THREE ESSAYS ON BANKING AND CENTRAL BANKING

By

IEGOR VYSHNEVSKYI

A DISSERTATION

Submitted to
KDI School of Public Policy and Management
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY
IN PUBLIC POLICY

2022

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ABSTRACT

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This dissertation studies banking and central banking from different perspectives, such as credit risk and monetary policy. Chapter 1 examines bank-specific factors such as related party lending, large exposure concentrations, and capitalization that determine nonperforming loans (NPLs) in Ukraine. It is demonstrated that banks' NPL stock increases with related party lending, and this association depends on the banks' ownership type and size in the case of the Ukraine banking system. For the study, we built a quarterly panel of 207 bank financial indicators and utilized dynamic panel fixed effects and panel VAR models. Chapter 2 examines the effect of monetary policy statements' readability and complexity on financial markets in developing countries. We built a unique dataset for 21 countries over an 11-year horizon and applied text analysis and a panel fixed effects estimator to find that poorly readable and complex monetary policy statements are associated with higher foreign exchange rate volatility. Chapter 3 studies the impact of monetary policy transparency on inflation for 34 developing countries from 1998 to 2019, taking into account their monetary policy independence and stance. A median quantile regression with fixed effects analysis revealed that higher MPT is associated with lower inflation in the following period for countries with either tight monetary policy or independent monetary policy controlling for its tight regime.

Keywords: nonperforming loans; monetary policy communication; complexity; readability; monetary policy transparency; inflation; developing countries.

Dedicated to

My family: Vira and Emiliia,

My parents: Ivan and Alla,

My fellow Ukrainians

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ABSTRACT

This study examines bank-specific factors such as related party lending, large exposure concentrations, and capitalization that determine nonperforming loans (NPLs) in Ukraine. We investigate the feedback effect of an exogenous shock in NPLs on macroeconomic fundamentals, the banking sector, and bank-level variables. We apply the fixed effects dynamic panel data methodology and panel vector autoregression (PVAR) model with a system generalized method of moments (GMM) to an unbalanced sample of 207 banks with quarterly data (Q2, 2008, to Q4, 2020). We find that banks' NPLs decrease with capital adequacy and increase with related lending. The PVAR model results reveal that a positive shock in NPLs causes a substantial increase in related lending over a 1-year horizon and a decrease in concentrations. Therefore, attentive monitoring of banks' lending policies and standards is important for suppressing excessive risk-taking behavior and moral hazard because an untimely resolution of NPLs may negatively affect the economy and the banking sector.

Keywords: nonperforming loans; Related party lending; Bank capitalization; Lending behavior; Economy and banking sector

[1] Co-authored by Professor Wook Sohn

1.1 INTRODUCTION

Ukraine experienced two financial crises in the twenty-first century that caused the non-performing loans (NPLs) amount on banks' balance sheets to peak at the highest historical level of about 58% of total loans in Q2 (2017) for the banking system.[2] Although it has constantly shrunk to a level of 48.4%, 41%, and 30% at the beginning of 2020, 2021, and 2022, respectively, it is still enormously high.

According to Minsky's financial instability hypothesis, the main driving cause of a crisis is insolvent debt accumulation in the non-government sector (Minsky, 1992). In the years after the global financial crisis (GFC), Minsky's theories gained a renaissance, and the issue of bad loans has been spotlighted owing to their substantial stock in the banking sectors of both developed and developing countries, which has led to an economic downturn and postponement of the rebound in many economies, and restrains banks' funding to more efficient and solvent borrowers (Barseghyan, 2010; Aiyar & Monaghan, 2015). Furthermore, a high NPL level prolongs and deepens the severity of post-crisis recessions (Ari et al., 2021). Some researchers refer to NPLs as "financial pollution" (Ghosh, 2015) because of their adverse effects on the financial system and the economy.

Although the banking sector of Ukraine experienced mainly some exogenous shocks in 2008 and 2014–2015, those shocks did not cause the banks' problems (Gontareva & Stepaniuk, 2020). Therefore, our study focuses largely on bank-specific factors, although we apply several macro-level variables to control for the macroeconomic environment and some industry-related factors.

[2] In the literature, the terms "non-performing loans" (NPLs), "bad loans," "insolvent debt," "distressed debt," "bad debt," "bad loans," "non-performing exposure," "impaired asset," "problem asset," "impaired loans," "problem loans," "past-due exposure," "defaulted exposure," "defaulted loans," and "non-performing asset" have been often used interchangeably as synonyms, though they are not identical but similar concepts. Conventionally, NPLs are defined in a narrow sense, referring to loans that have already defaulted, are past due by more than 90 days, and/or the obligation fulfillment is unlikely without foreclosure of collateral (Konstantakis et al., 2016; Manz, 2019).

In this study, we analyze the banking system of Ukraine – a country heavily exposed to financial crises – examining the NPL amount determinants from diverse perspectives. Apart from the classic factor of banks' capitalization as the main determinant of NPLs for the Ukrainian banking sector, we examine two specific factors that are rarely studied in the current NPL literature, namely banks' related party lending (hereinafter related lending) and banks' large exposure concentrations. We studied the interaction terms between NPL factors and banks' ownership type and size to assess the possible nonlinear relationship. We check the feedback effect of an exogenous shock on NPLs on macroeconomic fundamentals and the sector- and bank-level variables of Ukraine.

Our study applies fixed effects dynamic panel data methodology and panel vector autoregression (PVAR) modeling with a system-generalized method of moments (system GMM) to an unbalanced sample of 207 banks with quarterly data covering the period from Q2 (2008) to Q4 (2020). Data on NPLs and related party lending in the Ukrainian banking sector must be treated with caution because the pre-2015 reporting may not fully reflect the real portfolio quality (Gontareva & Stepaniuk, 2020; National Bank of Ukraine, 2018, 2019a).

Our first key finding is that banks' capital adequacy and related party lending are significant determinants of NPLs with a negative (i.e., lowering NPLs) and positive (i.e., increasing NPLs) impact, respectively. Second, we found evidence that the relationship between bank-level factors and NPLs may be considered nonlinear depending on the banks' ownership type and size. Supervisory policies to mitigate related party lending and maintain capital adequacy can be heterogeneous based on bank size and ownership type. The PVAR model results reveal that a positive shock in NPLs causes a substantial increase in related party lending over a year and an opposite effect on large exposure concentrations. Banks' capitalization tended to increase during the year after the crisis occurred. In the case of macroeconomic variables, all responses turned out to be statistically significant, though with a

modest magnitude. The results suggest that bank supervisory authorities pay close attention to banks' lending policies toward related parties and maintaining capital adequacy. Supervisory policies to mitigate related party lending and maintain capital adequacy can be heterogeneous based on bank size and ownership type. An effective resolution mechanism must be developed to mitigate the spillover effect from NPLs. Finally, for the robustness check of our panel fixed effect methodology, we tested the models on the subsample banks after Q3 (2016) and applied another dependent variable. In the case of PVAR, we checked the different sequences of variables entering the system and additional lags.

Our research contributes to the literature in a number of ways. First, to the best of our knowledge, our study is the first to empirically examined two unique NPL factors —related party lending and large exposure concentrations—that are challenging to analyze because of the lack of data. Second, we inspected the interaction terms of NPL factors and banks' ownership type and size to find the nonlinear relationship. Further, following the literature, we also found the negative effects of NPLs on some bank-level and macroeconomic variables. Our results can also be seen from the viewpoint of emerging nations, as, similar to Ukraine, they may also have different NPL determinants than developed nations. This sets the stage for a discussion about the relevance of NPL factors in Ukraine to other developing countries.

This paper is structured as follows: Section 2 provides a brief literature review of the key sources in the field, and Section 3 explains the evolution of the Ukrainian banking system. The hypotheses and research questions, as well as data and methodology, are stated in Section 4. Section 5 describes empirical results and their implications, and Section 6 presents conclusions.

1.2 LITERATURE REVIEW

Existing studies determine and examine various idiosyncratic and systematic factors

that cause NPL emergence and accumulation over time. Idiosyncratic factors include bank-specific, industry-related, borrower-related, and loan-related ones, whereas systematic factors are macroeconomic and country-specific.

The general framework of NPL studies to a wide range of macroeconomic and industry-related factors is based on broader theories of business cycles, economic growth, the role of financial institutions in the economy, credit cycles, credit risk, and stress-testing modeling, life-cycle consumption models with default options, and banks' efficiency (Berger & DeYoung, 1997; Bernanke & Gertler, 1989; Grigoli et al., 2018; Kiyotaki & Moore, 1997; Lawrence, 1995; Pesaran et al., 2006). The studies in the bad loans area were pioneered by Keeton and Morris (1987) and, Sinkey and Greenawalt (1991).

Over time, three clear trends were observed. First, the trend of exploring purely idiosyncratic factors of NPLs was established by Berger and DeYoung (1997) focusing mainly on banks' cost efficiency. Most studies followed Berger and DeYoung, such as Podpiera and Weill (2008), who estimated a causal relation between NPLs and a cost-efficiency evidenced "bad management" hypothesis. Zhang et al. (2016) confirmed the "moral hazard" hypothesis. Altunbas et al. (2007) conclude no specific relation between bank risk profile and inefficiency in the European banks. Bank-specific factors include a wide variety of metrics, such as a positive relation of credit growth to NPLs (Festić et al., 2011; Foos et al., 2010).[3]

The second trend focuses solely on systematic determinants. Fofack (2005) indicates that the main causes of an increase in NPLs are volatility in real exchange rate growth, net interest margins, the real interest rate, economic growth, and interbank loans. Rinaldi and Sanchis-Arellano (2006) found that a substantial impact on household NPLs is caused by disposable income, unemployment, and monetary conditions. Contrarily, Buncic and Melecky

[3] Though there are studies that explore bank lending from "zombie lending" and "evergreening" perspectives, stating that the latter is applied to hide the former in a way that NPLs are not affected.

(2013) concluded that the following were statistically negligible: the change in the credit-to-GDP ratio; the exchange rate; the log of GDP per capita; and the FX share in total loans.

The third trend is basically a synthesis of the previous two trends. Salas and Saurina (2002) concluded that both macro- and micro-level indicators (namely, net interest margin, bank size, capital ratio, real GDP growth, and market power) significantly determine NPLs. Some initial studies, such as Louzis et al. (2012), estimated that systematic determinants prevail. Conversely, Ghosh (2015) concluded that bank-level factors (poor credit quality, higher capitalization, etc.) substantially influence bad loans. Moreover, NPLs are negatively related to some macroeconomic factors (personal income and state real GDP growth, state housing price increase), while positively related to US public debt, state unemployment, and inflation. The fact that both groups of factors might influence NPLs has been evidenced by Klein (2013). Huljak et al. (2020) revealed that banks' lending volume and real GDP growth responded negatively and lending spread responded positively to the exogenous shock in NPLs.[4]

Empirical studies on the problem of bad loans in Ukraine are limited and come mainly from the National Bank of Ukraine (NBU), international organizations, and the media. In addition, Gontareva and Stepaniuk (2020) provided wide coverage of Ukraine's banking sector reforms and developments after 2014. Some researchers have covered Ukraine in their studies as either a part of global or regional CEE country studies (Beck et al., 2013; De Bock & Demyanets, 2012; Klein, 2013). Meanwhile, few studies focus solely on the NPL issue in Ukraine (Goczek & Malyarenko, 2015; Pham et al., 2021). The studied factors were usually considered in developed countries. They found that both idiosyncratic and systematic factors influenced loan quality.

[4] Apart from these trends, there are studies on bad loan issues from different perspectives, either at the countries or single country level. From the governance-related side: Fraccaroli (2019), Hirtle et al. (2020), and Lafuente et al. (2019); from the commodities side: Al-Khazali and Mirzaei (2017); from the asset side: Gerlach and Peng (2005); from production: Cifter et al. (2009).

This study enhances the existing literature on the empirical factors of bad loans as follows: Firstly, we have examined two banks' specific characteristics that are rarely considered in the current NPL literature because of either data unavailability or their irrelevance in developed countries, namely banks' related party lending and banks' large exposure concentrations.[5] Secondly, data from Ukraine are utilized in this study, which provides the opportunity to examine the NPL amount determinants from diverse perspectives. Thirdly, our study accounts for many events in the Ukrainian banking sector, studies Ukraine NPLs from size and ownership perspectives, and the feedback effect of NPLs in Ukraine.

1.3 BANKING SECTOR IN UKRAINE

This research is solely focused on the Ukrainian banking sector, which for the past two decades experienced two severe crises in 2008–09 and 2014–16, in addition to the 1997–1998 currency crisis and technical default (Reinhart & Rogoff, 2011).

In Ukraine, an independent banking system emerged in 1991, simultaneously with the creation of the NBU. The early 2000s were marked by relative macroeconomic stability and favorable internal and external environments. The Ukrainian economy and banking sector enjoyed large capital inflows from abroad, experiencing a boom period. The NPL volume was moderate (not exceeding 5% until late 2008).

After the GFC, the demand for traditional export goods dropped, and there was a foreign capital shortage, leading to a decline in the Ukrainian economy in late 2008 and early 2009. Misbalances in the Ukrainian economy, currency depreciation, and weak standards of loan underwriting and credit risk management, together with numerous other factors, caused a sharp increase in NPLs of around 14–18% for the system.

[5] There are some papers that study an insider lending (a loan made by a bank to one or more of its own officials or directors), especially in transition/developing countries. For more information, see Brownbridge (1998). Although some researches consider insider lending and a related party lending as a same concept, they are distinct concepts.

In 2010, the economy began to recover from the 2008–2009 crisis and the following downturn. The bad loans remained not properly provisioned as on the signs of gradual banking sector recovery, and lenders were overoptimistic about the capability of borrowers to repay their past-due or excess debts. The slow economic recovery was not accompanied by a capital inflow, causing a capital shortage in the financial system. All these factors resulted in bad practices such as related party lending and an abnormal concentration of business groups' loans (NBU 2018, 2019a, 2019b, 2020). Specifically, issuing loans to shareholders was the main business of a large number of banks (Gontareva & Stepaniuk, 2020). Thus, after the 2008–2009 crisis, nonrecognition of bad loans by banks and destructive practices, such as nontransparent and inefficient borrowers' credit scoring, banks' large exposure concentration, and vast related party lending, remained.

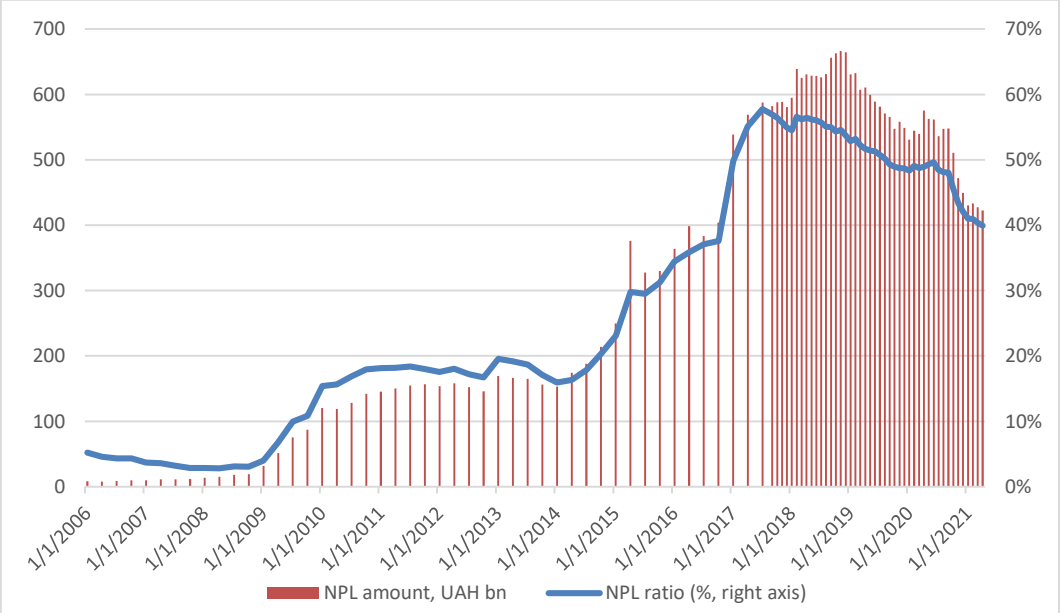
In 2014–2016, Ukraine faced severe challenges such as the revolution, war, loss of territories, and breaking of economic ties, along with the above-mentioned poor practices in the Ukrainian banking sector, and about half of the banks' assets and liabilities were denominated in foreign currencies, mainly the US dollar (Gontareva & Stepaniuk, 2020). As a consequence of all these factors, 72% of all loans on the banks' balance sheets at the 2013-year end were classified as NPLs in 2014–2018 (Kliuka, 2020). Bankrupt banks accounted for about a third of the banking system's loan portfolio at the beginning of 2014 (Kliuka, 2020).

In 2015–2016, the NBU conducted the first bank-wide stress tests, which included a large-scale asset quality review (AQR) and deep diagnostics of banks' operations with related parties. It was the only way to find the extent of bad loans in the system (Kliuka, 2020). Later, the introduction of new regulations on related party identification and assessment led to the recognition of nonperforming assets by the banks.[6]

[6] The NBU Board Resolution No. 315 of May 12, 2015, on Approval of the Regulation on a Bank's Related Party Identification (updated); the NBU Board Resolution No. 314 of May 12, 2015, on Measures on Bringing Banks'

Figure 1.1(A) indicates that the share of NPLs climbed dramatically from 2013 to 2017, to the highest in Ukrainian history and one of the highest in international experience, with about 58% of gross loans in Q2 (2017), confirming a concealed level of NPLs and flaws in previous policy and regulations.[7] Although Figure 1.1(B) depicts that the NPL ratio is sufficiently different across the banks' groups by ownership, the significant increase in the NPL ratio during Q4 (2016)-Q1 (2017) is mainly attributed to the new regulations and the recognition of corporate NPLs by private banks. Most NPLs are corporate loans, often granted to related parties in the case of private banks and politically motivated in the case of state-owned banks (NBU, 2019a). About 37% of them were concentrated in the top 20 largest business groups (Gontareva and Stepaniuk, 2020). About 75 percent of NPLs were attributed to 128 corporate entities as of April 2019 (NBU, 2019a).

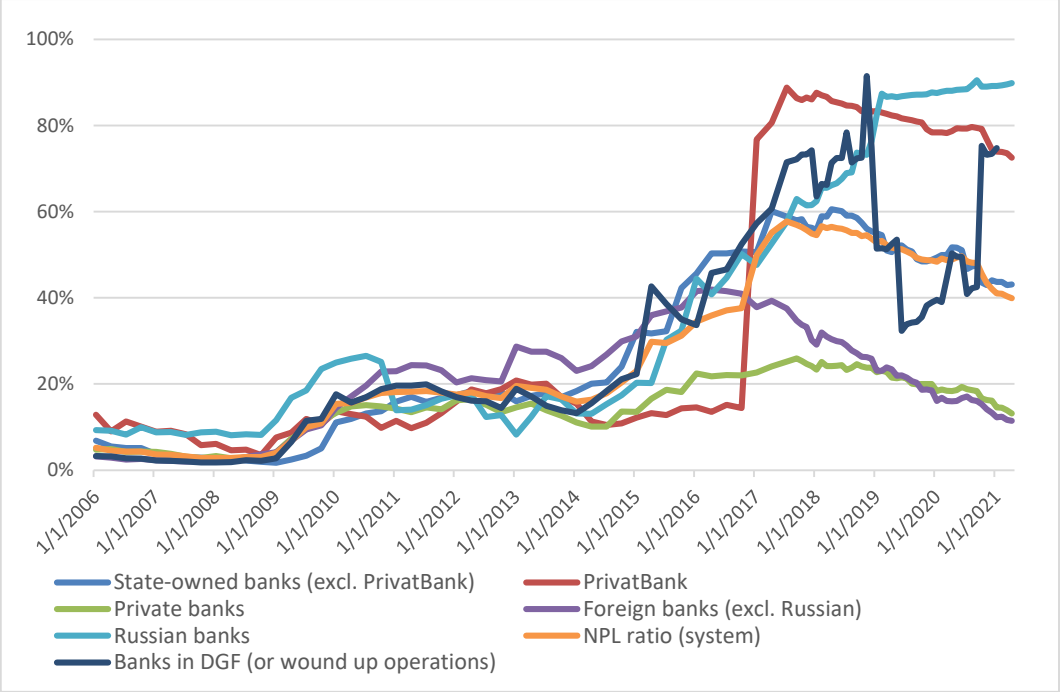
Figure 1.1: NPLs dynamics in Ukraine's banking sector



Panel A. The NPL ratio for the system and the NPL amount at current prices

Exposures to Related Parties in Compliance with Requirements.

[7] Notwithstanding the role of economic conditions and banking practices, it is worth mentioning that such a high NPL level was also attributed to the malfunctioning of Ukraine's legislative system, which caused limitations and a lack of incentives for banks to foreclose or restructure assets (IMF Staff Country Reports 2017, Ukraine: 2016 Article IV).



Panel B. NPL ratios by groups of banks and for the system
Source: National Bank of Ukraine; Note: Based on NBU calculations, banks are grouped according to bank classification on April 1, 2021.

Additionally, after the nationalization of the largest private commercial bank in Ukraine (PrivatBank) in 2016, the chunk of NPL in the state-owned banks was around 70% of the whole system's bad loans at the beginning of both 2022 and 2021 (75% at the beginning of 2020), according to NBU data.

Some effective steps should be taken urgently to resolve the high NPL volume issue. The Law on Financial Restructuring, introduced in 2017, set the legal base for out-of-court debt restructuring and gave some positive push, but in practice, it did not resolve the crucially high level of NPLs (Gontareva & Stepaniuk, 2020). In June 2019, the NBU published requirements for nonperforming assets management in commercial banks to enhance and accelerate the NPL reduction process (NBU, 2019b). After incorporating all measures, the reduction has been slower than expected because many impediments still exist, and the NPL ratio was 41% and 30% as of the beginning of 2021 and 2022, respectively, i.e., decreasing by 7.4 p.p. and 11 p.p. year-on-year. Bad loans have an approximate provisioning coverage ratio of 100%. Owing to the overall improved loan underwriting practices of local banks, further

NPL growth is moderate.[8]

1.4 HYPOTHESES, DATA, AND METHODOLOGY

1.4.1 Hypotheses

This study draws on Berger and de Young (1997), Salas and Saurina (2002), Podpiera and Weill (2008), Louzis et al. (2012), Zhang et al. (2016), etc., which examine the determinants of NPLs.

Based on the literature review and the context of Ukraine's banking sector development, we examine three key variables that determine NPLs in Ukraine.[9] First, a bank's lending to entities related to its owners, related party lending, (related lending) may increase NPLs. In particular, La Porta et al. (2003) report that loans to a firm controlled by the bank's owners in Mexico are 33% more prone to default than unrelated ones.[10] The widespread related lending in the Ukrainian banking sector led to the deterioration of banks' loan portfolios and bank failures (Gontareva & Stepaniuk, 2020).[11] Second, a concentration of a bank's lending to certain borrowers (namely, a large exposure concentration) may lead to an increase or decrease in NPLs.[12] Third, a low bank capitalization may increase NPLs because a bank with low capital has an incentive to take more risks to maximize profit. This argument does not have unified

[8] For more details on the Ukrainian banking sector's developments, please see the Financial Stability Reports of the NBU or Gontareva and Stepaniuk (2020).

[9] We leave other possible factors, for instance, the quality of corporate governance in the Ukrainian banking sector, for further studies.

[10] Moreover, they argue that related party lending originates in situations where "*…banks are controlled by persons or entities with substantial interests in nonfinancial firms. Quite often, a significant fraction of bank lending is directed toward these related parties, which include shareholders of the bank, their associates and family, and the firms they control.*" (La Porta et al., 2003, p. 321)

[11] According to the NBU's examinations, related party lending was almost always carried out without proper analysis of borrowers' financial health, often with fake collateral, on nonmarket terms, and there were ongoing restructurings to cover the poor quality of such assets (NBU, 2018). Overall, banks in Ukraine did not properly assess the credit risks of related party borrowers and often issued loans at the direct instruction of the shareholders. The devastating consequences of this practice in the Ukrainian banking sector were the overload of the Deposit Guarantee Fund and the severe cost to the state budget and banks' clients (NBU, 2018).

[12] The NBU conducted stress testing of banks' large borrowers in 2014 and 2015–2016 to reveal that banks at that time had a high concentration on large borrowers (Gontareva and Stepaniuk, 2020). This type of imperfect diversification arose due to various factors, like poor practices in borrowers' financial health assessment, poor risk management, and concentration in Ukrainian markets.

evidence in the literature.

Fourth, the effects of related lending, the concentration of large exposures, and bank capital on NPLs might be nonlinear, depending on the type of bank ownership and the size of the bank. It is important to examine this possibility, as private domestic banks were most exposed to related lending practices in Ukraine (NBU, 2018).

Most studies argue that macroeconomic factors have an impact on banks' asset quality (Espinoza & Prasad, 2010). NPLs are countercyclical to the business cycle measured by GDP growth, and unemployment, inflation, lending rates, and foreign exchange rates are positively associated with bad loans (Lawrence, 1995; Nkusu, 2011). Hence, we incorporate real GDP growth, the cost of loans, inflation, and the unemployment rate into our model for examining the determinants of NPLs as controls.[13] Finally, as a feedback effect, NPLs may adversely affect the banking sector and economy, following Espinoza and Prasad (2010) and Klein (2013). Accordingly, we seek to test the following hypotheses:

Hypothesis 1: A bank's related lending increases NPLs;

Hypothesis 2: A concentration of a bank's large exposures increases NPLs;

Hypothesis 3: A higher level of bank capitalization may be associated with lower NPLs;

Hypothesis 4: The effects of related lending, the concentration of large exposures, and bank capital on NPLs differ depending on the type of bank ownership and the size of the bank;

Hypothesis 5: NPLs adversely affect the banking sector and economy.

Hypotheses 1–3 indicate that we examine related lending and concentration of banks' large exposures as determinants of NPLs in Ukraine, which drew less attention in the literature,

[13] Although the banking sector of Ukraine experienced mainly some exogenous shocks in 2008 and 2014–2015, which worsened banks' stance, yet those shocks did not cause the occurrence of banks' problems (Gontareva & Stepaniuk, 2020). Furthermore, according to NBU (2019a), the banking sector's internal issues were major determinants of loans' quality deterioration to the NPL status, though some external factors decreased loans quality indeed.

and bank capitalization that were often considered in the existing literature. Hypothesis 4 examines the possible nonlinear effects of the three key variables on NPLs depending on bank ownership and size. We also test the feedback effect of NPLs on the banking sector and economy in Hypothesis 5. The descriptions of variables in hypotheses 1–4 and their expected signs in the test are provided in Table 1.1.

Table 1.1: Description of variables and their expected signs in the hypotheses

Variable	Description	Expected sign
Related lending	Loans to banks' related parties	(+)
Large exposures	Loans to banks' large borrowers	(+/-)
Bank capitalization	Banks' capital adequacy ratio calculated as regulatory capital over risk-weighted assets	(-)
Bank size	Size of bank asset (large, upper-medium, medium, and small)	(+/-)
Bank ownership	Bank ownership (state-owned, private, foreign, Russian)	(+/-)

1.4.2 Data

For our study, we constructed a dataset that consists of quarterly observations of Ukrainian banks' financial indicators, banking sector characteristics, and macroeconomic variables, which covers the period from Q2 (2008) to Q4 (2020).[14]

Table 1.2: Bank groups by size

Percentile	Total	<p50	p50~75	p75~90	p90~95	p95~98	p98~99	≥p99
As of end-2Q 2008								
Number of banks	178	89	45	27	9	5	2	1
Mean assets (2008 UAH m)		375	1,409	5,832	16,682	29,593	45,767	75,738
Median assets (2008 UAH m)		336	1,319	5,051	16,090	27,690	45,767	75,738
Share of total assets (%)	100	4.6	8.8	21.9	20.9	20.6	12.7	10.5
As of end-4Q 2020								
		<p50	p50~75	p75~90	p90~95	p95~98	p98~99	≥p99
Number of banks	74	37	19	11	4	2	1	0
Mean assets (2008 UAH m)		1,819	7,972	44,603	130,133	261,024	471,712	0
Median assets (2008 UAH m)		1,683	6,577	36,497	127,418	261,024	471,712	0
Share of total assets (%)	100	3.0	6.8	22.1	23.4	23.5	21.2	0.0

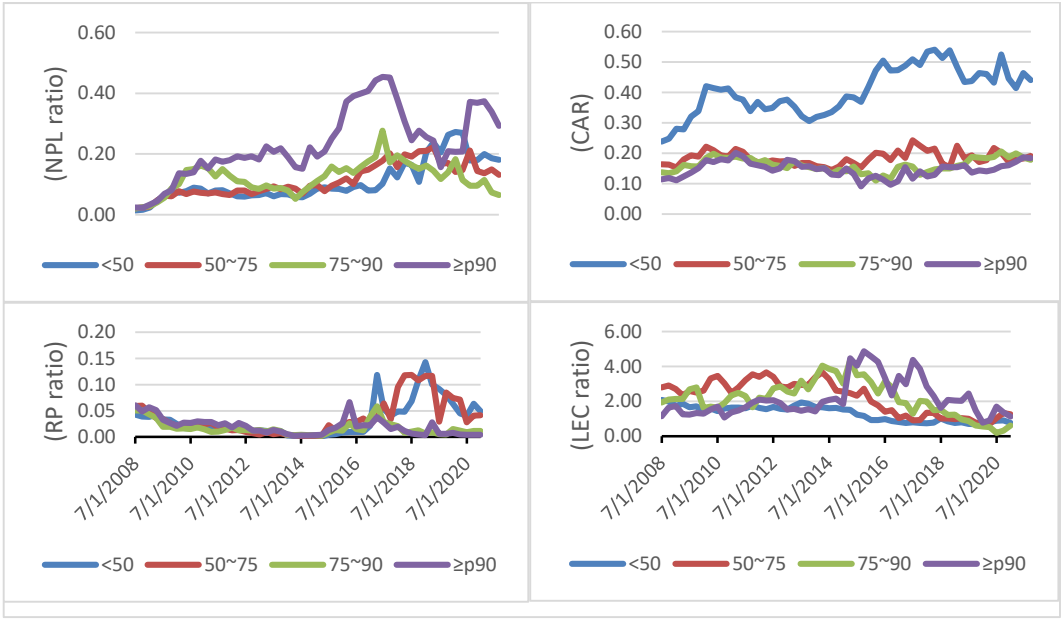
[14] Most data for the earlier period are unavailable.

Notes: Banks' grouping is based on original data. Authors' compilations and calculations, UAH million and %.

As indicated in Table 1.2, the size distribution of our data is heavily skewed, implying that the top 10% of banks concentrated 65% and 68% of assets in Q2 (2008) and Q4 (2020), respectively, and had substantially larger mean and median assets than other banks. In addition, Table 1.2 indicates the substantial decrease in the number of banks from 2008 to 2020 years (from 178 to 74, respectively), largely due to the 2014–2016 economic and banking crises. Meanwhile, both mean and median assets increased across all groups.

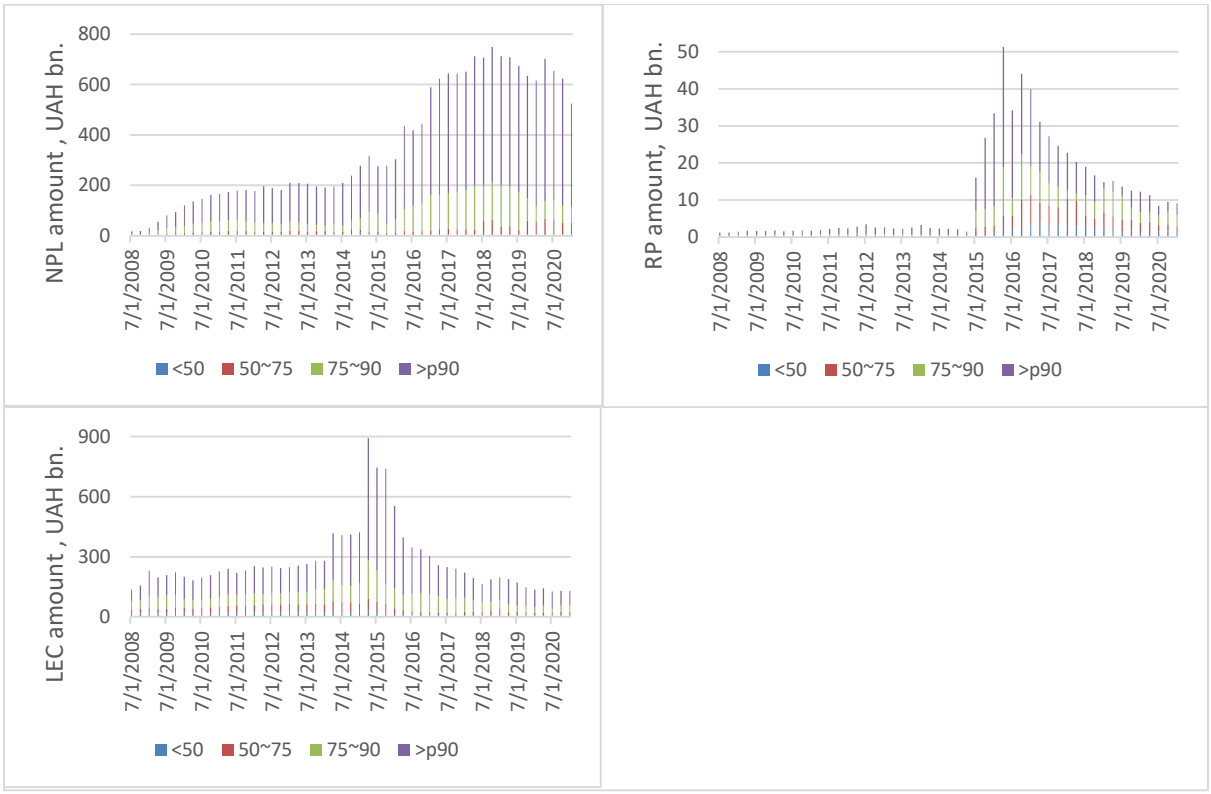
Several studies (Kashyap & Stein, 2000; Kim & Sohn, 2017) report that banks behave differently depending on their size in terms of NPL ratio, the ratio of loans to related parties, and the ratio of large loan exposures, as well as the amounts. We divide the sample into four groups: small banks with total assets of less than 50th percentile in each period, medium banks with 50–75th percentiles, upper-medium banks with 75–90th percentiles, and large banks with above 90th percentile (Figure 1.2).

Figure 1.2: NPL Median by percentile groups



Panel A. Median by percentile groups: NPL ratios

Notes: NPL ratio is banks' NPLs to total gross loans; CAR is the capital adequacy ratio calculated as regulatory capital over risk-weighted assets (N2 ratio for Ukraine banks); RP ratio – all claims to banks related parties over regulatory capital (N9 ratio for Ukraine banks); LEC ratio – all claims to banks large exposures over regulatory capital (N8 ratio for Ukraine banks). Note: the authors' calculation of percentile groups by assets in 2008 prices. Banks' observations with empty data for CAR and loans with zero values are deleted; 2008 prices.



Panel B. Median by percentile groups: *NPLs in* UAH units.

Notes: NPLs are the amount of nonperforming loans; RP – the amount of all claims to banks-related parties; LEC – the amount of all claims to banks` large exposures. The authors' calculation of percentile groups by assets in 2008 prices. Banks' observations with empty data for CAR and loans with zero values are deleted; 2008 prices.

The median of both NPL ratio and NPL amount of large banks was substantially larger than the other groups for most of our sample time span. The median indicators of large and small bank groups were typically opposite one another. Therefore, it would be misleading to apply the full single sample regression analysis because the results could be heavily affected by some particular group of banks (Kim & Sohn, 2017).

We also divided our sample into five groups by ownership type, namely state-owned banks (excluding private banks that are state-owned since 2016 end), foreign banks (excluding Russian), Russian banks, and private banks. The NBU has classification only for acting banks, and thus we hand-collected the ownership information for failed and closed banks as well. Table 1.3 shows that the asset distribution among bank groups by their ownership types is not homogeneous. The state banks accounted for about a third (and about half with PrivatBank) of the Ukrainian banking system's assets in Q4 (2020), while the fraction of private banks

substantially decreased over 2008–2020, largely due to banks' failures in 2014–2016.

