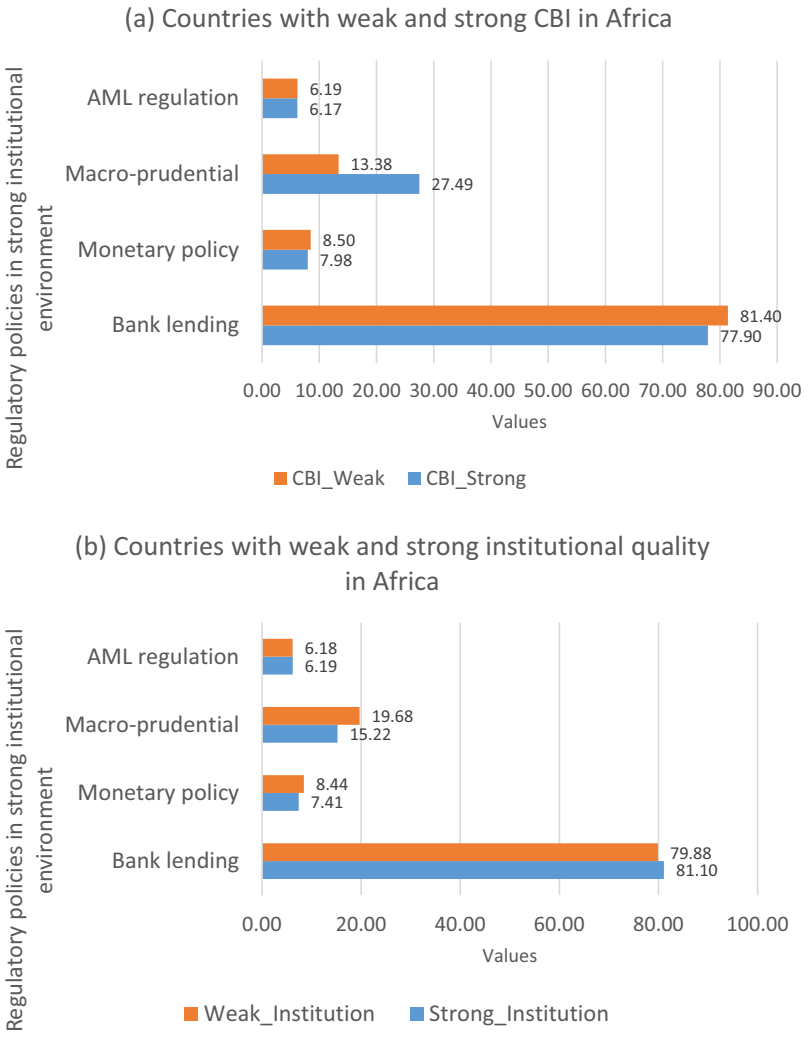

Figure 2. Monetary policy, prudential regulations and bank lending in countries with different institutional environment. **Source**: Authors' construction and data analysis based on data from the World Bank, IMF, Andriushin and Kuznetsova (2013) databases.

3. Literature Review

The importance of financial intermediation channels for regulatory policy has increasingly gained recognition after the global financial crisis (GFC). In both established and developing economies, monetary policy and prudential policy are frequently utilized, particularly in the wake of the global financial crisis (Andriushin and Kuznetsova 2013; Cagliarini 2016; Claessens 2015; Mishkin 2011). The current study builds on the literature on the effects of monetary policy and prudential policy on bank lending. Although there is no evidence of how monetary policy and prudential regulation combine to produce a desirable outcome for bank lending behaviour, interesting arguments concerning how bank lending behaviour is likely to respond to changes in central bank policy are

provided by certain theoretical techniques (Saadaoui 2014). The policy literature shows that very low interest rates can increase banks' willingness to accept credit and liquidity risk (Jiménez et al. 2012). For instance, a study by Adrain and Shin (2010) analyse the monetary policy risk channel and find that an expansionary monetary policy boosts bank lending when its value at risk is correlated with capital. Therefore, lower interest rates boost consumer credit demand, but higher interest rates typically boost banks' risk-taking (borrowing) incentives and can result in bank profits.

From the perspective of Olivero, Li, and Jeon (2011a), central banks are able to alter the volume of capital in their reserves available to banks through regulatory policy. For instance, stringent capital requirements put pressure on banks to maintain higher capital – forcing banks to increase lending rates by shifting the burden to their customers (mostly safe borrowers). This in turn reduces access to funds by clients while banks lower their lending volumes. Thus, banks reduce lending capacity in a stringent capital regulatory environment. Despite the many studies that have investigated the effect of measures of monetary regulations on bank lending (Abuka et al. 2019; Hodula and Ngo 2021; Modugu and Dempere 2022), less attention has been given to sets of monetary and prudential regulations, especially, monetary policy, macro-prudential regulation and Anti-money laundering (AML) regulations – and how each affects bank lending behaviour from the African context. Based on the above discussion, the current study formulates the following hypothesis:

H_1: Monetary policy, macro-prudential and AML regulations reduce bank lending behaviour

In the literature, macro-prudential policy has been used along with micro-prudential supervision to reduce the build-up of financial imbalances. For instance, recognizes that the pursuit of price stability through monetary policy, of financial stability through macro-prudential policy and of money laundering risk exposures through anti-money laundering regulations – are to a large extent complementary (European Central Bank 2021; Lubis, Alexiou, and Nellis 2019; Maddaloni and Peydró 2013; Martin, Mendicino, and der Ghote 2021; World Bank 2005). However, whether, these measures complements or substitutes each other in determining bank lending behaviour in Africa, is yet to be explored. There is evidence that the combination of capital and reserve requirements with monetary policy rates, as well as capital buffers are tools for reducing possible credit crunches (Maddaloni and Peydró 2013; Mishkin 2011). In order to reduce bank lending and improve banking system stability, regulations, rules or laws must work closely with other policies, such as market power (Aikman et al. 2019). However, the literature does not include much evidence for these interactions.

Empirical studies have demonstrated the impact of regulatory policies of the central bank on banks' core intermediation activities, particularly bank lending behaviour. In a study by Abuka et al. (2019), monetary policy is proven to be a weak source of bank lending in emerging countries. They provided new evidence that contractionary monetary policy reduces credit supply, leading to greater rejection of loan applications and the tightening of lending rates and volumes. Modugu and Dempere (2022) examine the nexus between monetary policy instruments and bank lending in sub-Saharan Africa using the generalized method of dynamic moments (GMM) for 80 banks over the period,

2010–2019. They found that expansionary monetary policy (i.e. easing interest rates and increasing the money supply) stimulates bank lending, while monetary contractions (i.e. raising monetary policy interest rates and decreasing the money supply) lead to credit contraction. They found that the magnitude of the impact of monetary policy on bank lending depends on the nature of monetary policy transmission channels. In a study by Cehajic and Kosak (2021), macro-prudential policies were found to affect bank lending in the European Union. They discovered that regulatory authorities efficiently modulate the credit operations of banks during business cycles by using macro-prudential instruments. They offer empirical evidence that macro-prudential policies are connected favourably with bank lending during loosening cycles. However, the impact is weak during periods of tightening actions, where the measures of macro-prudential policies are discovered to have a negative impact on bank lending. Hodula and Ngo (2021) applied an instrumental variable (IV) estimation framework to demonstrate that the tightening of macro-prudential policy increases the bank lending behaviour. Furthermore, the impact is strongest in a poorly capitalized banking system, leading to restructuring and redistribution of credit from banks to the non-banking sector. Ayyagari et al. (2017, 2019) combined data from 1.3 million companies operating in 59 countries from 2002 to 2011 that experienced some changes in macro-prudential regulation during that period. They found evidence that macro-prudential action is important for curbing credit growth. A previous study by Maddaloni and Peydró (2013) analysed the impact of short-term interest rates and macroprudential policies on lending before the 2008 crisis. They show how stricter prudential rules can reduce the impact of low interest rates on monetary policy. However, they demonstrate that low monetary policy rates help to ease tightening lending conditions brought on by bank capital constraints following the 2008 crisis. They came to the conclusion that monetary policy rates and long-term capital and liquidity provision by the central bank are complements in working to curb a possible credit crunch for companies. The discussions above show that the effect of different regulatory policies on the lending capacity of banks differs across countries with different institutional environments in the world. However, the differences in the impact of those regulations on bank lending behaviour across different institutional environments (i.e. central bank independence and institutional quality) in Africa has not been empirically tested. For that matter, the current study tests the hypothesis that:

H_2: The negative effects of monetary policy, macro-prudential and AML regulations on bank lending behaviour differ across different institutional environments.

Interestingly, Beyer et al. (2017) explained that macro-prudential, micro-prudential, and monetary policies all have distinct goals, and they employ various tools to achieve those goals. However, the three policies are likely to interact in a dampening or amplifying manner since changes in the various instruments may be communicated through similar channels, i.e. affect the same financial instruments or economic sectors. The question of how potential interactions may affect policy efficiency and effectiveness in achieving those goals and influencing the macro economy is yet to be tested empirically. From the theoretical and empirical reviews, it is evident that bank lending behaviour may be influenced by monetary policy and prudential regulations (macro-prudential and AML regulation). However, empirical studies to test whether the individual regulatory policies

complement each other in determining bank intermediation activities, are nonexistent in Africa. Studies have examined the independent effect of different sets of regulations on bank lending. For instance, Modugu and Dempere (2022), Abuka et al. (2019) and Borio and Gambacorta (2017) highlight a negative effect of monetary policy on bank lending behaviour in developing countries; Altunbas et al. (2018) show that macro-prudential policy reduces the supply of bank lending; and Chong and Lopez-De-Silanes (2015) and Loayza et al. (2017) found that AML regulatory framework limits bank lending. However, none has examined the joint effect of those policies on bank lending. In this study, we attempt to present first-time evidence on how monetary policy and prudential regulations independently affect bank lending behaviour and how they jointly affect bank lending behaviour. For that reason, the study formulates the following hypotheses:

H_3: The joint impact of monetary policy, macro-prudential and AML regulations are complementary in determining bank lending behaviour.

4. Data and methodology

The study uses a panel dataset of 54 African economies covering the period 2004–2021. The panel approach allows us to consider the country-specific differences in technologies, institutional structures and economic issues. The base model is expressed as:

$$\text{Bank lending behaviour} = f(\text{Monetary Policy},\ \text{Prudential Regulations},\ \text{Control variables}) \quad (1)$$

4.1. Model specification and measurements

4.1.1. Monetary policy, prudential regulations and bank lending behaviour

We examine how monetary policy and prudential instruments influence bank lending behaviours by following the works of Abuka et al. (2019), Hodula and Ngo (2021) and Modugu and Dempere (2022). We expand our baseline model (i.e. Equation 1) and we specify as follows:

$$Bank\ lending\ behaviour_{jt} = \sum_{l=1}^{4} \alpha_l Monetary\ policy_{jt} + \alpha_3 Prudential\ Regulation_{jt} + \sum_{k=1}^{N} \beta_k X_{jt} + \gamma_j + \mu_t + \varepsilon_{jt} \quad (2)$$

'where subscript j denotes cross-sectional dimension (country specifics), j = 1, …, M; t denotes the time-series dimension (time), $t = 1, \ldots, T$; α_l :,represent the regression coefficients of a vector of four macro-prudential regulation variables; β_k: $k = 1, \ldots, N$, are regression parameters for vector X (control variables) to be estimated; γ_j is the country fixed effect; and μ_t is the time fixed effect t; and ε_{ijt} is idiosyncratic error term, which controls for unit-specific residual in the model for the j^{th} *country* at *period* t'.

In, the dependent variable, bank lending behaviour, is measured using the ratio of total bank credit to gross domestic product (GDP) of a country. This indicates the average level of bank lending in the real economy (see Abuka et al. 2019; Borio and Gambacorta 2017;

Modugu and Dempere 2022). Data on bank credit to GDP was obtained from the World Bank Global Financial Development Database.

In, monetary policy and prudential regulation are the main variables of interest.

Monetary Policy is measured as monetary policy rates (see, Abuka et al. 2019). Monetary policy data was obtained from the IMF (International Financial Statistics) databases. The range of monetary policy rates is 0 to 1 (100%), with more high values representing tight monetary policy. Monetary policy rates are anticipated to have a detrimental effect on bank lending. This means that an increase in policy rates leads to a decrease in bank lending behaviour. This broadly confirms with the research by Abuka et al. (2019), which demonstrates how monetary contraction lowers the availability of bank lending.

In we use two proxies to measure **prudential regulation**, namely: (1) Macro-prudential regulation (2) Anti-money laundering regulations (see Agénor et al. 2018; de Haan, Jin, and Chen 2019; Grigaitė, Dias, and Magnus 2021; Osinski, Seal, and Hoogduin 2013) –.

Macro-prudential regulation is measured as an aggregate (composite) index of 17 variables is used to construct the data on macro-prudential policies, which captures the sum of all the dummies of the policy actions recorded in the databases and takes values ranging from −1 (relaxing the policy action), 0 (no policy change or action), to 1 (stricter policy action). Data were obtained from the iMaPP databases and the 'IMF's annual macro-prudential policy survey' (see Alam et al. 2021; Lim et al. 2011). We expect macro-prudential regulation to have a negative effect on bank lending. This implies that increasing the policy action results in less lending capacity of the banks induced by lower risk-taking. Thus, an increase in macro-prudential action or tightening of macro-prudential tools increases banks' capital requirement, limits bank risk-taking and tames their willingness to lend aggressively. This supports the findings of Cehajic and Kosak (2022) and Altunbas et al. (2018) that macro-prudential actions adversely impact shadow lending.

Anti-money laundering regulation is measured as an index, based on data obtained from the Basel Institute on Governance. Following the Basel Institute on Governance database, the Basel AML index consists of the quality of the AML/CFT framework (0.65), bribery and corruption (0.10), financial transparency and standards (0.15), public transparency and accountability (0.05) and legal and political risks (0.05). The index ranges from 0 to 10, which has been rescaled following Agoba et al. (2019). We expect a negative AML-lending nexus. This implies that banks that comply with the AML standards within a given country are able to reduce bank lending behaviour, as supported by Slutzky et al. (2020).

4.1.1.1. Robustness check. Consistent with differences in institutional environment (CBI structure and institutional structure) across economies, we test whether the results are sensitive when estimating the impact of monetary policy and prudential regulation on bank lending across those environments.

Given that institutional environments (i.e. central bank independence (CBI) and institutional quality) matter for banking intermediation (Buallay and Hamdan 2023) and that differences in these frameworks may yield different results in the regulation-bank lending nexus, we decompose CBI (a de jure measure of central bank independence which is a weighted aggregate of 16 legal indicators, based on the criteria and weights of the Cukierman, Webb, and Neyapti (CWN) index) and institutional quality (components range

from −2.5 to 2.5 (based on World Governance Indicators), with higher values indicating better institutional outcomes) into strong and weak CBI and institutions, respectively. This methodology is consistent with the work of Ofori-Sasu et al. (2023) who explained that the coordinated regulatory policies of the central bank differ in countries with different CBI regimes. Based on that, we split the dataset into countries operating in a stringent CBI framework and those operating in a less stringent CBI framework. Following the work of Ofori-Sasu et al. (2023), we classify countries (country observations) as having strong or weak CBI and institutional quality based on whether they are above or below the average of CBI and institution variables in a given year. Countries that are above or equal to the average are categorized as having strong CBI and institutions, and those strictly below average as having weak CBI and institutions for that year. A robust independent role for central banks enables them to keep an eye on managers' opportunistic conduct and control excessive risk-taking. Similarly, countries with strong institutions have the structure in place to control the functions of the financial system. Hence, it is expected that the impact of monetary policy and prudential regulations (macro-prudential and AML regulations) on bank lending should be better for countries with a strong CBI and institutional environment compared to countries with a weak CBI and institutional environment.

4.1.2. Interaction effect of monetary policy and prudential regulations on bank lending

We describe a model to describe how monetary policy and prudential (macro-prudential and AML) regulations interact to affect bank lending behaviour. This is specified as follows:

$$\begin{aligned} \textit{Bank lending behaviour}_{jt} = {} & \alpha_1 \textit{Monetary policy}_{jt} + \sum_{l=1}^{2} \lambda_l \textit{Prudential regulation}_{jt} \\ & + \sum_{q=1}^{p} \delta_q \left(\textit{Monetary policy}_{jt} * \textit{Prudential regulation}_{jt}\right) \\ & + \sum_{k=1}^{N} \beta_k X_{jt} + \sigma_j + \theta_t + \mu_{jt} \end{aligned} \tag{3}$$

'where $\delta_q : q = 1, \ldots, p$ denote the coefficients of the interaction terms between monetary policy and the prudential regulations (macro-prudential and AML); α_1 represents the coefficient of monetary policy rate; $\beta_k, k = 1, \ldots, N$ are the coefficients of the control variables (for vector X); $\lambda_l : l = 1, \ldots, 2, r$ represent the coefficients of the prudential regulation variables; ϕ_i is individual bank effect; σ_j is the individual country effects and θ_t is the time fixed effects and μ_{jt} is the composite error term'.

In, we capture possible unobserved heterogeneity in order to analyse the joint effect of monetary policy and prudential regulations on bank lending behaviour. In, we are interested in testing whether (1) monetary policy and prudential regulation variables complement each other or substitute each other to yield a desirable outcome of bank lending behaviour and (2) monetary policy and prudential regulation variables jointly magnify or reduce the determination of bank lending behaviour.