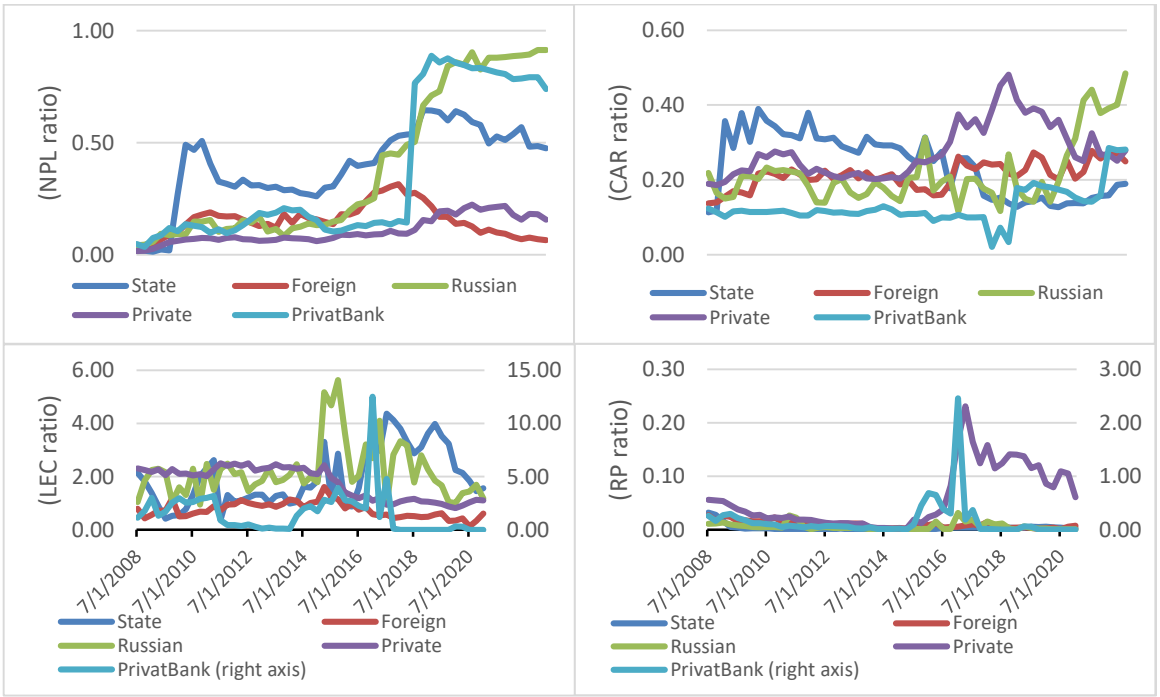
Table 1.3: Banks groups by ownership types

	Total	State	PrivatBank	Foreign	Russian	Private
As of end-2Q 2008						
Number of banks	178	3	1	30	6	138
Mean assets (2008 UAH m)		19,772	75,738	8,960	4,057	2,112
Median assets (2008 UAH m)		23,852	75,738	3,864	1,951	628
Share of total assets (%)	100	8.2	10.5	37.4	3.4	40.5
As of end-4Q 2020						
		State	PrivatBank	Foreign	Russian	Private
Number of banks	74	4	1	18	2	49
Mean assets (2008 UAH m)		174,115	471,712	34,750	22,556	7,855
Median assets (2008 UAH m)		204,316	471,712	11,696	22,556	2,462
Share of total assets (%)	100	31.3	21.2	28.1	2.0	17.3

Notes: Banks' grouping is based on original data, authors' compilations, and calculations, UAH million and %.

Figure 1.3 shows that there are substantial differences in the NPL ratio, loans to related parties' ratio, and large exposures ratio, as well as the amounts among bank groups by ownership type. The median NPL ratio of state banks is usually higher compared to private banks, while related party lending practices are largely identified in private banks.

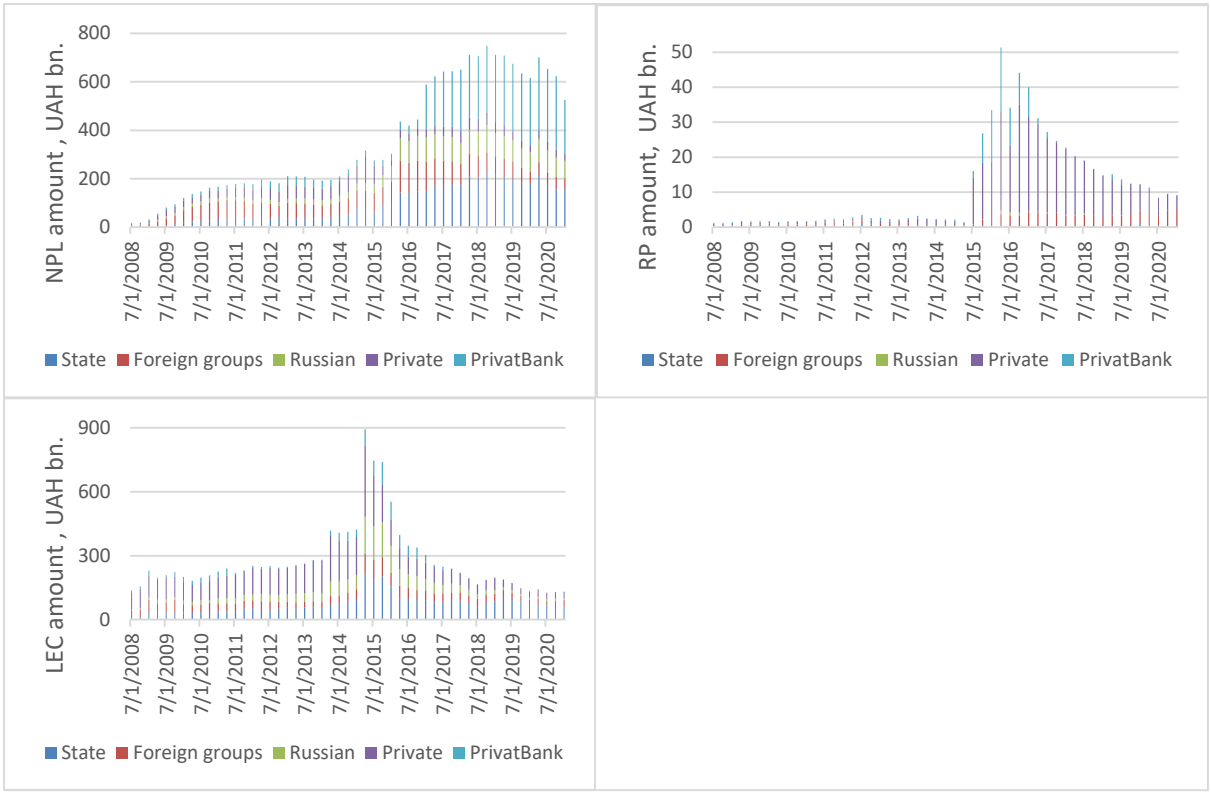
Figure 1.3: NPL Median by ownership groups



Panel A. Median by ownership groups: ratios

Notes: NPL ratio is banks' NPLs to total gross loans; CAR is the capital adequacy ratio calculated as regulatory capital over risk-weighted assets (N2 ratio for Ukraine banks); RP ratio – all claims to banks related parties over

regulatory capital (N9 ratio for Ukraine banks); LEC ratio – all claims to banks large exposures over regulatory capital (N8 ratio for Ukraine banks). Note: the authors' computation of ownership groups. Banks' observations with empty data for CAR and loans with zero values are deleted; 2008 prices.



Panel B. Median by ownership groups: UAH units

Notes: NPLs are the amount of nonperforming loans; RP – the amount of all claims to banks-related parties; LEC – the amount of all claims to banks` large exposures. The authors' computation of ownership groups. Banks' observations with empty data for CAR and loans with zero values are deleted; 2008 prices.

Our dataset is unbalanced because, during the study period, some banks were closed, acquired, merged, liquidated, or had their licenses revoked, while new banks were opened. Five banks were excluded from the original sample because they either did not perform any lending activities or had fewer than five quarters of observations. We also removed a large outlier, namely the largest state-owned bank, Privatbank. We dropped several observations for the banks at the beginning of their operational activities, as NPLs would emerge only after some time (typically 90 days). Banks' observations of negative regulatory capital were excluded, as the NBU restrictions on the active operations of such banks were most likely to be imposed. Finally, we excluded observations of banks that had a quarterly change of assets that was either higher than 50% or lower than 50%. We checked all variables for outliers and missing values to minimize their influence. Lastly, the bank examination revealed a pattern that failed banks

whose assets were transferred to the Deposit Guarantee Fund (DGF) had some reporting issues, and hence, we dropped such incorrect observations. All variables were measured in Ukrainian hryvnia and deflated to 2008 prices.

After all the adjustments, we end up with 207 banks and 51 periods (from Q2 (2008) to Q4 (2020)), resulting in an unbalanced panel of 6496 observations. The number of observations is expected to decrease as we include lagged variables in the models. We initially considered 30 bank- and sector-specific variables and 8 macroeconomic data series. According to the pairwise correlation between variables and multicollinearity analysis, we ended up with seven bank-specific variables, one sector-specific variable, four macroeconomic variables, and four dummies.[15] We apply these dummies for controlling for crises and regulation/accounting changes. As such, we have two dummies that indicate the 2008–2009 and 2014–2016 banking crises: a dummy for changes in banking regulation and a dummy for changes in accounting requirements (the introduction of IFRS 9).[16]

1.4.3 Methodology

To test hypotheses 1–4, we employed a fixed-effects panel method following Berger and de Young (1997), Ghosh (2015), and Louzis et al. (2012), who showed that bank-specific factors and NPLs were endogenous. We examined a dynamic causal relationship between NPLs and chosen bank-specific factors controlled for industry and macroeconomic variables in the Ukrainian banking sector (Ghosh, 2015; Podpiera & Weill, 2008).[17] To test hypothesis 5, on the feedback effect of NPLs, we adopt the PVAR model (Abrigo & Love, 2016; Grossmann et al., 2014; Love & Ariss, 2014; Love & Zicchino, 2006).

[15] Not shown to conserve space; available upon request.
[16] We have identified banking crises periods based on literature review that includes NBU statements; notable regulation changes started in 2015 with implementation of Regulation #315 mentioned earlier; IFRS 9 was introduced by banks in Ukraine on January 1, 2018.
[17] We especially take into account Kim and Sohn (2017) who grounded and applied the fixed effects panel method and discussed the application of the system GMM panel methodology.

1.4.3.1 Fixed Effect Panel Data Estimation

Our model specifications for multivariate panel data for time *t* and bank *i* are as follows:

$$NPLs_{it} = \Gamma_0 + \Gamma_1 X_{it-1} + \Gamma_2 Size_{it-1} + \Gamma_3 Ownership_{it-1} + \Gamma_4 X_{it-1} * Size_{it-1} * Ownership_{i-1} + \Gamma_5 Controls_{it} + \varphi_i + \theta_s + Y_j + \varepsilon_{it}, \quad (1.1)$$

where $NPLs_{it}$ is a logarithmic transformation of the amount of NPLs in bank i at quarter t,[18] which include loans to corporates, individuals, interbank, and public authorities as well as local governments.[19] X_{it-1} stands for a vector of variables of our main interest lagged for a one-quarter period, namely $Related\ Lending_{it-1}$ is the log-transformed related parties lending (all claims amount to banks' related parties recognized by banks, i.e., corporates and individuals that are connected to banks owners), $Large\ Exposure_{it-1}$ is the log-transformed large exposure concentrations (all claims amount to banks' large exposures, i.e., exposures that exceed 10% of banks' regulatory capital), $Bank\ Capitalization_{it-1}$ is bank capitalization measured by the capital adequacy ratio of banks.[20] We use bank size $Size_{it-1}$ and ownership $Ownership_{it-1}$ dummies as banks behave differently based on their size and ownership structure and add interaction terms of these variables with each variable of our main interest. By implementing such interactions, we intend to see the impact of examined NPL factors across banks depending on their size and ownership. We add a one-period lag of NPL, $NPLs_{it-1}$, as an explanatory variable to account for their persistence.

[18] Although many studies used the ratio of NPLs over total gross loans, we utilized NPL amount in our study. There are several reasons for this. First, we focus on the determinants of NPL stock per se. We are not looking for cross-banks comparability of either NPLs or banks' lending behavior but rather for the bad loans' stock of banks, controlling for the change in banks' market share by total assets and by banks' age. Second, the ratio application would have misled us because, for example, the same ratio size for large and small banks in fact, has a different implication for the banking system. Last but not least, usually the figures of NPL amount per bank are harder to obtain. So, having level data gives us a chance to better explore the factors behind NPL stock. We use the logarithmic transformation of NPLs to avoid the non-normality of the error-term distribution, taking non-linearity into consideration.

[19] In future, NPLs of corporates and individuals may be studied separately upon the data availability. We reckon that most likely retail NPLs may have different determinants than corporates NPLs.

[20] Our model's coefficients have captured a short-term influence on NPLs due to a change in the variable (Kim & Sohn, 2017). The long-run effect could be found by dividing some particular coefficient by (1-the coefficient of $NPLs_{it-1}$).

$Controls_{it}$ refers to a vector of macroeconomic variables lagged for two periods to account for the time it takes for macroeconomic shocks to influence banks' loan portfolios, a banking sector variables lagged for one period, bank characteristics lagged and non-lagged, controls for changes in banking regulation and accounting requirements, and banking crises in Ukraine.[21] We include a variety of control variables to account for bank-, sector-, and macro-specific variables, banking system conditions, and regulatory changes. For bank-level controls, we use bank market share ($Market\ Share_{it}$) measured by a ratio of a bank's assets to the whole banking system's assets, bank age ($Bank\ Age_{it}$) measured in years from a bank registration date; and banks' profitability measured by the return on assets ratio (ROA_{it-1}). We utilize banking sector dollarization ($Dollarization_{it-1}$), measured by the lagged ratio of foreign currency-denominated loans to total loans. To account for macroeconomic conditions, we use the lagged unemployment rate ($Unempl_{t-2}$), the consumer price index (CPI_{t-2}), real GDP growth rate ($Real\ GDP\ _{t-2}$), and the cost of loans to the real sector of the economy ($Loans\ Cost_{t-2}$), measured by the interest rate on loans. We interpret the real GDP growth rate as a proxy measure of macroeconomic shocks that affect all banks uniformly. Further, we consider dummy variables to account for changes in banking regulation ($Reg\ Change$) and accounting requirements ($IFRS\ 9$) and the two periods of banking crises in Ukraine, where $Crisis\ 08$ and $Crisis\ 14$ stand for the 2008–2009 and 2014–2016 crises, respectively. [22] Akaike's and Schwarz's Bayesian information criteria are used to test the correctness of the lag selection.

Finally, φ_i refers to a vector that captures the fixed effects of all unobserved time-invariant NPL determinants at the bank level. We also take seasonality and the business cycle

[21] We use a one-period lag for bank- and sector-specific factors and a two-period lag for macroeconomic determinants to account for the gap between shocks in any independent variables and changes in banks' NPLs.
[22] Although banks in Ukraine moved to IFRS from December 1, 2015, here we account for IFRS 9 only, as this standard has a significant effect on asset quality assessment in banks.

into account by including quarterly θ_s and yearly Y_j dummies. ε_{it} is a vector of residuals.

Table 1.4 gives a summary of the descriptive statistics for the variables used in the regressions. The mean of log-transformed NPLs, which are measured in millions of hryvnias (the national currency of Ukraine), is about 3.88, whereas the standard deviation and maximum are 4.64 and 11.64, respectively. Meanwhile, related lending (log-transformed monetary units) varies with a 4.17 standard deviation from the mean of 0.29 and a maximum of 9.28. Furthermore, the large exposure (log-transformed monetary units) mean is at 5.41, while the standard deviation and maximum are at 4.14 and 11.58, respectively. Lastly, the capital adequacy mean is about 40% with a standard deviation of 79%.

Table 1.4: Summary statistics

Variable	Mean	Std. dev.	Min	Max
NPLs	3.88	4.64	-13.82	11.64
Related Lending	0.29	4.17	-13.82	9.28
Large Exposure	5.41	4.14	-13.82	11.58
Bank Capitalization	0.40	0.79	0.01	25.39
Ownership: State	0.04	0.18	0.00	1.00
Ownership: Foreign	0.18	0.39	0.00	1.00
Ownership: Russian	0.04	0.20	0.00	1.00
Ownership: Private	0.74	0.44	0.00	1.00
Size: Large	0.09	0.29	0.00	1.00
Size: Upper-medium	0.16	0.36	0.00	1.00
Size: Medium	0.26	0.44	0.00	1.00
Size: Small	0.49	0.50	0.00	1.00
Market Share	0.01	0.02	0.00	0.18
ROA	0.00	0.08	-1.93	1.59
Bank age	15.71	7.30	0.27	29.24
Dollarization	0.48	0.07	0.35	0.60
Unempl	0.08	0.01	0.05	0.11
CPI	0.08	0.10	-0.01	0.43
Real GDP gr	0.05	0.16	-0.37	0.25
Loans Cost	0.18	0.03	0.13	0.28
Reg Change	0.30	0.46	0.00	1.00
IFRS 9	0.13	0.34	0.00	1.00
Crisis 08	0.13	0.33	0.00	1.00
Crisis 14	0.22	0.42	0.00	1.00

Notes: The dependent variable, NPL, is the log transformation of the total amount of bad loans; Related Lending stands for the log transformation of all claims to banks' related parties lagged; Large Exposure is the log transformation of all claims to large exposures lagged, a measure of large exposures concentration; Bank Capitalization is the lagged capital adequacy ratio. Following the NBU classification, we have divided our sample into five groups by ownership type, namely state-owned banks (excl. PrivatBank), PrivatBank, and foreign banks (banks that belong to foreign banks groups excl. Russian), Russian banks, and private banks. Privatbank has been excluded from the analysis as an outlier. Large banks are defined as having total assets that are higher than the 90th percentile for each period; upper-medium banks, from the 75th to 90th percentiles; medium banks, from the 50th to 75th percentiles; and small banks, below the 50th percentile. Market Share is the measure of a bank market share; ROA is the return on assets lagged; Bank age – bank age from the registration date; Dollarization – banking

sector dollarization ratio lagged; Real GDPgr is the quarterly real GDP growth rate lagged; CPI stands for lagged inflation; Unempl is the quarterly unemployment rate lagged; Loans Cost is the lagged aggregate cost rates on loans to the real sector of the economy; Crisis 08 – dummy, 1 for the period from Q4 (2008) to Q4 (2009); Crisis 14 – dummy, 1 for the period from Q1 (2014) to Q4 (2016); Reg Change – dummy, 1 for the period starting from Q2 (2015); IFRS 9 – dummy, 1 for the period starting from Q1 (2018).

We develop a dynamic panel model with a fixed-effect estimator as in Eq. (1.1), which allows us to account for time-invariant bank-specific heterogeneity and bank-invariant but time-variant unobserved factors.[23] According to Brei et al. (2013), the application of the fixed effect estimator is consistent with the case of a nonrandomly selected sample of banks from the population. Fixed effect estimators may be appropriate whenever the number of *t* is large enough (Roodman, 2009), and Judson and Owen (1999) argue that fixed effects perform well when the data span more than 30 periods. In this study, we have 51 periods that justify the application of the fixed effect panel method.

1.4.3.2 System GMM - PVAR Estimation

We construct the PVAR model because it keeps an unobserved individual heterogeneity of panel data, allowing us to incorporate a fixed effect. Also, PVAR considers the simultaneous dependence of each variable on its historical value and other variables in the model (Love & Zicchino, 2006).[24] We apply the model by Andrews and Lu (2001) and moment selection criteria (MMSC)[25] to apply the first-order PVAR as our optimal lag order. Hence, the first-order PVAR model is as follows:

$$Z_{it} = \Gamma_0 + \Gamma_1 \mathrm{A}(L) Z_{it} + \varphi_i + \varepsilon_{i,t}\,, \tag{1.2}$$

where *i* denotes the number of banks and *t* refers to time, $\mathrm{A}(L)$ stands for a lag operator $\mathrm{A}(L) = \mathrm{A}_1 L^1 + \mathrm{A}_2 L^2 + \cdots + \mathrm{A}_p L^p$, where p refers to a lag order that equals 1, and Z_{it} is a vector of stationary variables, *NPLs, Related Lending, Large Exposure, Bank Capitalization,*

[23] We performed several tests, including the panel unit root test and Hausman test, to confirm the use of a fixed effects model. The results are available upon request.

[24] The Appendix contains some more details of the PVAR methodology. For more on PVAR details and advantages, please refer to Abrigo and Love (2016) and Love and Zicchino (2006).

[25] Andrews and Lu's (2001) optimal MMSC simulates the widely used likelihood-based selection criteria Akaike's Information Criteria (AIC), Hannan-Quinn Information Criteria, and Bayesian Information Criteria (HQIC), which are based on the Hansen's J statistic of testing over-identifying restrictions.

Dollarization, Real GDP growth, CPI, and *Unempl*. φ_i refers to a vector that captures the fixed effects of all unobserved time-invariant NPL determinants at the bank level. And $\varepsilon_{i,t}$ stands for a vector of residuals with $\mathrm{E}(\varepsilon_{it}) = 0;\ \mathrm{E}\left(\varepsilon_{it}^{'}\varepsilon_{it}\right) = \Sigma;\ \mathrm{E}\left(\varepsilon_{it}^{'}\varepsilon_{ip}\right) = 0$ for $t > p$. Table 1.5 gives a summary of descriptive statistics for the variables used in our PVAR model. As in Love and Ariss (2014), we do not account for time-fixed effects in this model because we have panel invariant macro variables to be accounted for.

Table 1.5: Summary statistics for PVAR model variables.

Variable	Mean	Std. dev.	Min	Max
NPLs	3.88	4.64	-13.82	11.64
Related Lending	0.34	4.14	-13.82	9.28
Large Exposure	5.39	4.19	-13.82	11.58
Bank Capitalization	0.39	0.73	0.01	25.39
Dollarization	0.48	0.07	0.35	0.60
Real GDP gr	0.05	0.16	-0.37	0.33
CPI	0.09	0.10	-0.01	0.43
Unempl	0.09	0.01	0.05	0.11

Notes: The dependent variable, NPLs, is the log transformation of the total amount of bad loans; Related Lending stands for the log transformation of all claims to banks' related parties lagged; Large Exposure is the log transformation of all claims to large exposures lagged, a measure of large exposures concentration; Bank Capitalization is the lagged capital adequacy ratio; Dollarization – banking sector dollarization ratio lagged; Real GDPgr is the quarterly real GDP growth rate lagged; CPI stands for lagged inflation; Unempl is the quarterly unemployment rate lagged. All variables are included in levels except for Dollarization, which is included in differences.

Next, we have applied the forward orthogonal deviation (FOD) transformation of Arellano and Bover (1995) (i.e., the "Helmert procedure"), under which independent variables remain accurate instruments because FOD does not include past realizations (Abrigo & Love, 2016). Also, FOD keeps more data in case of missing observations or unbalanced panels. Further, we have applied the variance-covariance matrix of errors decomposition proposed by Sims (1980), also known as the Cholesky decomposition, meaning that the order of variables in the VAR model should be recursive depending on their exogeneity. In our study, following the existing literature and our hypotheses, we state the following order: Real GDP growth → Unemployment → CPI → Dollarization → Related Lending → Large Exposure → Bank

Capitalization → NPLs. We suggest that macroeconomic variables enter the model first; followed by sector- and bank-specific factors.

We further obtained the Granger causality among used variables and examined the short-term response of a particular variable from the model to a one-standard-deviation exogenous shock in NPLs, provided all other shocks equal zero (Love et al., 2016).[26] We explore this by applying the impulse-response function (IRFs) that is constructed on already estimated PVAR coefficients and their standard errors (Abrigo & Love, 2016). For this, we have estimated the function's confidence intervals, which are computed utilizing Monte Carlo simulations with 500 bootstraps. Thus, with the help of IFRs, we can study the feedback effect of NPLs on the macroeconomic, sector-, and bank-specific variables (Klein, 2013). Lastly, we have estimated and presented the variance decomposition according to Abrigo and Love (2016), which expresses the percentage change of a variable due to shocks in NPLs accumulated over time.

1.5 EMPIRICAL RESULTS

1.5.1 Panel Fixed Effects Estimation

Table 1.6 indicates the estimates of various specifications of Eq. (1.1) using the panel fixed effects method.[27] There is a strong persistence of NPLs, indicating a 66–67% effect from the previous quarter's NPLs to the present quarter. Such a large magnitude implies that the shock of NPLs will be long-lasting for each bank, and that the NPL reduction will take a sufficient amount of time (Ghosh, 2015). NPLs tend to rise with an increase in *Related Lending* with its coefficients of 0.026 – 0.034 that are statistically significant at 5% or 10% levels,

[26] There are several possible causes for such a shock. Please refer to, for example, Huljak et al. (2020) for more information.

[27] Actually, we first checked the results of static panel fixed effect estimations. Although they are biased because they do not account for the persistence of previous periods' NPL impacts, the signs of interest coefficients are going in line with our expectations. Please see Appendix Table A 1.1.

confirming hypothesis 1. This result implies that a 10% increase in *Related Lending* causes on average an increase in NPLs of about 0.26% in the next quarter and about 0.77% in the long run (Specification 4).[28] The table shows that *Large Exposure* is not statistically significant across all models. Specifications (3) and (4) show that a 10-percentage point decrease in *Bank Capitalization* leads to an increase in NPL of 1.35 – 1.37% in the next quarter, validating hypothesis 3.

We also find that the coefficients for *State*, *Foreign*, and *Russian* are positive (0.539, 0.879, and 0.707, respectively, in the model specification (4)) with respect to *Private*, suggesting that state, foreign, and Russian banks tend to have higher NPLs compared to private banks. The coefficients of *Large, Upper Medium,* and *Medium* are positive (0.929, 0.776, and 0.483, respectively – specification (4)) with a reference of *Small*, suggesting that the larger the bank size, the higher the NPL compared to small banks in Ukraine.

Table 1.6: Baseline Panel FE models

	(1)	(2)	(3)	(4)
NPLs $_{t-1}$	0.673***	0.669***	0.665***	0.662***
	(0.036)	(0.035)	(0.036)	(0.036)
Related Lending$_{t-1}$	0.034**	0.032**	0.027*	0.026*
	(0.015)	(0.014)	(0.014)	(0.014)
Large Exposure$_{t-1}$	0.004	0.006	0.002	0.004
	(0.012)	(0.012)	(0.012)	(0.012)
Bank Capitalization$_{t-1}$	-0.134	-0.132	-0.137*	-0.135*
	(0.086)	(0.082)	(0.080)	(0.077)
State $_{t-1}$		0.492**		0.539**
		(0.212)		(0.222)
Foreign $_{t-1}$		1.019**		0.879**
		(0.415)		(0.376)
Russian $_{t-1}$		0.746**		0.707**
		(0.368)		(0.340)
Private $_{t-1}$		Reference		Reference
Large $_{t-1}$			0.972***	0.929***
			(0.212)	(0.214)
Upper-medium $_{t-1}$			0.825***	0.776***
			(0.207)	(0.201)
Medium $_{t-1}$			0.524***	0.483***
			(0.190)	(0.178)
Small $_{t-1}$			Reference	Reference

[28] To calculate the long run coefficient, we have divided the coefficient of lagged *Related Lending* by one minus the coefficient of lagged NPLs from Table 1.6 Model 4 [0.026/(1-0.662)].

Controls	Yes	Yes	Yes	Yes
Adj. R^2	0.571	0.572	0.574	0.574
Observations	5923	5923	5923	5923

Notes: The dependent variable, NPLs, is the log transformation of the total amount of bad loans; Related Lending stands for the log transformation of loan amounts advanced to related parties; Large Exposure is the log transformation of the loan amounts advanced to large clients; Bank Capitalization is the capital adequacy ratio; Following the NBU classification, we have divided our sample into five groups by ownership type, namely state-owned banks (excl. PrivatBank), PrivatBank, foreign banks (banks that belong to foreign banks groups excl. Russian), Russian banks, and private banks. Privatbank has been excluded from the analysis as an outlier. Large banks are those with total assets above the 90th percentile in each period; upper-medium banks, from the 75th to 90th percentiles; medium banks, from the 50th to 75th percentiles; and small banks, below the 50th percentile. Controls include banks' return on assets ratios, banks' market shares, bank sector dollarization, the real GDP growth rate, the CPI, the aggregate cost rates on loans to the real sector of the economy, unemployment, dummies for the 2008–2009 and 2014–2016 banking crises, dummies for changes in banking regulation and accounting requirements. All regressions account for seasonality and the business cycle by including quarterly and yearly dummies. A constant is not reported but included in all models. Clustered by banks robust standard errors, reported in parentheses. *, **, and *** denote significance at 10 %, 5 %, and 1 %, respectively.

To see the different behavior of banks depending on their size and ownership type more closely, we include the interaction terms of *Related Lending, Large Exposure,* and *Bank Capitalization* with the size of banks (*Large, Upper Medium, Medium,* and *Small*) and ownership type (*State, Foreign, Russian,* and *Private*).

Table 1.7 shows the results of panel FE regression with these interaction terms for large banks. For large state-owned banks, only one factor – *Bank Capitalization* – is statistically significant, although the sign and especially magnitude do not match our expectations. A possible explanation for such a result is the supposition that state banks increased their *Bank Capitalization* right before the reclassification of some loans to NPLs. The high magnitude of the coefficient (-3.375) reveals that state-owned banks in Ukraine are among the largest banks having the highest NPLs on average. In contrast, we found that private banks have a negative statistically significant relationship between *Related Lending* and NPLs, though of a small magnitude (-0.097). It is assumed that, for instance, related borrowers less frequently defaulted on their debts owing to favorable loan conditions. Meanwhile, large Russian banks have a positive relationship between *Large Exposure* and NPLs (0.166). The output for large foreign banks goes in line with our expectations, though it is not significant. We conduct similar regressions also for upper-medium, medium, and small banks (see Appendix Table A 1.2).

Table 1.7: Panel FE models with interaction terms for large banks

	(1)	(2)	(3)	(4)
NPLs $_{t-1}$	0.672***	0.668***	0.669***	0.673***
	(0.036)	(0.036)	(0.036)	(0.035)
Related Lending $_{t-1}$	0.034**	0.020	0.034**	0.034**
	(0.016)	(0.019)	(0.017)	(0.015)
Large Exposure $_{t-1}$	0.005	-0.007	0.022	0.004
	(0.013)	(0.011)	(0.019)	(0.014)
Bank Capitalization $_{t-1}$	-0.131	-0.203	-0.099*	-0.137
	(0.084)	(0.197)	(0.053)	(0.086)
State $_{t-1}$	2.024***			
	(0.670)			
Foreign $_{t-1}$			0.901**	
			(0.349)	
Russian $_{t-1}$				-0.012
				(0.160)
Private $_{t-1}$		-1.190***		
		(0.368)		
Large $_{t-1}$	0.643**	0.313	0.507	0.610**
	(0.254)	(0.211)	(0.334)	(0.246)
State $_{t-1}$*Related Lending $_{t-1}$	-0.002			
	(0.032)			
State $_{t-1}$*Large Exposure $_{t-1}$	-0.061			
	(0.053)			
State $_{t-1}$*Bank Capitalization $_{t-1}$	-3.330***			
	(1.186)			
State $_{t-1}$*Large $_{t-1}$	-1.827**			
	(0.743)			
Foreign $_{t-1}$*Related Lending $_{t-1}$			-0.019	
			(0.030)	
Foreign $_{t-1}$*Large Exposure $_{t-1}$			-0.033	
			(0.024)	
Foreign $_{t-1}$*Bank Capitalization $_{t-1}$			-0.086	
			(0.179)	
Foreign $_{t-1}$*Large $_{t-1}$			-0.151	
			(0.485)	
Russian $_{t-1}$*Related Lending $_{t-1}$				-0.001
				(0.020)
Russian $_{t-1}$*Large Exposure $_{t-1}$				0.009
				(0.015)
Russian $_{t-1}$*Bank Capitalization $_{t-1}$				-0.231
				(0.651)
Russian $_{t-1}$*Large $_{t-1}$				-2.052**
				(0.844)
Private $_{t-1}$*Related Lending $_{t-1}$		0.015		
		(0.027)		
Private $_{t-1}$*Large Exposure $_{t-1}$		0.037		
		(0.028)		
Private $_{t-1}$*Bank Capitalization $_{t-1}$		0.124		
		(0.190)		
Private $_{t-1}$*Large $_{t-1}$		-0.141		
		(0.832)		
Large $_{t-1}$*Related Lending $_{t-1}$	-0.046**	-0.015	-0.050**	-0.041*
	(0.020)	(0.029)	(0.025)	(0.024)
Large $_{t-1}$*Large Exposure $_{t-1}$	-0.017	-0.003	-0.007	-0.004
	(0.018)	(0.015)	(0.026)	(0.019)
Large $_{t-1}$*Bank Capitalization $_{t-1}$	-0.974	-1.012	-1.054	-0.956
	(0.626)	(0.751)	(0.964)	(0.773)
State $_{t-1}$*Large $_{t-1}$*Related Lending $_{t-1}$	0.068			

	(0.050)			
State $_{t-1}$*Large $_{t-1}$*Large Exposure $_{t-1}$	0.077			
	(0.059)			
State $_{t-1}$*Large $_{t-1}$*Bank Capitalization $_{t-1}$	3.375**			
	(1.542)			
Foreign $_{t-1}$*Large $_{t-1}$*Related Lending $_{t-1}$			0.027	
			(0.043)	
Foreign $_{t-1}$*Large $_{t-1}$*Large Exposure			0.007	
			(0.030)	
Foreign $_{t-1}$*Large $_{t-1}$*Bank Capitalization $_{t-1}$			0.540	
			(1.279)	
Russian $_{t-1}$*Large $_{t-1}$*Related Lending $_{t-1}$				0.001
				(0.035)
Russian $_{t-1}$*Large $_{t-1}$*Large Exposure $_{t-1}$				0.166*
				(0.085)
Russian $_{t-1}$*Large $_{t-1}$*Bank Capitalization $_{t-1}$				0.573
				(1.115)
Private $_{t-1}$*Large $_{t-1}$*Related Lending $_{t-1}$		-0.097**		
		(0.042)		
Private $_{t-1}$*Large $_{t-1}$*Large Exposure $_{t-1}$		0.107		
		(0.085)		
Private $_{t-1}$*Large $_{t-1}$*Bank Capitalization $_{t-1}$		-0.526		
		(1.663)		
Controls	Yes	Yes	Yes	Yes
adj. R^2	0.571	0.572	0.572	0.570
Observations	5923	5923	5923	5923

Notes: Large banks are defined as having total assets that are higher than the 90th percentile for each period; upper-medium banks, from the 75th to 90th percentiles; medium banks, from the 50th to 75th percentiles; and small banks, below the 50th percentile. Following the NBU classification, we have divided our sample into five groups by ownership type, namely state-owned banks (excl. PrivatBank), PrivatBank, and foreign banks (banks that belong to foreign banks groups excl. Russian), Russian banks, and private banks. Privatbank has been excluded from the analysis as an outlier. The dependent variable, NPLs, is the log transformation of the total amount of bad loans; Related Lending stands for the log transformation of the loan amounts advanced to related parties; Large Exposure is the log transformation of the loan amounts advanced to large clients; Bank Capitalization is the capital adequacy ratio; Controls include banks return on assets ratios, banks market shares, bank sector dollarization, the real GDP growth rate, the CPI, the aggregate cost rates on loans to the real sector of the economy, unemployment, dummies for the 2008–2009 and 2014–2016 banking crises, dummies for changes in banking regulation and accounting requirements. All regressions account for seasonality and the business cycle by including quarterly and yearly dummies. A constant is not reported but included in all models. Clustered on banks' standard errors in parentheses. *, **, and *** denote significance at 10 %, 5 %, and 1 %, respectively.

We present Table 1.8, which contains the compilation of 48 coefficients estimated from FE panel regressions (3 key variables × 4 sizes × 4 ownership types) that are taken from Tables 1.7 and A 1.1. These results reveal that there is a nonlinear relationship for certain combinations of key factors, size groups, ownership types, and NPLs.

Overall, the results for non-large private banks were not anticipated. The only statistically significant - inverse - relationship (-0.08) between *Related Lending* and NPLs is for medium-sized private banks. To justify the findings, we may apply the information gained from some of the field professionals who considered *related* lending a valid banking business,

as it decreases the information asymmetry between a lender and a borrower as a bank may know everything needed to accurately assess the borrower's credit risk, provided that a positive spread between bank lending rates and bank funding costs is maintained. Of course, this thought has some pitfalls, as the approach had the clear incentive for bank owners to default on their debt to the bank and eventually leave DGF to deal with bank deposit holders. This happened in practice in Ukraine from 2014 to 2017.

Table 1.8: Panel FE model's coefficients of interaction terms classified by ownership types and size group

Size group	**Ownership type**	**Factors**			N	R2
		Related Lending $_{t-1}$	Large Exposure $_{t-1}$	Capital Adequacy $_{t-1}$		
Large $_{t-1}$	State $_{t-1}$	0.068 (0.050)	0.077 (0.059)	3.375** (1.542)	5923	0.571
Large $_{t-1}$	Foreign $_{t-1}$	0.027 (0.043)	0.007 (0.030)	0.540 (1.279)	5923	0.572
Large $_{t-1}$	Russian $_{t-1}$	0.001 (0.035)	0.166* (0.085)	0.573 (1.115)	5923	0.570
Large $_{t-1}$	Private $_{t-1}$	-0.097** (0.042)	0.107 (0.085)	-0.526 (1.663)	5923	0.572
Upper-medium $_{t-1}$	State $_{t-1}$	-0.036 (0.032)	0.097 (0.062)	4.227*** (1.228)	5923	0.572
Upper-medium $_{t-1}$	Foreign $_{t-1}$	-0.005 (0.037)	0.051* (0.027)	-0.177 (0.526)	5923	0.572
Upper-medium $_{t-1}$	Russian $_{t-1}$	0.031 (0.035)	0.115* (0.064)	1.808** (0.864)	5923	0.571
Upper-medium $_{t-1}$	Private $_{t-1}$	0.013 (0.026)	-0.043 (0.033)	0.096 (0.973)	5923	0.573
Medium $_{t-1}$	State $_{t-1}$	0.026 (0.041)	0.077 (0.116)	5.119*** (1.831)	5923	0.574
Medium $_{t-1}$	Foreign $_{t-1}$	0.095** (0.038)	-0.023 (0.040)	0.789 (0.921)	5923	0.576
Medium $_{t-1}$	Russian $_{t-1}$	0.033 (0.040)	0.008 (0.026)	0.321 (0.911)	5923	0.573
Medium $_{t-1}$	Private $_{t-1}$	-0.080** (0.034)	0.078 (0.067)	-0.441 (0.989)	5923	0.576
Small $_{t-1}$	State $_{t-1}$	0.007 (0.022)	-0.217*** (0.024)	-5.255*** (0.827)	5923	0.576
Small $_{t-1}$	Foreign $_{t-1}$	-0.108*** (0.041)	-0.027 (0.053)	-1.160* (0.695)	5923	0.577
Small $_{t-1}$	Russian $_{t-1}$	-0.031 (0.033)	-0.003 (0.030)	-0.068 (0.501)	5923	0.574
Small $_{t-1}$	Private $_{t-1}$	0.060 (0.037)	-0.049 (0.060)	0.955 (0.889)	5923	0.577

Notes: The table shows the results related to hypothesis 4 "interactions" only. The coefficients presented are the interaction terms between particulate size groups, factors, and ownership types (i.e., interactions between three variables). All other variables and interaction terms are included but not reported due to space limitations. Our sample period spans from Q2 (2008) to Q4 (2020 Large banks are defined as having total assets that are higher than the 90th percentile for each period; upper-medium banks, from the 75th to 90th percentiles; medium banks, from the 50th to 75th percentiles; and small banks, below the 50th percentile. Following the NBU classification, we have divided our sample into five groups by ownership type, namely state-owned banks (excl. PrivatBank),

PrivatBank, and foreign banks (banks that belong to foreign banks groups excl. Russian), Russian banks, and private banks. Privatbank has been excluded from the analysis as an outlier. The dependent variable, NPLs, is the log transformation of the total amount of bad loans; Related Lending stands for the log transformation of the loan amounts advanced to related parties; Large Exposure is the log transformation of the loan amounts advanced to large clients; Bank Capitalization is the capital adequacy ratio; Controls include banks return on assets ratios, banks market shares, bank sector dollarization, the real GDP growth rate, the CPI, the aggregate cost rates on loans to the real sector of the economy, unemployment, dummies for the 2008–2009 and 2014–2016 banking crises, dummies for changes in banking regulation and accounting requirements. Adjusted R2 for all regressions ranges from 0.570 to 0.580. The number of observations of 5923 is the same for all regressions. All regressions account for seasonality and the business cycle by including quarterly and yearly dummies. A constant is not reported but included in all models. Clustered by banks robust standard errors, reported in parentheses. *, **, and *** denote significance at 10 %, 5 %, and 1 %, respectively.

The coefficients of interactions for foreign bank groups and Russian banks are mostly similar to what we expected. Meanwhile, the numbers of observations for state-owned banks in each non-large size group are small, which makes us take the respective coefficients with caution as they are not precisely estimated, though their signs are mostly as expected.

1.5.2 Robustness Checks

After studying the literature on the evolution of the Ukrainian banking sector, we have concerns regarding the reliability of some data series. According to NBU (2018), related party lending was largely underreported up until May 2015, when the respective regulations were amended. Furthermore, Gontareva and Stepaniuk (2020) mentioned that the NBU diagnostic study of banks' related party lending in 2015 and 2016 revealed that the real level of related party lending was significantly higher than what banks had previously disclosed. Meanwhile, NBU (2019a) mentioned that banks in Ukraine started to recognize the real quality of assets with a delay. In addition, Gontareva and Stepaniuk (2020) stated the problem of "hidden NPLs," as data on NPLs in the Ukrainian banking sector before 2014 do not reflect the real asset quality of that time.

On the contrary, first, prior to 2015 changes in related regulations, banks performed regulatory reporting based on that time's respective requirements, which were rather formal (Gontareva & Stepaniuk, 2020). The wide two-round banks' AQR in 2015–2016 stated that many banks overestimated their asset quality. Second, as the banks in Ukraine were and are the objects of an annual external independent examination (external audit), all the figures in

the banks' audited statements (including asset quality and operations with related parties) must be correct. Besides, we have not managed to find any literature or documents ex-post mentioning that some figures in banks' statements were misreported.[29]

Therefore, it is unclear whether this issue should be treated as misreporting owing to a lack of supervisory enforcement actions or as a lack of credit risk assessment capacity and good practices in the market at that time. Besides, data on NPLs and related party lending must be treated with caution, as the pre-2015 reporting may not reflect the real portfolio quality completely. [30] To tackle this issue, our strategy is to perform our dynamic panel analysis on the actual data, accounting for the difference in reporting frameworks before and after 2016, by introducing a dummy variable with a robustness check of the findings based on the period with reliable data only (Q3, 2016). Here, we assume that any measurement errors occurring in NPLs and *Related Lending* are random. The latter assumption is also applicable for PVAR modeling.

First, we divide our sample into two periods, before and after the introduction of Regulation #351 (Q3, 2016). During this period, two new regulations regarding NPLs and *Related Lending* were implemented simultaneously. We apply the dynamic panel model fixed effects estimations (see the Appendix Table A 1.3) to the sub-sample of banks from Q3 (2016) based on Eq. (1.1). The results are qualitatively similar to those in Table 1.6, although only one factor, *Related Lending,* becomes nonsignificant due to a substantial decrease in observation numbers.

Second, as the time span becomes substantially shorter, this check may be sensitive to dynamic panel bias. Therefore, we utilize a two-step variant system GMM estimator of

[29] Except in the case of PrivatBank, whose external auditing company PWC was excluded from the Register of accounting firms authorized to audit banks due to verification of the bank's misreporting. For more information, see https://old.bank.gov.ua/control/en/publish/article?art_id=52267796.

[30] The issue of reliable data on NPLs and related party lending may be the venue for further computations and investigations. In our opinion, that may be done, for instance, through backward calculation of NPLs and Related Lending s volumes based on NBU data obtained from AQR in 2015–2016. Another way may be the application of related econometric approaches. Of course, there may be some limitations and discrepancies.

Arellano and Bover (1995) and Blundell and Bond (1998) with Windmeijer-corrected cluster-robust errors (Roodman, 2009).[31] We run system GMM estimation for specification (4) in Table 1.6. Most results are consistent with our previous findings (see Appendix Table A 1.4). The only difference is that most variables are statistically insignificant owing to a substantial decrease in observation numbers, though the expected signs are mostly kept. Nevertheless, the relationship between *Related Lending* and NPLs is positive and statistically significant.

Third, to check the interaction term results stated in Table 1.7, we first examined the results of static panel fixed effects estimations for such specifications. Although they are biased because they do not account for the persistence of previous periods' NPL impacts, the signs of interactions' coefficients are the same as in our main output in Table 1.7 (see Appendix Table A 1.5).

Fourth, instead of measuring the NPLs as the log transformation of the total amount of bad loans, we have applied the NPL ratio as a dependent variable (see the Appendix Table A 1.6), as for large banks, where all significant coefficients of interaction terms remain except for the coefficient of *Bank Capitalization* for state-owned banks. Meanwhile, some other coefficients for large banks become significant with the same signs as in Table 1.8 (*Related Lending* of state-owned banks, *Large Exposure* of private banks and foreign banks). The interaction terms of upper-medium banks, particular ownership types, and NPL factors remained qualitatively similar. All the respective significant coefficients remained significant except for the *Bank Capitalization* of Russian banks. Moreover, some other coefficients for upper-medium banks become significant with the same signs as in Table 1.8 (*Large Exposure* of private banks, *Bank Capitalization* of private and foreign banks). Medium banks' coefficients in Table 1.8 became nonsignificant, though they kept the signs (all except the

[31] Despite the criticism of the system GMM, we believe that this estimator remains the most appropriate to address the empirical challenges. Other estimators, including MLE, may work properly only with $t < 10$. For more information, please see Roodman (2009).

coefficient of *Bank Capitalization* of state banks, which even changed the signs). *Related Lending* and *Large Exposure* have become significant for state banks, though the coefficients for non-large banks should be taken with caution as the numbers of observations for state-owned banks for each non-large size group are small. The coefficients of medium banks from Table 1.8 also became nonsignificant even after keeping the signs, although the coefficient of Russian banks' *Bank Capitalization* became statistically significant with the same sign as in Table 1.8.

1.5.3 System GMM-PVAR Estimation

This section contains the results of our model, which includes macroeconomic, sector-, and bank-specific variables using system GMM estimation. The stability graph in Appendix Figure A 1.1 shows that our PVAR model satisfies the stability condition (Abrigo & Love, 2016).

Table 1.9: Estimation results of the PVAR model

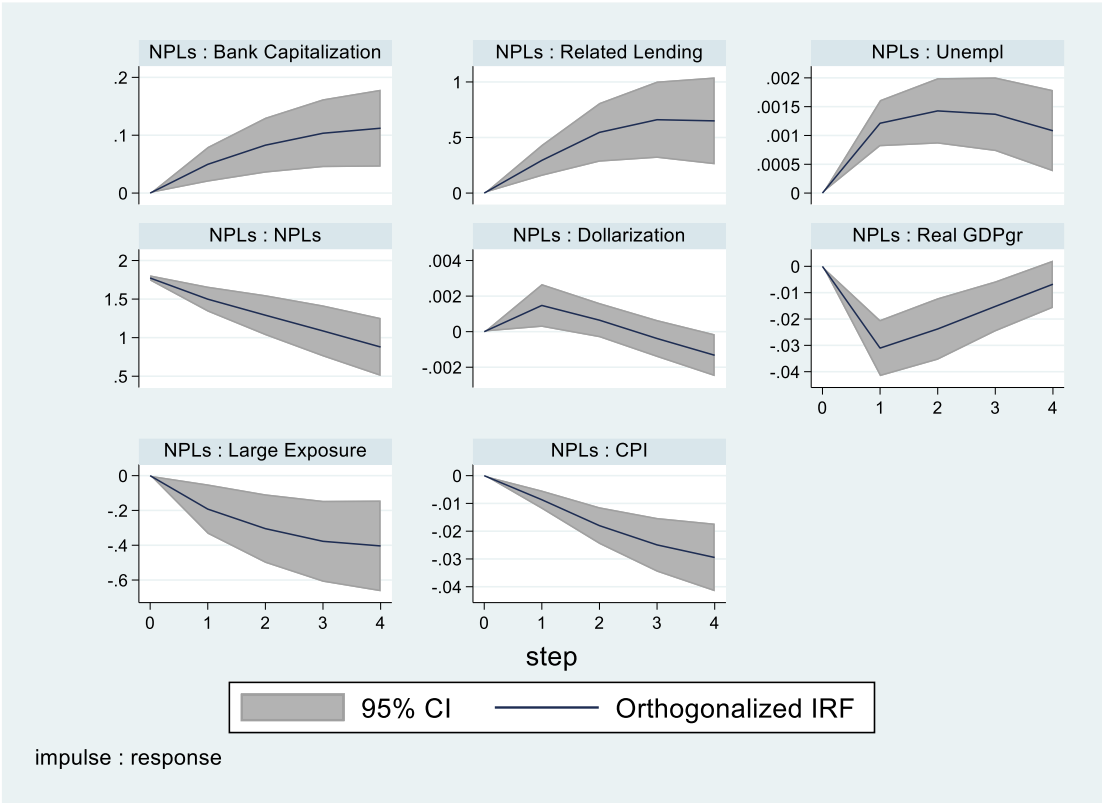
	Real GDPgr	Unempl	CPI	Dollari-zation	Related Lending	Large Exposure	Bank Capitaliz.	NPLs
$RealGDPgr_{t-1}$	-0.096***	0.025***	0.123***	0.026***	0.894**	-1.767***	0.189***	0.587**
	(0.021)	(0.001)	(0.006)	(0.003)	(0.420)	(0.520)	(0.062)	(0.261)
$Unempl_{t-1}$	6.877***	0.420***	0.852***	0.977***	-98.277***	-1.813	-3.895***	-53.959***
	(0.459)	(0.026)	(0.137)	(0.073)	(9.541)	(12.074)	(1.306)	(7.078)
CPI_{t-1}	-0.185***	0.008***	0.798***	0.102***	-3.654***	3.363***	-0.762***	-0.966***
	(0.022)	(0.001)	(0.012)	(0.002)	(0.537)	(0.614)	(0.067)	(0.330)
$Dollarization_{t-1}$	-5.545***	0.357***	0.397***	0.127***	109.264***	-33.674***	6.820***	55.584***
	(0.118)	(0.005)	(0.028)	(0.016)	(2.212)	(2.442)	(0.295)	(1.822)
$Related\ Lending_{t-1}$	-0.009***	0.001***	-0.004***	-0.001**	0.894***	-0.117**	0.022**	0.077***
	(0.003)	(0.000)	(0.001)	(0.000)	(0.049)	(0.053)	(0.009)	(0.027)
$Large\ Exposure_{t-1}$	-0.006**	0.000	0.002*	0.000	0.079**	0.297***	0.011	0.009
	(0.003)	(0.000)	(0.001)	(0.000)	(0.040)	(0.079)	(0.007)	(0.016)
Bank $Capitalization_{t-1}$	-0.014	0.001***	0.000	-0.001**	0.076	-0.485***	0.613***	-0.073*
	(0.009)	(0.000)	(0.003)	(0.000)	(0.088)	(0.147)	(0.085)	(0.038)
$NPLs_{t-1}$	-0.018***	0.001***	-0.005***	0.001**	0.166***	-0.108***	0.028***	0.845***
	(0.003)	(0.000)	(0.001)	(0.000)	(0.041)	(0.041)	(0.008)	(0.047)

Notes: The dependent variable, NPLs, is the log transformation of the total amount of bad loans; Related Lending stands for the log transformation of the loan amounts advanced to related parties; Large Exposure is the log transformation of the loan amounts advanced to large clients; Bank Capitaliz. is the capital adequacy ratio; Dollarization is bank sector dollarization; Unempl is the unemployment rate; CPI stands for inflation; Real GDPgr is the real GDP growth rate. All variables are included in levels except for Dollarization, which is included in differences. Standard errors in parentheses. *, **, and *** denote significance at 10 %, 5 %, and 1 %, respectively.

Table 1.9 shows the estimated coefficients for the baseline PVAR model of 198 banks with 5256 observations in total. Here, we interpret the results in terms of a pure "Granger-

causes" relationship between variables, as we do not place any additional restrictions on parameters (Abrigo & Love, 2016). This output will give a general understanding of the relationship between variables for an average bank. Notably, seven of the eight coefficients of the NPL explanatory variables are significant even after controlling. For instance, we may see related party lending and large exposure concentrations from a previous period's Granger-caused NPLs.

Figure 1.4: IRFs to the shock in NPLs of the 1-lag PVAR model



Notes: The dependent variable, NPL, is the log transformation of the amount of bad loans; Related Lending stands for the log transformation of the amount of loans to related parties; Large Exposure is the log transformation of the amount of loans to large clients; Bank Capitalization is the capital adequacy ratio; Dollarization is bank sector dollarization (BSD); Unempl is the unemployment rate; CPI stands for inflation; Real GDPgr is the real GDP growth rate. All variables are included in levels except for BSD that is included in differences. The 95% confidence interval band generated based on 500 Monte Carlo simulations. NPLs is the impulse variable. Response variables order is as follows: Real GDPgr, Unempl, CPI, Dollarization, Related Lending, Large Exposure, Bank Capitalization, NPLs.

For studying the feedback effect, we further concentrate on calculating the IRFs of shocks in NPLs for macro-, sector-, and bank-related variables on a 1-year horizon.[32] Figure

[32] We are isolating the shock in NPLs and observing the impact on other variables by considering the obtained coefficients and the error variance-covariance matrix (Love et al., 2016).

1.4 shows that the responses to the NPL shock vary among bank-specific variables, which is expected, and all responses are statistically significant because the 95% confidence interval area in graphs does not include the zero-line. For a longer time horizon, precision may be lost as the NPL shock may have no long-term effect on other variables.

Essentially, for example, *Bank Capitalization* responded positively to a one standard deviation shock in NPLs with a 4.8% increase at time one (i.e., a quarter after the shock happened) and an 8.3% increase in the second next quarter after the shock. This is mainly attributed to the fact that many banks were in practice recapitalized right after severe NPL shocks in the banking sector of Ukraine. *Large Exposure* has a significant negative response, with a decrease of about 41% in a year after the shock. We found that *Related Lending* response is positively significant to the NPL shock, with about a 30% increase at time one, implying that banks tend to grant credits to related parties after the quality of their loan portfolios deteriorates. Additionally, we noted that the NPL shock caused a further severe increase in NPLs. In the case of the banking system's dollarization, the response is not statistically significant, with nearly zero impact from the shock.

Table 1.10: Orthogonalized IRF magnitudes in the case of the shock (impulse) in NPLs

Forecast horizon	Response variables							
	Real GDPgr	Unempl	CPI	Dollariz ation	Related Lending	Large Ex posure	Bank Capi talization	NPLs
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.773
1	-0.031	0.001	-0.009	0.001	0.294	-0.192	0.048	1.499
2	-0.024	0.001	-0.018	0.001	0.546	-0.304	0.083	1.291
3	-0.015	0.001	-0.025	0.000	0.660	-0.377	0.103	1.087
4	-0.007	0.001	-0.029	-0.001	0.650	-0.404	0.112	0.879

Notes: The dependent variable, NPL, is the log transformation of the total amount of bad loans; Related Lending stands for the log transformation of the loan amounts advanced to related parties; Large Exposure is the log transformation of the loan amounts advanced to large clients; Bank Capitalization is the capital adequacy ratio; Dollarization is bank sector dollarization; Unempl is the unemployment rate; CPI stands for inflation; Real GDPgr is the real GDP growth rate. All variables are included in levels except for dollarization, which is included in differences.

Furthermore, the results reveal that the responses of macroeconomic variables are statistically significant and that the responses' direction (sign) is as expected. The shock in

NPLs tends to increase Unempl while decreasing CPI and Real GDP (Huljak et al., 2020).[33] Overall, we established that the NPL shock indeed had an impact on bank and macroeconomic variables over a 1-year horizon, while the effect on banking sector dollarization is statistically nonsignificant. We also present the detailed impulse-response magnitudes in Table 1.10.

In addition, we estimated the variance decomposition presented in Table 1.11, which indicates the percentage of the variation in the column variable explained by a shock of NPLs after four quarterly periods (cumulative). The results confirm the above-mentioned findings.

Table 1.11: Variance decomposition in the case of the shock (impulse) in NPLs (%)

Forecast horizon	Response variables							
	Real GD Pgr	Unempl	CPI	Dollariz ation	Related Lending	Large Ex posure	Bank Capi talization	NPLs
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.670
2	0.014	0.009	0.007	0.003	0.003	0.005	0.008	0.571
3	0.021	0.017	0.023	0.003	0.011	0.015	0.024	0.560
4	0.024	0.021	0.042	0.003	0.020	0.027	0.042	0.540
10	0.028	0.019	0.129	0.033	0.028	0.054	0.090	0.441

Notes: The dependent variable, NPL, is the log transformation of the total amount of bad loans; Related Lending stands for the log transformation of the loan amounts advanced to related parties; Large Exposure is the log transformation of the loan amounts advanced to large clients; Bank Capitalization is the capital adequacy ratio; Dollarization is bank sector dollarization; Unempl is the unemployment rate; CPI stands for inflation; Real GDPgr is the real GDP growth rate. All variables are included in levels except for dollarization, which is included in differences.

Notably, the shock in NPLs largely explains the variance in NPLs during the first year, with a further decline. In addition, we may see that the positive shock in NPLs explains a relatively large part of the CPI, *Bank Capitalization*, and *Large Exposure* variations of about 13%, 9%, and 5%, respectively, while the explanatory power for other variables is modest.

Finally, we conducted various robustness checks of our model in Eq. (1.2). Following Love et al. (2016), we tried different combinations of variables for IRF, mainly changing the order of bank-related variables, as macro variables are definitely "more exogenous." The checks have provided robust results. An IFR check is presented in Appendix Figure A 1.2.[34]

[33] The intuition here is that an NPL shock may cause a cooling of the economy when economic activity slows down, which eventually means a decrease in inflation and GDP growth (Klein, 2013).
[34] The entire robustness check results are not presented in the paper but could be provided upon request.

1.6 CONCLUSION

This study employs fixed effects dynamic panel data methods and PVAR modeling with a system GMM estimation to examine the determinants of NPLs and the NPL effect on the Ukrainian banking sector and the economy.

We find that banks' related lending and capital adequacy ratio are statistically significant determinants of NPLs with a positive and negative impact, respectively. Loan concentration on certain entities is not statistically significant, although it is positively associated with NPLs. These results suggest that banks' supervisory authorities pay close attention to banks' lending policies toward related parties and maintain capital adequacy. As the relationship between bank characteristics and NPLs is nonlinear depending on the banks' ownership type and size, supervisory policies to mitigate related party lending and maintain capital adequacy can be heterogeneous based on bank size and ownership type.

The PVAR model results reveal that a positive shock in NPLs causes a substantial increase in related lending over a 1-year horizon and a decrease in large exposure concentrations. An increase in NPLs positively affects banks' capitalization, which tends to increase over the year after the crisis occurs. In the case of macroeconomic variables, all responses were statistically significant, and the responses' direction (sign) was as expected, though with a modest magnitude. Over a 1-year horizon, both real GDP growth and CPI decline, while unemployment and banking sector dollarization only marginally change. The variance decomposition confirms the findings showing that the NPL shock has explanatory power for banks' capitalization, large exposure concentration, and CPI.

This research contributes to the existing literature in the following ways: First, we have examined two specific NPL determinants, which are difficult to study due to the limitation of the information about related lending and lending concentrations. Further, the study indicates

that the relationship between NPLs, related party lending, and bank capitalization is significant. These findings also may be interpreted from developing countries' perspectives. It seems that, like Ukraine, other developing countries may also have different NPL determinants (i.e., bank profitability, liquidity, etc.) than developed countries. This is a venue for further studies. Second, the research identifies that the effects of studied bank-level factors on NPLs are nonlinear depending on the banks' ownership type and size, though not for all combinations of factors, types, and groups.

As the banking sector in Ukraine has demonstrated, risk-based pricing cannot adequately compensate for increased credit risk, particularly from related party lending practices. Banks, heavily exposed to related parties' lending, often overestimate the quality of loans (and/or collateral) to price borrowers lower and form fewer loan loss provisions. This is more seen as a fraud activity to mislead the supervisors than to adequately estimate the costs through the risk-based pricing application. As such, banking supervisory authorities must closely monitor the practices of lending policies and related party lending, in particular, in terms of moral hazard and excessive risk-taking. A good example of such monitoring is the whole-scale AQR and in-depth diagnostics of banks' operations with related parties performed by the NBU in 2015–2016 and later on. Reporting of banks' lending operations and transparency should be set at a high level. Policy actions of banking regulation and supervision should reflect different behaviors of banks depending on their size and ownership. Furthermore, an effective resolution mechanism must be developed to mitigate the spillover effect from NPLs. The Bank for International Settlements has already developed best-practice recommendations and guidance for banking authorities to regulate and supervise banks' concentration of large exposures and transactions with related parties, which are included in the BIS Core Principles for Effective Banking Supervision (Principle 19: Concentration Risk and Large Exposure Limits and Principle 20: Transactions with Related Parties of BIS). In

addition, there are a number of guidance documents on NPL resolution from different institutions, including BIS, that contain best practices in the field.

The application of the data on loans and borrowers' levels and across loan types, which are currently unavailable, could benefit further studies. The studies related to corruption, politically motivated loans, and NPLs could contribute to the understanding of the factors responsible for conducting the lending practices that pose an excessive risk to deposit holders.

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APPENDIX

Table A 12: Baseline static Panel FE

	(1)	(2)	(3)	(4)
Related Lending $_{t-1}$	0.105***	0.099***	0.083***	0.079***
	(0.032)	(0.029)	(0.029)	(0.027)
Large Exposure $_{t-1}$	0.015	0.022	0.009	0.015
	(0.025)	(0.024)	(0.024)	(0.024)
Bank Capitalization $_{t-1}$	-0.319*	-0.307*	-0.321**	-0.311**
	(0.175)	(0.158)	(0.152)	(0.140)
State $_{t-1}$		0.915**		1.056**
		(0.458)		(0.474)
Foreign $_{t-1}$		3.293**		2.815**
		(1.366)		(1.186)
Russian $_{t-1}$		2.327*		2.163*
		(1.272)		(1.158)
Private $_{t-1}$		0.000		0.000
		(.)		(.)
Large $_{t-1}$			2.948***	2.767***
			(0.554)	(0.543)
Upper-medium $_{t-1}$			2.533***	2.343***
			(0.499)	(0.449)
Medium $_{t-1}$			1.523***	1.374***
			(0.459)	(0.371)
Small $_{t-1}$			0.000	0.000
			(.)	(.)
Controls	Yes	Yes	Yes	Yes
Adj. R^2	0.115	0.130	0.139	0.149
Observations	5923	5923	5923	5923

Notes: The dependent variable, NPL, is the log transformation of the total amount of bad loans; Related Lending stands for the log transformation of the loan amounts advanced to related parties; Large Exposure is the log transformation of the loan amounts advanced to large clients; Bank Capitalization is the capital adequacy ratio; Controls include banks return on assets ratios, banks market shares, bank sector dollarization, real GDP growth rate, CPI, the aggregate cost rates on loans to the real sector of the economy, unemployment, dummies for 2008–2009 and 2014–2016 banking crises, dummies for changes in banking regulation and accounting requirements. Large banks are defined as having total assets that are higher than the 90th percentile for each period; upper-medium banks, from the 75th to 90th percentiles; medium banks, from the 50th to 75th percentiles; and small banks, below the 50th percentile. Following the NBU classification, we have divided our sample into five groups by ownership type, namely state-owned banks (excl. PrivatBank), PrivatBank, and foreign banks (banks that belong to foreign banks groups excl. Russian), Russian banks, and private banks. Privatbank has been excluded from the analysis as an outlier. All regressions account for seasonality and business cycle by including quarterly and yearly dummies. A constant is not reported but included in all models. Clustered by banks robust standard errors, reported in parentheses. *, **, and *** denote significance at 10%%, 5%%, and 1%%, respectively.

Table A 13: Panel FE models with interaction terms of all banks' sizes (excl. large banks)

Panel A. Upper medium-sized banks

	(1)	(2)	(3)	(4)
NPLs $_{t-1}$	0.671***	0.667***	0.667***	0.672***
	(0.036)	(0.036)	(0.036)	(0.036)
Related Lending $_{t-1}$	0.037**	0.026	0.037**	0.037**
	(0.016)	(0.021)	(0.018)	(0.016)
Large Exposure $_{t-1}$	0.002	-0.011	0.024	0.002
	(0.015)	(0.012)	(0.021)	(0.016)
Bank Capitalization $_{t-1}$	-0.129	-0.207	-0.095*	-0.136
	(0.083)	(0.199)	(0.050)	(0.084)
State $_{t-1}$	2.159***			
	(0.776)			
Foreign $_{t-1}$			0.928**	
			(0.357)	
Russian $_{t-1}$				0.111
				(0.169)
Private $_{t-1}$		-1.208***		
		(0.371)		
Upper-medium $_{t-1}$	0.257**	0.013	0.485**	0.295**
	(0.120)	(0.169)	(0.209)	(0.127)
State $_{t-1}$*Related Lending $_{t-1}$	0.010			
	(0.032)			
State $_{t-1}$*Large Exposure $_{t-1}$	-0.104*			
	(0.061)			
State $_{t-1}$*Bank Capitalization $_{t-1}$	-3.718***			
	(1.279)			
State $_{t-1}$*Upper-medium $_{t-1}$	-1.716***			
	(0.643)			
Foreign $_{t-1}$*Related Lending $_{t-1}$			-0.019	
			(0.030)	
Foreign $_{t-1}$*Large Exposure $_{t-1}$			-0.043	
			(0.026)	
Foreign $_{t-1}$*Bank Capitalization $_{t-1}$			-0.094	
			(0.178)	
Foreign $_{t-1}$*Upper-medium $_{t-1}$			-0.415	
			(0.281)	
Russian $_{t-1}$*Related Lending $_{t-1}$				-0.009
				(0.023)
Russian $_{t-1}$*Large Exposure $_{t-1}$				0.008
				(0.016)
Russian $_{t-1}$*Bank Capitalization $_{t-1}$				-0.877
				(0.668)
Russian $_{t-1}$*Upper-medium $_{t-1}$				-1.568***
				(0.573)
Private $_{t-1}$*Related Lending $_{t-1}$		0.009		
		(0.029)		
Private $_{t-1}$*Large Exposure $_{t-1}$		0.041		
		(0.030)		
Private $_{t-1}$*Bank Capitalization $_{t-1}$		0.131		
		(0.191)		
Private $_{t-1}$*Upper-medium $_{t-1}$		0.547		
		(0.351)		
Upper-medium $_{t-1}$* Related Lending $_{t-1}$	-0.028**	-0.037	-0.030*	-0.037**
	(0.014)	(0.022)	(0.015)	(0.015)
Upper-medium $_{t-1}$* Large Exposure $_{t-1}$	0.006	0.015	-0.027	0.005
	(0.013)	(0.012)	(0.020)	(0.014)
Upper-medium $_{t-1}$* Bank	-0.277	-0.052	0.013	-0.254

Capitalization $_{t-1}$	(0.284)	(0.307)	(0.469)	(0.274)
State $_{t-1}$*Upper-medium $_{t-1}$* Related Lending $_{t-1}$	-0.036			
	(0.032)			
State $_{t-1}$*Upper-medium $_{t-1}$* Large Exposure $_{t-1}$	0.097			
	(0.062)			
State $_{t-1}$*Upper-medium $_{t-1}$* Bank Capitalization $_{t-1}$	4.227***			
	(1.228)			
Foreign $_{t-1}$*Upper-medium $_{t-1}$* Related Lending $_{t-1}$			-0.005	
			(0.037)	
Foreign $_{t-1}$*Upper-medium $_{t-1}$* Large Exposure $_{t-1}$			0.051*	
			(0.027)	
Foreign $_{t-1}$*Upper-medium $_{t-1}$* Bank Capitalization $_{t-1}$			-0.177	
			(0.526)	
Russian $_{t-1}$*Upper-medium $_{t-1}$* Related Lending $_{t-1}$				0.031
				(0.035)
Russian $_{t-1}$*Upper-medium $_{t-1}$* Large Exposure $_{t-1}$				0.115*
				(0.064)
Russian $_{t-1}$*Upper-medium $_{t-1}$* Bank Capitalization $_{t-1}$				1.808**
				(0.864)
Private $_{t-1}$*Upper-medium $_{t-1}$* Related Lending $_{t-1}$		0.013		
		(0.026)		
Private $_{t-1}$*Upper-medium $_{t-1}$* Large Exposure $_{t-1}$		-0.043		
		(0.033)		
Private $_{t-1}$*Upper-medium $_{t-1}$* Bank Capitalization $_{t-1}$		0.096		
		(0.973)		
Controls	Yes	Yes	Yes	Yes
adj. R^2	0.572	0.573	0.572	0.571
Observations	5923	5923	5923	5923

Panel B. Medium-sized banks

	(1)	(2)	(3)	(4)
NPLs $_{t-1}$	0.667***	0.666***	0.667***	0.668***
	(0.035)	(0.035)	(0.035)	(0.035)
Related Lending $_{t-1}$	0.049***	0.013	0.051***	0.049***
	(0.016)	(0.021)	(0.017)	(0.016)
Large Exposure $_{t-1}$	0.015	-0.003	0.017	0.013
	(0.016)	(0.011)	(0.021)	(0.015)
Bank Capitalization $_{t-1}$	-0.166	-0.787*	-0.100*	-0.176
	(0.123)	(0.471)	(0.052)	(0.127)
State $_{t-1}$	1.731***			
	(0.562)			
Foreign $_{t-1}$			1.075***	
			(0.390)	
Russian $_{t-1}$				0.058
				(0.202)
Private $_{t-1}$		-1.213***		
		(0.394)		
Mediumt-1	0.362**	-0.051	0.217	0.366**
	(0.148)	(0.164)	(0.242)	(0.160)
State $_{t-1}$*Related Lending $_{t-1}$	-0.014			
	(0.040)			
State $_{t-1}$*Large Exposure $_{t-1}$	-0.060			
	(0.046)			
State $_{t-1}$*Bank Capitalization $_{t-1}$	-2.780**			
	(1.096)			
State $_{t-1}$*Medium $_{t-1}$	-2.181*			
	(1.255)			
Foreign $_{t-1}$*Related Lending $_{t-1}$			-0.052	