First, we interpret our findings in accordance with Compton, Giedeman, and Hoover (2011) by taking into account the signs corresponding to the coefficients of the interaction terms and the coefficients of each regulatory framework. For instance, a negative monetary policy coefficient and a positive interaction coefficient between monetary policy and macro-prudential regulation indicate that monetary policy and macro-

prudential regulation substitute each other in influencing the behaviour of bank lending. However, the same signs associated with the monetary policy coefficients and the coefficient of the interaction terms between monetary policy and macro-prudential regulation mean that monetary policy and macro-prudential policy are complementary in influencing the behaviour of bank lending. Similar interpretations hold for other results with the introduction of interaction terms between monetary policy and AML rules, as well as between macro-prudential rules and AML. Second, for a proper interpretation of marginal effects, we employ the methodology of Brambor, Clark, and Golder (2006) by calculating the marginal effects of monetary policy on the behaviour of bank lending when conditioned on prudential regulation. Regarding the marginal effect of monetary policy, we expect macro-prudential or AML regulation to either strengthen or weaken the relationship between monetary policy and bank lending behaviour. A similar interpretation also applies to macro-prudential regulation and AML regulation.

In the equations above, X is a vector of control variables obtained from the World Bank Global Financial Development Database, which includes 'credit risk (ratio of nonperforming to gross loan); bank funding (deposit-to-asset ratio); bank concentration (the ratio of the asset of the three largest commercial banks to total commercial banking assets in a country); banking crisis (measured with a dummy equal 1, if a country experienced banking crisis in a - particular year, and 0 otherwise); inflation (measured with the consumer price index); real GDP per capita' and the central bank independence (obtained central bank independence from 'Garriga's CWN legal CBI index' and the 'IMF's Central Bank Law' databases (see, Agoba et al. 2020) and institutional quality (measured as an aggregate of six indicators (rule of law, government effectiveness, corruption control, political stability, regulatory quality, and voice and accountability) – extracted from the Global Governance Indicators). We expect these variables to be good determinants of bank lending.

4.2. Estimation techniques

The fact that decisions to conduct policy actions are based on financial conditions and are linked to the prospects of the banking sector presents one possible issue in finding endogeneity between the policy variables and bank lending variable. We use the instrumental variables (IV) method to address potential endogeneity. We instrument for differences in the use of monetary policy and prudential measures across nations using the strength of the monetary and macro-prudential authorities as well as their lags and leads in accomplishing its goals. The assumption underlying the selection of instruments is supported by several research works (e.g. Bodenstein, Guerrieri, and LaBriola 2019; Paoli and Paustian 2017). Thus, we employ the 2SLS estimation technique. This has been applied by Akhter (2019), and it helps us to address the issue of endogeneity (between policies and bank lending) and cross-correlation between the error factors. Existing studies have employed the generalized method of moment (GMM) estimations (Abbas, Iftikhar, and Alam 2019; Albinali 2023; Imbierowicz, Löffler, and Vogel 2021) since both the 2SLS and the GMM methods solve the endogeneity problem; however, the difference lies in the incorporation of instruments. We employ the 2SLS because it is useful when there are feedback loops in the model, it is applicable when some of the spatially varying exogenous variables are relevant, and it is an alternative in structural equation modelling to estimate the path coefficient (Lee 2007). For robustness checks, we use the quantile regression estimators because they provide consistent parameter estimates and

flexibility over other regression methods to identify differing relationships in different parts of the distribution of the dependent variable (see, Benoit and Van den Poel 2009). The method has the ability to construct prediction intervals and is ideally suited for managing bank loan portfolios.

5. Empirical results

In this section, we provide and discuss the results of the empirical estimations. These comprise the statistical summaries, correlation matrix, and regression findings.

5.1. Descriptive statistics and correlation matrix

Table 1 shows summary statistics for the variables, while Table 2a and 2b show the correlation coefficient results for the explanatory variables. In general, the correlation matrix results do not imply that multicollinearity must be an issue in our data. – confirmed by a VIF threshold below 10.

Table 1. Descriptive statistics.

Variables	Obs	Mean	Std. Dev.	Min	Max
Bank lending	864	0.486	0.090	0.008	0.96
Monetary policy	867	8.346	3.786	2.277	26
Macro-prudential regulation	864	0.175	0.619	−1.000	1.000
Central bank independence	869	0.545	0.092	0.246	0.991
AML regulation	843	6.184	0.794	3.170	8.327
Credit risk	728	4.255	3.409	−0.2120	45.300
Bank concentration	771	70.910	18.691	17.164	100
Banking crisis	639	0.078	0.269	0.000	1.000
Inflation	844	7.496	13.721	−9.798	29.488
Real GDP per capital	835	8.971	1.297	6.661	11.944
Institutional quality	848	−0.561	0.361	−1.778	0.855
Control of corruption	849	−0.614	0.355	−1.620	0.760
Rule of law	849	−0.556	0.378	−1.660	1.080
Voice and accountability	849	−0.571	0.466	−1.980	0.940
Political stability	849	−0.522	0.564	−2.670	1.200
Government effectiveness	849	−0.599	0.387	−1.690	1.060
Regulatory quality	849	−0.502	0.372	−2.230	1.130

Shows the summary of descriptive statistics of the variables.

Monetary policy (central bank policy rates) obtained from the IMF (International Financial Statistics) databases; **Macro-prudential policy** action is the sum of dummies for 17 Macro-prudential indicators obtained from the Alam et al. 2021 databases; AML regulations is measured as an index and data was obtained from the Basel Institute on Governance. **Macro-prudential policy action**, is the sum of dummies for all 17 categories: countercyclical capital buffer, requirements for banks to maintain a capital conservation buffer, capital requirements, limit on leverage of banks, loan loss provision requirements, limits on foreign currency, limits to the loan-to-value ratios, debt service-to-income ratio, minimum requirements for liquidity coverage ratios, limits to the loan–deposit ratio, limits to net or gross open foreign exchange positions, reserve requirements, loan restrictions, risk measures, taxes and levies applied to specified transactions, and other macro-prudential measures not captured in the above categories; **Credit risk** is the ratio of nonperforming to gross loan; **Bank concentration** is the industry asset concentration of banks, measured as the ratio of asset of the three largest commercial natural logarithm of total bank assets; **Banking crisis** (measured with a dummy equal 1, if a country experienced banking crisis in a particular year, and 0 otherwise); **Inflation** (measured with the consumer price index); real GDP per capita measures the per capita GDP of a country. Data on control variables was obtained from the World Bank Global Financial Development database. **Central bank independence** is the weighted average of components of central bank independence(Central Bank's ability to control monetary instruments, usually a set of restrictions on the government's influence on the management of monetary policy by the central bank); **Institutional quality** is measured as an aggregate of six indicators (rule of law, government effectiveness, control of corruption, political stability, regulatory quality and voice and accountability) and was obtained from the World Governance Indicators.

Table 2a. Pairwise correlations.

Variables	Mean VIF = 2.903	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(2) Monetary policy	2.008	1.000								
(3) Macro-prudential regulation	1.559	0.015 (0.671)	1.000							
(4) AML Regulation	1.117	0.133 (0.004)	0.032 (0.479)	1.000						
(5) central bank independence	1.617	−0.144 (0.000)	0.152 (0.000)	0.047 (0.310)	1.000					
(6) Credit risk	1.950	0.118 (0.001)	0.115 (0.002)	−0.036 (0.463)	−0.054 (0.147)	1.000				
(8) bank concentration	1.236	0.081 (0.055)	0.094 (0.025)	−0.154 (0.003)	−0.066 (0.116)	0.072 (0.119)	1.000			
(9) banking crisis	1.152	−0.109 (0.006)	0.005 (0.891)	0.015 (0.791)	0.195 (0.000)	0.180 (0.000)	−0.083 (0.095)	1.000		
(10) inflation	1.092	0.002 (0.947)	−0.032 (0.364)	0.023 (0.621)	0.004 (0.918)	−0.040 (0.290)	−0.134 (0.001)	−0.041 (0.316)	1.000	
(11) Real GDP per capital	3.111	0.034 (0.327)	−0.134 (0.000)	−0.106 (0.020)	0.000 (0.997)	−0.130 (0.001)	−0.066 (0.117)	−0.054 (0.183)	0.011 (0.741)	1.000
(12) Institutional quality	1.170	−0.129 (0.000)	0.014 (0.694)	−0.059 (0.203)	0.028 (0.411)	0.241 (0.000)	0.021 (0.616)	0.060 (0.139)	−0.007 (0.832)	−0.158 (0.000)
(13) Control of corruption	7.316	0.012 (0.724)	0.023 (0.507)	−0.008 (0.856)	0.079 (0.022)	0.108 (0.004)	0.065 (0.124)	0.036 (0.366)	−0.008 (0.830)	−0.093 (0.008)
(14) Rule of law	7.248	−0.117 (0.001)	0.018 (0.597)	−0.063 (0.173)	0.057 (0.099)	0.163 (0.000)	0.019 (0.648)	0.066 (0.102)	−0.007 (0.853)	−0.114 (0.001)
(15) Voice and accountability	4.562	−0.120 (0.001)	−0.104 (0.003)	−0.037 (0.425)	−0.124 (0.000)	0.194 (0.000)	−0.040 (0.347)	0.050 (0.216)	0.002 (0.951)	−0.178 (0.000)
(16) Political stability	2.010	−0.166 (0.000)	−0.019 (0.581)	−0.058 (0.206)	0.056 (0.107)	0.305 (0.000)	0.036 (0.395)	0.055 (0.172)	−0.010 (0.768)	−0.146 (0.000)
(17) Government effectiveness	5.067	−0.140 (0.000)	0.123 (0.000)	−0.063 (0.175)	0.091 (0.008)	0.163 (0.000)	0.018 (0.672)	0.039 (0.335)	−0.012 (0.735)	−0.128 (0.000)
(18) Regulatory quality	4.230	−0.096 (0.005)	0.070 (0.042)	−0.060 (0.193)	0.010 (0.780)	0.226 (0.000)	0.016 (0.703)	0.049 (0.225)	−0.004 (0.906)	−0.138 (0.000)