			(0.033)	
Foreign $_{t-1}$*Large Exposure $_{t-1}$			-0.025	
			(0.024)	
Foreign $_{t-1}$*Bank Capitalization $_{t-1}$			-0.674	
			(0.462)	
Foreign $_{t-1}$*Medium $_{t-1}$			-0.364	
			(0.329)	
Russian $_{t-1}$*Related Lending $_{t-1}$				-0.031
				(0.021)
Russian $_{t-1}$*Large Exposure $_{t-1}$				0.010
				(0.018)
Russian $_{t-1}$*Bank Capitalization $_{t-1}$				-0.165
				(0.266)
Russian $_{t-1}$*Medium $_{t-1}$				-0.134
				(0.320)
Private $_{t-1}$*Related Lending $_{t-1}$		0.040		
		(0.027)		
Private $_{t-1}$*Large Exposure $_{t-1}$		0.025		
		(0.028)		
Private $_{t-1}$*Bank Capitalization $_{t-1}$		0.704		
		(0.458)		
Private $_{t-1}$*Medium $_{t-1}$		-0.137		
		(0.538)		
Medium $_{t-1}$* Related Lending $_{t-1}$	-0.065***	-0.004	-0.079***	-0.065***
	(0.019)	(0.023)	(0.024)	(0.019)
Medium $_{t-1}$* Large Exposure $_{t-1}$	-0.037**	-0.025*	0.002	-0.038*
	(0.018)	(0.015)	(0.029)	(0.020)
Medium $_{t-1}$* Bank Capitalization $_{t-1}$	0.064	0.612	-0.161	0.068
	(0.099)	(0.385)	(0.826)	(0.103)
State $_{t-1}$*Medium $_{t-1}$* Related Lending $_{t-1}$	0.026			
	(0.041)			
State $_{t-1}$*Medium $_{t-1}$* Large Exposure $_{t-1}$	0.077			
	(0.116)			
State $_{t-1}$*Medium $_{t-1}$* Bank Capitalization $_{t-1}$	5.119***			
	(1.831)			
Foreign $_{t-1}$*Medium $_{t-1}$* Related Lending $_{t-1}$			0.095**	
			(0.038)	
Foreign $_{t-1}$*Medium $_{t-1}$* Large Exposure $_{t-1}$			-0.023	
			(0.040)	
Foreign $_{t-1}$*Medium $_{t-1}$* Bank Capitalization $_{t-1}$			0.789	
			(0.921)	
Russian $_{t-1}$*Medium $_{t-1}$* Related Lending $_{t-1}$				0.033
				(0.040)
Russian $_{t-1}$*Medium $_{t-1}$* Large Exposure $_{t-1}$				0.008
				(0.026)
Russian $_{t-1}$*Medium $_{t-1}$* Bank Capitalization $_{t-1}$				0.321
				(0.911)
Private $_{t-1}$*Medium $_{t-1}$* Related Lending $_{t-1}$		-0.080**		
		(0.034)		
Private $_{t-1}$*Medium $_{t-1}$* Large Exposure $_{t-1}$		0.078		
		(0.067)		
Private $_{t-1}$*Medium $_{t-1}$* Bank Capitalization $_{t-1}$		-0.441		
		(0.989)		
Controls	Yes	Yes	Yes	Yes
adj. R^2	0.574	0.576	0.576	0.573
Observations	5923	5923	5923	5923

Panel C. Small banks

	(1)	(2)	(3)	(4)
NPLs $_{t-1}$	0.663***	0.662***	0.663***	0.664***
	(0.036)	(0.035)	(0.035)	(0.035)
Related Lending $_{t-1}$	-0.009	0.003	-0.018	-0.010
	(0.016)	(0.014)	(0.018)	(0.014)
Large Exposure $_{t-1}$	-0.007	-0.013	0.019	-0.008
	(0.011)	(0.009)	(0.017)	(0.011)
Bank Capitalization $_{t-1}$	-0.105***	-0.180*	-0.527	-0.113***
	(0.039)	(0.096)	(0.550)	(0.040)
State $_{t-1}$	0.494*			
	(0.277)			
Foreign $_{t-1}$			0.616*	
			(0.334)	
Russian $_{t-1}$				-0.035
				(0.129)
Private $_{t-1}$		-1.146**		
		(0.485)		
State $_{t-1}$	-0.584***	0.026	-0.499**	-0.611***
	(0.204)	(0.268)	(0.219)	(0.219)
State $_{t-1}$*Related Lending $_{t-1}$	0.002			
	(0.022)			
State $_{t-1}$*Large Exposure $_{t-1}$	0.001			
	(0.013)			
State $_{t-1}$*Bank Capitalization $_{t-1}$	-0.440			
	(0.816)			
State $_{t-1}$*Small $_{t-1}$	Dropped because of collinearity (lack of variation)			
Foreign $_{t-1}$*Related Lending $_{t-1}$			0.029	
			(0.028)	
Foreign $_{t-1}$*Large Exposure $_{t-1}$			-0.032	
			(0.022)	
Foreign $_{t-1}$*Bank Capitalization $_{t-1}$			0.389	
			(0.559)	
Foreign t-1*Small $_{t-1}$			0.544	
			(0.384)	
Russian $_{t-1}$*Related Lending $_{t-1}$				0.006
				(0.026)
Russian $_{t-1}$*Large Exposure $_{t-1}$				0.008
				(0.013)
Russian $_{t-1}$*Bank Capitalization $_{t-1}$				-0.157
				(0.359)
Russian t-1*Small $_{t-1}$				0.327
				(0.284)
Private $_{t-1}$*Related Lending $_{t-1}$		-0.024		
		(0.027)		
Private $_{t-1}$*Large Exposure $_{t-1}$		0.072		
		(0.046)		
Private $_{t-1}$*Bank Capitalization $_{t-1}$		-0.228		
		(0.777)		
Private t-1*Small $_{t-1}$		-0.271		
		(0.499)		
Small $_{t-1}$*Related Lending $_{t-1}$	0.059***	0.016	0.076***	0.063***
	(0.019)	(0.029)	(0.022)	(0.019)
Small $_{t-1}$*Large Exposure $_{t-1}$	0.020	0.002	-0.006	0.022
	(0.022)	(0.026)	(0.028)	(0.024)

Small $_{t-1}$*Bank Capitalization $_{t-1}$	-0.052	-0.631	0.434	-0.046
	(0.088)	(0.417)	(0.549)	(0.087)
State $_{t-1}$*Small $_{t-1}$*Related Lending $_{t-1}$	0.007			
	(0.022)			
State $_{t-1}$*Small $_{t-1}$*Large Exposure $_{t-1}$	-0.217***			
	(0.024)			
State $_{t-1}$*Small $_{t-1}$* Bank Capitalization $_{t-1}$	-5.255***			
	(0.827)			
Foreign $_{t-1}$*Small $_{t-1}$*Related Lending $_{t-1}$			-0.108***	
			(0.041)	
Foreign $_{t-1}$*Small $_{t-1}$*Large Exposure $_{t-1}$			-0.027	
			(0.053)	
Foreign $_{t-1}$*Small $_{t-1}$* Bank Capitalization $_{t-1}$			-1.160*	
			(0.695)	
Russian $_{t-1}$*Small $_{t-1}$*Related Lending $_{t-1}$				-0.031
				(0.033)
Russian $_{t-1}$*Small $_{t-1}$*Large Exposure $_{t-1}$				-0.003
				(0.030)
Russian $_{t-1}$*Small $_{t-1}$* Bank Capitalization $_{t-1}$				-0.068
				(0.501)
Private $_{t-1}$*Small $_{t-1}$*Related Lending $_{t-1}$		0.060		
		(0.037)		
Private $_{t-1}$*Small $_{t-1}$*Large Exposure $_{t-1}$		-0.049		
		(0.060)		
Private $_{t-1}$*Small $_{t-1}$* Bank Capitalization $_{t-1}$		0.955		
		(0.889)		
Controls	Yes	Yes	Yes	Yes
adj. R^2	0.576	0.577	0.577	0.574
Observations	5923	5923	5923	5923

Notes: Large banks are defined as having total assets that are higher than the 90th percentile for each period; upper-medium banks, from the 75th to 90th percentiles; medium banks, from the 50th to 75th percentiles; and small banks, below the 50th percentile. Following the NBU classification, we have divided our sample into five groups by ownership type, namely state-owned banks (excl. PrivatBank), PrivatBank, and foreign banks (banks that belong to foreign banks groups excl. Russian), Russian banks, and private banks. Privatbank has been excluded from the analysis as an outlier. The dependent variable, NPL, is the log transformation of the bad loans amount; Related Lending stands for the log transformation of the loan amounts to related parties; Large Exposure is the log transformation of the loan amounts to large clients; Bank Capitalization is the capital adequacy ratio; controls include banks return on assets ratios, banks market shares, bank sector dollarization, the real GDP growth rate, the CPI, the aggregate cost rates on loans to the real sector of the economy, unemployment, dummies for the 2008–2009 and 2014–2016 banking crises, dummies for changes in banking regulation and accounting requirements. All regressions account for seasonality and the business cycle by including quarterly and yearly dummies. A constant is not reported but included in all models. Clustered on banks' standard errors in parentheses. *, **, and *** denote significance at 10 %, 5 %, and 1 %, respectively.

Table A 14: Robustness check of Table 1.6 baseline Panel FE models (Panel FE)

	(1)	(2)	(3)	(4)
NPLs $_{t-1}$	0.684***	0.689***	0.681***	0.687***
	(0.045)	(0.038)	(0.044)	(0.038)
Related Lending $_{t-1}$	0.017	0.016	0.014	0.013
	(0.011)	(0.011)	(0.011)	(0.011)
Large Exposure $_{t-1}$	0.036	0.036	0.036	0.036
	(0.032)	(0.032)	(0.031)	(0.032)
Bank Capitalization $_{t-1}$	-0.167*	-0.159*	-0.172*	-0.163**
	(0.094)	(0.083)	(0.092)	(0.081)
State $_{t-1}$		Dropped because of collinearity (lack of variation)		Dropped because of collinearity (lack of variation)
Foreign $_{t-1}$		-1.726		-1.690
		(2.197)		(2.194)
Russian $_{t-1}$		0.716*		0.742*
		(0.419)		(0.413)
Private $_{t-1}$		Reference		Reference
Large $_{t-1}$			0.844***	0.757***
			(0.306)	(0.269)
Upper-medium $_{t-1}$			0.505**	0.439**
			(0.202)	(0.179)
Medium $_{t-1}$			0.316*	0.298*
			(0.162)	(0.152)
Small $_{t-1}$			Reference	Reference
Controls	Yes	Yes	Yes	Yes
adj. R^2	0.592	0.596	0.592	0.596
Observations	1178	1178	1178	1178

Notes: The dependent variable, NPL, is the log transformation of the bad loans amount; Related Lending stands for the log transformation of the loan amounts to related parties; Large Exposure is the log transformation of the loan amounts to large clients; Bank Capitalization is the capital adequacy ratio; Following the NBU classification, we have divided our sample into five groups by ownership type, namely state-owned banks (excluding PrivatBank), PrivatBank, foreign banks (banks that belong to foreign banks groups excl. Russian), Russian banks and private banks. Privatbank has been excluded from the analysis as an outlier. Large banks are defined as having total assets that are higher than the 90th percentile for each period; upper-medium banks, from the 75th to 90th percentiles; medium banks, from the 50th to 75th percentiles; and small banks, below the 50th percentile. Controls include banks' return on assets ratios, banks' market shares, bank sector dollarization, the real GDP growth rate, the CPI, the aggregate cost rates on loans to the real sector of the economy, unemployment, dummies for the 2008–2009 and 2014–2016 banking crises, dummies for changes in banking regulation and accounting requirements. All regressions account for seasonality and the business cycle by including quarterly and yearly dummies. A constant is not reported but included in all models. Clustered by banks robust standard errors, reported in parentheses. *, **, and *** denote significance at 10 %, 5 %, and 1 %, respectively.

Table A 15: Robustness check of Table 1.6 (system GMM estimation)

	Model 1	Model 2	Model 3	Model 4
NPLs $_{t-1}$	0.847***	0.768***	0.825***	0.772***
	(0.061)	(0.091)	(0.077)	(0.053)
Related Lending $_{t-1}$	0.040*	0.068*	0.037*	0.026*
	(0.022)	(0.036)	(0.022)	(0.014)
Large Exposure $_{t-1}$	0.026	0.037	0.001	0.029
	(0.033)	(0.052)	(0.036)	(0.033)
Bank Capitalization $_{t-1}$	-0.016	-0.078	-0.109	-0.081
	(0.115)	(0.142)	(0.068)	(0.080)
State $_{t-1}$		4.935		3.903
		(5.509)		(3.337)
Foreign $_{t-1}$		-0.142		-0.493
		(1.029)		(0.763)
Russian $_{t-1}$		1.915		1.506
		(1.161)		(0.963)
Private $_{t-1}$		Reference		Reference
Large $_{t-1}$			1.000	0.857**
			(0.670)	(0.346)
Upper-medium $_{t-1}$			0.855**	0.592**
			(0.427)	(0.271)
Medium $_{t-1}$			0.470	0.434***
			(0.328)	(0.164)
Small $_{t-1}$			Reference	Reference
Controls	Yes	Yes	Yes	Yes
Hansen test	0.25	0.23	0.22	0.22
Banks	97	97	97	97
Observations	1178	1178	1178	1178

Notes: The dependent variable, NPL, is the log transformation of the bad loans amount; Related Lending stands for the log transformation of the loan amounts to related parties; Large Exposure is the log transformation of the loan amounts to large clients; Bank Capitalization is the capital adequacy ratio; Following the NBU classification, we have divided our sample into five groups by ownership type, namely state-owned banks (excl. PrivatBank), PrivatBank, foreign banks (banks that belong to foreign banks groups excl. Russian), Russian banks, and private banks. Privatbank has been excluded from the analysis as an outlier. Large banks are defined as having total assets that are higher than the 90th percentile for each period; upper-medium banks, from the 75th to 90th percentiles; medium banks, from the 50th to 75th percentiles; and small banks, below the 50th percentile. Controls include banks' return on assets ratios, banks' market shares, bank sector dollarization, the real GDP growth rate, the CPI, the aggregate cost rates on loans to the real sector of the economy, unemployment, dummies for the 2008–2009 and 2014–2016 banking crises, dummies for changes in banking regulation and accounting requirements. All regressions account for seasonality and the business cycle by including quarterly and yearly dummies. A constant is not reported but included in all models. Clustered by banks robust standard errors, reported in parentheses. *, **, and *** denote significance at 10 %, 5 %, and 1 %, respectively.

Table A 16: Robustness check of Table 1.7 of models with interaction terms for large banks (Panel FE)

	(1)	(2)	(3)	(4)
Related Lending $_{t-1}$	0.113***	0.022	0.111***	0.109***
	(0.034)	(0.023)	(0.035)	(0.033)
Large Exposure $_{t-1}$	0.017	-0.002	0.046	0.015
	(0.027)	(0.027)	(0.041)	(0.028)
Bank Capitalization $_{t-1}$	-0.311*	-0.279	-0.357*	-0.323*
	(0.171)	(0.226)	(0.199)	(0.175)
State $_{t-1}$	3.679***			
	(1.069)			
Foreign $_{t-1}$			2.675**	
			(1.137)	
Russian $_{t-1}$				0.162
				(0.449)
Private $_{t-1}$		-3.367***		
		(1.179)		
Large $_{t-1}$	1.994***	1.046*	1.571*	1.911***
	(0.676)	(0.540)	(0.805)	(0.567)
State $_{t-1}$*Related Lending $_{t-1}$	-0.136***			
	(0.048)			
State $_{t-1}$*Large Exposure $_{t-1}$	-0.084			
	(0.084)			
State $_{t-1}$*Bank Capitalization $_{t-1}$	-6.984***			
	(2.379)			
State $_{t-1}$*Large $_{t-1}$	-3.501**			
	(1.423)			
Foreign $_{t-1}$*Related Lending $_{t-1}$			-0.076	
			(0.049)	
Foreign $_{t-1}$*Large Exposure $_{t-1}$			-0.052	
			(0.059)	
Foreign $_{t-1}$*Bank Capitalization $_{t-1}$			0.138	
			(0.219)	
Foreign $_{t-1}$*Large $_{t-1}$			-0.235	
			(1.257)	
Russian $_{t-1}$*Related Lending $_{t-1}$				-0.084*
				(0.044)
Russian $_{t-1}$*Large Exposure $_{t-1}$				0.009
				(0.033)
Russian $_{t-1}$*Bank Capitalization $_{t-1}$				-2.273
				(1.804)
Russian $_{t-1}$*Large $_{t-1}$				-2.791
				(2.954)
Private $_{t-1}$*Related Lending $_{t-1}$		0.103**		
		(0.046)		
Private $_{t-1}$*Large Exposure $_{t-1}$		0.062		
		(0.064)		
Private $_{t-1}$*Bank Capitalization $_{t-1}$		-0.029		
		(0.224)		
Private $_{t-1}$*Large $_{t-1}$		2.883		
		(1.904)		
Large $_{t-1}$*Related Lending $_{t-1}$	-0.112**	0.004	-0.124**	-0.126**
	(0.049)	(0.055)	(0.054)	(0.056)
Large $_{t-1}$*Large Exposure $_{t-1}$	-0.073	-0.037	-0.038	-0.025
	(0.048)	(0.039)	(0.066)	(0.044)
Large $_{t-1}$*Bank Capitalization $_{t-1}$	-3.030*	-3.416**	-3.057	-3.270*
	(1.540)	(1.688)	(2.206)	(1.811)
State $_{t-1}$*Large $_{t-1}$*Related Lending $_{t-1}$	0.218*			
	(0.116)			

State $_{t-1}$*Large $_{t-1}$*Large Exposure $_{t-1}$	0.141			
	(0.095)			
State $_{t-1}$*Large $_{t-1}$*Bank Capitalization $_{t-1}$	6.846**			
	(3.435)			
Foreign $_{t-1}$*Large $_{t-1}$*Related Lending $_{t-1}$			0.084	
			(0.084)	
Foreign $_{t-1}$*Large $_{t-1}$*Large Exposure $_{t-1}$			-0.002	
			(0.083)	
Foreign $_{t-1}$*Large $_{t-1}$*Bank Capitalization $_{t-1}$			0.177	
			(3.345)	
Russian $_{t-1}$*Large $_{t-1}$*Related Lending $_{t-1}$				0.147
				(0.091)
Russian $_{t-1}$*Large $_{t-1}$*Large Exposure $_{t-1}$				0.119
				(0.298)
Russian $_{t-1}$*Large $_{t-1}$*Bank Capitalization $_{t-1}$				2.799
				(2.532)
Private $_{t-1}$*Large $_{t-1}$*Related Lending $_{t-1}$		-0.264***		
		(0.074)		
Private $_{t-1}$*Large $_{t-1}$*Large Exposure $_{t-1}$		-0.016		
		(0.179)		
Private $_{t-1}$*Large $_{t-1}$*Bank Capitalization $_{t-1}$		-4.985		
		(4.340)		
Controls	Yes	Yes	Yes	Yes
adj. R^2	0.118	0.133	0.129	0.114
Observations	5923	5923	5923	5923

Notes: The dependent variable, NPLs, is the log transformation of the bad loans amount; Related Lending stands for the log transformation of the loan amounts to related parties; Large Exposure is the log transformation of the loan amounts to large clients; Bank Capitalization is the capital adequacy ratio; Following the NBU classification, we have divided our sample into five groups by ownership type, namely state-owned banks (excl. PrivatBank), PrivatBank, foreign banks (banks that belong to foreign banks groups excl. Russian), Russian banks, and private banks. Privatbank has been excluded from the analysis as an outlier. Large banks are defined as having total assets that are higher than the 90th percentile for each period; upper-medium banks, from the 75th to 90th percentiles; medium banks, from the 50th to 75th percentiles; and small banks, below the 50th percentile. Controls include banks' return on assets ratios, banks' market shares, bank sector dollarization, the real GDP growth rate, the CPI, the aggregate cost rates on loans to the real sector of the economy, unemployment, dummies for the 2008–2009 and 2014–2016 banking crises, dummies for changes in banking regulation and accounting requirements. All regressions account for seasonality and the business cycle by including quarterly and yearly dummies. A constant is not reported but included in all models. Clustered by banks robust standard errors, reported in parentheses. *, **, and *** denote significance at 10 %, 5 %, and 1 %, respectively.

Table A 17: Robustness check of interaction effects of studied determinants, ownership types, and size group on NPL ratio (Panel FE)

Size group	Ownership type	Factors			N	R2
		Related Lending $_{t-1}$	Large Exposure $_{t-1}$	Capital Adequacy $_{t-1}$		
Large $_{t-1}$	State $_{t-1}$	0.010***	-0.001	0.060	5923	0.771
		(0.003)	(0.002)	(0.111)		
Large $_{t-1}$	Foreign $_{t-1}$	-0.000	0.003*	0.149	5923	0.771
		(0.003)	(0.002)	(0.128)		
Large $_{t-1}$	Russian $_{t-1}$	-0.002	0.024***	-0.142	5923	0.771
		(0.004)	(0.008)	(0.118)		
Large $_{t-1}$	Private $_{t-1}$	-0.009***	0.014**	0.092	5923	0.772
		(0.003)	(0.006)	(0.134)		
Upper-medium $_{t-1}$	State $_{t-1}$	0.001	0.001	0.192***	5923	0.770
		(0.002)	(0.002)	(0.073)		
Upper-medium $_{t-1}$	Foreign $_{t-1}$	-0.001	0.002*	-0.138***	5923	0.771
		(0.003)	(0.001)	(0.044)		
Upper-medium $_{t-1}$	Russian $_{t-1}$	0.009	0.023***	0.065	5923	0.771
		(0.005)	(0.008)	(0.068)		
Upper-medium $_{t-1}$	Private $_{t-1}$	0.001	-0.003**	0.121*	5923	0.771
		(0.002)	(0.001)	(0.072)		
Medium $_{t-1}$	State $_{t-1}$	0.004***	-0.065***	-0.161	5923	0.771
		(0.001)	(0.007)	(0.098)		
Medium $_{t-1}$	Foreign $_{t-1}$	0.001	-0.000	0.005	5923	0.772
		(0.002)	(0.001)	(0.036)		
Medium $_{t-1}$	Russian $_{t-1}$	0.005	0.000	-0.015	5923	0.771
		(0.004)	(0.002)	(0.067)		
Medium $_{t-1}$	Private $_{t-1}$	-0.001	0.002	0.002	5923	0.773
		(0.001)	(0.002)	(0.037)		
Small $_{t-1}$	State $_{t-1}$	-0.001	-0.001	-0.047	5923	0.771
		(0.001)	(0.002)	(0.077)		
Small $_{t-1}$	Foreign $_{t-1}$	0.000	-0.001	-0.006	5923	0.773
		(0.002)	(0.002)	(0.034)		
Small $_{t-1}$	Russian $_{t-1}$	0.000	-0.000	-0.105**	5923	0.771
		(0.003)	(0.001)	(0.046)		
Small $_{t-1}$	Private $_{t-1}$	-0.001	-0.001	-0.004	5923	0.773
		(0.001)	(0.002)	(0.036)		

Notes: The table shows the results of the robustness check in Table 1.8. The coefficients presented are the interaction terms among particulate size group, factors, and ownership types (i.e., interactions among three variables). All other variables and interaction terms are included but not reported due to space limitations. Our sample period spans from Q2 (2008) to Q4 (2020). Large banks are defined as having total assets that are higher than the 90th percentile for each period; upper-medium banks, from the 75th to 90th percentiles; medium banks, from the 50th to 75th percentiles; and small banks, below the 50th percentile. Following the NBU classification, we have divided our sample into five groups by ownership type, namely state-owned banks (excl. PrivatBank), PrivatBank, and foreign banks (banks that belong to foreign banks groups excl. Russian), Russian banks, and private banks. Privatbank has been excluded from the analysis as an outlier. The dependent variable, NPL ratio, the ratio of bad loans to total gross loans; Related Lending stands for the log transformation of the loan amounts advanced to related parties; Large Exposure is the log transformation of the loan amounts advanced to large clients; Bank Capitalization is the capital adequacy ratio; Controls include banks return on assets ratios, banks market shares, bank sector dollarization, the real GDP growth rate, the CPI, the aggregate cost rates on loans to the real sector of the economy, unemployment, dummies for the 2008–2009 and 2014–2016 banking crises, dummies for changes in banking regulation and accounting requirements. Adjusted R2 for all regressions ranges from 0.770 to 0. 775. The number of observations of 5923 is the same for all regressions. All regressions account for seasonality and the business cycle by including quarterly and yearly dummies. A constant is not reported but included in all models. Clustered by banks robust standard errors, reported in parentheses. *, **, and *** denote significance at 10 %, 5 %, and 1 %, respectively.

Figure A 1.5: The graph of stability conditions for the PVAR model

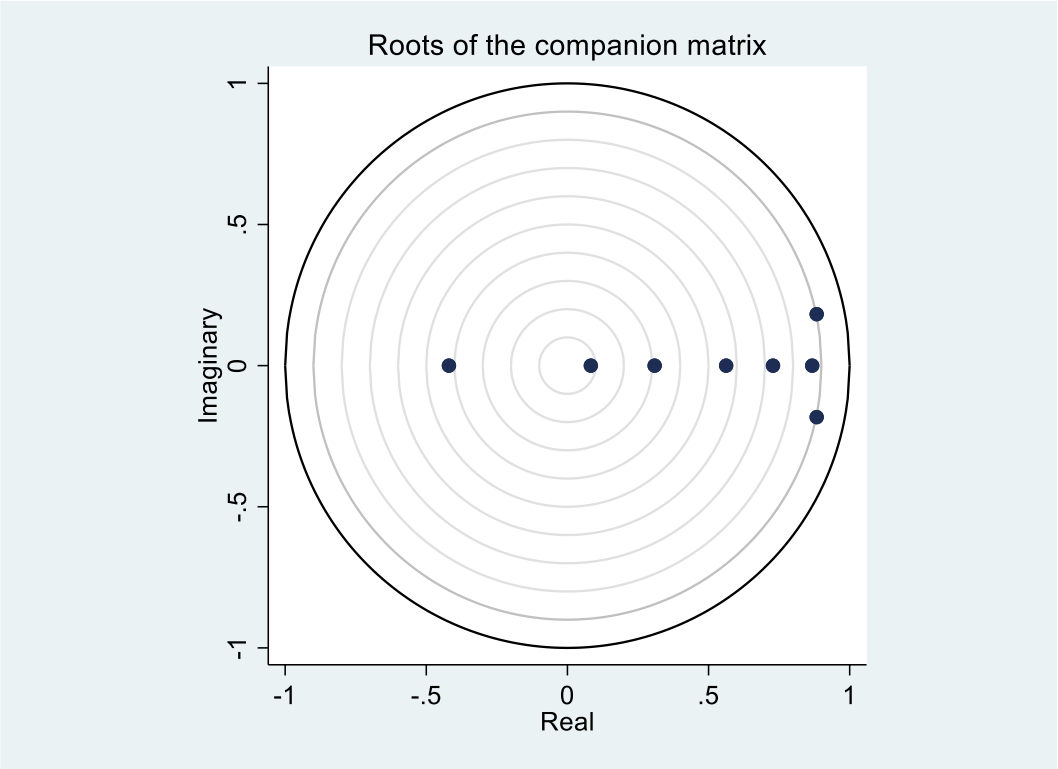
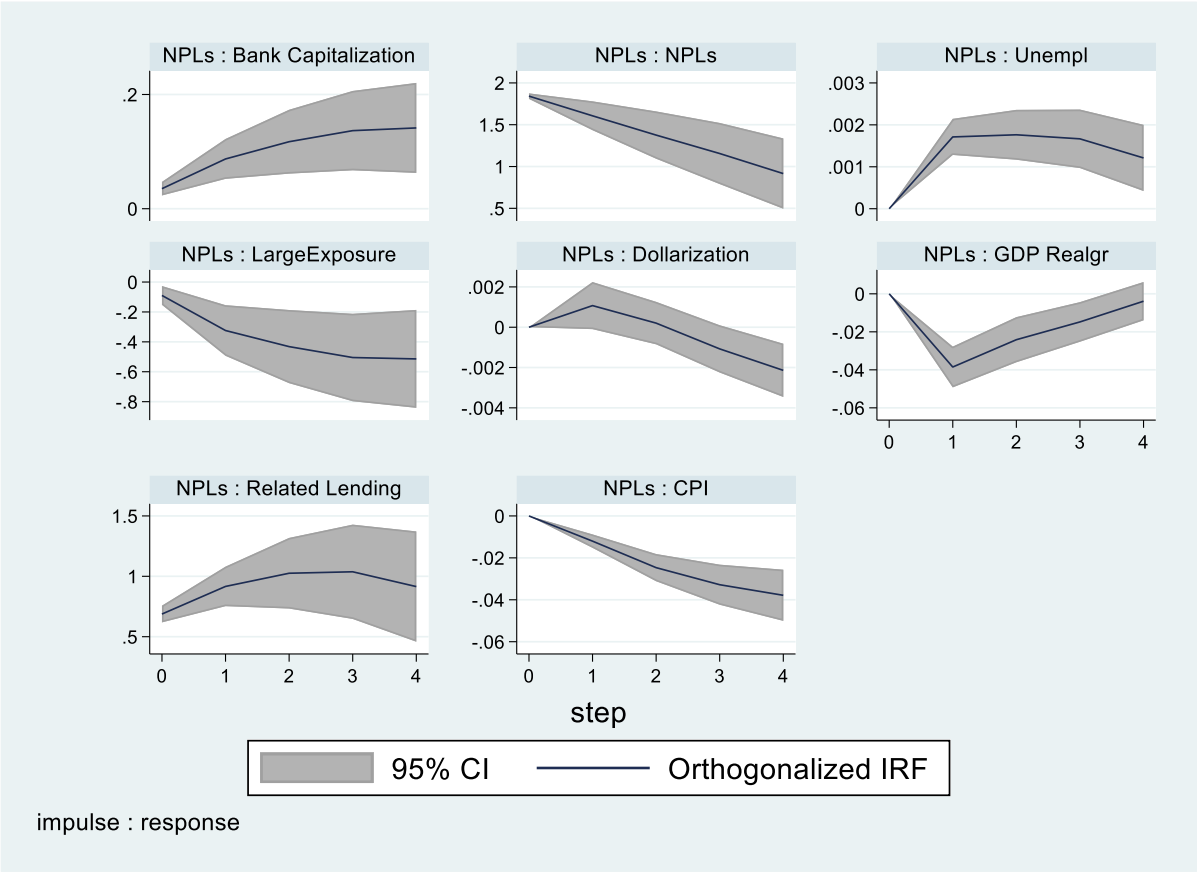


Figure A 1.6: Robustness check of Figure 1.4. IRFs to the shock in NPLs of the 1-lag PVAR model



Notes: The dependent variable, NPLs, is the log transformation of the total amount of bad loans; Related Lending stands for the log transformation of the loan amounts advanced to related parties; Large Exposure is the log transformation of the loan mounts advanced to large clients; Bank Capitalization is the capital adequacy ratio; BSD is bank sector dollarization; Unempl is the unemployment rate; CPI stands for inflation; Real GDPgr is the real GDP growth rate. All variables are included in levels except for BSD, which is included in differences. The 95% confidence interval band was generated based on 500 Monte Carlo simulations. NPLs are the impulse variable. Response variables order is as follows: Real GDPgr, Unempl, CPI, Dollarization, NPLs, Related Lending, Large Exposure, Bank Capitalization.

Table A 18: Baseline Panel FE models with NPL ratio (Panel FE)

	(1)	(2)	(3)	(4)
$NPLs_{t-1}$	0.854***	0.850***	0.850***	0.846***
	(0.023)	(0.024)	(0.023)	(0.024)
Related $Lending_{t-1}$	0.0001	0.0001	0.0001	0.0001
	(0.000)	(0.000)	(0.000)	(0.000)
Large $Exposure_{t-1}$	0.001*	0.001*	0.001	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)
Bank	-0.004	-0.004	-0.004	-0.004
$Capitalization_{t-1}$	(0.004)	(0.003)	(0.004)	(0.003)
$State_{t-1}$		0.056		0.057
		(0.040)		(0.038)
$Foreign_{t-1}$		0.029**		0.030**
		(0.012)		(0.013)
$Russian_{t-1}$		0.026**		0.026**
		(0.011)		(0.011)
$Private_{t-1}$		Reference		Reference
$Large_{t-1}$			-0.020	-0.023
			(0.016)	(0.016)
$Upper\text{-}medium_{t-1}$			0.000	-0.002
			(0.008)	(0.008)
$Medium_{t-1}$			-0.001	-0.003
			(0.005)	(0.004)
$Small_{t-1}$			Reference	Reference
Controls	Yes	Yes	Yes	Yes
adj. R^2	0.769	0.770	0.769	0.770
Observations	5923	5923	5923	5923

Notes: The dependent variable, NPL ratio, the ratio of bad loans to total gross loans; Related Lending stands for the log transformation of loan amounts advanced to related parties; Large Exposure is the log transformation of the loan amounts advanced to large clients; Bank Capitalization is the capital adequacy ratio; Following the NBU classification, we have divided our sample into five groups by ownership type, namely state-owned banks (excl. PrivatBank), PrivatBank, foreign banks (banks that belong to foreign banks groups excl. Russian), Russian banks, and private banks. Privatbank has been excluded from the analysis as an outlier. Large banks are defined as having total assets that are higher than the 90th percentile for each period; upper-medium banks, from the 75th to 90th percentiles; medium banks, from the 50th to 75th percentiles; and small banks, below the 50th percentile. Controls include banks' return on assets ratios, banks' market shares, bank sector dollarization, the real GDP growth rate, the CPI, the aggregate cost rates on loans to the real sector of the economy, unemployment, dummies for the 2008–2009 and 2014–2016 banking crises, dummies for changes in banking regulation and accounting requirements. All regressions account for seasonality and the business cycle by including quarterly and yearly dummies. A constant is not reported but included in all models. Clustered by banks robust standard errors, reported in parentheses. *, **, and *** denote significance at 10 %, 5 %, and 1 %, respectively.

Table A 19: Summary statistics of original (non-transformed or lagged) variables

Variable	Mean	Std. dev.	Min	Max
NPLs	1,880.98	8,070.54	0.00	113,909.60
Related Lending	70.58	446.97	0.00	10,748.78
Large Exposure	1,880.00	5,803.74	0.00	106,486.30
Bank Capitalization	0.39	0.73	0.01	25.39
Ownership: State	0.04	0.18	0.00	1.00
Ownership: Foreign	0.18	0.39	0.00	1.00
Ownership: Russian	0.04	0.20	0.00	1.00
Ownership: Private	0.74	0.44	0.00	1.00
Size: Large	0.09	0.29	0.00	1.00
Size: Upper-medium	0.16	0.36	0.00	1.00
Size: Medium	0.26	0.44	0.00	1.00
Size: Small	0.49	0.50	0.00	1.00
Market Share	0.01	0.02	0.00	0.18
ROA	0.00	0.08	-1.99	1.59
Bank age	15.71	7.30	0.27	29.24
Dollarization	0.48	0.07	0.35	0.60
Unempl	0.09	0.01	0.05	0.11
CPI	0.09	0.10	-0.01	0.43
Real GDP gr	0.05	0.16	-0.37	0.33
Loans Cost	0.18	0.03	0.12	0.28
Reg Change	0.30	0.46	0.00	1.00
IFRS 9	0.13	0.34	0.00	1.00
Crisis 08	0.13	0.33	0.00	1.00
Crisis 14	0.22	0.42	0.00	1.00

Notes: NPLs is the total amount of bad loans in UAH millions; Related Lending stands for all claims to banks' related parties in UAH millions; Large Exposure is all claims to large exposures in UAH millions, a measure of large exposures concentration; Bank Capitalization is the capital adequacy ratio. Following the NBU classification, we have divided our sample into five groups by ownership type, namely state-owned banks (excl. PrivatBank), PrivatBank, and foreign banks (banks that belong to foreign banks groups excl. Russian), Russian banks, and private banks. Privatbank has been excluded from the analysis as an outlier. Large banks are defined as having total assets that are higher than the 90th percentile for each period; upper-medium banks, from the 75th to 90th percentiles; medium banks, from the 50th to 75th percentiles; and small banks, below the 50th percentile. Market Share is the measure of a bank market share; ROA is the return on assets; Bank age – bank age from the registration date; Dollarization – banking sector dollarization ratio; Real GDPgr is the quarterly real GDP growth rate; CPI stands for inflation; Unempl is the quarterly unemployment rate; Loans Cost is the aggregate cost rates on loans to the real sector of the economy; Crisis 08 – dummy, 1 for the period from Q4 (2008) to Q4 (2009); Crisis 14 – dummy, 1 for the period from Q1 (2014) to Q4 (2016); Reg Change – dummy, 1 for the period starting from Q2 (2015); IFRS 9 – dummy, 1 for the period starting from Q1 (2018).

Some details on PVAR model application.

The PVAR model has several practical benefits in terms of our study purposes. First, PVAR keeps an unobserved individual heterogeneity of a panel data that allows us to introduce a fixed effect. Second, PVAR considers all the model variables as being endogenous, as in the conventional VAR approach, which introduces simultaneous dependence of each variable from its historical value and other variables in the model (Charfeddine & Kahia, 2019; Love & Zicchino, 2006). Additionally, PVAR is a relatively straightforward and practically proven instrument. All this results in an unbiased and consistent estimation.