Shows the pairwise correlation coefficient matrix of the variables. Refer to Table 1 for the definition and description of the variables.

Table 2b. Pairwise correlation cont'd.

Variables	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(12) Institutional quality	1.000						
(13) Control of corruption	0.895 (0.000)	1.000					
(14) Rule of law	0.940 (0.000)	0.852 (0.000)	1.000				
(15) Voice and accountability	0.806 (0.000)	0.627 (0.000)	0.703 (0.000)	1.000			
(16) Political stability	0.768 (0.000)	0.592 (0.000)	0.653 (0.000)	0.509 (0.000)	1.000		
(17) Government effectiveness	0.890 (0.000)	0.861 (0.000)	0.873 (0.000)	0.615 (0.000)	0.517 (0.000)	1.000	
(18) Regulatory quality	0.905 (0.000)	0.802 (0.000)	0.860 (0.000)	0.711 (0.000)	0.546 (0.000)	0.871 (0.000)	1.000

5.2. Regression results: monetary policy, prudential regulation actions and bank lending

In Table 3, we demonstrate that the monetary policy significantly and negatively affects bank lending (see Models 1 and 4; see Appendix I). The negative impact of monetary policy on bank lending behaviour has its roots in the monetary policy transmission

Table 3. Individual impact of regulations on bank lending: 2SLS regression.

Variables	Model 1	Model 2	Model 3	Model 4
Monetary policy	**−1.625*** **			**−6.638*** **
	(0.4935)			**(1.469)**
Macro-prudential regulation		**−15.510*** **		**−15.430*** **
		(5.36)		**(3.723)**
AML regulation			**−24.140*** **	**−5.632*** **
			(6.401)	**(1.623)**
Credit risk	1.877	0.255	−0.218	5.815***
	(1.874)	(1.211)	(0.884)	(1.589)
Bank concentration	0.0682	0.254**	0.0400	0.0856***
	(0.0577)	(0.107)	(0.0276)	(0.0251)
Banking crisis	8.923	16.490	−1.824	0.175
	(14.50)	(13.05)	(6.210)	(4.727)
Inflation	−5.38e-05	0.0004	−8.56e-05	−0.00011
	(0.00039)	(0.0004)	(0.00017)	(0.00013)
Real GDP per capital	−0.470	−5.465	1.759	−3.535**
	(3.067)	(3.801)	(1.605)	(1.680)
Central bank independence	371.8*	−109.700*	−58.270	267.7***
	(222.0)	(58.040)	(54.83)	(87.24)
Institutional quality	−28.78	−18.580	−3.427	−1.736
	(18.52)	(11.420)	(5.936)	(4.580)
Country Effect	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes
Constant	−349.4*	72.99*	180.0***	−144.7***
	(198.1)	(41.40)	(52.55)	(53.29)
Observations	277	280	280	280
Wald Chi^2	76.00***	59.54***	26.59***	46.55***
R-squared	0.5496	0.5510	0.5633	0.5538

Shows the individual impact of monetary policy, macro-prudential regulation and AML regulation on bank lending behaviour using the Two Stage Least Square (2SLS) regression. Variables are described and defined under Table 1. Standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

mechanism lens, as argued by Friedman (1968). He explained that an increase in the money supply leads to a fall in the benchmark interest rate, which leads to an increase in bank credit. Therefore, tight monetary policies, such as an increase in interest rates by central banks, constrain banks' liquidity and lending capacity, thereby, reducing credit expansion to borrowers, businesses and the private sector. This is consistent with the results of Modugu and Dempere (2022), Abuka et al. (2015, 2019) and Borio and Gambacorta (2017), who supported the claim that an increase in monetary policy rates reduces bank lending behaviour in developing countries.

In Table 3, we show that macro-prudential has a negative and significant impact on banks' lending behaviour (models 2 and 4; see Appendix I). The macro-prudential policies of the central bank encourage banks to maintain capital in their reserves and buffers, and therefore banks need to increase their capitalization in response to a possible rise in risk exposures. According to Altunbas et al. (2018) macro-prudential tools are used to moderate the risk-taking incentives arising from monetary policy decisions. For instance, the impact of tight monetary policy on defaults can be contained by putting in place sound macro-prudential regulations. We explain our results that the tightening of macro-prudential policy increases the capital stock in banks' reserves and consequently reduces banks' ability to lend. Our results suggest that tight macro-prudential policies by central banks moderate banks' aggressive lending behaviour. Thus, the use of macro-prudential measures can lead to higher capitalization and make the financial sector more resilient and reduce its exposure to risk. This is consistent with the results of Cehajic and Kosak

(2022), who show that the stringent macro-prudential policies can mean a restriction imposed on banks to lend more to firms, especially smaller firms with funding opportunities and significant reliance on bank loans, as well as firms with the possibility of credit default. However, our results contradict a recent study by Hodula and Ngo (2021), which provided robust estimates that tightening macro-prudential policies leads to an increase in parallel bank lending.

In Table 3, prudential action (anti-money laundering (AML) regulatory framework) affects bank lending behaviour negatively (see model 3; see Appendix I). This suggests that countries that enforce stricter AML measures reduce bank lending behaviour. It is proven that money laundering undermines the integrity of the financial system and channel resources to less efficient sectors (Chong and Lopez-De-Silanes 2015; Loayza, Villa, and Misas 2017). However, money laundering can increase banks' liquidity and allow firms to borrow and invest (Levi and Reuter 2006), an effective AML action imposes restrictions on bank lending. Following the AML regulatory framework, which require financial institutions to develop sophisticated customer due diligence plans to assess money laundering risks and detect suspicious transactions, an increase in these set rules, laws, procedures and regulations – can cause banks to hold more capital (including illicit funds) in their reserves – and consequently restrict their ability to lend to the public. Our findings confirm the work of Slutzky et al. (2020), who documents that effective AML policies could produce a sudden decrease in liquidity in the financial sector, reducing credit availability and thus inducing a negative impact on bank lending behaviour.

In terms of the controls, Table 3 shows that the control variables had their expected results. Interestingly, we observe that central bank independence is an important determinant of bank lending but the impact differs when a different regulation was introduced in the model (see model 1, 2 and 4). This supports the work by Anwar (2023), who found a diverse CBI-lending nexus and confirmed that the strength of CBI was highly effective in greatly reducing the credit gap among developing countries, but the impact differs in countries with low and high macro-prudential regimes

5.3. Robustness results: quantile regression

Table 4 shows a quantile regression estimation to analyse the levels at which monetary policy and the prudential regulations impact bank lending. In Table 4, the negative impact of monetary policy on bank lending reduced at the 10^{th}, 25^{th} and 50^{th} quantile levels of bank lending. This means that countries with higher lending capacity have a better monetary policy mechanism to reduce bank lending behaviour, but the impact dissipates as the lending capacity increases. We found that the negative nexus between macro-prudential regulation and bank lending behaviour is reduced from the 10^{th} to the 50^{th} quantile levels. This means that countries with higher lending capacity have better macro-prudential policy mechanisms in place to reduce bank lending behaviour, but the impact dissipates as the lending capacity increases. We observe that the negative impact of AML regulation on bank lending reduced from the 10^{th} to the 50^{th} percentile but tends to increase at the 75^{th} and 90^{th} quantile levels. These findings support the findings of Kang et al. (2021), who show consistent evidence of a detrimental and non-monotonic impact of macro-prudential policies on the amount of bank financing of businesses, depending on the distributive quantiles.

Table 4. Quantile regression: the impact of regulations on bank lending at quantile levels.

	(0.10 Quantile)	(0.25 Quantile)	(0.50 Quantile)	(0.75 Quantile)	(0.90 Quantile)
Variables	Model 5	Model 6	Model 7	Model 8	Model 9
Monetary policy	**−0.719*** **	**−0.488** **	**−0.443*** **	−0.360	−0.184
	(0.229)	**(0.197)**	**(0.159)**	(0.277)	(0.387)
Macro-prudential regulation	**−5.259*** **	**−3.302** **	**−3.024** **	2.041	3.066
	(1.231)	**(1.557)**	**(1.513)**	(1.637)	(1.946)
AML regulation	**−1.944*** **	**−1.783*** **	**−1.425** **	**−2.621*** **	**−2.755** **
	(0.609)	**(0.623)**	**(0.690)**	**(0.869)**	**(1.145)**
Central bank independence	−42.32*	−41.86**	−38.78**	−59.45	−98.43**
	(22.65)	(19.04)	(18.21)	(39.20)	(45.38)
Credit risk	0.0218	−0.0743	−0.000682	−0.390	−0.994
	(0.310)	(0.321)	(0.287)	(0.545)	(0.727)
Bank concentration	−0.0381*	0.00783	0.0174	−0.00737	0.0651***
	(0.0194)	(0.0203)	(0.0272)	(0.0361)	(0.0210)
Banking crisis	−5.767	1.051	0.108	−0.00332	−0.831
	(3.976)	(4.290)	(1.868)	(1.888)	(1.977)
Inflation	−0.000129***	−0.000163***	−0.000215***	−0.000223***	−0.000251***
	(2.93e-05)	(2.38e-05)	(2.76e-05)	(4.80e-05)	(5.26e-05)
Real GDP per capital	0.319	1.996**	2.961***	1.193	0.168
	(0.668)	(0.905)	(0.972)	(1.246)	(0.987)
institution	−5.696***	−6.898***	−5.223***	−5.467***	−3.035
	(2.119)	(1.772)	(1.410)	(2.031)	(4.098)
Country Effect	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes
Constant	34.53***	19.90*	10.35	49.31	89.31***
	(11.79)	(11.76)	(15.66)	(30.02)	(30.93)
Observations	196	196	196	196	196
Pseudo R^2	0.4195	0.4386	0.3978	0.3420	0.3859

Shows the independent impact of monetary policy, macro-prudential regulation and AML regulation on bank lending behaviour using the quantile regression as a robustness check. Variables are described and defined under Table 1. Standard errors in parentheses ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

In general, our results suggest that the dampening effects of monetary policy and prudential regulation (macro-prudential and AML policies) on bank lending decrease at higher quantiles of bank lending but the impacts for monetary policy and macro-prudential policies are insignificant at extreme quantile levels. However, at extremely higher quantile levels, AML regulation has a greater negative and non-monotonic influence on bank lending behaviour.

5.4. Impacts across different institutional environments

In Table 5, we are interested in the level of impact of the regulations on bank lending across different institutional environments. We show that the impact of monetary, macro-prudential and AML regulations on bank lending differs across different institutional environments (central bank independence and institutional quality). For example, in Table 5, the negative impact of monetary policy on banks' lending behaviour is lower in countries with weak central bank independence (model 10) compared to those in the strong CBI regime (model 11). The implication is that countries with strong independent central banks have the capacity to control financial regulations and restrict excessive risk-taking behaviour. Similarly, the negative impact of monetary policy on banks' lending behaviour is lower in countries with weak institutional quality (model 12) compared to those with strong institutional quality (model 13). A strong institutional quality includes

Table 5. Effect of monetary policy, prudential regulations and bank lending behaviour across different institutional environments.

	Countries with weak CBI	Countries with strong CBI	Countries with weak institutional quality	Countries with strong institutional quality
Variables	Model 10	Model 11	Model 12	Model 13
Monetary policy	**−0.748*** **	**−1.845*** **	**−0.464*** **	**−1.219*** **
	(0.150)	**(0.492)**	**(0.162)**	**(0.432)**
Macro-prudential regulation	−1.228	**−5.744*** **	2.032	**−5.116*** **
	(1.879)	**(0.995)**	(1.596)	**(1.189)**
AML regulation	−1.529***	−2.109***	−0.784***	−1.637***
	(0.256)	(0.660)	(0.260)	(0.548)
Credit risk	0.176	−0.723***	−0.486*	−0.758***
	(0.262)	(0.262)	(0.274)	(0.262)
Bank concentration	0.0288***	0.00348	0.0338***	0.0153**
	(0.00781)	(0.00792)	(0.00796)	(0.00753)
Banking crisis	−3.142*	−2.480	−2.819*	−3.141*
	(1.642)	(1.831)	(1.631)	(1.681)
Inflation	−0.000203***	−0.000269***	−0.000222***	−0.000268***
	(4.81e-05)	(5.20e-05)	(4.92e-05)	(5.04e-05)
Real GDP per capital	0.947**	2.593***	0.726	1.375***
	(0.479)	(0.483)	(0.482)	(0.484)
Central bank independence			−73.59***	−71.71***
			(16.05)	(16.46)
Institutional quality	−5.025***	−4.551***		
	(1.573)	(1.701)		
Country Effect	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes
Constant	4.704	−6.110	49.09***	46.51***
	(4.175)	(4.579)	(10.61)	(10.45)
Observations	197	197	202	202
Wald Chi^2	25.76***	25.18***	69.12***	68.51***
R-squared	0.521	0.426	0.502	0.470

Shows the independent impact of monetary policy, macro-prudential regulation and AML regulation on bank lending behaviour across weak and strong central bank independence framework (models 10 and 11, respectively), and across weak and strong institutional quality environments (models 12 and 13, respectively). Variables are described and defined under Table 3. Standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

well-functioning governments, private companies, political jurisdictions, court systems, legislatures, and regulators in a country. This leads to a better institutional quality that creates an optimal regulatory policy effect on bank lending behaviour. Therefore, countries with strong institutional quality may induce a relatively greater reductive impact of monetary policy on bank lending compared to those with weak institutional quality.

In Table 5, macro-prudential regulation has no impact on bank lending behaviour in countries with weak central bank independence (model 10), but it has a negative impact on bank lending behaviour in countries with strong central bank independence (model 11). A weak independent central bank is one whose mandate – to achieve responsible control of financial regulations or monetary policy is affected by anything the government might do; hence, no impact exists on the macro-prudential-bank lending nexus. The implication is that strong independent central banks successfully control monetary policy and tend to induce a negative impact of macro-prudential regulation on bank lending. Similarly, macro-prudential regulation has no impact on bank lending behaviour in countries with weak institutional quality (model 12), but it has a negative impact on bank lending behaviour in countries with strong institutional quality (model 13). The

explanation is that a weak institutional quality may not have a robust mechanism to moderate bank lending through regulations; thus, no impact exists on the macro-prudential-bank lending nexus. The implication is that regulatory authorities and policy-makers in Africa should improve on institutional quality in order to induce a greater significant impact between macro-prudential and bank lending behaviour.

In Table 5, the negative impact of AML regulation on bank lending behaviour is less in countries with weak central bank independence (model 10) compared to countries with strong central bank independence (model 11). Similarly, the negative impact of AML regulation on bank lending behaviour is less in countries with weak institutional quality (model 12) compared to those with institutional quality (model 13). Thus, countries with weak CBI and institutional quality should strengthen their mandate to achieve responsible control of financial regulations without government interference. This helps to control or modulate the impact of AML regulation on bank lending.

Our results are close to the findings of Albrizio et al. (2020) who found a robust evidence that an increase in funding costs following an exogenous monetary tightening leads to a statistically and economically significant decline in cross-border bank lending and the effect is weakened during periods of uncertainty. Based on the work of Altunbas et al. (2018), changes in macro-prudential tools differ among banks, depending on their banking characteristics. In particular, macro-prudential policies are more effective in a tightening environment than in an easing episode. Therefore, our results confirm that countries in strong institutional environment have the mechanism to improve on the relationship between regulation and bank lending. The overall implication is that independent central banks and good institutions have the capacity to control financial regulations and restrict excessive risk-taking behaviour. Therefore, strong central bank independence and institutional quality are required to induce a relatively greater impact of monetary policy and prudential regulations on bank lending.

5.5. Results on interaction effects

In this section, the study argues that the individual regulatory framework can either complement or substitute each other in shaping the bank lending behaviour (see Table 5). It also shows the joint impact of the set of regulations on bank lending behaviours.