Following Love and Zicchino (2006), when we combine the VAR modelling and panel data, we must be confident that for all banks in the panel the underlying structure is the same. However, in practice, this condition is mostly violated. To overcome that constraint, we introduce fixed effects, φ_i in the model Eq. (1.2), i.e., recognize "individual heterogeneity" in all variables' levels. It means that each bank is allowed to have a bank-specific level of every variable in the system. Also, some other time-invariant determinants, for example, differences in workout procedures, are taken into account (Grossmann et al., 2014). However, this step has raised a further estimation challenge, typical for models with lagged outcome variables—the lagged dependent variables are correlated with the fixed effects, which causes bias in the coefficients of OLS. According to Love and Zicchino (2006), to overcome this problem, we have applied the Forward Orthogonal Deviation (FOD) transformation of Arellano and Bover (1995), also known as forward-mead differencing or the "Helmert procedure." FOD extracts only the forward mean. It means that all future observations mean values of each bank and time, aiming to keep the orthogonality between the lagged independent variables and the transformed variables, allowing us to use the lag of independent variables as instruments. According to Abrigo and Love (2016), independent variables remain accurate instruments because FOD does not include past realizations. Also, FOD keeps more data in case of missing observations or unbalanced panels.

Taking into account that, usually in practice, our earlier-mentioned assumptions about the vector of residuals (ε_{it}) are violated because the defined variance-covariance matrix of the residuals is rarely diagonal. Hence, this does not allow us to study the effect of a shock in particular variable on any other in the system, while holding the remaining variables steady, i.e., orthogonal shock impact. Hence, to examine the shock impact of a variable, we have to decompose the errors to become orthogonal. For this purpose, we have applied the variance-covariance matrix of errors decomposition proposed by Sims (1980), also known as the Cholesky decomposition, meaning that the order of variables in the VAR model should be recursive depending on their exogeneity. It implies that the variable that is first in the model has to be the most exogenous, with further diminishing to the most endogenous. The key assumption for a variable's ordering identification is the following: the variable that comes first in the model's ordering affects the later variables at once; meanwhile, the next variables affect the earlier ones with a lag only (Grossmann et al., 2014; Love & Zicchino, 2006).

Table A 20: Estimation results of Panel Data Error Correction Model (PECM)

		Dependent variable	$NPLs_{t-1}$		ECT			
			Coefficient	std. err.	Coefficient	std. err.	adj. R^2	*Obs.*
Model 1	Long Run	Real GDPgr	-0.001*	0.001			0.153	5923
Model 1	Short Run	Real GDPgr	-0.001*	0.001	-0.088**	0.035	0.129	5576
Model 2	Long Run	Unempl	0.000	0.000			0.505	5923
Model 2	Short Run	Unempl	0.000*	0.000	0.432***	0.01	0.511	5576
Model 3	Long Run	CPI	-0.000	0.000			0.54	5923
Model 3	Short Run	CPI	0.000	0.000	-0.012	0.016	0.569	5576
Model 4	Long Run	Dollarization	-0.000	0.000			0.129	5851
Model 4	Short Run	Dollarization	0.000	0.000	0.645***	0.026	0.106	5507
Model 5	Long Run	Related Lending	0.012	0.015			0.509	5919
Model 5	Short Run	Related Lending	0.011	0.021	-0.132**	0.06	0.498	5573
Model 6	Long Run	Large Exposure	0.008	0.012			0.338	5919
Model 6	Short Run	Large Exposure	0.002	0.011	-0.198***	0.065	0.369	5573
Model 7	Long Run	Bank Capitalization	-0.003	0.002			0.507	5923
Model 7	Short Run	Bank Capitalization	-0.003	0.003	0.181*	0.098	0.43	5576
Model 8	Long Run	NPLs	0.679***	0.034			0.569	5923
Model 8	Short Run	NPLs	0.718***	0.043	-0.103**	0.048	0.543	5576

Notes: Real GDPgr is the real GDP growth rate; Unempl is the unemployment rate; CPI stands for inflation; Dollarization is the banking sector's dollarization; Related Lending stands for the log transformation of the amount of loans to related parties; Large Exposure is the log transformation of the amount of loans to large clients; Bank Capitalization is the capital adequacy ratio; NPLs is the log transformation of the amount of bad loans. All variables are included in levels except for Dollarization, which is included in differences, all other variables are used in levels. Standard errors clustered on banks. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively. The ECTs of Models 2, 4, and 7 exceed the boundaries of (-1;0), which means that these results are explosive and the models have to be reestimated or reviewed. Obs.—number of observations.

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2. CHAPTER TWO[35]: Monetary Policy Communication on Key Financial Variables in Developing Countries

ABSTRACT

This study utilizes a newly built dataset drawn from more than 850 monetary policy statements from 21 developing countries over an 11-year horizon to establish that unclear statements are associated with higher foreign exchange (FX) rate volatility. The text mining tools permitted us to construct a set of monetary policy statements complexity and readability measures, identify statements' topics, and assess central banks' sentiments about the economic situation. Our results were not only consistent with previous related studies but also robust to different measures of readability and complexity indicators. The results for lending, money market and treasury bill rates are, however, not robust. We observe that the adoption of central bank communication as a tool for monetary policy is not enough for better monetary policy outcomes. There is a need for appropriate execution, and messages are required to be clear, simple, and easier to comprehend by markets.

Keywords: monetary policy communication, complexity, readability, FX rate, lending rate, money market rate, treasury bill rate, volatility.

[35] Co-authored by Wytone Yohane Jombo

2.1 INTRODUCTION

Over the last two decades, central banks have become more interested in communicating monetary policy. This contrasts with previous central bank beliefs, in which central banking issues, and particularly monetary policy issues, were treated almost like a secret cult, and markets were usually driven by "surprise." Therefore, the markets had no clue what to expect, the public never understood why certain policy decisions were made, and the central bank owed no one an explanation for its actions. For example, the then chairman of the Fed, Paul Volcker, declined to disclose the Fed's decisions immediately in 1984 on the basis that announcing the decisions immediately would mean commitment. Similarly, Chairman Alan Greenspan, opposed the Fed's decision to be made public right away in 1989 because he feared that "public announcement requirement also could impede timely and appropriate adjustment to policy" (Blinder et al., 2008), although he changed his stance later in 2003 and explicitly managed expectations by telling everyone the forward guidance on the direction of Federal funds rate.

The popularity of monetary policy communication altered the rules of the game. Most monetary authorities are now forthright and willing to disclose the fundamental assumptions underlying their decisions; they are also keen to explain what could go wrong and what could go right in the short and medium term, as well as what they would do depending on future economic conditions. Indeed, central banks are now prepared to reveal their anticipated moves and the rationale behind them. A major question arises as to why there has been a sudden change of heart by central banks. Amato et al. (2002) identify three reasons. Firstly, since many central banks have earned independence, they need to increase accountability, which demands more open communication with the public about policymakers' ideas and monetary policy operations. Secondly, many industrialized and developing market nations have embraced inflation targeting since New Zealand first implemented it in 1990—a monetary policy regime

that places importance on the communication practices of central banks. Finally, the significance of financial markets in many countries and the critical role of market players in determining market prices necessitate the need to anchor and manage such expectations, which is a critical component of monetary policy. This would be a near-impossible task without a strong line of communication with market participants.

The evidence on the impact of monetary policy communication on financial markets' variables is abundant for advanced economies but still scanty for developing markets. According to Guthrie and Wright (2000), the Reserve Bank of New Zealand's communications—called "open mouth operations" by the authors—were found to have a long-lasting effect on interest rates across the maturity range. Furthermore, Kohn and Sack (2003) claim to have found evidence that the Federal Open Market Committee's pronouncements have an impact on interest rates over the short and medium term. Similar evidence is found by Reeves and Sawicki (2007) in England and Musard-Gies (2006) in the European Central Bank (ECB). A handful of studies on the subject are also available for emerging markets. For example, Ahokpossi et al. (2020) report that financial surprises have a significant impact on money market rates in Indonesia, while Su et al. (2020) state that informal communication appears to be more effective than formal communication in China.

This study departs from the earlier related studies in two ways. Firstly, most of the studies on this topic have been done in advanced economies where financial markets are well developed and the response of financial markets is almost guaranteed. In developing countries, there is no such luxury. Financial markets are usually slow to react to news, and at times no response at all. For instance, when a sitting president in Malawi suddenly died in April 2012, the stock market indices were intact around those dates. In developed economies, the response to such tragic news would have been noticeable, if not strong. Now that most central banks in the developing world have begun producing statements in the last decade, it is timely to

investigate whether the impact of communication on financial markets experienced in advanced economies could be observed in the developing world. Secondly, our study is unique because it uses over 850 statements from 21 central banks of developing countries. This diverse data is expected to provide robust results, which can be easily inferred from other countries with similar characteristics.

Results show that complexity and readability of statements are both essential variables in the determination of foreign exchange rate volatility, whereas they are weak in the driving of lending rates, money market rates, and local Treasury Bill (T-Bill) rates in developing nations. The results further suggest that central banks' views about economic situations can affect exchange rate and interest rates movements in developing markets.

This paper contributes to the related literature in various respects. First, we studied the monetary policy statements of developing countries' central banks utilizing a newly created dataset. We further quantified these statements' complexity and readability as well as the central banks' sentiments about the economic situation. Furthermore, we discovered that, with the exception of a few economies, forward guidance tools are rarely used in developing countries. In line with the literature, we found evidence suggesting that ambiguous statements are linked to high exchange rate volatility but no evidence that monetary policy statements are associated with market rates volatility.

The study is organized as follows: Section 2 details the theoretical underpinnings of monetary policy communication and the expected response from the financial markets. This section also unveils studies that have been conducted in this area and the results. Section 3 contains the research questions and hypotheses we explore. Section 4 describes the data used in this study, while Section 5 contains the methodological framework this study uses. Empirical results and discussion are presented in Section 6, while Section 7 concludes the study with policy recommendations.

2.2 LITERATURE REVIEW

2.2.1 The Theory of Monetary Policy Announcements

In a broad sense, the central bank monetary policy communication refers to the process when the information is made public by the central bank regarding its present and future policy objectives, the current economic outlook, and the expected route for future monetary policy choices (Blinder et al., 2008). In theory, effective monetary policy announcements make policy decisions more predictable and anchor long-run inflation expectations (Lewis et al., 2019). Over the recent decades, central banks have been able to inform the general public about monetary policy decisions, objectives, strategies, and outlooks for macroeconomic conditions. This approach is most prevalent in developed countries, where central banks regularly provide information on the economic outlook and the potential for future monetary policy adjustments (Lewis, Makridis, and Mertens 2019). Similarly, Mathur and Sengupta (2020) report that communication is less effective in most emerging economies due to asymmetric information, weak financial institutions, and smaller financial markets. Therefore, existing literature covers extensive communication in developed countries (Ahokpossi et al., 2020).

Blinder et al. (2008) present a persuasive theory of central bank communication. They argue that a central bank's power to impact the economy is dependent on its ability to alter market expectations about the future course of the overnight interest rate. Term structure theories dictate that longer-term interest rates, R_t, should mirror future overnight rates.

$$R_t = a_n + \frac{1}{n}(r_t + r_{t+1}^e + r_{t+2}^e + \cdots + r_{t+n-1}^e) + \varepsilon_{1t} \qquad (2.1)$$

Where R_t denotes interest rates of longer-term instruments, r_t is the current overnight rate, and r_{t+1}^e is the expectation of tomorrow's overnight rate, a_n is a term premium. Equation (2.1) states unequivocally that intermediate and long-term interest rates should be mostly determined by public expectations about future central bank actions. Present overnight interest

rates are mostly irrelevant, as what counts is the anticipation of future rates, which is influenced by central bank communication (Bernanke, Reinhart, and Sack 2004). This idea is incorporated into the macroeconomic framework, which is designed to illustrate the role of central bank communication (signals).

$$y_t = \mathrm{D}(r_t - \pi^e_{t,}\, R_t - \pi^e_{t,} \dots) + \varepsilon_{2t} \qquad (2.2)$$

If we consider r as the short rate in equation (2.1) and R as the long rate, aggregate demand is , therefore, dependent on r, R and expected inflation $\pi^e_{t,}$ among other factors. It is easy to understand how aggregate demand, driven by expectations in (2.2), affects aggregate supply in (2.3).

$$\pi_t = \beta\mathrm{E}(\pi_{t+1} + \gamma(y_t - y^*_t) + \varepsilon_{3t} \qquad (2.3)$$

Where π_t is actual inflation and y_t and y^*_t are actual and potential output, respectively. The reaction function in (2.4) closes the model.

$$r_t = \mathrm{G}(y_t - y^*_t,\, \pi_t, \pi^*_{t,} \dots) + \varepsilon_{4t} \qquad (2.4)$$

Where $\pi^*_{t,}$ is the central bank's inflation target.

This theoretical framework suggests that if the economic environment is stationary, the central bank is credible in its commitment to the policy rule, and expectations are rational, then bank communication is immaterial. Woodford (2005) contends that any regular pattern in the central bank's actions can be correctly inferred. In practice, the economy is nonstationary, expectations might be nonrational, and information cannot be symmetric between the bank and the public (Blinder et al. 2008). Moreover, Bernanke et al. (2004) believe that defining a strict policy rule from which the central bank would never stray is impractical. Additionally, Blinder et al. (2008) argue that the number of possible policy responses that a central bank can pursue is effectively unlimited. As such, central bank communication becomes relevant.

When there is asymmetric information, the economic environment is not stationary, and expectations are not entirely rational, it allows the central bank to boost economic performance by disclosing its long-run inflation target (Bernanke et al., 2004). In many cases, offering more information solves an information problem. It helps to anchor expectations. The economy cannot converge to the rational expectations equilibrium if the public does not know the central bank's reaction function. In this simplified approach, we capture these notions by specifying an explicit equation for interest rate expectations, such as:

$$r_{t+1}^{e} = H_j(y_t\ R_t\ r_t\ , \dots,\ \boldsymbol{s_t}) + \varepsilon_{5t} \qquad (2.5)$$

where $\boldsymbol{s_t}$ is a vector of central bank signals ranging from obvious signals, such as an announcement of an inflation target, to more cryptic signals.

In summary, the above theory suggests that there are three different conduits through which central bank communication diffuses into the economy, which are as follows: the direct effect of the overnight rate on aggregate demand (equation 2.2); the direct effect of central bank signals on expected future short rates (equation 2.5); and the effect of changes in the short rate on expected future short rates (equations (2.1) and (2.5)), and their subsequent feedback onto long rates (R_t) (equation 2.1).

The theory further postulates that monetary policy statements guide interest rates and inflation expectations, promote transparency and accountability, and help ensure the credibility of central bank operations (Ahokpossi et al., 2020). For example, the public can assess the performance of the central bank based on its ability to keep inflation within target limits. There is consensus in the literature that communication is an essential and effective monetary policy tool to ensure the success of central banks (Ahokpossi et al., 2020; De Fiore, Lombardi, and Schuffels, 2021; Lewis et al., 2019; Mathur & Sengupta, 2020). Jenkins (2004) found that effective monetary policy communication is directly linked to achieving good economic

outcomes. With effective communication, Pescatori (2018) acknowledged that economic agents are less surprised by the actions of central banks, thereby curbing asset price volatility.

The information provided by central banks has a significant impact on the economy. For this reason, the effectiveness of communication depends on its clarity (Ahokpossi et al., 2020). Well-transmitted monetary policy tends to be more effective (Jenkins, 2004). Similarly, Demiralp and Jorda (2002) report that concisely communicating the central bank's intentions to the public increases the likelihood that interest rates will stabilize. Ambiguous communication leads to different interpretations by the public, causing fluctuations in financial markets and thus impeding economic development (Mathur & Sengupta, 2020).

It is also widely discussed in the literature on economic agents' asymmetric responses to bad and good news. Agents are thought to react more strongly to bad news than to good news (Barberis, Shleifer, and Vishny 1998). This implies that market reaction may be affected not only by the size of the monetary policy shock but also by whether the shock is inherently good or bad news. Recognizing this theoretical underpinning, central banks tend to issue longer monetary policy statements when delivering bad news or during economic downturns. It is not surprising, then, that Coenen et al. (2017) and Smales and Apergis (2017b) observe that Federal Open Market Committee (FOMC) statements have become noticeably longer and more difficult to read since the financial crisis, even though the trend has recently reversed.

2.2.2 Evolution of Monetary Policy Announcements

Before the 1970s, central banks acted secretly to surprise markets. However, the sharp inflation of the 1970s highlighted the need to effectively manage expectations for economic outcomes through increased transparency (Assenmacher et al., 2021). Yet, for example, only in February 1994 FOMC issued a statement in support of the decision. Blinder et al. (2017) add that the global financial crisis of 2008 further amplified the need for broader communication with the public. This led to a paradigm shift from deliberate secrecy to

increased transparency in the operations of central banks around the world (Assenmacher et al., 2021; Jenkins, 2004). Since then, the focus has been on monetary policy communication to support the financial sector's stability. In the years after the crisis, the central banks' communication intensified exponentially and they have been focusing more on the general public (Haldane, 2017).

The introduction of new monetary policy frameworks, such as the inflation-targeting approach in most developing and developed countries, has further increased the need for transparency from the central banks. This approach involves disclosing the medium-term inflation target and strategies to achieve it (Assenmacher et al., 2021). If agents are aware of future inflation, their actions are in line with their expectations, thereby stabilizing the macroeconomic environment (Jenkins, 2004). Mathur and Sengupta (2020) argued that in most emerging markets, inflation targeting tends to be more effective in influencing the expectations of economic agents that are in line with central bank targets. This has made the communication approach an important mechanism of monetary policy (Mishkin & Posen, 1998). More generally, Hansen and McMahon (2016) state that, to moderate inflation expectations, central banks have turned to communication as a major instrument.

Most central banks in developed countries use forward guidance to actively communicate with the public, although the US FED recently declared the abandonment of this policy. [36] Forward guidance includes informing the public about the future direction of the policy rate (Woodford, 2008). Den Haan (2013) explains that the economic logic of "forward-guidance" is that it links the decisions made during the current period to the public's expectations for the future. It was first developed as a monetary policy tool in 1999 by the Bank of Japan (Den Haan 2013). Before its introduction, it had been tested for decades in the United

[36] For example, see https://www.wsj.com/articles/goodbye-fed-guidance-let-us-hope-jerome-powell-federal-reserve-inflation-monetary-policy-11658955848

States, Japan, and Europe (Woodford 2008). Zeidy (2020) shows that forward guidance was refined in the United States at the beginning of the 2008 Great Recession. Since then, the FED has provided a transparent outlook for future base interest rate paths. Woodford (2012) points out that forward guidance is more effective when it is coupled with commitment, not just prediction. However, Blinder (2018) believes that forward guidance is and will always be about forecasting, not commitment. Non-commitment forecasts are called "Delphic forward guidance," and the opposite is called "Odyssean forward guidance" (Campbell et al., 2012). Effective forward guidance helps ease financial conditions and stimulate economic growth and job creation (Williams, 2013).

Moreover, some central banks have moved toward the digital frontier in recent decades with significant advances in information technology and telecommunications (Assenmacher et al., 2021). This has changed the way information is communicated to the general public. Changes in the functioning of financial markets have required the central bank to disseminate its economic outlook and policy stance more quickly (Ehrmann & Talmi, 2020). Ahokpossi et al. (2020) also recognize that central banks in countries like Indonesia are adapted to the digital age; for instance, social media is also extensively used to communicate with the general public.

2.2.3 Forms of Monetary Policy Communications

The forms of monetary policy communications in most economies are common. Reeves and Sawicki (2007) found that the Bank of England uses four major channels to convey information to the public. These are minutes of the Monetary Policy Committee (MPC) meetings, Inflation Report, Speeches, and Testimony by the MPC. The minutes of the MPC meetings are published thirteen days following a meeting. They provide timely and valuable information on monetary policy stance, economic outlook, and risks to economic agents. The inflation reports are forward-looking, published quarterly, and include the projections of GDP growth and inflation and the underlying economic assumptions. On the other hand, speeches and interviews

are given by all the MPC members. Luangaram and Wongwachara (2017) argue that central banks in advanced economies tend to provide better-structured information than in emerging economies. It was further noted that communications in emerging economies are more diverse, both in content and style.

Most low-income countries use similar communication channels as the developed economies, but the literature alleges that they are inefficient. For instance, Pinshi (2020) reports that the Central Bank of Congo (BCC) uses five means of communication: monetary policy report, post-MPC meeting statements, press conferences, conjuncture notes, and annual reports. It was reported that the information from the BCC is unclear and ineffective, which undermines the confidence of the economic agents. As highlighted by the author, the communication failures included a lack of publication series, failure of the monetary policy report, delay of annual reports, and lack of adaptive website.

2.2.4 The Impact of Monetary Policy Communications on Financial Markets

2.2.4.1 Empirical Literature

Two closely related papers on Canada by Hendry and Madeley (2010) and Hendry (2012) studied the impact of central bank communication on financial markets. They both utilize several different text mining methods. Followed by Hansen and McMahon (2016), who assessed the Federal Open Market Committee (FOMC) of the USA and released information on the conditions of the economy as well as its direction on future monetary policy actions (forward guidance), using computation linguistic tools, more specifically LDA topic modeling and dictionary methods. They further applied the Factor-Augmented Vector Autoressive (FAVAR) framework to find that neither communication had a significant impact on actual economic variables.

To better understand the effects of monetary policy-related announcements on financial markets in South Korea, Sohn et al. (2006) conducted a comprehensive study using 138

monetary policy-related announcements. The study concluded that monetary policy announcements had increased the volatility of financial variables but had an insignificant effect on their actual levels. The study further reveals that government monetary policy-related pronouncements are seen as disruptive variables that impair the effectiveness of monetary policy announcements and elevate market volatility without having any independent effect on financial markets.

Luangaram and Wongwachara (2017) recommend using computational linguistic tools to analyze the impact of monetary policy announcements. The study focused on the three fundamental facets of policy communications: readability, topics (key themes of the statements), and tone of the statements. Latent Dirichlet Allocation (LDA) and dictionary techniques were used to extract the subjects and tone of the announcements. The authors argued that the readability of the statements is crucial; consequently, the Flesch-Kincaid grade (FK) and the Educational Testing Service in the United States (ETS) index were used to decide the clarity of the statements. In each technique, the average number of words per sentence was recommended as a good indicator of clarity. Econometric evaluation displays that lowering the average number of words per sentence tends to enhance the clarity of the statements. The study further assessed the impact of communication topics and tone on key macroeconomic variables. The findings show that an increase in the proportion of growth topics was correlated with GDP growth and the unemployment rate. Likewise, inflation topics were closely related to the actual inflation change.

Further, Mathur and Sengupta (2020) proposed the use of computational linguistics techniques to measure the impact of monetary policy communication on Indian financial markets. The study evaluated changes in the way central banks communicate with the public before and after the introduction of the inflation-targeting approach in 2016. Word length and readability in statements were used as indicators of language complexity. They adopted the

Farr-Jenkins-Paterson (FJP) index, which is a widely used standard index for readability. The FJP index measures the number of single-syllable words per 100 words. The higher the index value, the better the readability of the statement. Readability indicators from the popular Flesch-Kincaid and Gunning-Fog were also used to check robustness. The usual ordinary least squares (OLS) regression model was used to econometrically measure the impact of communications on financial markets. The study assumes that as statement complexity increases, market volatility increases. The results show that stock and currency markets tend to be more volatile the more words they contain in their financial statements. A one percent increase in the number of words increased the volatility of the stock and currency markets by 0.24 percent and 0.23 percent, respectively. However, there was no statistical evidence of its impact on the bond market. In addition, the readability of the statement was not important in explaining volatility fluctuations in equity, currency, and bond markets

Similarly, Ahokpossi et al. (2020) investigated the impact of monetary policy communications in Indonesia. The study focused on the transparency and clarity of the Bank of Indonesia's monetary announcements. The readability of the announcement was measured using Flesch-Kincaid's readability index. Like most readability indicators, it assumes that longer sentences reduce the intelligibility of the announcements. This study analyzed 314 statements in both English and Indonesian Bahasa between 2006 and 2018. Most statements were difficult to read and found to require at least 11 years of education to comprehend the presentation. According to the survey, monetary policy announcements played no role in explaining fluctuations in market interest rates. The study further looked at the impact of monetary policy surprises on financial markets (money, bonds, and exchange rates). The surprises were measured as the difference between the central bank's actual interest rate determination and the forecasted interest rate. Econometric analysis was performed using the

OLS regression model. The results prove that financial surprises have a significant impact on money market rates but not on bond or currency markets.

Smales and Apergis (2017) argued that complex statements are more challenging to comprehend and may be interpreted differently by several agents. Due to this, market participants' beliefs become more diverse, which leads to an increase in market activity. They found that the amount of trade and volatility in the equities, bond, and currency futures markets are significantly impacted by the linguistic complexity (readability and word count measured through the Flesch-Kincaid Grade Level Index and word count, respectively) of the language used in the US Fed FOMC statement.

In one of the most recent studies, Gonzalez and Tadle (2021) used linguistic tools such as LDA, an automated language method, to analyze and compare the information included in monetary press releases from a collection of inflation-targeting nations. They found that the complexity of press releases in most countries requires some college education. To understand the press releases from the remaining countries, one needs at least a tenth-grade high school education. Furthermore, they discovered that the length of press releases is converging, with shorter press releases growing in length and originally longer press releases decreasing in the average word count.

McMahon et al. (2018) conducted a corresponding survey on communication at the Central Bank of China. According to this survey, the People's Bank of China (PBC) uses four major channels to communicate with the public: Monetary Policy Executive Report, Press Releases on Monetary Policy Committee Meetings, Speeches and Press Conferences, and Open Market Operations Announcements. First, the OLS regression model was employed to assess the impact of these channels on interest rate fluctuations. It is indicated that the monetary policy executive report is associated with lower volatility of the short-term notes. Precisely, this channel was associated with 0.03 percent and 0.01 percent volatility reductions for 1-month

short term notes and 3-month short-term notes, respectively. Similarly, speeches and press conferences were associated with a 0.023% drop in market volatility. However, the study also found that heterogeneous variance and autocorrelation affected the estimates. Therefore, the authors adopted a general autoregressive conditional heteroscedastic (GARCH) model to obtain robust results. A class of GARCH called Nelson's EGARCH model (non-linear model) was used. The results of the survey suggest that PCB financial communications have had a significant impact on short-term market interest rates.

In a similar study, Wang and Mayes (2012) focused on New Zealand, the United Kingdom, Australia, and the Eurozone. They used an event study method to measure the impact of monetary policy announcements. Initially, short-term returns of stock indices (period around an announcement) were regressed against monetary policy surprises. However, the possibility of endogenous problems was recognized. To mitigate this issue, they used a one-day event window. In addition, a threshold regression approach was adopted to illustrate the impact of the business cycle. Consistent with several other studies, monetary policy announcements have been observed to affect stock prices.

Rosa and Verga (2008) used an intra-day dataset to investigate the impact of ECB communications on asset prices. The study adopted an event-study approach for econometric analysis. In addition, the study estimated the regression model using the autoregressive process. The results show that the asset market reacts quickly if the announcement deviates from general expectations. This is in line with our hypothesis that monetary policy communication is the key to influencing financial markets.

Mpofu and Peters (2017) use the event study technique to investigate the impact of monetary policy communication on South African exchange rates. The study argues that the approach is valuable because it systematically quantifies the unexpected effects of other events on the outcome variable. The survey found that the announcement was an important factor

influencing the exchange rates. Approximately 66% of the published announcements were important in explaining exchange rate fluctuations. The authors concluded that the South African rand could rise or fall when the central bank announced a rate hike. This shows the reaction of the foreign exchange market to monetary communications.

In the same way as the previous studies, we conducted a quantitative study of central bank monetary policy statements and examined their influence on financial market variables in our study. Nevertheless, we utilize both complexity/readability as well as sentiment analyses of MPS to cover the financial market's reaction of the developing countries.

2.3 RESEARCH QUESTIONS AND HYPOTHESES

The majority of studies from the field focus on either developed countries or some single developing country's monetary policy communication issues. In this study, we are mainly investigating whether financial markets in developing countries care about central bank communication and, indeed, whether changes in financial markets' variables reflect central bank messages. As central banks across the globe are being encouraged to adopt communication as one of the most important tools to facilitate monetary policy effectiveness, it is timely to explore how the readability and complexity dimensions of such communication affect the variables of the financial market. Specifically, this study will answer the following questions:

1. Does the clarity of central bank communication affect financial market variables in developing countries?
2. Do financial market variables respond to monetary policy stance and signals?
3. Do financial market variables respond to central banks' sentiments about economic conditions in the economy?

Following the literature related to advanced and some developing countries, we believe that the more complex the central banks MPS are, and the less readable the central bank's MPS are, the more unclear the statements become. Consequently, the more unfavorable reaction from the financial market variables they face. Longer sentences in policy statements have a high likelihood of relaying unclear information and present a higher probability for market players to have a large variance in their judgments regarding the current and prospective policies. Considering the different MPS readability measures, we further expect that unclear statements tend to have an unfavorable effect on financial markets as the uncertainty caused by such MPS is quickly reflected in assets prices and market rates and indexes while increasing markets volatility. We also expect that the negative tone of a statement pertaining to the economic situation at a given point in time would be associated with adverse effects on financial markets. Formally, this study has the following hypotheses:

Hypothesis 1: The increase in average sentence length of central bank MPS is associated with the increase in local currencies' exchange rates volatility a few days after the date of statement publication and is also associated with an increase in the volatility of lending rates, money market rates, and treasury bills rates;

Hypothesis 2: The increase in readability scores for central bank MPS is associated with an increase in local currencies' exchange rates volatility a few days after the date of statement publication, and is also associated with an increase in the volatility of lending rates, money market rates, and treasury bills rates;

Hypothesis 3: The negative view on the economic stance of the central banks' MPS at a given point in time is associated with a negative impact on local currencies' exchange rates volatility a few days after the date of statement publication and associated with an increase in the volatility of lending rates, money market rates, and treasury bills rates.

2.4 DATA AND DESCRIPTIVE STATISTICS

In this study, we have applied textual analysis to measure the clarity of official Monetary Policy Statements, focusing on their complexity and readability aspects, as well as information on the state of the economy across several countries, which we further use for the empirical analysis. In addition, we utilize a number of control variables from various sources such as IHS Markit, International Monetary Fund, and central banks' websites. As such, the purpose of this section is to describe the sample creation process and provide information about the data sources.

2.4.1 Sample formation

Since the interest of this study is not in advanced economies, we looked for all countries that belong to groups of low and lower-middle-income economies based on the World Bank's June 2020 classification[37] as possible candidates for our sample. Then, we compiled official Monetary Policy Statements[38] (MPS), released publicly soon after monetary policy meetings on the related authorities' websites. Due to the technical limitation of analyzing non-English or manually translated into English textual data and for purposes of standardization and same study base, we follow Gonzalez and Tadle (2021), by focusing on statements that are in English only, either originally or in the related authorities' translation into English. Therefore, we have excluded some countries from our sample for three reasons. Firstly, because English statements were not available. Secondly, there are two groups of countries that belong to monetary unions; as such, they do not have a country-based monetary authority and, hence, no related statements (5 countries from the Bank of Central African States and 8 countries from the Central Bank of

[37] Low and lower middle-income countries classifications are often interchangeably used with the "developing countries" term, though the definition of the former is not harmonized worldwide.

[38] In our study by Monetary Policy Statement we mean any official communication of authorities in charge of the monetary policy, mainly from Monetary Policy Committees, related to key policy rate (or its analogue) decisions together with explanation on such decisions. Statements without numerical Appendixes and personal statements transcriptions.

the West African States). Finally, other countries simply did not have any related official information.

Overall, we ended up with a sample of 21 countries with a total of 889 statements from 2010 until 2021 (Table 2.1). We have discovered several interesting insights regarding the cross-country similarities and differences in monetary policy communication, while looking through the sources and descriptions of these MPS. For example, as expected, the main authority in charge of policy rate setting and communication is a central bank, where a discussion on the rate is largely conducted by the Monetary Policy Committee (MPC). In addition, there are several communication types, namely press releases, press conferences, and statements. Meanwhile, on average, LMIE (Lower-Middle Income Economies) countries in our sample have more statements and a longer policy rate communication history than LIE (Low-Income Economies) countries. This suggests that issues regarding monetary policy communication are well established in the advanced economies and are now diffusing to the emerging and developing countries. This is the reason this study is timely, to establish whether the communication is working in these developing markets.

Table 21: Sample structure

#	Country	Income Group	Statements Number	Statement Type	Discussion Level	Source
1	Egypt	LMIE	85	Press Release	Monetary Policy Committee	Central Bank of Egypt
2	Eswatini	LMIE	39	Monetary Policy statement	Monetary Policy Consultative Committee	Central Bank of Eswatini
3	The Gambia	LIE	25	Press Release	Monetary Policy Committee	Central Bank of The Gambia
4	Ghana	LMIE	51	Press release	Monetary Policy Committee	Bank of Ghana
5	Kenya	LMIE	34	Press Release	Monetary Policy Committee	Central Bank of Kenya
6	Lesotho	LMIE	23	CBL MPC Statement	Monetary Policy Committee	Central Bank of Lesotho
7	Liberia	LIE	9	Communique	Monetary Policy Committee	Central Bank of Liberia
8	Malawi	LIE	21	Statement of MPC	Monetary Policy Committee	Reserve Bank of Malawi
9	Moldova	LMIE	119	Monetary policy decision	Executive Board	National Bank of Moldova

10	Mongolia	LMIE	45	Monetary Policy Statement	Monetary Policy Committee	Bank of Mongolia
11	Mozambique	LIE	26	Communique	Monetary Policy Committee	Bank of Mozambique
12	Nigeria	LMIE	65	Communique	Monetary Policy Committee	Central Bank of Nigeria
13	Pakistan	LMIE	54	Monetary Policy Statement	Monetary Policy Committee	State Bank of Pakistan
14	Rwanda	LIE	12	Press Release	Monetary Policy Committee	National Bank of Rwanda
15	Sierra Leone	LIE	10	MPS	Monetary Policy Committee	Bank of Sierra Leone
16	Sri Lanka	LMIE	96	Press Release	Monetary Board	Central Bank of Sri Lanka
17	Tajikistan	LIE	13	Press Release / MPA	Monetary Policy Committee	National Bank of Tajikistan
18	Uganda	LIE	80	MPS	Monetary Policy Committee	Bank of Uganda
19	Ukraine	LMIE	59	Press Release	Monetary Policy Committee	National Bank of Ukraine
20	Uzbekistan	LMIE	4	Press Release	The Board of the Central Bank	The Central Bank of the Republic of Uzbekistan
21	Zambia	LMIE	19	MPC Statement	Monetary Policy Committee	Bank of Zambia

Note: LIE - Low-Income Economies; LMIE - Lower-Middle Income Economies.

2.4.2 Complexity and readability measures of statements' clarity

To assess the clarity of the MPS through its complexity and readability, we follow Benoit, Munger, and Spirling (2019), Bonsall et al. (2017), Gonzalez and Tadle (2021), Li (2008), Loughran and McDonald (2011, 2014, 2016), Mathur and Sengupta (2020) by applying linguistic analysis tools widely used in the literature on monetary policy communication, finance, and policy studies.[39] Here we are motivated by Levin's (2014) assertion that clarity appears to be important in improving the efficacy of monetary policy.

To measure the linguistic complexity, we utilize the following proxies: the number of sentences per statement, the average sentence length (number of words over the number of sentences per document), the average number of syllables in a word, and the type-token ratio

[39] Prior to this, we pre-processed the collected statements to end up with the corpus of textual data. We first removed text not related to a statement (contact details, page numbers, etc.). Next, we have removed all numerals, special signs, and punctuation and replaced common abbreviations, and then assume the remaining periods are sentence terminations to parse for sentences (Loughran & McDonald, 2014). We seriously took Loughran and McDonald (2016)' guidance that "*identifying sentences is a critical aspect of a textual study, the researcher must carefully identify the steps taken to avoid some of the challenges associated with this aspect of parsing.*" (p. 1217). We consider as a sentence, a text located between two periods.

(dividing the number of types in a text by its number of tokens). We have assessed each statement to estimate the measures mentioned.

Table 2.2 contains the average complexity measures for each country based on the available statements. We observe that, on average, the maximum number of sentences per statement is around 90 and the minimum is 9, while the mean is 39. Further, we see that the longest average sentence length is above 31 words per sentence and the shortest is about 19 words per sentence, while the average is 24. Meanwhile, it is understood that longer sentences have higher information-processing costs (Li, 2008). In terms of the complexity measures based on the number of syllables per word, we found that the sample is more concentrated around the average of 1.80, with a maximum and minimum of 1.87 and 1.70, respectively. While the fewer syllables the words contain (on average), the "easier" the text is (Flesch, 1979).

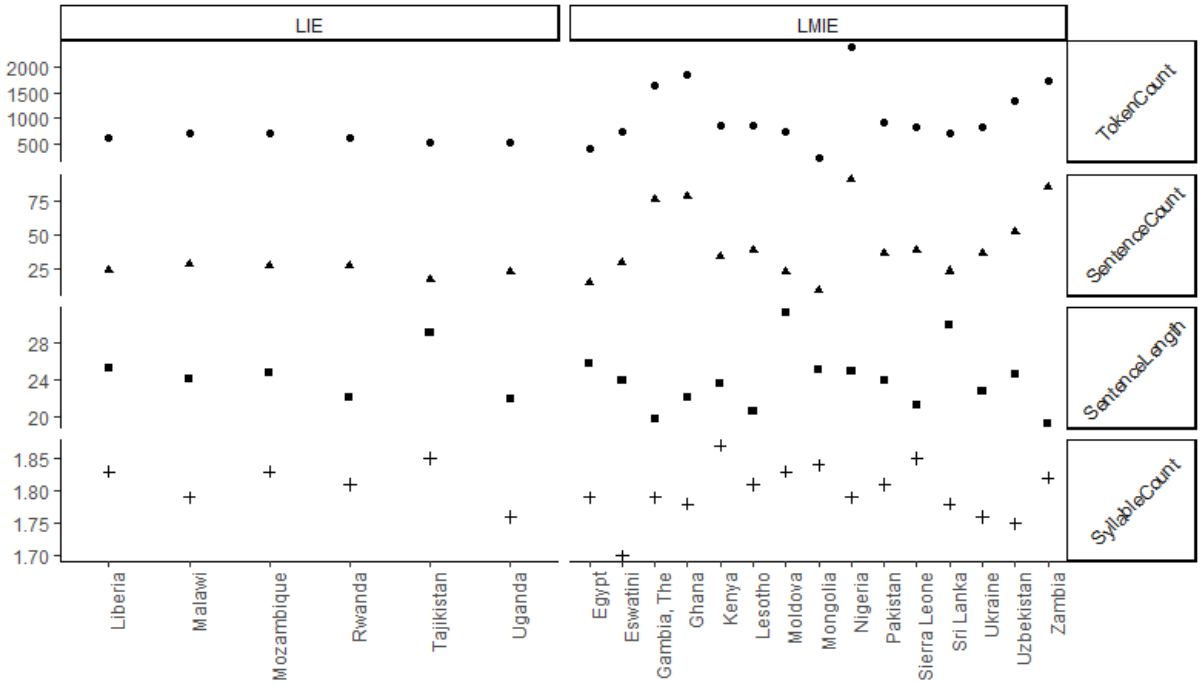
Table 22: Countries' averages for each complexity measure

#	Country	Income Group	Token Count	Sentence Count	Sentence Length	Syllable Count
1	Egypt	LMIE	403.76	14.96	25.82	1.79
2	Eswatini	LMIE	747.38	29.79	23.89	1.70
3	Gambia, The	LMIE	1,629.36	76.68	19.71	1.79
4	Ghana	LMIE	1,856.25	78.84	22.10	1.78
5	Kenya	LMIE	850.91	34.41	23.61	1.87
6	Lesotho	LMIE	877.26	39.17	20.62	1.81
7	Liberia	LIE	637.00	24.22	25.30	1.83
8	Malawi	LIE	720.43	28.38	24.14	1.79
9	Moldova	LMIE	748.06	22.94	31.37	1.83
10	Mongolia	LMIE	241.89	9.27	25.09	1.84
11	Mozambique	LIE	702.50	27.31	24.76	1.83
12	Nigeria	LMIE	2,390.78	91.25	25.02	1.79
13	Pakistan	LMIE	912.85	36.61	23.94	1.81
14	Rwanda	LIE	637.33	27.83	22.16	1.81
15	Sierra Leone	LMIE	845.80	38.50	21.22	1.85
16	Sri Lanka	LMIE	709.39	23.51	30.05	1.78
17	Tajikistan	LIE	525.69	17.46	29.12	1.85
18	Uganda	LIE	522.09	22.53	21.98	1.76
19	Ukraine	LMIE	834.14	36.26	22.72	1.76
20	Uzbekistan	LMIE	1,357.50	53.00	24.58	1.75
21	Zambia	LMIE	1,742.42	85.68	19.29	1.82
	Sample Max		2,390.78	91.25	31.37	1.87
	Sample Min		241.89	9.27	19.29	1.70
	Sample Mean		947.28	38.98	24.12	1.80

Note: Sentence count is the average number of sentences per statement for a given country; Sentence length stands for an average sentence length per statement for a given country; Syllable count is the average syllable number per word in a statement for a given country; Token count stands for an average number of tokens per statement for a given country. In this case, tokens equal to words because all other types of semantic units were removed. LIE - Low-Income Economies; LMIE - Lower-Middle Income Economies.

Figure 2.1 illustrates the statements' complexity measures across the sampled countries. On average, countries with long statements (by number of sentences) have shorter sentence lengths (for example, The Gambia, Zambia, etc.).

Figure 2.1: Countries' averages for each complexity measure



Note: Sentence count is the average number of sentences per statement for a given country; Sentence length stands for the average sentence length per statement for a given country; Syllable count is an average syllable number per word in a statement for a given country; Token count stands for an average number of tokens per statement for a given country. In this case, tokens equal to words because all other types of semantic units were removed. LIE - Low-Income Economies; LMIE - Lower-Middle Income Economies.

To capture the other dimension of clarity, we assess the MPS readability. We have constructed the Flesch reading ease score, the Flesch-Kincaid score, the ARI, the SMOG score, and the Gunning Fog index as readability proxies used in this study.[40]

The Flesch Reading Ease (FL) score is one of the most well-known and extensively used readability metrics of Flesch (1948), and is defined by

[40] For more on these indexes, please refer to Flesch (1948), Gunning (1952), Kincaid et al. (1975), McLaughlin (1969) and Senter and Smith (1967). It is true to say that there is a large discussion in the literature regarding the best acceptable readability measurement, which is yet to be clear. Some say that the current index-based approach to measuring readability has some pitfalls; see, for example, Bonsall et al. (2017) and Loughran and McDonald (2016) for more on this. Yet, taking into consideration the nature of MPS/A, we follow (Mathur & Sengupta, 2020) and see chosen indexes as an appropriate and one of the most efficient approaches in terms of time spent and output quality balance.

$$FL = 206.835 - 1.015\left(\frac{words}{sentences}\right) - 84.6(\frac{syllables}{words}),$$

where *words* and *sentences* correspond to their numbers in each of the MPS, and *syllables* stands for the total number of syllables in a statement. The FL sees statements with longer words and sentences as ones harder for reading. A higher FL value means a text is easier to read (a text with a score of 100 is very easy to read), while a score closer to zero indicates that a text is very challenging to read.

The Flesch-Kincaid (FK) readability score, also known as the FK grade level, is one of the most famous and widely applicable readability measures of Kincaid et al. (1975), and is given by

$$FK = 0.39\left(\frac{words}{sentences}\right) + 11.8\left(\frac{syllables}{words}\right) - 15.59,$$

where *words* and *sentences* correspond to their counted numbers in each of the MPS, and *syllables* stand for the total number of syllables in a statement. The FK gives a grade level, where a score of 4 means that the text is easy to read and can be read by a 4^{th} grade of the U.S. grade level, while a score of 18 or higher implies that the text is extremely hard to read and is for professionals.

The Automated Readability Index (ARI) of Senter and Smith (1967) is calculated as

$$ARI = 0.5\left(\frac{words}{sentences}\right) + 4.71\left(\frac{characters}{words}\right) - 21.34,$$

where all *words* and *sentences* are used with the same meaning as in the formulas above, while *characters* stand for the number of letters in each word. To generate a readability score, ARI utilizes long words and long sentences. The reasoning is that the more characters in a word, the more difficult it is to read. Hence, the ARI score indicates how difficult it is to read the text. Each score corresponds to a proficiency reading level and can be matched to a U.S. grade level.

As such, a score of 12 suggests that the text can be comprehended by 12th graders or 17-year-olds and above.

The Gunning Fog (FOG) index of Gunning (1952) is defined as

$$FOG = 0.4[\left(\frac{words}{sentences}\right) + 100\left(\frac{complex\ words}{words}\right)],$$

where all *words* and *sentences* are used with the same meaning as in the formulas above, while *complex words* refer to the number of words with three-syllables or more. FOG interprets the statements with longer words and lengthy sentences as hard to read. A typical result ranges from 0 to 20, with the direct result matching the respective U.S. grade level.

The Simple Measure of Gobbledygook (SMOG) of McLaughlin (1969) is given by

$$SMOG = 1.0430\sqrt{polysyllables} * \frac{30}{sentences} + 3.1291,$$

where *sentences* are used with the same meaning as in the formulas above, while *polysyllables* refer to the number of words with 3 or more syllables. SMOG sees the statements with longer words as documents that are harder to read. The index gives a grade-level score that matches the difficulty of the text. For example, a score of 6 means that the text may be understood by 6th grade of the U.S grade level and above.

To assess all measures of complexity and readability mentioned above, we have utilized the quanteda package in R of Benoit et al. (2018).

Table 23: Countries' averages for each readability measure

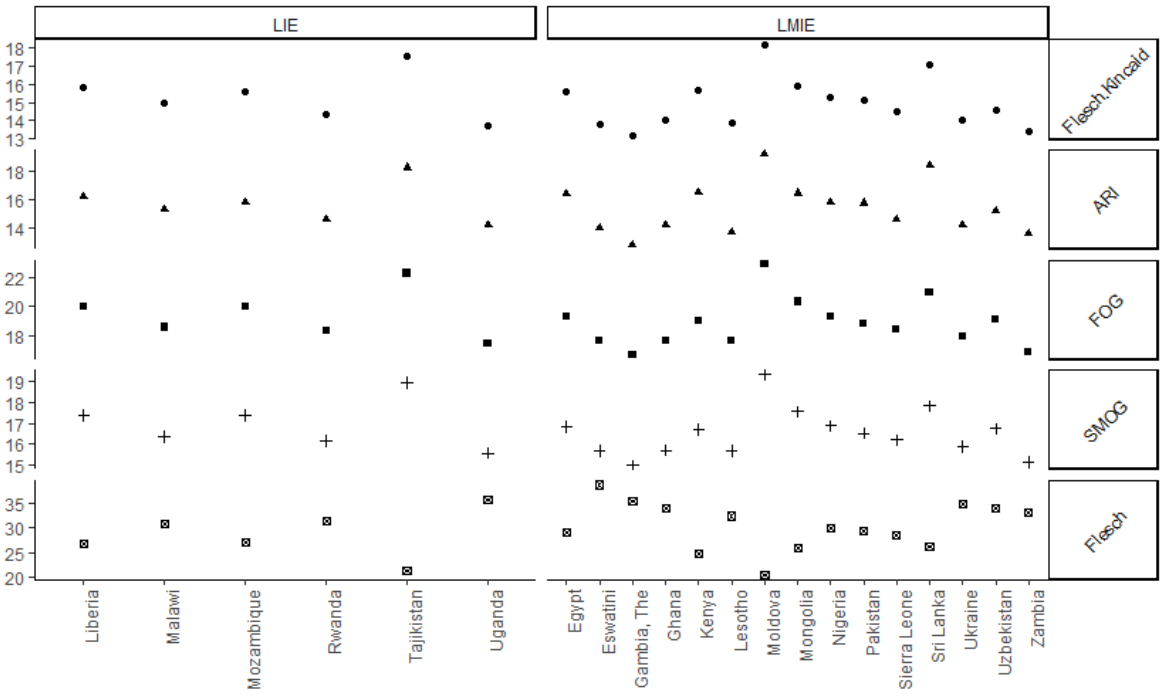
#	Country	Income Group	FL	FK	ARI	FOG	SMOG
1	Egypt	LMIE	29.01	15.63	16.37	19.32	16.84
2	Eswatini	LMIE	38.85	13.77	14.04	17.66	15.67
3	Gambia, The	LMIE	35.53	13.20	12.81	16.65	14.98
4	Ghana	LMIE	33.92	14.02	14.20	17.64	15.70
5	Kenya	LMIE	24.80	15.67	16.46	19.01	16.69
6	Lesotho	LMIE	32.46	13.86	13.74	17.65	15.68
7	Liberia	LIE	26.68	15.82	16.18	20.01	17.37
8	Malawi	LIE	30.91	14.94	15.33	18.56	16.35
9	Moldova	LMIE	20.31	18.22	19.13	22.88	19.33
10	Mongolia	LMIE	25.88	15.88	16.43	20.32	17.57

11	Mozambique	LIE	27.12	15.63	15.79	19.97	17.37
12	Nigeria	LMIE	29.88	15.31	15.83	19.29	16.88
13	Pakistan	LMIE	29.39	15.11	15.74	18.79	16.52
14	Rwanda	LIE	31.45	14.38	14.62	18.31	16.16
15	Sierra Leone	LMIE	28.59	14.54	14.62	18.43	16.20
16	Sri Lanka	LMIE	26.16	17.08	18.36	20.94	17.84
17	Tajikistan	LIE	21.16	17.54	18.21	22.27	18.94
18	Uganda	LIE	35.86	13.72	14.22	17.48	15.57
19	Ukraine	LMIE	34.91	14.03	14.23	17.96	15.89
20	Uzbekistan	LMIE	34.11	14.61	15.16	19.11	16.75
21	Zambia	LMIE	33.17	13.42	13.64	16.89	15.13
	Sample Max		38.85	18.22	19.13	22.88	19.33
	Sample Min		20.31	13.20	12.81	16.65	14.98
	Sample Mean		30.01	15.07	15.48	19.01	16.64

Note: FK is the Flesch-Kincaid readability score; FL Flesch reading ease score; ARI stands for the Automated Readability Index; FOG is the Gunning Fog index; SMOG is the Simple Measure of Gobbledygook. LIE - Low-Income Economies; LMIE - Lower-Middle Income Economies.

Table 2.3 contains the average readability measures for each country for all available statements. We discovered that, overall, the average readability scores of statements evidence that MPS are difficult to read. For example, an average FK of 15 means that statement is hard to understand and requires at least a college education level for comprehension. Furthermore, an average FL score of about 30 also suggests that, on average, statements are difficult to read and require at least college-level education.

Figure 2.2: Countries' averages for each readability measure



Note: FK is the Flesch-Kincaid readability score; Flesch is the Flesch reading ease score; ARI stands for the Automated Readability Index; FOG is the Gunning Fog index; SMOG is the Simple Measure of Gobbledygook. LIE - Low-Income Economies; LMIE - Lower-Middle Income Economies. Y-axis – scores.

Figure 2.2 illustrates the statements' readability measures across the sampled countries. On average, we observe that there is a clear pattern and a correlation between all indexes.

2.4.3 Descriptive analysis: complexity and readability

To describe complexity and readability, we use metrics from Moldova and The Gambia as examples. The former is the country with the largest average sentence length, while the latter is the second lowest one. From tables 2.1, 2.2, and 2.3 above, we know that Moldova has 109 MPS, with an average sentence length ranging from 21.1 to 44.5 and averaging 31.4, and FK ranging from 13.6 to 23.1 and averaging 18.2. It shows that on average, Moldova has relatively complex statements to comprehend. If we pick the closest statement to the average statement of Moldova by FK, for September 29, 2016, we see that the number of sentences is 31 and tokens are 1029.[41] As such, the average sentence length is about 33.2 words, while the effective length for most technical communication is an average of 15 to 20 words. It means this statement is indeed hard to comprehend. Meanwhile, Gambia has 25 statements with an average sentence length from 17.5 to 23.1 and an average of 19.7, and an FK range from 11.8 to 14.7 and an average of about 13.2. The closest statement to the average statement by FK is the MPS as of November 28, 2018, which has 81 sentences and 1674 tokens. Hence, the average sentence length is 20.7. This means that despite the statement being long, the actual complexity depends more on the sentences' complexity. Lastly, the FK of the chosen Gambian's statement is 13.2, while the Moldova one is 18.2, which means that the latter is more complex. As such, it suggests that on average, Moldova has relatively complex (measured by an average sentence length and an average FK) statements, while the Gambia has relatively

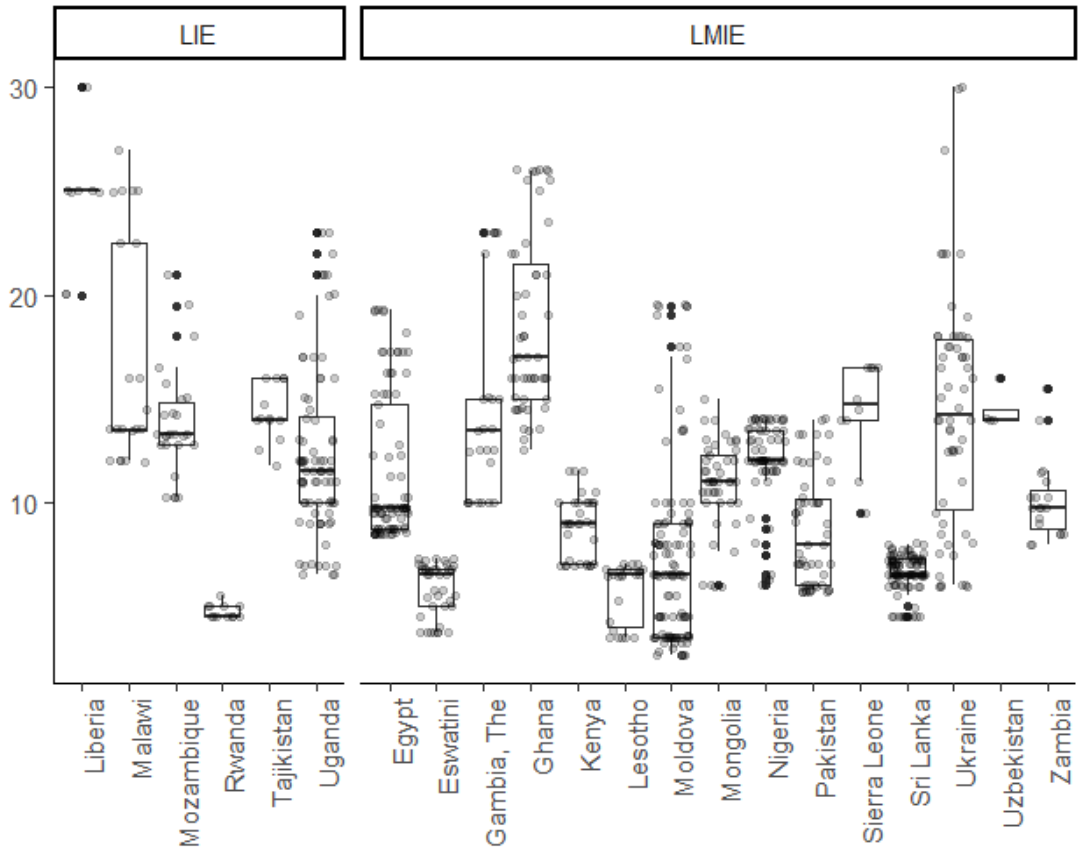
[41] Please see the examples of the statements for both countries in the Appendix.

easier-to-comprehension MPS, despite the fact that on average, the Gambia's statements have more sentences than Moldova ones.

2.4.4 Measures of monetary policy dimensions and economic stance

Next, we examine the content of MPS through several dimensions. First, we look for the traditional aspect of monetary policy —the policy stance. As such, we collected the data on key policy rates of sampled countries and, depending on the dynamics of the rate, we have assessed whether the monetary policy for a given period was either tight, loose, or neutral (i.e., no changes).

Figure 2.3: Countries' policy rates distribution and raw data points



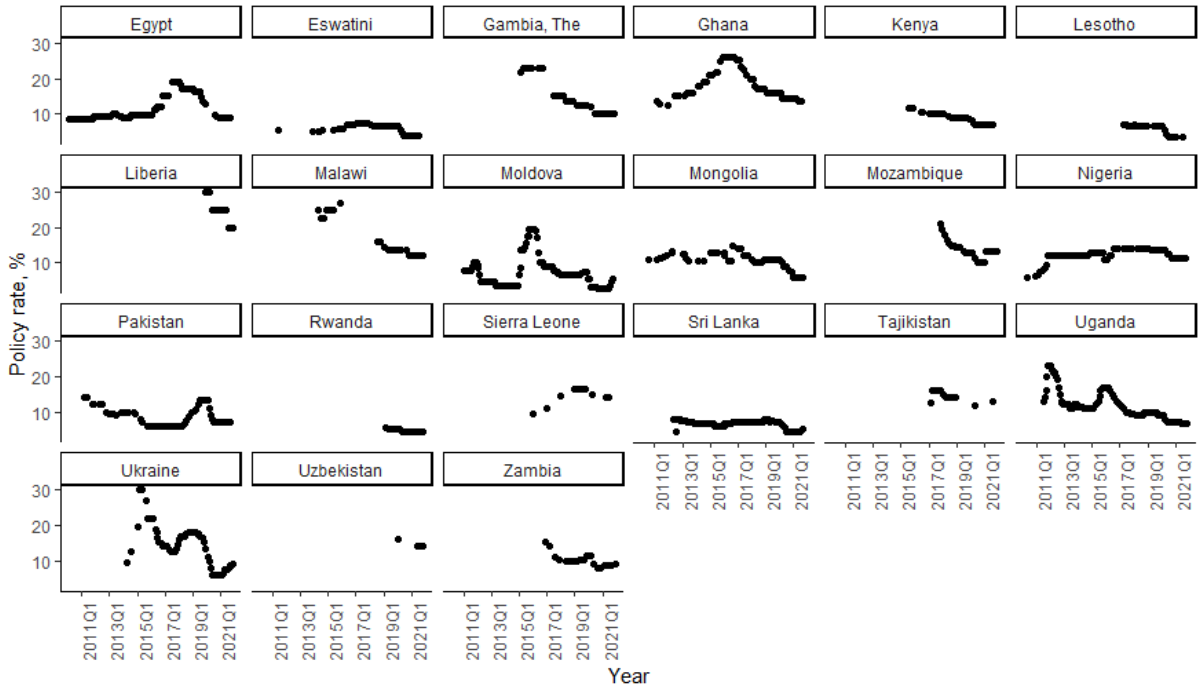
Note: LIE - Low-Income Economies; LMIE - Lower-Middle Income Economies. Y axis – policy rate in %.

Figure 2.3 shows that countries' policy rates vary greatly. In addition, the historical dynamic since 2010 is shown in Figure 2.4. Second, we have followed Hansen and McMahon (2016) to measure the central banks' views about the economy through content analysis of their

statements.[42] We utilized the Latent Dirichlet Allocation (LDA) algorithm of Blei and Lafferty (2009) to estimate the topic of each sentence for each policy statement for each sampled country.[43] This allows us to identify and isolate sentences with topics related to the economic situation of each country.

Each country has its optimal number of topics related to the economy, which were chosen through a two-fold algorithm. First, we run several evaluation metrics of Arun et al. (2010), Cao et al. (2009), Deveaud, SanJuan, and Bellot (2014), and Griffiths and Steyvers (2004) for up to 20 topics to assess the optimal number of topics.[44] For example, Figure A 2.1 shows that the optimal number of topics for Egypt is in a range between 8 and 10.[45] Second, we check these numbers through manual identification based on the read statements.

Figure 2.4: Countries' policy rates dynamics



Note: LIE - Low-Income Economies; LMIE - Lower-Middle Income Economies. Y axis – policy rate in %.

[42] We have removed punctuation and specific symbols, capitalization, stop words, numbers, highly frequent related words (like policy rate, monetary policy, central bank, etc.), and extra space. We also stem words.
[43] Please see Hansen and McMahon (2016) and Benchimol, Kazinnik, and Saadon (2020) for detailed explanation on LDA and text mining application for the sake of statements analysis and further estimations.
[44] Based on our observations, the statements in our sample cover no more than 20 topics.
[45] As an example, we show only one country.

Then we identify topics related to the economic situation only. In the next step, we measured the tone of selected sentences (those related to economic development) through the dictionary method, more specifically, word counting. We have utilized positive and negative finance-related word lists (Loughran & McDonald, 2011) and updated them for specific words related to monetary policy statements. Table A 2.1 contains some words that we associated with economic expansion and contraction. As Hansen and McMahon (2016), based on the isolated sentences, we count words associated with economic stance to create the measure of the MPS on the economic situation (ES) of sampled countries by:

$$ES = \frac{n_{pos,it} - n_{neg,it}}{total\ words_{it}},$$

where $total\ words_{it}$ stands for the total number of words about the economic situation, it is country i at time t ; and $n_{pos,it}$ ($n_{neg,it}$) is the positive (negative) words number per sentence. Therefore, we have a quantified view of a central bank on the economy. Figure A 2.2 contains the ES index for Egypt. [46]

Lastly, we have analyzed the statements for forward monetary policy guidance.[47] Our initial plan was to follow Hansen and McMahon (2016) to quantify and measure the character of forward guidance and utilize this in our further analysis. Though after the stage of identification of the forward guidance relevant parts (e.g., sentences) of each MPS, by manual reading through all statements, we have seen that just a few sampled countries have forward guidance in their statements. We found that out of the 21 countries in our sample, only five have forward guidance in their MPS. And out of those five, only two countries (Uganda and Ukraine) have a relatively stable application of forward guidance in their MPS. As such, we have a very limited number of related observations for further cross-country analysis.

[46] As an example, we show only one country.
[47] We understand "forward guidance" as in Campbell et al. (2012) and Hansen and McMahon (2016), where statements contain forward-looking views about key policy rate decisions at future meetings.

2.4.5 Panel formation

As we aim to analyze market response to the monetary policy decisions, we need to take into consideration the prompt financial markets response to the central bank movements and signals. For this sake, we need to keep the lowest date-unit possible (either days, weeks, or months).

Since most collected statements differ by date and frequency (total number and even months of statements do not match) per year, for further analysis, we have structured our raw data from its original daily date format to a uniform period basis. This allows us to keep the original frequency and quality of our data on MPS to further conduct our econometric analysis. Although, some studies applied data transformation to quarterly frequency data by calculating averages were needed (Luangaram & Wongwachara, 2017).[48] As such, we have constructed an unbalanced panel with a total of 874 observations and a large enough number of panels (21 countries) and periods (40 periods on average).

Overall, the MPS of 21 countries' central banks, collected from their official websites, comprise our raw data. For each sampled country we collected all available statements that are in line with the abovementioned criteria for MPS. Then we measured several dimensions of monetary policy (policy stance, economic conditions, and forward guidance) utilized data related to sampled country monetary policy collected from respective central banks' websites. Proxies for financial market reaction on MPS, i.e., our dependent variables, were collected from the World Economic Service of IHS Markit and the International Finance Statistics (IFS) of the International Monetary Fund. In addition, some missing data on interest rates were directly collected from central banks' websites. Further, monthly data on macroeconomic fundamentals (consumer price index – CPI and balance of payment – BoP international

[48] For instance, for countries with several meetings in a quarter, they calculate a simple average of these meetings, while for countries without a meeting in a quarter, they use the data of the previous nearest meeting.

reserves), banking sector characteristics (Foreign assets), and countries' risk profiles were collected from the same sources.

2.5 ECONOMETRIC METHODOLOGY

The overarching objective of this study is to examine the relationship between monetary policy communication and key financial variables. We set the daily volatility of local currencies' exchange rates to USD; and the monthly volatility of treasury bill rates, money market rates, and lending rates as dependent variables. The selection of these variables is well supported in the literature (for example, Ahokpossi et al. (2020), McMahon et al. (2018), Mpofu and Peters (2017), and Sohn et al. (2006)). We take advantage of the availability of daily exchange rates data to construct a set of volatility of exchange rate dependent variables for periods of 3, 5, and 10 business days after the monetary policy announcement. This will allow us to understand how exchange rates react to announcements, immediately after the announcements. We calculated annualized volatility based on standard deviations for each period. The market rates volatilities will be used in logarithmic form. For the volatility of treasury bill rates, interbank rates, and lending rates, we calculate 3-month volatility based on monthly data. Indeed, unlike exchange rates that are likely to have an immediate response, interest rates adjustments are gradual by different banks after an announcement, particularly in developing countries. As such, we do not lose valuable information by using monthly data. The key descriptive/explanatory variables are the various measures of clarity of monetary policy communication, which were described above. Specifically, in the description part, we use log-transformed data for the following: the Flesch reading ease score, the Flesch-Kincaid readability score, the Automated Readability Index, the Gunning Fog index, the Simple Measure of Gobbledygook, the type-token ratio, the average sentence length, the number of sentences, and the average number of syllables in a word. While these independent variable measures are different in measurement, they are in principle related. Therefore, following Hayo

et al. (2022), our main estimations will use the Flesch reading ease score and the average sentence length as key explanatory variables. These variables are widely used in the literature. The control variables in this study include a measure of the state of the economy, monetary policy stance change (dummy equals 1 if a policy rate was changed, otherwise 0), inflation, money supply (M1), level of international reserves, and others. It is worth mentioning that, as referred to in several related studies, the monetary policy surprise effect is captured through monetary policy stance and related dummies in our study. Meanwhile, as macroeconomic conditions may also have an impact on markets and statements length, we account for this by utilizing the computed economic stance index (ES).

As observed from the related literature, most studies employed Ordinary Least Squares (OLS) to establish the relationship between monetary policy communication and various macroeconomic indicators (Ahokpossi et al., 2020; Mathur & Sengupta, 2020; McMahon et al., 2018). Others used Factor-Augmented Vector Autoregressive (FAVAR) models for similar analysis (Hansen & McMahon, 2016). Taking into account the type of our data, which is a panel of 21 developing countries with data spanning from 2010 to 2021, we specify the following panel regression with fixed effects:

$$y_{it} = \beta_0 + X_{it}\beta + Z_{it}\delta + \alpha_i + T_i + \mu_{it} \qquad (2.6)$$

Where, y_{it} is the dependent variable for period *t* for country i;

X_{it} is a vector of independent variables of interest;

Z_{it} is a vector of control variables;

α_i are country-specific intercepts that capture heterogeneities across countries;

T_i is time as a binary (dummy) variables, so we have *t-1* time periods to capture fixed effects;

β is the coefficient of interest for our key explanatory variable;

μ_{it} is an error term.

In order to minimize the possible impact of outliers, we log-transformed the complexity and readability scores estimated by their respective measures.

Although some studies, for example, Mathur and Sengupta (2020), employ the lag of dependent variables to account for the impact of their past values and persistence. In our model, the score of economic stance includes the past realization of market rates.

We look for non-stationarity to examine if the means, variances, and autocorrelation patterns of our data have remained constant throughout time. We use panel unit root tests to account for the imbalanced structure of our panel data sample and discover that most of the data are stationary at the 1% significance level. The Kao panel-data cointegration test is also used to see if the combination of our non-stationary variables is stationary over time (Kao, 1999). We find that reserves, domestic credit, debt service risk, and GDP per capita risk all cointegrate in the long run. As a result, these series are included in the panel fixed-effects models in log form, ensuring that no spurious regression findings are produced. The findings of the Fisher Augmented Dickey-Fuller (ADF) test and the cointegration test are presented in Appendix Tables A 2.4 and A 2.5, respectively, as well as correlation checks in Tables A 2.2 and A 2.3.

Table 2.4 below summarizes all the key variables for our regression analysis in this study and their descriptive statistics.

Table 24: Summary statistics

Variable	N	Mean	Std. dev.	Min	Max	Short definition
			Dependent variables			
FX volat 10d	874	-4.29	1.75	-9.21	0.33	Log of the 10 days foreign exchange rates volatility annualized

FX volat 5d	874	-4.56	1.89	-9.21	0.68	Log of the 5 days foreign exchange rates volatility annualized
FX volat 3d	874	-4.86	2.07	-9.21	0.86	Log of the 3 days foreign exchange rates volatility annualized
Lending rate volat 3m	819	-3.22	1.49	-6.91	-0.03	Log of the 3 months lending rates volatility annualized
Money market rate volat 3m	707	-2.21	1.85	-6.91	3.57	Log of the 3 months money market rates volatility annualized
Treasury bill rate volat 3m	732	-2.45	1.40	-6.91	3.43	Log of the 3 months treasury bill rates volatility annualized
			Independent variables			
FL	872	3.34	0.31	1.18	4.10	Log of Flesch reading ease score
Sentence length	874	3.21	0.18	2.72	3.81	Log of average sentence length
			Robustness check variables			
Sentence count	874	3.35	0.70	1.10	4.93	Log of number of sentences
Syllable count	874	0.58	0.04	0.44	0.74	Log of mean word syllables
FK	874	2.73	0.13	2.16	3.14	Log of Flesch-Kincaid readability score
ARI	874	2.76	0.15	2.13	3.23	Log of Automated Readability Index
FOG	874	2.96	0.12	2.56	3.37	Log of Gunning Fog index
SMOG	874	2.82	0.95	2.51	3.17	Log of Simple Measure of Gobbledygook
			Controls			
Policy rate change	874	0.35	0.48	0.00	1.00	Dummy for a monetary policy stance change
Economic situation	798	-0.02	0.07	-0.33	0.40	Economic situation index
Reserves	831	8.47	1.45	0.00	10.83	Log of international reserves BoP
CPI	848	4.87	0.43	3.55	5.98	Log of consumer price index
Inflation risk	784	2.01	0.19	1.10	2.30	Log of risk for inflation
Budget risk	784	1.53	0.30	0.41	2.08	Log of risk for budget balance
War risk	784	1.33	0.13	0.92	1.39	Log of war risk
International liquidity risk	784	-0.23	2.10	-4.61	1.61	Log of risk for international liquidity
Money supply M1	698	12.04	3.17	0.00	16.82	Log of M1 money supply
GDP pp risk	784	-2.11	2.02	-4.61	0.01	Log of risk for per capita GDP

Note: Control variables and Exchange rate data is sourced from IHS Markit, Treasury Bills and interest rates from IHS Markit, IFS of International Monetary Fund, and central banks websites, complexity and readability indicators are computed by the authors using the algorithm in R. Interest rates are used in terms as in IFS of IMF: Lending rate is the rate used by other depository corporations to satisfy the private sector's short- and medium-term financial needs; Money market rate - the rate at which short-term loans are made between financial institutions; Treasury bill rate - short-term government debt is issued and sold on the market. Volatility calculated based on standard deviation of rates either with daily or monthly frequency and further annualized.

2.6 EMPIRICAL RESULTS AND DISCUSSION

This section contains the estimation results for analysing the implication of monetary policy communication on financial markets in developing countries. We further discuss the findings.

2.6.1 Results: FX rates

We begin by checking the impact of MPS' complexity and readability measures on foreign exchange rates volatility. Table 2.5 contains the results of the regression analysis of statement complexity measured by sentence length and the Flesch reading ease score. We observe that on average sentence length increases FX rate volatility in the horizon of 3, 5 and 10 business days after the statement release date, though not statistically significant, ceteris paribus. It means that a statement that is linguistically complex, i.e., difficult to comprehend, is associated with higher volatility of local currencies' exchange rates in the short run.