In Table 6 we present the results after introducing the interaction terms (i.e. monetary policy and macro-prudential regulation; monetary policy and AML regulation; and macro-prudential regulations and AML regulations). In Table 5, the unconditional effects of monetary policy and the interaction terms vary across the models. Following Compton et al. (2011), we interpreted our results by observing the signs of the coefficients of the variable of interest and its interaction term. For example, in Model 14, both the monetary policy coefficient and the interaction coefficient between monetary policy and macro-prudential regulation are significantly negative. This implies that monetary policy and macro-prudential regulation are complementary in reducing the level of bank lending behaviour. This is consistent with the work of Nier and Kang (2016), who argued that the conduct of monetary policy and macro-prudential measures can have 'side effects' on each other's objective. Therefore, in the face of such side effects, effective monetary policy and macro-prudential measures complement each other and lead to superior outcomes.

Table 6. Interaction effect of monetary policy and prudential regulations on bank lending behaviours.

Variables	Model 14	Model 15	Model 16
Monetary policy	**−1.578*** **	**−1.637***	
	(0.640)	**(0.948)**	
Macro-prudential regulation	**−16.05***		**−21.390*** **
	(8.926)		**(7.440)**
AML regulation		−0.670	−0.936
		(1.807)	(0.885)
Monetary policy*Macro-prudential regulation	**−2.567*** **		
	(0.734)		
Monetary policy*AML regulation		**−0.361*** **	
		(0.0782)	
Macro-prudential regulation*AML regulation			**−3.125** **
			(1.407)
Credit risk	1.369	3.409	0.00686
	(1.175)	(2.556)	(1.138)
Bank concentration	0.0425	−0.326**	0.112
	(0.119)	(0.150)	(0.120)
inflation	−0.443	−0.644	−0.809
	(0.934)	(0.815)	(0.929)
Banking crisis	−3.324	2.513	−5.411
	(9.853)	(9.839)	(10.21)
Real GDP per capital	−22.63***	−17.36***	−17.55***
	(5.649)	(4.365)	(5.523)
Central bank independence	86.17*	−72.73	70.95
	(47.27)	(96.16)	(47.02)
institution	−7.530	−35.46**	−7.199
	(8.215)	(14.63)	(8.223)
Constant	193.3***	243.6***	172.5***
	(43.41)	(51.48)	(43.94)
Country Effect	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes
Observations	291	289	288
R-squared	0.5105	0.418	0.6100
Wald Chi^2	61.26***	56.76***	60.75***
Marginal Effect	**−2.0272*** **	**−3.87*** **	**2.065*** **

Shows the interaction effect of monetary policy, macro-prudential regulation and AML regulation on bank lending behaviour. Variables are described and defined under Table 3. Standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Both measures, thus, complement each other in moderating banks' lending behaviour. In model 15, the monetary policy coefficient is negative and the coefficient of the interaction term (i.e. monetary policy and AML regulation) is also negative. This suggests that AML regulation is a complements monetary policy in determining bank lending behaviour. The implication is that the impact of monetary policy and AML regulation on bank lending behaviour has a synergistic effect and one regulatory policy should work hand-in-hand with the other. In model 16, the coefficients of macro-prudential regulation and its interaction with AML regulation are both negative. This suggests that AML regulation and macro-prudential regulation are both complements in determining bank lending behaviour. Beyer et al. (2017) explained that monetary policy, macro-prudential and micro-prudential policies pursue different objectives and they use different instruments to achieve them, and thus, the three policies are likely to interact in a dampening or amplifying manner. Thus, our results affirm that monetary policy, macro-prudential and AML regulations exhibit significant complementarities and interactions between them to determine a desirable outcome of bank lending.

Consistent with Brambor et al. (2006), there is the need to compute the overall effect of the different set of regulations on bank lending, using the marginal effect. In Table 6, the unconditional effect of monetary policy is negative in model 14 and 15. For instance, using model 14 and model 15, the marginal effect of monetary policy on macro-prudential regulation, as well as the marginal effect of monetary policy on AML regulation – based on their respective coefficients, are more negative than their unconditional effects. However, the marginal effect of macro-prudential policies is positive when conditioned on AML regulation.

This suggests that macro-prudential regulation enhances the negative effect of monetary policy on bank lending behaviour. This is because macro-prudential policy action serves as a risk reduction or mitigating tool for regulators and therefore supplements monetary policy to further reduce bank lending behaviour. Consistent with the bank lending channel and the empirical work of Takats and Temesvary (2021) – who examined the interaction effect of macro-prudential and monetary policy on bank lending and found that macro-prudential action moderates the effect of monetary policy on lending. They show that UK macro-prudential amplifies the negative effect of the tightening of the United States monetary policy on bank loan outflows from banks in the United Kingdom. Therefore, monetary policy reduces bank lending behaviour at stringent or tightening of macro-prudential regulation.

Further, AML regulations magnify the negative effect of monetary policy on bank lending (see model 15). This is because AML regulation serves as a risk combating tool for money laundering and terrorist financing and imposes greater risk controls through bank lending channels. This confirms the work of Beyer et al. (2017) who show that macro-prudential policy and micro-prudential have a dampening effect, and, therefore, they jointly reduce bank lending. This claim supports our results that monetary policy reduces bank lending at stricter AML regulatory framework.

Conversely, it can be observed in model 16 that the negative effect of macro-prudential regulation on bank lending is reversed when conditioned on AML regulations. This means that macro-prudential regulation increases bank lending at the tightening of AML regulations. The implication is that countries should come up with an optimal mix of policy structures, based on macro-prudential and AML framework, in order to determine a desirable outcome of bank lending.

6. Conclusion and policy implications

This study examines the effect of monetary policy and prudential regulations on bank lending behaviour in Africa. By employing the Two-Stage Least Square (2SLS) estimation for a panel dataset of 54 African countries over 2004–2021 period, the study found that monetary policy, macro-prudential and AML regulations reduce bank lending. We show that the impact of these measures on bank lending is consistent and non-monotonic to the level of banks' lending conditional on the quantiles in distribution. In addition, the study reveals that countries with strong central bank independence and institutional quality induce a relatively greater impact of monetary policy and prudential regulations on bank lending compared to those in weak central bank independence and institutional quality. This study provides evidence to support the idea that prudential regulations (macro-

prudential and AML policies) complement monetary policy in determining bank lending behaviour. Our results affirm that monetary policy, macro-prudential and AML regulations exhibit significant complementarities and interactions in determining a desirable outcome of bank lending. The study shows that macro-prudential regulation amplifies the negative effect of monetary policy on banks' lending behaviour. Similarly, AML regulations magnify the negative impact of monetary policy on bank lending but alter the negative impact of macro-prudential regulation on bank lending behaviour. Therefore, monetary policy reduces bank lending behaviour at a higher stringency of macro-prudential and AML regulations.

Based on these findings, policymakers and regulatory authorities should consider the monetary independent and institutional environment when designing or formulating regulatory frameworks in testing the optimal relationship between monetary policy and prudential regulations on bank lending behaviours. In addition, the right mix of central bank policies is important in explaining bank lending behaviour. It is a wake-up call for countries with a weak independent central bank framework and economic institutions to strengthen their regulatory framework. This will enable them to better strategize in order to yield a desirable outcome of bank lending to the real economy.

6.1. Limitation and future recommendation

In the estimation process, acquiring the data was very difficult because some were not publicly available as a secondary source. Future research is required to explore this study in other regions in the world to reveal how applicable this model fits the other parts of the world. Some other moderators of policy variables should also be tested in this context to ensure their role in aligning varying regulatory policies with the interest of regulatory authorities in achieving optimal levels of bank lending. This study could not explore alternative estimation techniques in analysing the effect of regulations on bank lending due to shortfalls associated with generating consistent estimates. Future studies should employ diverse estimation techniques such as the system GMM to explore the relationship between regulatory policies and bank lending in Africa and beyond.

Disclosure statement

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References

Abbas, Z., S. F. Iftikhar, and S. Alam. 2019. "Does Bank Capital Affect the Monetary Policy Transmission Mechanism? A Case Study of Emerging Market Economies (EMEs)." *International Journal of Financial Engineering* 6 (2): 1950019. https://doi.org/10.1142/S2424786319500191.

Abuka, C., R. K. Alinda, C. Minoiu, J.L. Peydro, and A.F. Presbitero. 2015. "Monetary Policy and Bank Lending in Developing Countries: Loan Applications and Real Effects." *IMF Working Paper, WP/15/270*.

Abuka, C., R. K. Alinda, C. Minoiu, J.-L. Peydro, and A.F. Presbitero. 2019. "Monetary Policy and Bank Lending in Developing Countries: Loan Applications, Rates, and Real Effects." *Journal of Development Economics* 139 (1): 185–202. https://doi.org/10.1016/j.jdeveco.2019.03.004.

Abuka, C., R. K. Alinda, C. Minoiu, J.L. Peydró, and A.F. Presbitero. 2019. "Monetary Policy and Bank Lending in Developing Countries: Loan Applications, Rates, and Real Effects." *Journal of Development Economics* 139 (1): 185–202. https://doi.org/10.1016/j.jdeveco.2019.03.004.

Adrian, T., and H.S. Shin. 2010. "The Changing Nature of Financial Intermediation and the Financial Crisis of 2007–2009." *Annu. Rev. Econ* 2 (1): 603–618.

Agénor, P.R., L. Gambacorta, E. Kharroubi, and L.A. Pereira da Silva. 2018. "The Effects of Prudential Regulation, Financial Development and Financial Openness on Economic Growth." *BIS Working Papers No. 752*.

Agoba, A.M., J.Y. Abor, K.A. Osei, and J. Sa-Aadu. 2020. "Do Independent Central Banks Exhibit Varied Behaviour in Election and Non-Election Years?: The Case of Fiscal Policy in Africa." *Journal of African Business* 21 (1): 105–125.

Agoba, A.M., J.Y. Abor, K. Osei, J. Sa-Aadu, B. Amoah, and G.C.O. Dzeha. 2019. "Central Bank Independence, Elections and Fiscal Policy in Africa: Examining the Moderating Role of Political Institutions." *International Journal of Emerging Markets* 14 (5): 809–830.

Aikman, D., B. Nelson, and M. Tanaka. 2015. "Reputation, Risk-Taking, and Macroprudential Policy." *Journal of Banking and Finance* 50: 428–439.

Aikman, D., J. Bridges, A. Kashyap, and C. Siegert. 2019. "Would Macroprudential Regulation Have Prevented the Last Crisis?." *Journal of Economic Perspectives* 33 (1): 107–130.

Aiyar, S., C. W. Calomiris, and T. Wieladek. 2015. "Bank Capital Regulation: Theory, Empirics, and Policy." *IMF Economic Review* 63 (4): 955–983. https://doi.org/10.1057/imfer.2015.18.

Akhter, N. 2019. "Assessing the Relationship Between Efficiency, Capital and Risk of Commercial Banks in Bangladesh." *International Journal of Business & Management* 14 (1): 55–63.

Akinci, O., and J. Olmstead-Rumsey. 2018. "How Effective are Macroprudential Policies? An Empirical Investigation." *Journal of Financial Intermediation* 33:33–57.

Alam, Z., A. Alter, J. Eiseman, G. Gelos, H. Kan, et al. 2021. *Digging Deeper: Evidence on the Effects of Macroprudential Policies from a New Database*. Washington, DC: International Monetary Fund.

Albinali, A. 2023. "Bank Lending and Macroprudential Policies: Are Islamic Banks Differentially Affected?" *Islamic Economic Studies* 30 (2): 104–120. https://doi.org/10.1108/IES-02-2022-0018.

Albrizio, S., S. Choi, D. Furceri, and C. Yoon. 2020. "International Bank Lending Channel of Monetary Policy." *Journal of International Money and Finance* 102:102124. https://doi.org/10.1016/j.jimonfin.2019.102124.

Altunbas, Y., M. Binici, and L. Gambacorta. 2018. "Macroprudential Policy and Bank Risk." *Journal of International Money and Finance* 81:203–220. https://doi.org/10.1016/j.jimonfin.2017.11.012.

Andriushin, S., and V. Kuznetsova. 2013. "Macroprudential Policy Instruments of Central Banks." *Problems of Economic Transition* 56 (7): 75–94.

Araujo, L., B. Guimaraes, and D. Rodrigues. 2020. "Financial Constraints and Collateral Crises." *Review of Economic Dynamics* 38:238–250.

Argimon, I., C. Bonner, R. Correa, P. Duijm, J. Frost, J. de Haan, L. de Haan, et al. 2019. "Financial institutions' Business Models and the Global Transmission of Monetary Policy." *Journal of International Money & Finance* 90:99–117.

Auer, S., C. Friedrich, M. Ganarin, T. Paligorova, and P. Towbin. 2019. "International Monetary Policy Transmission Through Banks in Small Open Economies." *Journal of International Money & Finance* 90:34–53.

Ayyagari, M., T. Beck, and M.S. Martinez Peria. 2017. "Credit Growth and Macroprudential Policies: Preliminary Evidence on the Firm Level." *BIS Paper* (91a).

Ayyagari, M., T. Beck, M. Soledad, and M. Peria. 2019. "Credit Growth and Macro-Prudential Policies: Preliminary Evidence on the Firm Level 1." *BIS Papers No 91*.

Benoit, D. F., and D. Van den Poel. 2009. "Benefits of Quantile Regression for the Analysis of Customer Lifetime Value in a Contractual Setting: An Application in Financial Services." *Expert Systems with Applications* 36 (7): 10475–10484. https://doi.org/10.1016/j.eswa.2009.01.031.

Beyer, A., G. Nicoletti, N. Papadopoulou, P. Papsdorf, G. Rünstler, C. Schwarz, and O. Vergote. 2017. "The Transmission Channels of Monetary, Macro-And Microprudential Policies and Their Interrelations (No. 191)." *ECB Occasional Paper*.

Bodenstein, M., L. Guerrieri, and J. LaBriola. 2019. "Macroeconomic Policy Games." *Journal of Monetary Economics* 101:64–81.

Borio, C., and L. Gambacorta. 2017. "Monetary Policy and Bank Lending in a Low-Interest-Rate Environment: Diminishing Effectiveness?" *BIS Working Paper, No. 612*.

Brambor, T., W.R. Clark, and M. Golder. 2006. "Understanding Interaction Models: Improving Empirical Analyses." *Political Analysis* 14 (1): 63–82.

Buallay, A., and A. Hamdan. 2023. "Guest Editorial: Sustainability Reporting in Different Institutional and Regulatory Environments." *Competitiveness Review: An International Business Journal* 33 (1): 1–6. https://doi.org/10.1108/CR-12-2022-191.

Cagliarini, A. 2016. "Macroprudential Policy: More Questions Than Answers." *Australian Economic Review* 49 (1): 89–92.

Cehajic, A., and M. Kosak. 2021. "Tightening and Loosening of Macro-Prudential Policy, Its Effects on Credit Growth and Implications for the COVID-19 Crisis." *Economics and Business Review* 23 (4): 207–233. https://doi.org/10.15458/2335-4216.1293.

Cehajic, A., and M. Kosak. 2022. "Bank Lending and Small and Medium-Sized enterprises' Access to Finance – Effects of Macroprudential Policies." *Journal of International Money and Finance* 124:1–23. https://doi.org/10.1016/j.jimonfin.2022.102612.

Chibba, M. 2008. "Monetary Policy for Small Emerging Market Economies: The Way Forward." *Macroeconomics and Finance in Emerging Market Economies* 1 (2): 299–306. https://doi.org/10.1080/17520840802252894.

Chong, A., and F. Lopez-De-Silanes. 2015. "Money Laundering and its Regulation." *Economics and Politics* 27 (1): 78–123. https://doi.org/10.1111/ecpo.12051.

Claessens, S. 2015. "An Overview of Macroprudential Policy Tools." *Annual Review of Financial Economics* 7:397–422.

Claessens, S., S. R. Ghosh, and R. Mihet. 2013. "Macro-Prudential Policies to Mitigate Financial System Vulnerabilities." *Journal of International Money and Finance* 39:153e185. https://doi.org/10.1016/j.jimonfin.2013.06.023.

Coimbra, N., and H. Rey. 2017. *Financial Cycles with Heterogeneous Intermediaries (No. w23245)*. National Bureau of Economic Research.

Compton, R.A. D.C. Giedeman, and G.A. Hoover 2011. "Panel Evidence on Economic Freedom and Growth in the United States." *European Journal of Political Economy* 27 (3): 423–435.

Cubillas, E., and N. Suárez. 2018. "Bank Market Power and Lending During the Global Financial Crisis." *Journal of International Money & Finance* 89:1–22.

de Haan, J., Z. Jin, and Z. Chen. 2019. "Micro-Prudential Regulation and banks' Systemic Risk." *DeNederlandscheBank Working Paper No. 656 Eurosystem*.

Dell'Ariccia, G., L. Laeven, and G.A. Suarez. 2017. "Bank Leverage and Monetary Policy's Risk-Taking Channel: Evidence from the United States." *The Journal of Finance* 72 (2): 613–654.

European Central Bank. 2021. "The Role of Financial Stability Considerations in Monetary Policy and the Interaction with Macro-Prudential Policy in the Euro Area." *Occasional Paper Series ECB Strategy Review, No 272*, September.

Friedman, M.1968. "Money, Quantity Theory." In *International Encyclopedia of the Social Sciences*, 432–447. New York: Macmillan and Free Press.