Table 25: Panel FE. FX volatility annualized

	3 days		**5 days**		**10 days**	
	(1)	(2)	(1)	(2)	(1)	(2)
Sentence length	0.255		0.224		0.602	
	(0.475)		(0.428)		(0.426)	
FL		-0.876**		-0.747*		-0.697**
		(0.368)		(0.349)		(0.310)
MP stance change	0.380	0.362	0.415*	0.404*	0.425*	0.424*
	(0.222)	(0.216)	(0.209)	(0.203)	(0.223)	(0.214)
Economic situation	-0.127	-0.110	-0.312	-0.328	-0.170	-0.167
	(0.726)	(0.734)	(1.003)	(1.065)	(0.637)	(0.668)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	588.000	586.000	588.000	586.000	588.000	586.000
Countries	13.000	13.000	13.000	13.000	13.000	13.000
R2	0.257	0.266	0.247	0.254	0.233	0.239

Notes: The dependent variables, the log of the 3, 5 and 10 days' foreign exchange rates volatility annualized, own calculation based on IHS Markit data; Sentence length stands for the log of average sentence length based on our calculations; FL stands for the log of Flesch reading ease score based on our calculations; MP stance change is a dummy variable indicating a change in monetary policy stance; Economic situation stands for the economic situation index from own estimation. Controls include log of international reserves BoP; log of consumer price index; log of risk for inflation; log of risk for budget balance; log of risk for per capita GDP; log of risk of war; log of risk for international liquidity; log of M1 money supply). All models are based on panel estimations, account for country fixed effects and controlled for period fixed effects. A constant is not reported but included in all specifications. Clustered on countries robust standard errors in parentheses. Clustered on countries' robust standard errors in parentheses. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Next, it is shown that the relationship between MPS readability, measured by the Flesch reading ease score, and FX rates volatility is negative and statistically significant for all periods and specifications. Good communication is expected to have calming effects on exchange rates, as reported by Fišer and Horvath (2010) in their analysis of Czech National Bank communication and macroeconomic news on exchange rate volatility. The increased volatility

of the exchange rate as a result of monetary policy statements may suggest that the statements were largely unclear. For instance, the FL score has an average of 20.3 (see Table 2.3), suggesting that the statements are hard to understand and hence likely not to be clear. Likewise, an average score of 13 for FK suggests a highly unreadable text and requires at least a college education level for comprehension. As such, instead of the statements playing a calming effect on exchange rate volatility, they actually bring about volatility. Certainly, this is the reason Blinder et al. (2008) argue that ineffective communications due to poor design and execution could cause more harm than good. Moreover, Mathur and Sengupta (2019) found that longer and more complex monetary policy statements generate greater uncertainty and a wider dispersion of information, which in turn result in heightened volatility.

Furthermore, the monetary policy change causes an increase in FX rate volatility. The explanation for this relationship is two-pronged. Firstly, as observed by Galí and Monacelli (2005), there is a trade-off between policy to stabilize domestic inflation and the output gap on the one hand and nominal exchange rate stability on the other. It suggests that as the central bank would regularly adjust the policy rate-either upwards or downwards-to stabilize the output gap and inflation, it would entail substantially larger volatility of the nominal exchange rate.

Secondly, the result could be due to backward-looking tendencies by economic agents that make the exchange rate volatility highly persistent. As such, despite policy tightening in the current period, for example, the market allocates much weight to the previous exchange rate volatility. Indeed, as reported by Hassan (2012), the exogenous shocks that affect exchange rate volatility may take time to wane off. Moreover, the monetary policy statements in our sample do not provide adequate forward guidance to assure the market of future economic developments. Out of 21 countries, only two countries attempted to provide forward guidance. Yoon, Kim, and Lee (2020) found similar results for Thailand and Indonesia and referred to this outcome as the “exchange rate puzzle.”

2.6.2 Results: Market rates

We also examined the impact of MPS' complexity and readability measures on markets rates, namely lending rates, money market rates, and treasury bills rates for 3 months' volatility. The results are presented in Table 2.6. The estimates show that MPS complexity, measured by sentence length, and the MPS readability, i.e., the FL index, have no significant relationship with market rates. The results are consistent with Ahokpossi et al. (2020), who found that monetary policy reports do not have a significant impact on market rates and that press releases do not have a significant impact on market rates beyond the impact of the policy rate decision itself.

Similarly, Bulíř, Čihák, and Jansen (2018) found a weak relationship between the clarity of monetary policy reports for Czech National Bank, the European Central Bank, the Bank of England, and Sveriges Riksbank and market volatility using the Flesch-Kincaid grade level score and concluded that there is no guarantee that investment in well-drafted monetary policy papers would always correlate with reduced volatility in the financial markets, as previously suggested. The fact that this relationship is consistent both in advanced and developing countries is enlightening. Specifically, the current narrative around monetary policy formulation board rooms, globally, seems to suggest that central bank communication is so important to an extent that the traditional policy tools are being thrown to the periphery.

Table 26: Panel FE. Market rates. 3 months annualized volatility

	Lending rate		**Money market rate**		**Treasury bill rate**	
	(1)	(2)	(1)	(2)	(1)	(2)
Sentence length	-0.618		-0.331		0.064	
	(0.628)		(0.752)		(0.827)	
FL		0.519		-0.276		0.069
		(0.405)		(0.467)		(0.297)
MP stance change	0.360***	0.363***	0.354*	0.344*	0.288	0.292
	(0.097)	(0.097)	(0.165)	(0.164)	(0.181)	(0.182)
Economic	-0.811	-0.892	0.834	0.818	-0.669	-0.683
situation	(0.690)	(0.659)	(1.343)	(1.360)	(0.936)	(0.951)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	579.000	577.000	512.000	510.000	515.000	514.000

Countries	13.000	13.000	13.000	13.000	13.000	13.000
R2	0.194	0.200	0.241	0.242	0.260	0.261

Notes: The dependent variables, log of the 3 months lending rate, money market rate and treasury bill rate volatility annualized, own calculation based on IHS Markit data; Sentence length stands for the log of average sentence length based on our calculations; FL stands for the log of Flesch reading ease score based on our calculations; MP stance change is a dummy variable indicating a change in monetary policy stance; Economic situation stands for the economic situation index from own estimation. Controls include log of international reserves BoP; log of consumer price index; log of risk for inflation; log of risk for budget balance; log of risk for per capita GDP; log of risk of war; log of risk for international liquidity; log of M1 money supply). All models are based on panel estimations, account for country fixed effects and controlled for period fixed effects. A constant is not reported but included in all specifications. Clustered on countries robust standard errors in parentheses. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

2.6.3 Robustness check

For sensitivity analysis of our findings, we have utilized other measures of MPS complexity and readability while following the methodology from the respective part of this study. Tables 2.7 and 2.8 comprise estimations with sentence count and syllable count (for complexity measures) as well as FK, ARI, SMOG, and FOG (for readability measures). It is shown in Table 2.7 that readability measures have a positive and statistically significant relationship with FX rates volatility. Specifically, FK and SMOG were found to have a significant relationship with 5-days and 10-days FX rate volatility at a 10 percent significance level. However, as found in Table 2.5, complexity does not have a significant relationship with FX volatility. Overall, this result is consistent with the results stated in Table 2.5 above.

Table 27: Panel FE. FX rate volatility

Dependent	Explanatory	Coefficient	R^2
3 days FX rate volatility	Syllable count	6.186 (3.775)	0.266
	Sentence count	0.463 (0.380)	0.263
	FK	1.173 (0.723)	0.26
	ARI	0.846 (0.592)	0.259
	FOG	1.329 (0.838)	0.26
	SMOG	1.941 (1.109)	0.261
5 days FX rate volatility	Syllable count	5.842 (3.398)	0.257
	Sentence count	0.358 (0.406)	0.251
	FK	1.083* (0.591)	0.25
	ARI	0.807 (0.504)	0.249

	FOG	1.147 (0.687)	0.249
	SMOG	1.687* (0.902)	0.25
10 days FX rate volatility	Syllable count	4.028 (2.647)	0.237
	Sentence count	0.204 (0.311)	0.233
	FK	1.276* (0.707)	0.236
	ARI	0.954 (0.573)	0.235
	FOG	1.414 (0.847)	0.236
	SMOG	1.885* (1.026)	0.236

Notes: The dependent variables, log of the 3, 5 and 10 days foreign exchange rates volatility annualized, own calculation based on IHS Markit data; Syllable count is the log of mean word syllables; Sentence count is the log of number of sentences; FK stands for the log of Flesch-Kincaid readability score based on our calculations; ARI stands for the log of Automated Readability Index based on our calculations; FOG stands for the log of Gunning Fog index based on our calculations; SMOG stands for the log of Simple Measure of Gobbledygook based on our calculations; MP stance change is a dummy for a monetary policy stance change based on own analysis; Economic situation stands for the economic situation index from own estimation. Controls include log of international reserves BoP; log of consumer price index; log of risk for inflation; log of risk for budget balance; log of risk for per capita GDP; log of risk of war; log of risk for international liquidity; log of M1 money supply). All models are based on panel estimations, account for country fixed effects and controlled for period fixed effects. All specifications include controls and have 588 observations. Clustered on countries robust standard errors in parentheses. Clustered on countries' robust standard errors in parentheses. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

Further, to check the sensitivity of our findings for market rates from Table 2.6, we again utilize sentence count and syllable count measures as well as FK, ARI, SMOG, and FOG for complexity and readability measures. Table 2.8 contains the results of estimations with SMOG and FOG, respectively. Even for other measures, we found that the complexity and readability of MPS have still a weak relationship with market rates. This follows our findings in Table 2.6.

Table 28: Panel FE. Market rates. 3 months annualized volatility

Dependent	Explanatory	Coefficient	Observations	R^2
Lending rate	Syllable count	-2.836 (2.365)	579	0.196
	Sentence count	0.002 (0.175)	579	0.19
	FK	-1.104 (0.920)	579	0.198
	ARI	-0.932 (0.796	579	0.198
	FOG	-1.147 (1.128)	579	0.197
	SMOG	-1.540 (1.402)	579	0.197

Money market rate	Syllable count	0.499 (2.392)	512	0.241
	Sentence count	0.147 (0.230)	512	0.242
	FK	-0.283 (0.903)	512	0.241
	ARI	-0.517 (0.751)	512	0.242
	FOG	-0.454 (0.971)	512	0.241
	SMOG	-0.571 (1.229)	512	0.241
Treasury bill rate	Syllable count	-0.380 (2.337)	515	0.26
	Sentence count	-0.040 (0.258)	515	0.26
	FK	-0.054 (0.881)	515	0.26
	ARI	0.098 (0.803)	515	0.26
	FOG	-0.174 (0.971)	515	0.26
	SMOG	-0.190 (1.214)	515	0.26

Notes: The dependent variables, log of the 3 months lending rate, money market rate and treasury bill rate volatility annualized, own calculation based on IHS Markit data; Syllable count is the log of mean word syllables; Sentence count is the log of number of sentences; FK stands for the log of Flesch-Kincaid readability score based on our calculations; ARI stands for the log of Automated Readability Index based on our calculations; FOG stands for the log of Gunning Fog index based on our calculations; SMOG stands for the log of Simple Measure of Gobbledygook based on our calculations; MP stance change is a dummy for a monetary policy stance change based on own analysis; Economic situation stands for the economic situation index from own estimation. Controls include log of international reserves BoP; log of consumer price index; log of risk for inflation; log of risk for budget balance; log of risk for per capita GDP; log of risk of war; log of risk for international liquidity; log of M1 money supply). All models are based on panel estimations, account for country fixed effects and controlled for period fixed effects. All specifications include controls. Clustered on countries robust standard errors in parentheses. Clustered on countries' robust standard errors in parentheses. *, **, and *** denote significance at 10 percent, 5 percent, and 1 percent, respectively.

2.7 CONCLUSION AND POLICY IMPLICATIONS

In this study, we examine central bank communication and its transmission to financial market variables in developing countries. We analyze a large corpus of monetary policy statements from 21 developing countries' central banks for a period from 2010 to 2021. At first, we quantified MPS clarity, i.e., complexity and readability dimensions, across sampled countries over time utilizing text mining tools. Then we empirically explored the MPS transmission to financial markets from the statements clarity perspectives via panel fixed-effects estimations. Our approach is in line with the existing literature.

The descriptive part of this study shows that, on average, LMIE countries from our sample have more statements and a longer policy rate communication history than LIE countries. This suggests that issues regarding monetary policy communication are well established in the advanced economies and are now diffusing to the emerging and developing countries. We also notice the shift from highly frequent policy rate decisions (and communication as a function of meetings) towards less frequent ones (quarterly or semi-quarterly). This may be understood in a way that, as time goes by, to lead the markets, central banks do not require frequent policy rate decisions interventions. Further, we find that on average, countries with long statements have a shorter sentences length, meaning that the basic logic of having a long but more readable statement prevails. Finally, on average, one needs to have at least a college-level education to comprehend a monetary policy statement in our sample.

Our empirical analysis revealed that statements' complexity and clarity are important in explaining FX rate volatility but weak in explaining lending rates, money market rates, and local T-bill rates volatilities for developing countries.

This study contributes to the literature strands in several ways. First, we studied the monetary policy statements of the central banks in 21 developing countries over 11 years. We quantified these policy statements' complexity and readability and measured the central banks' views about economic conditions at some particular time. Moreover, we found that forward guidance tools are rarely applied in developing countries, though a few countries do. We found robust evidence suggesting that unclear statements are associated with high exchange rate volatility, but there is no evidence to suggest a relationship between monetary policy statements and market rates' volatility. These results are adequately supported in the literature.

The study's findings have significant policy consequences. Firstly, central banks must make their communication clearer. While several emerging economies have used central bank

communication as a tool for monetary policy, the fact that a monetary policy announcement can only be understood by a college student on average is dispiriting. The primary goal of monetary policy communication is to keep economic agents informed about the central bank's actions. Households, businesses, financial analysts, and small business owners are examples of these agents. Given the literacy levels in most developing nations, it may suggest that such communication is poorly comprehended. We argue that ambiguous statements can cause economic destabilization because they disperse expectations. We contend that central banks should make their communications, including policy pronouncements, as clear as possible. Second, the central banks' announcements should incorporate forward guidance. One of the primary goals of central bank communication is to anchor expectations. Expectations are anchored when the central bank is not timid about disclosing the short- to medium-term pathways of key variables like interest rates and inflation. Only 16 percent of the statements in our sample provided forward direction. A lack of forward guidance could indicate a lack of confidence on the part of central banks, lowering their credibility and elevating uncertainty.

APPENDIX

Table A 29: Some words associated with economic expansion and contraction

Expansion	***Contraction***
Acceler	Abnormal
Achieve	Bailout
Advances	Bans
Bolstered	Caution
Booming	Contract
Enhance	Cool
Expand	Crisis
Faster	Decreas
Favorable	Fall
Foster	Lose
Gain	Low
Increas	Moder
Rise	Soften
Risen	Subdu
Stable	Worsen

Note: All words are stemmed.

Figure A 2.5: Estimated number of topics for Egypt

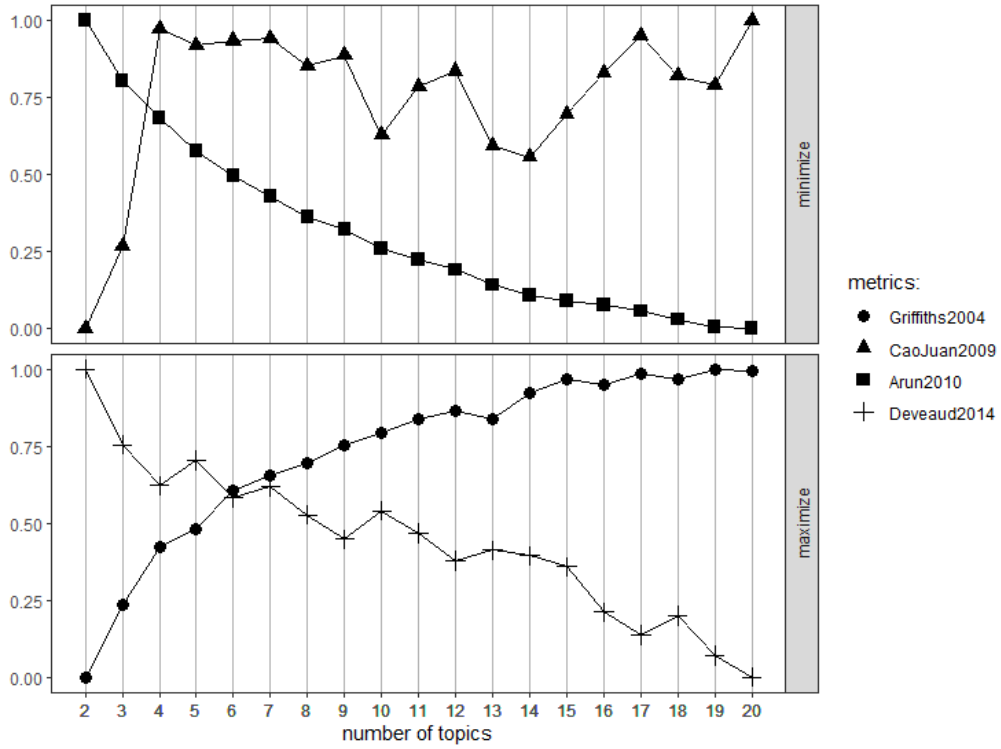


Figure A 2.6: Evolution of the Index of the Economic Situation in Egypt

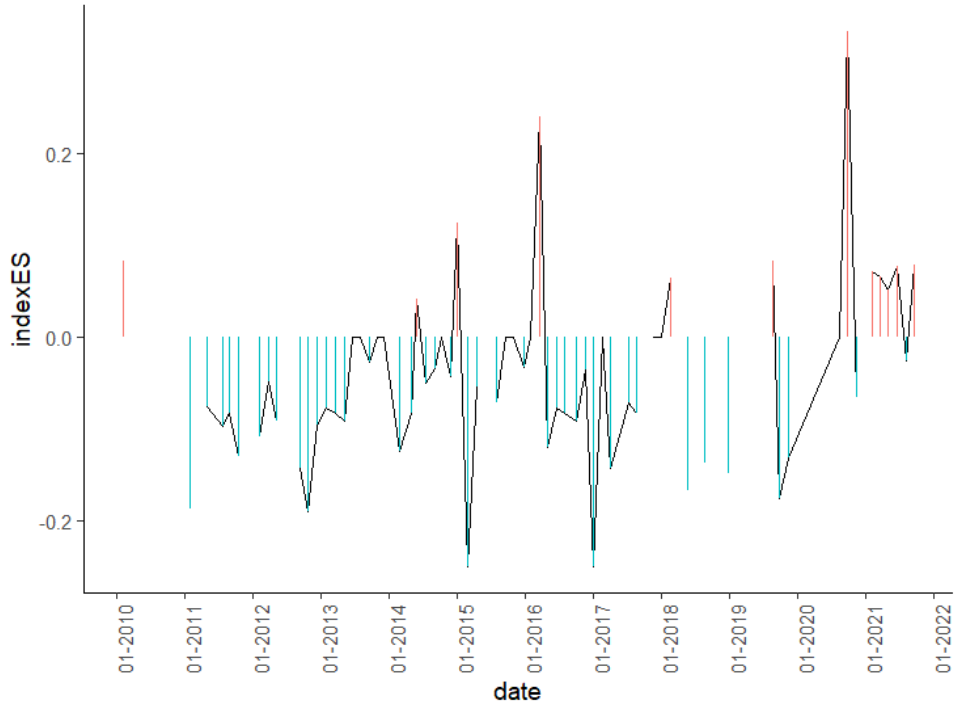


Table A 30: Correlation: key independent and robustness check variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Log of FX volat 10d	1.00													
(2) Log of FX volat 5d	0.90	1.00												
(3) Log of FX volat 3d	0.83	0.92	1.00											
(4) Log of Treasury bill rate volat 3m	-0.04	-0.07	-0.04	1.00										
(5) Log of Money market rate volat 3m	-0.10	-0.09	-0.10	0.38	1.00									
(6) Log of Lending rate volat 3m	-0.09	-0.10	-0.11	0.30	0.36	1.00								
(7) Log of mean sentence length	-0.12	-0.15	-0.17	0.14	0.09	0.09	1.00							
(8) Log of mean_word_syllables	-0.11	-0.10	-0.06	0.05	0.19	0.11	0.01	1.00						
(9) Log of number of sentences	-0.07	-0.05	-0.05	-0.08	0.12	-0.06	-0.30	-0.01	1.00					
(10) Log of FK	-0.16	-0.18	-0.19	0.15	0.16	0.14	0.89	0.45	-0.28	1.00				
(11) Log of FL	0.08	0.09	0.08	-0.12	-0.21	-0.14	-0.62	-0.73	0.23	-0.88	1.00			
(12) Log of ARI	-0.16	-0.19	-0.19	0.16	0.17	0.14	0.92	0.37	-0.31	0.98	-0.83	1.00		
(13) Log of FOG	-0.14	-0.16	-0.16	0.15	0.15	0.17	0.85	0.48	-0.27	0.98	-0.88	0.95	1.00	
(14) Log of SMOG	-0.14	-0.16	-0.15	0.15	0.16	0.17	0.83	0.52	-0.25	0.97	-0.89	0.93	1.00	1.00

Table A 31: Correlation: control variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) Log of FX volat 10d	1.00															
(2) Log of FX volat 5d	0.88	1.00														
(3) Log of FX volat 3d	0.84	0.94	1.00													
(4) Log of Treasury bill rate volat 3m	0.04	-0.01	-0.00	1.00												
(5) Log of Money market rate volat 3m	0.02	0.03	0.03	0.36	1.00											
(6) Log of Lending rate volat 3m	0.12	0.11	0.09	0.22	0.09	1.00										
(7) Policy rate change	0.27	0.26	0.23	0.12	0.08	0.17	1.00									
(8) Economic situation index	0.05	0.06	0.07	-0.07	0.04	-0.05	0.00	1.00								
(9) Log of international reserves	-0.29	-0.22	-0.20	-0.05	-0.08	-0.09	-0.09	0.01	1.00							
(10) Log of consumer price index	0.03	0.04	0.02	0.16	0.31	0.24	0.12	-0.01	0.11	1.00						
(11) Log of risk for inflation	-0.00	-0.02	-0.01	-0.02	-0.03	-0.07	-0.06	0.12	-0.05	-0.07	1.00					
(12) Log of risk for budget balance	-0.03	-0.03	-0.05	0.11	0.35	0.10	0.01	-0.03	-0.09	0.60	0.02	1.00				
(13) Log of risk for per capita GDP	-0.08	-0.07	-0.08	-0.03	-0.24	0.04	-0.12	0.01	0.29	-0.01	0.13	-0.11	1.00			
(14) Log of war risk	-0.28	-0.29	-0.30	-0.01	0.11	-0.23	-0.20	-0.07	-0.27	-0.44	0.15	-0.03	-0.15	1.00		
(15) Log of risk for international liquidity	0.03	0.02	-0.01	0.06	0.21	0.04	0.03	-0.13	0.02	0.18	0.09	0.28	-0.05	-0.01	1.00	
(16) Log of M1 money supply	-0.23	-0.18	-0.15	0.02	-0.06	0.00	-0.06	-0.02	0.69	0.21	0.02	0.06	0.21	-0.12	-0.20	1.00

Table A 32: Augmented Dickey Fuller Panel Unit Root Test results

Variables	chi2	p-value
Log of FX volat 10d	380.969	0.000
D. Log of FX volat 10d	696.058	0.000
Log of FX volat 5d	443.801	0.000
D. Log of FX volat 5d	703.255	0.000
Log of FX volat 3d	483.492	0.000
D. Log of FX volat 3d	736.430	0.000
Log of Lending rate volat 3m	290.690	0.000
D. Log of Lending rate volat 3m	589.256	0.000
Log of Money market rate volat 3m	206.298	0.000
D. Log of Money market rate volat 3m	559.078	0.000
Log of Treasury bill rate volat 3m	214.579	0.000
D. Log of Treasury bill rate volat 3m	507.852	0.000
Log of average sentence length	320.100	0.000
D. Log of average sentence length	701.928	0.000
Log of mean word syllables	299.087	0.000
D. Log of mean word syllables	769.081	0.000
Log of Flesch-Kincaid readability score	300.415	0.000
D. Log of Flesch-Kincaid readability score	726.588	0.000
Log of Automated Readability Index	297.506	0.000
D. Log of Automated Readability Index	691.696	0.000
Log of Gunning Fog index	315.823	0.000
D. Log of Gunning Fog index	730.176	0.000
Log of Simple Measure of Gobbledygook	310.088	0.000
D. Log of Simple Measure of Gobbledygook	724.443	0.000
Log of number of sentences	191.578	0.000
D. Log of number of sentences	729.141	0.000
Economic situation index	444.778	0.000
D. Economic situation index	629.325	0.000
Log of international reserves	40.010	0.470
D. Log of international reserves	394.061	0.000
Log of consumer price index	103.227	0.000
D. Log of consumer price index	283.682	0.000
Log of risk for inflation	61.544	0.001
D. Log of risk for inflation	429.829	0.000
Log of risk for budget balance	49.344	0.026
D. Log of risk for budget balance	384.547	0.000
Log of risk for per capita GDP	40.780	0.137
D. Log of risk for per capita GDP	253.131	0.000
Dummy for a monetary policy stance change	505.910	0.000
D. Dummy for a monetary policy stance change	797.172	0.000
Log of war risk	3.991	1.000
D. Log of war risk	105.544	0.000
Log of risk for international liquidity	46.500	0.047
D. Log of risk for international liquidity	410.850	0.000
Log of M1 money supply	43.319	0.018
D. Log of M1 money supply	281.843	0.000

Table A 33: Kao panel-data cointegration test results for Log of international reserves, Log of risk for per capita GDP, and Log of war risk

	Statistic	p-value
Modified Dickey–Fuller t	-9.7899	0.0000
Dickey–Fuller t	-9.3155	0.0000
Augmented Dickey-Fuller t	-4.1724	0.0000
Unadjusted modified Dickey-Fuller t	-31.2263	0.0000
Unadjusted Dickey-Fuller t	-14.3997	0.0000

Table A 34: Summary statistics of original (non-transformed) variables

Variable	N	Mean	Std. Dev.	Min	Max	Short definition
Dependent variables						
FX volat 10d	874	0.04	0.09	0.00	1.40	the 10 days foreign exchange rates volatility annualized
FX volat 5d	874	0.04	0.11	0.00	1.96	the 5 days foreign exchange rates volatility annualized
FX volat 3d	874	0.04	0.11	0.00	2.37	the 3 days foreign exchange rates volatility annualized
Lending rate volat 3m	819	0.08	0.09	0.00	0.97	the 3 months lending rates volatility annualized
Money market rate volat 3m	707	0.40	1.47	0.00	35.60	the 3 months money market rates volatility annualized
Treasury bill rate volat 3m	732	0.22	1.17	0.00	30.97	the 3 months treasury bill rates volatility annualized
Independent variables						
FL	872	29.47	7.68	3.26	60.05	Flesch reading ease score
Sentence length	874	25.21	4.63	15.20	45.33	average sentence length
Robustness check variables						
Sentence count	874	36.21	26.87	3.00	138.00	number of sentences
Syllable count	874	1.79	0.07	1.55	2.10	mean word syllables
FK	874	15.42	2.04	8.66	23.13	Flesch-Kincaid readability score
ARI	874	15.99	2.48	8.42	25.34	Automated Readability Index
FOG	874	19.36	2.34	12.92	29.19	Gunning Fog index
SMOG	874	16.87	1.63	12.34	23.86	Simple Measure of Gobbledygook
Controls						
Policy rate change	874	0.35	0.48	0.00	1.00	Dummy for a monetary policy stance change
Economic situation	798	-0.02	0.07	-0.33	0.40	Economic situation index
Reserves	831	10437.89	12204.39	0.00	50395.86	international reserves BoP
CPI	848	141.41	60.83	33.97	395.98	consumer price index
Inflation risk	784	7.58	1.24	3.00	10.00	risk for inflation
Budget risk	784	4.79	1.25	1.50	8.00	risk for budget balance
War risk	784	3.79	0.41	2.50	4.00	war risk
International liquidity risk	784	1.90	1.29	0.00	5.00	risk for international liquidity
Money supply M1	698	2130000	4000000	0.00	20100000	M1 money supply
GDP pp risk	784	0.38	0.35	0.00	1.00	risk for per capita GDP

Note: Control variables and Exchange rate data is sourced from IHS Markit, Treasury Bills and interest rates from IHS Markit, IFS of International Monetary Fund, and central banks websites, complexity and readability indicators are computed by the authors using the algorithm in R. Interest rates are used in terms as in IFS of IMF: Lending rate is the rate used by other depository corporations to satisfy the private sector's short- and medium-term financial needs; Money market rate - the rate at which short-term loans are made between financial institutions; Treasury bill rate - short-term government debt is issued and sold on the market. Volatility calculated based on standard deviation of rates either with daily or monthly frequency and further annualized.

" Press release of the National Bank of Moldova, 29 September 2016

Within the meeting of the 29 September 2016, the Executive Board of the National Bank of Moldova adopted the following decision by unanimous vote:

1. to decrease the base rate applied on main short-term monetary policy operations by 0.5 percentage points from 10.0 to 9.5 percent annually;

2. to decrease the interest rates:

- on overnight loans by 0.5 percentage points from 13.0 to 12.5 percent annually;

- on overnight deposits by 0.5 percentage points from 7.0 to 6.5 percent annually;

3. to maintain the required reserves ratio from financial means attracted in freely convertible currency at the level of 14.0 percent of the base.

4. to maintain the required reserves ratio from financial means attracted in MDL and non-convertible currency at the current level 35.0 percent of the base;

The analysis of the most recent statistic data shows the downward trend of the annual inflation rate for the eighth consecutive month and its return within the range of ± 1.5 percentage points from the 5.0 percent target.

The annual inflation rate was 3.6 percent in August 2016 or by 3.4 percentage points less compared to the previous month.

The deceleration of the annual inflation rate in August is in line with the latest forecast of the NBM (published in August 2016) and validates the correctness of monetary policy decisions taken in 2015 and at the beginning of the year.

The annual rate of core inflation was 7.5 percent in August 2016, decreasing by 1.3 percentage points compared to the previous month.

In the second quarter of 2016, the economic activity recorded an increase of 1.8 percent compared to the same period of 2015. In terms of uses, this dynamic is determined by the increase in household final consumption and changes in inventories, generating a contribution of 1.9 percentage points and 4.0 percentage points, respectively. By categories of resources, the positive dynamics of GDP was determined by the increase of gross value added in all sectors, except for that of the subcomponent "construction" and "public administration". Thus, the gross value added recorded increases in "agriculture' (4.1 percent), "trade" (4.1 percent), "transport and storage" (7.0 percent) and "industry" (0.6 percent).

The dynamics of macroeconomic indicators in July and August 2016 shows moderate signs of a further economic activity recovery in the third quarter. In July 2016, exports increased by 0.5 percent compared to the same period of 2015, while imports decreased by 7.9 percent. At the same time, the industrial output recorded a decrease of 5.2 percent, the turnover of trade in services by 5.6 percent, while the turnover of retail trade increased by 1.2 percent. In August 2016, the annual growth rate of transported goods recorded a pronounced increase up to the level of 19.0 percent.

In terms of consumer demand, the annual average real wage growth in the economy was 0.9 percent in July 2016, by 0.8 percentage points lower that in June 2016. Money transfers to individuals through the banks of the Republic of Moldova fell by 6.0 percent in January-August 2016, while in August 2016, these transfers increased, in nominal terms, by 18.4 percent compared with the same periods of 2015.

In August 2016, lending and saving processes recorded similar developments. The volume of new loans granted during the reporting period increased by 17.3 percent, while new attracted deposits increased by 19.9 percent compared to the same period of last year. The total balance of credits at the end of August decreased by 13.7 percent compared to the same period of last year, while total balance of deposits recorded an increase of 4.0 percent compared to August 2015.

The average rate of new loans granted in national currency decreased by 0.30 percentage compared to the level recorded in July 2016, accounting for 13.70 percent. The rate of new deposits attracted in MDL decreased in August 2016 by 1.62 percentage points, reaching the level of 8.24 percent.

The monetary policy continues to be affected by the complexity of risks and uncertainties associated with the development of internal and external environment. The external disinflationary risks associated with the weak economic activity in the Euro area countries and the recession of the Russian Federation - the main trading partners of the Republic of Moldova, with repercussions on short-term decrease in foreign currency income of the households and domestic exporters through the remittances and foreign trade channel. Potential risks to inflation arise from the increased volatility of the international financial foreign exchange markets, along with the uncertainties relating to oil prices, international prices for raw materials and food products. The main internal risks and uncertainties arise from postponing the adjustment of regulated tariffs, the modification of excise duties, in terms of fiscal policy conduct for 2017 and of harvest in 2016, respectively. Thus, the disinflationary risks are prevailing significantly and a fast decrease process of the annual growth rate of prices is anticipated, also due to the high base of comparison in 2015.

In assessing the inflation outlook in the short and medium term, within the meeting held on 29 September 2016, the members of the Executive Board of the NBM decided by unanimous vote to decrease the policy rate by 0.5 percentage points from 10.0 to 9.5 percent annually.

The decision is aimed at maintaining the inflation rate close to the target of 5.0 percent over the medium-term, with a possible deviation of ± 1.5 percentage points. The gradual calibration of monetary policy conduct aims to ensure adequate real monetary conditions for supporting the lending and savings and for boosting the domestic demand, along with further adaptation of domestic economic environment to the volatility and uncertainty related to external environment.

NBM will continue to manage firmly the liquidity excess through sterilization operations, according to the announced schedule.

At the same time, National Bank will continue to offer banks liquidity, according to the schedule announced for 2016, through REPO operations with the term of 14 days, at a fixed rate equal to the base rate of the National Bank plus a margin of 0.25 points percentage.

NBM will further monitor and anticipate the domestic and international economic environment developments, so that by the flexibility of operational framework specific for the inflation targeting strategy to ensure price stability in the medium term.

The next meeting of the Executive Board of the NBM on monetary policy will take place on 27 October 2016, according to the announced schedule. "[49]

[49] Taken form the National Bank of Moldova website.

" CENTRAL BANK OF THE GAMBIA

PRESS RELEASE

MONETARY POLICY COMMITTEE

The Monetary Policy Committee (MPC) of the Central Bank of the Gambia met on Wednesday November 28, 2018 to review recent economic developments and decide on the monetary policy rate. The following summarizes the deliberations on key economic indicators that informed the Committee's decision.

Global Economic Outlook.

1. Global economic growth remains on track, although risks to the outlook have shifted to the downside. In its October release of the World Economic Outlook, the International Monetary Fund (IMF) has revised downwards its growth projection for 2018 to 3.7 percent (the same level as in 2017) from 3.9 percent reported in its July update, as trade and investment moderate and financial conditions tighten.

2. In advanced economies, growth is projected at 2.4 percent in 2018, compared to 2.3 percent in 2017. The rising global interest rates combined with the strengthening of the U.S. dollar, have contributed to tighter financial conditions and moderated capital flows to the emerging and developing economies. Growth in emerging market and developing economies is projected to remain unchanged at 6.5 percent in 2018 compared to 2017 before declining to 6.3 percent in 2019. In sub-Sahara Africa, economic recovery continues, supported by stronger external demand, higher commodity prices and improved access to capital. Economic growth in the region is projected at 3.1 percent in 2018, higher than 2.7 percent in 2017.

3. Global inflation is projected to accelerate to an average of 3.5 percent in 2018, higher than 3.1 percent in 2017, driven largely by rising energy prices. Inflation pressures in sub-Saharan Africa have broadly softened, with annual inflation projected to ease to 8.6 percent in 2018, from 11 percent in 2017.

Domestic Economic Outlook.

Real Sector.

4. Economic recovery in the Gambia continues to gather strength evidenced by the rebound in tourism, construction activities, finance and insurance, trade, and telecommunication. The strong business confidence and prudent macroeconomic policies were also important contributors to growth during the period. The Gambia Bureau of Statistics (GBoS) estimated real GDP to have grown by 4.6 percent in 2017, higher than 0.4 percent in 2016. Growth is expected to remain robust in 2018 and the medium-term outlook is positive on the back of continued implementation of sound macroeconomic policies and structural reforms.

External Sector.

5. Preliminary balance of payments estimates for the first nine months of 2018 indicate a wider current account deficit compared to the corresponding period of 2017, attributed largely to the sharp increase in imports which reflects increased economic activity.

6. The current account deficit is estimated to have widened to US$55.58 million in the first nine months of 2018 from a deficit of US$28.11million a year ago. The services account balance surged to a surplus of US$52.23 million or by 43.50 percent in the first nine months of 2018 from US$36.40 million in the same period last year. Performance in the services account

is attributed, in the main, to the increase in travel income reflecting robust start to the tourism season. Similarly, current transfers rose to US$136.68 million or by 20.46 percent.