Grigaitė, K., C. Dias, and M. Magnus. 2021. "Preventing Money Laundering in the Banking Sector-Reinforcing the Supervisory and Regulatory Framework." *Economic Governance Support Unit (EGOV), Directorate-General for Internal Policies PE 659.654*, October.

Hodula, M., and N.A. Ngo. 2021. "Does Macro-Prudential Policy Leak? Evidence from Non-Bank Credit Intermediation in EU Countries." *Czech National Bank, Working Paper Series*, May.

Igan, D., and H. Kang. 2011. "Do Loan-To-Value and Debt-To-Income Limits Work? Evidence from Korea." *IMF Working Paper, n 297*.

Imbierowicz, B., A. Löffler, and U. Vogel. 2021. "The Transmission of Bank Capital Requirements and Monetary Policy to Bank Lending in Germany." *Review of International Economics* 29 (1): 144–164. https://doi.org/10.1111/roie.12500.

Jimenez, G., S. Ongena, J.-L. Peydro, and J. Saurina. 2017. "Macro-Prudential Policy, Countercyclical Bank Capital Buffers, and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiments." *Journal of Political Economy* 125 (6): 2126–2177. https://doi.org/10.1086/694289.

Jiménez, G., S. Ongena, J.L. Peydró, and J. Saurina. 2012. "Credit Supply and Monetary Policy: Identifying the Bank Balance-Sheet Channel with Loan Applications." *The American Economic Review* 102 (5): 2301–2326.

Lee, L.F. 2007. "GMM and 2SLS Estimation of Mixed Regressive, Spatial Autoregressive Models." *Journal of Econometrics* 137 (2): 489–514. https://doi.org/10.1016/j.jeconom.2005.10.004.

Levi, M., and P. Reuter. 2006. "Money laundering." *Crime and Justice* 34 (1): 289–375. https://doi.org/10.1086/501508.

Lim, C.H., A. Costa, F. Columba, P. Kongsamut, A. Otani, M. Saiyid, T. Wezel, et al. 2011. "Macroprudential Policy: What Instruments and How to Use Them? Lessons from Country Experiences."

Loayza, N., E. Villa, and M. Misas. 2017. "Illicit Activity and Money Laundering from an Economic Growth Perspective: A Model and an Application to Colombia." *Journal of Economic Behaviour and Organization* 1 (1): 1–23.

Lubis, A., C. Alexiou, and J. Nellis. 2019. "What Can We Learn from the Implementation of Monetary and Macroprudential Policies: A Systematic Literature Review." *Journal of Economic Surveys* 33 (4): 1123–1150. https://doi.org/10.1111/joes.12313.

Maddaloni, A., and J.L. Peydró. 2013. "Monetary Policy, Macro-Prudential Policy and Banking Stability Evidence from the Euro Area." *ECB Working Paper Series. NO 1560*, July.

Martin, A., C. Mendicino, and A.V. der Ghote. 2021. "On the Interaction Between Monetary and Macro-Prudential Policies." *ECB Working Paper Series No 2527*, February.

Meuleman, E., and R. Vander Vennet. 2020. "Macroprudential Policy and Bank Systemic Risk." *Journal of Financial Stability* 47:100724.

Mishkin, F. S. 2011. "Monetary Policy Strategy: Lessons from the Crisis." *NBER Working Paper 16755*

Modugu, K. P., and J. Dempere. 2022. "Monetary Policies and Bank Lending in Developing Countries: Evidence from Sub-Sahara Africa." *Journal of Economics and Development* 24 (3): 217–229. https://doi.org/10.1108/JED-09-2021-0144.

Nier, E.W., and H. Kang. 2016. "Monetary and Macroprudential Policies–Exploring Interactions." *BIS Paper* (86e).

Ofori-Sasu, D., E.K. Agbloyor, E. Sarpong-Kumankoma, and J.Y. Abor. 2023. "Central Bank Coordinated Policies and Bank Market Power: An Insight from the African Context." *Cogent Economics & Finance* 11 (1): 2196851.

Olivero, M.P., Y. Li, and B.N. Jeon. 2011a. "Competition in Banking and the Lending Channel: Evidence from Bank-Level Data in Asia and Latin America." *Journal of Banking and Finance* 35 (1): 560–571. https://doi.org/10.1016/j.jbankfin.2010.08.004.

Olivero, M.P., Y. Li, and B.N. Jeon. 2011b. "Consolidation in Banking and the Lending Channel of Monetary Transmission." *Journal of International Money Finance* 30 (6): 1034–1054. https://doi.org/10.1016/j.jimonfin.2011.06.006.

Osinski, J., K. Seal, and M.L. Hoogduin. 2013. "Macroprudential and microprudential policies: toward cohabitation." *International Monetary Fund* 2013 (5). https://doi.org/10.5089/9781484369999.006.

Paoli, B.D., and M. Paustian. 2017. "Coordinating Monetary and Macroprudential Policies." *Journal of Money, Credit, and Banking* 49 (2–3): 319–349.

Saadaoui, Z. 2014. "Business Cycle, Market Power and Bank Behaviour in Emerging Countries." *International Economics* 139:109–132. https://doi.org/10.1016/j.inteco.2014.04.001.

Slutzky, P., M. Villamizar-Villegas, and T. Williams. 2020. "Drug Money and Bank Lending: The Unintended Consequences of Anti-Money Laundering Policies." *SSRN 3280294*.

Takats, E. aand J. Temesvary. 2021. "How Does the Interaction of Macro-Prudential and Monetary Policies Affect Cross-Border Bank Lending?" *Journal of International Economics* 132:103521. https://doi.org/10.1016/j.jinteco.2021.103521.

World Bank. 2005. "The International Bank for Reconstruction and Development." *The World Bank*.

Appendix I: Effects of regulations on bank lending

Variables	Model 17	Model 18	Model 19	Model 20	Model 21	Model 22	Model 23
Monetary policy	−0.612***	−0.638***	−0.578***	−0.622***	−0.626***	−0.628***	−0.591***
	(0.155)	(0.156)	(0.154)	(0.154)	(0.156)	(0.155)	(0.154)
Macro-prudential regulation	−4.326***	−4.261***	−4.474***	−4.238***	−4.202***	−4.252***	−4.342***
	(0.912)	(0.914)	(0.903)	(0.907)	(0.910)	(0.925)	(0.901)
AML regulation	−1.850***	−1.848***	−1.857***	−1.803***	−1.870***	−1.873***	−1.847***
	(0.489)	(0.491)	(0.483)	(0.491)	(0.490)	(0.490)	(0.484)
Central bank independence	−49.38***	−54.37***	−50.78***	−50.33***	−56.16***	−55.38***	−51.13***
	(16.45)	(16.01)	(15.67)	(16.37)	(15.92)	(15.94)	(15.73)
Credit risk	−0.151	−0.187	−0.266	−0.141	−0.178	−0.179	−0.204
	(0.271)	(0.271)	(0.270)	(0.271)	(0.281)	(0.271)	(0.268)
Bank concentration	0.0318***	0.0335***	0.0316***	0.0331***	0.0345***	0.0339***	0.0315***
	(0.00780)	(0.00780)	(0.00759)	(0.00766)	(0.00764)	(0.00791)	(0.00764)
Banking crisis	−1.887	−1.809	−1.841	−1.591	−1.799	−1.832	−1.924
	(1.622)	(1.621)	(1.598)	(1.625)	(1.625)	(1.625)	(1.604)
Inflation	−0.000219***	−0.000219***	−0.000221***	−0.000217***	−0.000219***	−0.000219***	−0.000218***
	(4.61e-05)	(4.61e-05)	(4.54e-05)	(4.60e-05)	(4.61e-05)	(4.61e-05)	(4.56e-05)
Real GDP per capital	0.611	0.533	0.647	0.601	0.478	0.503	0.656
	(0.488)	(0.489)	(0.479)	(0.489)	(0.481)	(0.487)	(0.482)
Institutional quality	**0.822*** **						
	(0.269)						
Control of corruption		**0.421*** **					
		(0.226)					
Rule of law			−3.259**				
			(1.360)				
Voice and accountability				**0.628*** **			
				(0.208)			
Political stability					**0.739*** **		
					(0.224)		
Government effectiveness						**0.587*** **	
						(0.227)	
Regulatory quality							−2.426**
							(1.135)
Country Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	41.62***	45.40***	42.31***	42.27***	47.72***	46.85***	42.53***

(*Continued*)

(Continued).

Variables	Model 17	Model 18	Model 19	Model 20	Model 21	Model 22	Model 23
	(11.01)	(10.93)	(10.33)	(11.11)	(10.45)	(10.62)	(10.41)
Observations	196	197	197	197	197	197	197
Wald Chi^2	39.48***	49.55***	44.26***	47.57***	42.57***	52.12***	47.03***
R-squared	0.550	0.551	0.563	0.554	0.550	*0.550*	*0.561*

Standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.