7. The deficit in the goods account widened to US$252.64 million or 16.47 percent of GDP in the first nine months of 2018 from US$ 205.51 million in the corresponding period of 2017, due to the increase in imports.

8. The surplus in the capital and financial account improved to US$ 40.15 million in the first nine months of 2018 from a deficit of US$ 13.55 million in the same period a year ago. Gross international reserves are projected at 4 months of next year's imports of goods and services.

Exchange rate developments.

9. Activity in the foreign exchange market, measured by aggregate sales and purchases of foreign currency has picked up rapidly. In the year to End-October 2018, volume of transactions in the domestic foreign exchange market totaled US$1.9 billion, higher than US$1.2 billion in the same period last year. The strong performance reflects improved supply conditions.

10. Purchases of foreign currency increased markedly by 50.7 percent to US$965.4 million as at End-October 2018 from US$640.4 million in the corresponding period in 2017. Similarly, sales of foreign currency, which indicates demand, increased significantly by 68.4 percent to US$963.3 million in the review period from US$572.2 million in the same period of 2017.

11. The exchange rate of the dalasi remains stable. From December 2017 to October 2018, the dalasi appreciated against the pound sterling by 0.2 percent but depreciated against the U.S. dollar and Euro by 3.7 percent and 0.3 percent respectively. In real effective exchange rate terms, however, the dalasi has appreciated. The exchange rate is expected to remain stable in the near to medium-term, predicated on the continued implementation of sound macroeconomic policies, improved supply conditions and confidence.

Government Fiscal Operations.

12. Preliminary government fiscal operations for the nine months to end- September 2018 indicate total revenue and grants of D7.8 billion compared to D10.9 billion in the same period last year. Domestic revenue, comprising tax and non-tax revenues, rose by 16.0 percent to D6.7 billion.

13. Total expenditure and net lending declined to D10.7 billion or by 19.1 percent reflecting mainly the marked drop in interest payments by 20.4 percent.

14. The budget balance (excluding grants) narrowed to a deficit of D4.0 billion in the nine months to End-September 2018 compared to a deficit of D7.5 billion in the corresponding period a year ago.

Domestic Debt.

15. The stock of domestic debt increased slightly to D29.66 billion (42.7 percent of GDP) as at End-October 2018 from D29.14 billion (42.0 percent of GDP) in the corresponding period a year ago. Stock of Treasury and Sukuk-Al Salaam bills increased by 0.96 percent to D17.14 billion during the period under review.

16. Yields on all Treasury bills increased. The 91- day, 182-day, and 364-day Treasury bills rates increased from 3.68 percent, 4.77 percent, and 6.34 percent in October 2017 to 4.97 percent, 6.83 percent, and 9.25 percent, respectively in October 2018.

17. As part of broader reforms of the monetary policy framework of the Bank, the Central Bank has started issuing its own bills for liquidity management beginning October 2018. In addition, the Bank has also introduced the interest rate corridor comprising overnight lending and deposit facilities.

Banking Sector.

18. The banking sector remains fundamentally sound. The industry remains highly capitalize, liquid and profitable. The industry registered asset growth of 15.8 percent in the year to End-September 2018. The asset quality has also improved. Non-performing loan ratio stood at 4.7 percent, lower than 5.9 percent reported at the previous MPC and 10.2 percent in the same period last year.

19. The risk weighted capital adequacy ratio stood at 33.6 percent, significantly higher than the statutory requirement of 10 percent. Liquidity ratio was 98.48 percent in September 2018, also remains well above the requirement of 30 percent.

Development in Monetary Aggregates.

20. As at End-September 2018, money supply grew by 22.4 percent, higher than 20.0 percent recorded a year earlier. The net foreign assets of the banking system expanded to D9.4 billion or by 33.1 percent during the period. The net foreign assets of the Central Bank and commercial banks increased to D3.8 billion and D5.6 billion or by 4.0 percent and 64.4 percent respectively.

21. The banking system's net domestic assets increased to D22.7 billion or by 18.4 percent following a contraction of 6.7 percent at end- September 2017. Claims on government, net, grew by 14.5 percent relative to a growth rate of 3.2 percent a year ago.

22. Private sector credit expanded by robust 28.2 percent at end- September 2018 compared to a contraction of 12.3 percent a year ago.

23. Reserve money growth slowed largely reflecting decline in the Bank's net claims on government. As at End-September 2018, reserve money grew by 11.8 percent, lower than 29.3 percent recorded last year. Central Bank financing of fiscal deficit remains zero in November 2018.

Price Movements.

24. Inflation as measured by the National Consumer Price Index (NCPI) remained largely subdued. According to the latest release from the Gambia Bureau of Statistics (GBOS), inflation decelerated to 6.5 percent in October, 2018 from 7.4 percent a year ago, thanks to the decline in consumer food inflation.

25. Food inflation, which is the main driver of headline inflation, decelerated to 6.5 percent in October 2018 from 7.9 percent last year. Price indices of all the components of the food basket declined with the exception of fruits and nuts. Non-food inflation, on the other hand, edged up slightly to 6.8 percent from 6.7 percent during the review period. The marginal increase in non-food inflation is attributed largely to the rise in price indices of housing, fuel and lighting, hotels and restaurants, transportation, health, furniture, and education.

Inflation Outlook.

26. The outlook for inflation is a further deceleration towards the Bank's medium term target of 5 percent. This is premised on the following:

o The exchange rate of the dalasi is projected to remain broadly stable supported by improved confidence and supply conditions in the foreign exchange market.

o The Bank's Business Sentiment Survey indicated that inflation expectations are well anchored with majority of respondents projecting subdued inflationary environment.

o Pressures from global food prices are expected to remain mild.

o Monetary and fiscal policies will remain prudent and well- coordinated.

27. However, there are risks to the outlook:

o Global inflation is accelerating which may put upward pressure on prices of imported goods.

o The rising interest rates in advanced economies and stronger U.S. dollar in the international market.

o Increase in domestic energy prices may affect inflation expectations.

Decision.

Taking the above factors in to consideration, the Monetary Policy Committee has decided to keep the monetary policy rate unchanged at 13.5 percent.

The Committee also decided to maintain the overnight deposit rate at 2.0 percent.

Information Note

The next Monetary Policy Committee (MPC) meeting is scheduled for February 27, 2019. The meeting will be followed by the announcement of the policy decision on February 28, 2019."[50]

[50] Taken form the Central Bank of the Gambia website

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3. CHAPTER THREE: Monetary Policy Transparency, Independence and Inflation in Developing Countries

ABSTRACT

This paper examines the impact of monetary policy transparency on inflation in 34 developing countries from 1998 to 2019, taking into account their monetary policy independence and stance. The association between monetary policy transparency (MPT) and subsequent period inflation is weakly negative for the studied nations but significantly negative for Inflation Targeting (IT) countries, according to graphical analysis of simple correlation. An application of the median quantile regression with fixed effects revealed that greater MPT is associated with lower inflation in the following period for the countries which have either tight monetary policy or independent monetary policy controlling for its tight regime. For both tight and loose policy stances, the overall effect of MPT on inflation is primarily negative. The study found that monetary policy transmission may act against theoretical expectations for nations with non-IT regimes and where monetary policy is dependent. When developing countries have independent monetary policies, they may benefit more from increased MPT. The role of monetary policy instruments and characteristics in combating inflation may be limited in the case of developing nations due to a variety of factors, including the lack of key policy rate transmission.

Keywords: monetary policy, transparency, independence, key policy rate, inflation, developing countries.

3.1 INTRODUCTION

In 2019, the National Bank of Ukraine (i.e., the central bank of Ukraine, the NBU) received the prestigious Central Banking Transparency Award for making significant progress toward more transparency and improving stakeholder communication.[51] Moreover, in 2019, the NBU managed to contain inflation to a six-year low of 4.1%, reaching its medium-term inflation target of 5% ± 1 pp (National Bank of Ukraine, 2020). Prior to this, the NBU had a tough time addressing a set of serious threats to the country's financial system, including the war in eastern Ukraine, rising inflation, and a dysfunctional banking sector since 2014. Among other things, these were tackled by ensuring the independence and transparency of monetary policy (Gontareva & Stepaniuk, 2020).

In fact, in the past decades, many central banks were granted greater monetary policy independence and called for greater transparency as a result of the rational expectation concept's development and the shift from targeting output to maintaining price stability (Dincer et al., 2022; Weber, 2018). Since then, the question of the inflation phenomenon has engaged the international literature, with scholars concentrating on both its implications and determining factors. Nevertheless, while there are pretty many studies devoted to inflation in both developed and developing countries, the stream of literature that empirically studies the nexus between inflation, monetary policy transparency (MPT), and independence (MPI) is rather modest, especially for the developing world. Furthermore, the actual outcomes of studies in this domain in developing countries are unclear. As a result, it is critical for developing nations to analyze the influence of MPT on inflation while also considering their overall monetary policy independence and stance. Taking into account the evidence from Ukraine's case— a developing country—the goal of this study is to examine the impact of MPT as well

[51] The National Bank of Ukraine: https://bank.gov.ua/en/news/all/natsionalniy-bank-otrimav-nagorodu-central-banking-transparency-award

as the interaction effect of transparency and independence on inflation for other developing nations.

This study is one of the few to look at the impact of MPT on inflation for several developing countries through the prism of monetary policy independence and stance, and accounting for inflation targeting (IT) countries. The graphical examination of simple correlation has revealed that the relationship between MPT and the following period's inflation is weakly negative for the sampled countries, while the correlation between MPT and inflation is moderately negative for IT countries. Employing annual data from 34 developing countries from 1998 to 2019 and applying a median quantile regression fixed effects panel data approach while controlling for a large number of factors, the research finds that greater transparency is associated with lower subsequent period inflation for the countries that have either tight monetary policy or independent monetary policy controlling for its tight regime. For the studied nations with either a tight or an easy monetary policy stance, the overall effect of transparency on inflation is primarily negative. The study found that in non-IT non-MPI nations, monetary policy transmission may act against theoretical expectations, confirming previous empirical literature. This is supported by a number of robustness tests.[52] Due to a range of circumstances, including the lack of key policy rate transmission, the function of monetary policy instruments and features in managing inflation is restricted in developing countries.

This study extends the associated literature in a variety of ways. First, this paper contributes to the existing body of literature by studying the nexus between inflation, monetary policy transparency (MPT), independence (MPI), and stance in developing countries. Second, this study suggests using the Monetary Independence Index (Aizenman et al., 2008, 2010, 2013) as the measure of MPI, because this provides the opportunity to observe de facto monetary

[52] See section 6 and Tables A 3.6–A 3.11 in the Appendix.

policy independence at the country level. Third, scatterplot diagrams analysis highlighted the ambiguity of MPI and stances of monetary policy and a weak diminishing impact of transparency on inflation in sampled developing nations. Further to that, countries with a monetary policy regime of IT have a moderate negative relationship between MPT and inflation. Next, the effects on inflation of MPT as well as both the interactions of MPT with MPI, and MPT with MPI and monetary policy stances have been studied in a novel setting, taking into consideration inflation-targeting countries. For this, and considering the issue of hyperinflation in the developing world, the study applies a novel empirical strategy.

The rest of this paper is organized as follows: Theoretical and empirical research on the link between monetary policy transparency and independence and inflation are summarized in Section 2. The research questions and hypotheses are discussed in Section 3. The data utilized in this study is described in Section 4, and the methodological framework is described in Section 5. The estimation results and robustness checks are provided and discussed in Section 6. Policy recommendations and conclusions are made in Section 7.

3.2 LITERATURE REVIEW

Separately, the issues of monetary policy transparency (MPT), monetary policy independence (MPI), and especially drivers of inflation have been in the spotlight for a long while.[53] Meanwhile, the study of transparency and independence relationships with inflation started just a few decades ago (Weber, 2018). This section will provide an overview of the

[53] Following Dincer et al. (2022) the paper uses a more narrow concept of monetary policy transparency rather than the more commonly used term "central bank transparency," as, for example, central bank transparency criteria in terms of macroprudential or microprudential policies may differ from those for monetary policy transparency. Also, we may think about monetary policy transparency as a part of broader central bank transparency. The same is true for central bank independence, which is a broader concept nowadays than just monetary policy independence. Central banks may be responsible for many more things, such as micro- and macroprudential supervision, resolution, and so on, and the concept of monetary policy independence may have different criteria than the other concepts mentioned.

theoretical dimension of the relationship and an overview of the empirical research that has been undertaken so far in the field, followed by the model I intend to test.

3.2.1 Theory of concepts and empirical research

The years of the 1990s and 2000s witnessed dramatic changes in central banking. In the early 1990s, many countries started to provide substantial legal independence to their central banks (Cukierman, 1998). At the same time, many central banks introduced landscape-changing practices in their operational activity and monetary policy frameworks. For example, the central banks of New Zealand, Canada, the U.K., and Sweden alternately shifted to an "inflation targeting" regime, which has a clear inflation target and publishes inflation projections, among other important features.[54] Some other countries' monetary policy authorities (e.g., Brazil, Japan, and the USA) became more open through other actions, like revealing voting records on policy decisions and discussions around them, and giving detailed explanations about their decisions and actions (Demertzis & Hughes Hallett, 2007). Moreover, the survey by Fry et al. (2000) on the conduct of a monetary policy by 94 central banks in 1998 revealed that the two most important things in their frameworks of monetary policy, after maintaining low inflation expectations, were central bank independence and transparency. The fact that they are associated with a stronger anchoring of inflation expectations and, therefore, help combat inflation, has aided the shift toward more independent and transparent central banks (Demertzis & Hughes Hallett, 2007). As such, central bank independence and transparency, referring to its monetary policy domain, have become the new monetary policy trends (Geraats, 2002).

Although it had already existed for a while, for example, do Vale (2021) argues that the concept of central bank independence existed in the 1920s, rooted in the Bank of England's

[54] For more information on inflation targeting, see Bernanke et al. (2018) and Svensson (1999).

international recommendations and principles. Both concepts are not explicitly or precisely defined (Crowe & Meade, 2008; Eijffinger & De Haan, 1996).

3.2.1.1 Independence

There are a vast number of studies devoted to central bank (monetary policy) independence and even summarizing the related literature (Berger et al., 2001; Crowe & Meade, 2008; Eijffinger & De Haan, 1996; Masciandaro et al., 2020). The concept of central bank independence for conducting monetary policy was initially proposed in academic circles in the early 1960s (Vonessen et al., 2020). Friedman (1962) sees a central bank's autonomy (i.e., independence) from the government in a similar way to the relationship between the judiciary and the government. The court can only rule independently on the basis of laws enacted by the legislature, and it can only be forced to rule differently if the legislation is changed. In other words, an independent central bank is protected against intervention or pressure from any public institutions or other bodies or persons while performing its goals in line with its mandate and related legislation.

Between the 1970s and 1980s, the concept was further spread to policy-makers, when many developed countries suffered from stagflation, to get a broad policy consensus in the 1990s. As such, by the end of the 2000s, central banks in virtually all developed nations and many emerging economies had been given monetary policy independence, though to various degrees (Vonessen et al., 2020).

There are several theory streams justifying the need for central bank monetary policy independence (Crowe & Meade, 2008; Fischer, 1995) that are mostly related to the ability of an independent central bank to address inflationary biases (de Haan et al., 2018). As politicians can pressure the central bank to bust GDP growth in the short run in order to benefit in the next election, or as the government can finance its expenditures by pressuring the central bank to print money, the central bank cannot be trusted to stick to the agreed-upon inflation target due

to loss of credibility (i.e., time inconsistency). To resolve these, first, monetary policymakers should be protected from political pressure (Blinder, 1999). Second, to deal with the time-inconsistency problem[55] that afflicts discretionary policy, Rogoff (1985) suggests delegating monetary policy to a conservative central banker, an institution that is highly averse to inflation. While Walsh (1995) and Persson and Tabellini (1993) see the solution from the principal-agent point of view, suggesting any policymaker with appropriate incentives and a well-defined mandate be in charge of monetary policy. Yet, Crowe and Meade (2008) noted that central bankers and some scholars criticized the literature's emphasis on time inconsistency, claiming that it is not a significant problem for modern central banks, particularly in industrialized nations. Thus, some other issues, like political economy, might be used to justify delegation.

Therefore, according to Walsh (2017), independence has two main aspects: isolation from politics when establishing the goals of monetary policy and autonomy in fulfilling the policy after those objects have been established. Earlier, Grilli et al. (1991) called them political and economic independence, respectively. Also, Fischer (1995) distinguishes them as "goal independence" (i.e., the central bank is free to follow its own policy preferences) and "instrument independence" (the central bank chooses instruments to achieve goals set by the government). Meanwhile, Hasse (1990) identified three areas where government influence on the central bank must be substantially limited or prohibited, namely personnel independence, financial independence, and policy independence. Yet, the degree of independence matters only when the central bank, contrary to the government, places a greater focus on alternative policy goals (Eijffinger & De Haan, 1996).

Regardless of theoretical reasoning, the MPI concept has been recognized, and the level of central bank independence has grown substantially since the time it was first measured in

[55] See Kydland and Prescott (1977) and Barro and Gordon (1983) for more information.

late 1980 (Crowe & Meade, 2008). At this point, the literature discusses other dimensions of central bank independence, like, for example, supervisory independence (Fraccaroli et al., 2020).

3.2.1.2 Transparency

After the concept of independence was adopted by most central banks, it prompted public concern about whether or not including unelected authorities in monetary policymaking is democratic (Stiglitz, 1998). As a result, the critically significant concept of central bank transparency appeared to make central banks more responsible while also increasing their public credibility (Spyromitros & Tuysuz, 2012). Transparency has become a condition for central banks to gain more independence while becoming more accountable, which overall allows them to increase the efficiency of monetary policy (Dincer & Eichengreen, 2014). As such, the transparency of monetary policy is a necessary complement to monetary policy independence, which enables accountability to protect independent central banks' democratic legitimacy (Geraats, 2002). Meanwhile, some scholars consider MPT to be part of the independence concept. For example, Jasmine et al. (2019) measured the independence of the central bank, including transparency as a component.

It is hard to find a comprehensive definition of transparency as it is a multidimensional phenomenon that may be seen from different perspectives (Eijffinger & Geraats, 2006). Geraats (2002) identifies central bank transparency (clearly from the monetary policy side) as *"…the absence of asymmetric information between monetary policy makers and other economic agents. This means that it reduces uncertainty and this is often believed to be beneficial (although it need not be).*" It also limits the central bank's abilities to influence private-sector beliefs. Andrieş et al. (2020) and Yıldırım-Karaman (2017) see central bank transparency as the degree to which a central bank communicates information regarding its decision-making methods, policy choices and objectives, policy implementations, and

economic variables essential to the condition of the economy. Geraats (2002) identifies several aspects of transparency, namely political transparency, economic transparency, procedural transparency, policy transparency, and operational transparency. Many studies, including (Crowe & Meade, 2008; Dincer & Eichengreen, 2007, 2014; Eijffinger & Geraats, 2006) benchmark this taxonomy to develop their measurements of transparency of monetary policy.

Dincer and Eichengreen (2014) outlined several reasons for the transparency concept's development in the central banking field. First, it is part of a larger movement to make the government more responsive to the people regarding public demand. Second, in an era of central bank independence, transparency is considered an important aspect of accountability. Third, central bank transparency is considered a means to help markets react more effectively to policy actions. Fourth, transparency can help the central bank's pledges become more credible. It says that when the central bank explains fully how and why its actions are expected to set the target inflation rate, it will be easier to believe that it is committed to keeping inflation low and stable. More recently, MPT has become a cornerstone for central bank communication policy and forward guidance that helps to eliminate time-inconsistency problems (Dincer et al., 2022).

At the same time, the developed, more complex financial markets demanded more information from central banks, and to guide market expectations, central banks had to become more transparent (Crowe & Meade, 2008). In addition, the widespread application of inflation targeting made monetary policy more information-intensive compared to other policy anchors like the money aggregate rule or the fixed exchange rate (Crowe & Meade, 2008). In fact, the most vocal proponents of enhanced transparency have been inflation-targeting central banks (Westelius, 2009). As a result, both the supply and demand for transparency have risen (Blinder et al., 2001; Geraats, 2002).

Although there has been a less dramatic increase in MPT, compared to MPI or central bank independence, since the late 1990s (Crowe & Meade, 2008), the number of measures shows that transparency, as well as independence, has steadily improved over time (Dincer & Eichengreen, 2014). The central bank's move towards greater transparency is true for countries of all income groups (Dincer et al., 2022). As evidence of the great importance of this concept nowadays, the IMF published its updated Central Bank Transparency Code, a best-practice book in the transparency domain of the central banking field (International Monetary Fund, 2020).

Even though transparency and independence of monetary policy of central banks have been actively studied just since the early 2000s, they have demonstrated to be critical components for monetary policy effectiveness and, as a result, for central banks to control inflation (Alesina & Summers, 1993; Crowe & Meade, 2008; Demertzis & Hughes Hallett, 2007; Dincer et al., 2019; Dincer & Eichengreen, 2014; Eijffinger & De Haan, 1996; Geraats, 2005; Hughes Hallett & Libich, 2006; Papadamou & Arvanitis, 2015; Spyromitros & Tuysuz, 2012; Weber, 2018 among few). Some theoretical studies, however, suggest that central bank transparency may have adverse implications (Westelius, 2009).

3.2.1.3 Complementary concepts

Although many scholars treat central bank (monetary policy) independence and transparency as separate concepts, Crowe and Meade (2008) see them as complementary ideas that are necessary for good governance. Moreover, Dudchenko (2020) investigates the fact that the terms "central bank independence" and "central bank transparency" have strong conceptual and practical overlap. Furthermore, Dincer and Eichengreen (2014) show that transparency and independence of central banks go together, being driven by the same imperatives. They show that both transparency and independence have a considerable impact on outcomes such as inflation level and variability.

3.2.1.4 Empirical findings

A vast body of empirical research focuses on the impact of transparency and independence on many macroeconomic variables, including inflation (level, volatility, and persistence). A number of studies found that independence is related to lower inflation (Alesina, 1988, 1989; Alesina & Summers, 1993; Brumm, 2006; Crowe & Meade, 2008; Cukierman et al., 1992; Grilli et al., 1991; Ismihan & Ozkan, 2004) and lower inflation persistence (Diana & Sidiropoulos, 2004; Papadamou et al., 2017). Yet some studies discover that independence has no effect on inflation (Cecchetti & Krause, 2002; Spyromitros & Tuysuz, 2012). Some other studies see that this relationship is ambiguous (Arnone & Romelli, 2013). As such, Masciandaro et al. (2020) recently concluded that academia has not come to an agreement, neither on the direction of the MPT-inflation relationship nor on the factors that may influence this relationship.

In terms of transparency impact, various studies have found that more transparency has a favorable (decreasing) impact on inflation (Cecchetti & Krause, 2002; Dincer & Eichengreen, 2014; Geraats, 2002; Spyromitros & Tuysuz, 2012; Weber, 2018) and a negative impact on inflation persistence (Dincer & Eichengreen, 2007; Oikonomou et al., 2021; Van Der Cruijsen & Demertzis, 2007). While Demertzis and Hughes Hallett (2007) found a positive impact only on inflation variability, there was no effect on inflation level. Crowe and Meade (2007) found no impact either.

3.2.1.5 Developing countries

Fry et al. (2000) found that, on average, the central banks of developing countries are less independent and transparent. Dincer and Eichengreen (2014) confirmed that developing countries have lower transparency than either developed or emerging markets.

While early central bank independence research focused on a modest number of developed countries, further studies, which had either a larger number of developed countries

and/or developing countries, discovered more ambiguous outcomes (Arnone et al., 2009; Crowe & Meade, 2008; De Haan & Kooi, 2000; Eijffinger & De Haan, 1996; Klomp & De Haan, 2010). The studies of Presnak (2005) and Kasseeah (2011) on the independence and inflation relationship in Africa contradict each other. The former found no independence impact, while the latter observed a significant effect of independence on inflation. Agoba et al. (2017) find that in Africa and the developing world, CBI is insufficient to achieve lower inflation, unlike in advanced nations. Ismihan and Ozkan (2004) argued that there's no link between independence and decreased inflation in developing countries, while Brumm (2006) opposed these findings, exploring that independence and inflation have a significant negative association for developing nations. Independence and inflation have a negative association for some Latin American and Caribbean countries (Jácome & Vázquez, 2008). Other scholars demonstrate the importance of independence and transparency in maintaining a lower inflation rate for a selection of emerging markets and developing countries (Arnone et al., 2009; Laurens et al., 2009).

In fact, studies related to independence in developing countries greatly outperform those focused on transparency in numbers. Transparency and accountability reduce inflation in developing nations (Hughes Hallett & Libich, 2006). For some emerging market economies, independence and transparency may be prerequisites to lower inflation (Aguir, 2018). Transparency is an important tool to maintain inflation under control in Brazil (de Mendonça & de Siqueira Galveas, 2013). At the same time, there is a gap in cross-country studies on the impact of transparency and the transparency - independence relationship on inflation in the developing world.

3.2.2 Model

This study utilizes the model based on Eijffinger and Geraats (2006), where there is a central bank with the following objective function:

$$W = \alpha(\pi - \pi^*)^2 + \beta(y - y^*)^2 \quad (3.1)$$

where inflation is π and output y, while π^* and y^* their respective targets. As Eijffinger & Geraats (2006) noted, at this stage, perfect transparency (they were more specific about the policy transparency dimension of central bank transparency) would mean sharing with the private sector all the information on targets and relative preferences α/β and the objective function functional form. Yet, no central banks are transparent to this extent (Cukierman, 2002). As such, in an ordinary case, transparency would comprise sharing information on the inflation target π^*. Eijffinger and Geraats (2006) emphasize that institutional arrangements are also important since they reveal monetary policymakers' motivations. That is, at this point, MPI ensures that central bankers can fulfill (3.1) without being influenced by politics, as the incentive schemes effectively adjust their objective function.

The aggregate demand and supply equations can be used to illustrate the economy's structure.

$$y = \bar{y} - a(i - \pi^e - \bar{r}) + d \quad (3.2)$$

$$\pi = \pi^e + b(y - \bar{y}) + s \quad (3.3)$$

where inflation expectations are represented by π^e, the nominal interest rate is i, $\bar{r}$ stands for long-run real interest rate, and $\bar{y}$ is a natural output rate. While d and s stand for aggregate demand and supply shocks, respectively. In this regard, “transparency” (its economic dimension) refers to the fact that the private sector and the central bank share the same knowledge about the economy. And also about the structure of the economy and the portion of the d and s disturbances that the central bank independently anticipates and reflects in its independent actions.

Consider the nominal interest rate i as a monetary policy tool, which is used under central bank discretion in line with MPI settings. Eijffinger and Geraats (2006) list several

possible ways for the central bank to set i. Either utilize Taylor's rule or maximize (3.1) subject to (3.2) and (3.3) applying a framework for targeting that allows judgment alike (Svensson, 2002). Likewise, the central bank might employ various methods and develop its own monetary policy strategy. At this stage, transparency (its procedural dimension) is demonstrated through the openness of the central bank's strategy, minutes, voting records, etc., to the private sector.

Furthermore, transparency (from the policy dimension) implies that the central bank communicates its policy instrument decision as soon as possible under the model. In addition, when monetary policy faces some errors related to the policy instrument or aggregate supply and demand shocks that were not expected, the central bank MPT is required to inform the public.

3.3 HYPOTHESIS

Since the Asian financial crisis, central banking has undergone a transparency revolution. It has been started by central banks in high-income nations and is spreading throughout the globe (Dincer et al., 2022). Transparency is a critical component of most central banks' monetary policy frameworks nowadays (Dincer et al., 2019). Various studies have discovered that more transparent monetary policy will decrease the inflation rate.

However, developing countries experience difficulties using this instrument as their institutions are generally weak and their past experience with hyperinflation affects their monetary policies (de Mendonça & de Siqueira Galveas, 2013). Meanwhile, some emerging market countries even reversed their transparency level in 2008 after some significant improvements were achieved earlier (Dincer & Eichengreen, 2014). Furthermore, the empirical results of these domain studies for the developing world are not that clear. As such, it is especially important for developing countries to examine the impact of MPT on inflation while considering their independence and monetary policy stance.

Following the model settings in Section 2, it is hypothesized that:

Hypothesis 1: an increase in MPT at the time t is associated with a decrease in inflation in time $t + 1$;

Hypothesis 2: an increase in MPT at the time t has a diminishing impact on inflation in time $t + 1$ for tightening/easing monetary policy stances;

Hypothesis 3: an increase in MPT at the time t has a diminishing impact on inflation in time $t + 1$ in countries with independent monetary policy;

Hypothesis 4: at the time t, when an average central bank of an average developing country takes a decision on the future monetary policy stance, measured by a key policy rate direction (tightening or easing), the effect of this decision on inflation in time $t + 1$ will be greater if the monetary policy is independent and its transparency is higher.

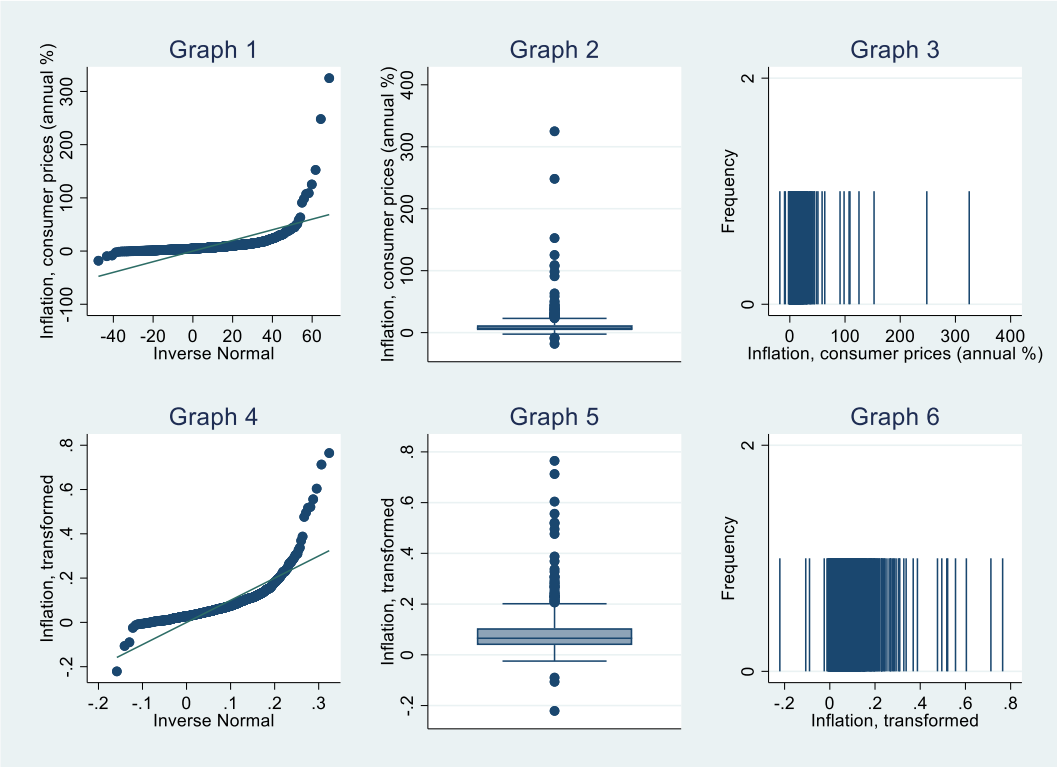
As such, the following are the research questions: *Does monetary policy transparency affect inflation in developing countries? Does monetary policy transparency affect inflation in developing countries given its independence and stance?* In particular, this study aims to see whether increased MPT leads to better handling of inflation in developing countries.

3.4 DATA

For the purpose of this study, a constructed dataset consists of yearly observations of developing countries' monetary policy related variables, financial indicators, banking sector characteristics, macroeconomic variables, and other socio-economic characteristics that cover the period from 1998 to 2019. The study considers a developing country as a country that is on the list of low- and lower-middle-income economies countries in the World Bank's classification for the 2020 fiscal year.[56] At that time, there were 78 countries on the list.[57]

[56] The terms "low and lower middle-income nations" are frequently interchanged with "developing countries," despite the fact that the latter's definition is not universally agreed upon.
[57] The period of study and number of countries are largely determined by the data accessibility of MTI by Dincer et al. (2014, 2022) and have also decreased for the countries that belong to monetary unions.

Figure 3.1: Inflation data examination



Note: Graph 1 – a Q-Q plot of Original Inflation data to a normal distribution, Graph 2 – a box plot of Original Inflation data, Graph 3 – a spike plot (frequency plot) of Original Inflation data, Graph 4 – a Q-Q plot of transformed Inflation data to normal distribution, Graph 5 – a box plot of transformed Inflation data, Graph 6 – a spike plot (frequency plot) of transformed Inflation data.

The dependent variable, the inflation rate, is based on consumer price level (CPI) annual change data from the World Bank's World Development Indicators (originally from the International Financial Statistics of the IMF). Given the nature of inflation in developing countries, i.e., frequent hyperinflations experienced, it is hardly expected to have this variable distribution be close to normal, mainly due to a large number of outliers (Figure 3.1, Graphs 1-3). As such, the initial data on inflation rates was rescaled by applying the following approach: $\pi_{it}/(1+\pi_{it})$.[58] This type of transformation is particularly valuable for research on emerging markets and developing nations, which are exposed to hyperinflationary periods (Arnone & Romelli, 2013). Although the transformation helps to make the shape of the distribution closer to normal, yet it is seen that the outliers' issue persists (Figure 3.1, Graphs 4-6). Nevertheless,

[58] Given that the original inflation data is in %, the transformation formula is actually $(\pi_{it}/100)/(1+(\pi_{it}/100))$.

especially in the case of response variables, these outliers may be informative, as they have a sense, taking into account the hyperinflation periods of some countries. As such, the goal is to accommodate them rather than cut them out. Therefore, this issue must be addressed through the application of an appropriate empirical methodology.

A set of independent variables, which are the main focus of this study, consist of a measure of MPT, key policy rates, and a measure of MPI for sampled countries. There are several ways in the literature to measure central bank transparency (from the monetary policy side). This study utilizes the composite transparency index of Dincer et al. (2022). Following Eijffinger and Geraats (2006) and an extension of Dincer and Eichengreen (2014) and Dincer et al. (2019), which is one of the most widely utilized measures in the field. The measures are available for 112 countries from 1998 to 2019. This index consists of five dimensions, namely political, economic, procedural, policy, and operational transparency. Where each dimension has a sub-index comprised of three items, each with a score of 0, 0.5, or 1. The composite index equals the sum of all items' scores. It has a range from 0 to 15. Dincer et al. (2022) utilized publicly available information in English to build this index.

In terms of MPI measures, there are also a number of approaches. This study departs from the standard practice of using the mostly applicable index of Cukierman et al. (1992) or the mostly recent index of Romelli (2022) in search of a proxy for MPI. Instead, the MPI is measured through the Monetary Independence Index of Aizenman et al. (2008, 2010, 2013), which gives a chance of seeing the de facto monetary policy independence at the country level. The authors calculate the index for a vast number of countries, including developing nations, across time. They use the inverse of the yearly correlation between the monthly interest rates of the home and base countries, and as such, the index values have a continuous nature. The index ranges from 0 to 1, where more monetary policy independence is associated with higher index scores. For this study's purposes, next, a binary indicator has been developed, with 1

indicating a country with a monetary independence index greater than 0.4800511 (the index's mean value), indicating that the country has an independent monetary policy, and 0 indicating otherwise.[59]

Lastly, the annual data on central bank policy rates (average over the period) from IHS Markit of S&P Global has been utilized. Then, there have been created the binary indicators for monetary policy tightening (1 means rate increase, 0 otherwise) and monetary policy easing (1 means rate decrease, 0 otherwise). In addition, inflation-targeting countries have been identified based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime.[60]

Apart from the variables mentioned above, the study also employs plenty of control factors that have been shown in empirical research to affect inflation (Arnone & Romelli, 2013; Weber, 2018). The macroeconomic variables are mostly taken from the World Development Indicators and the International Financial Statistics of the IMF. The data comes from the Worldwide Governance Indicators, IHS Markit of S&P Global, and the Global Financial Development Database. In addition, the study takes advantage of Nguyen et al. (2022) financial crises' data. To reduce the impact of outliers and missing data, all variables have been verified for them. To find some missing data, the central banks' websites of particular countries were exploited.

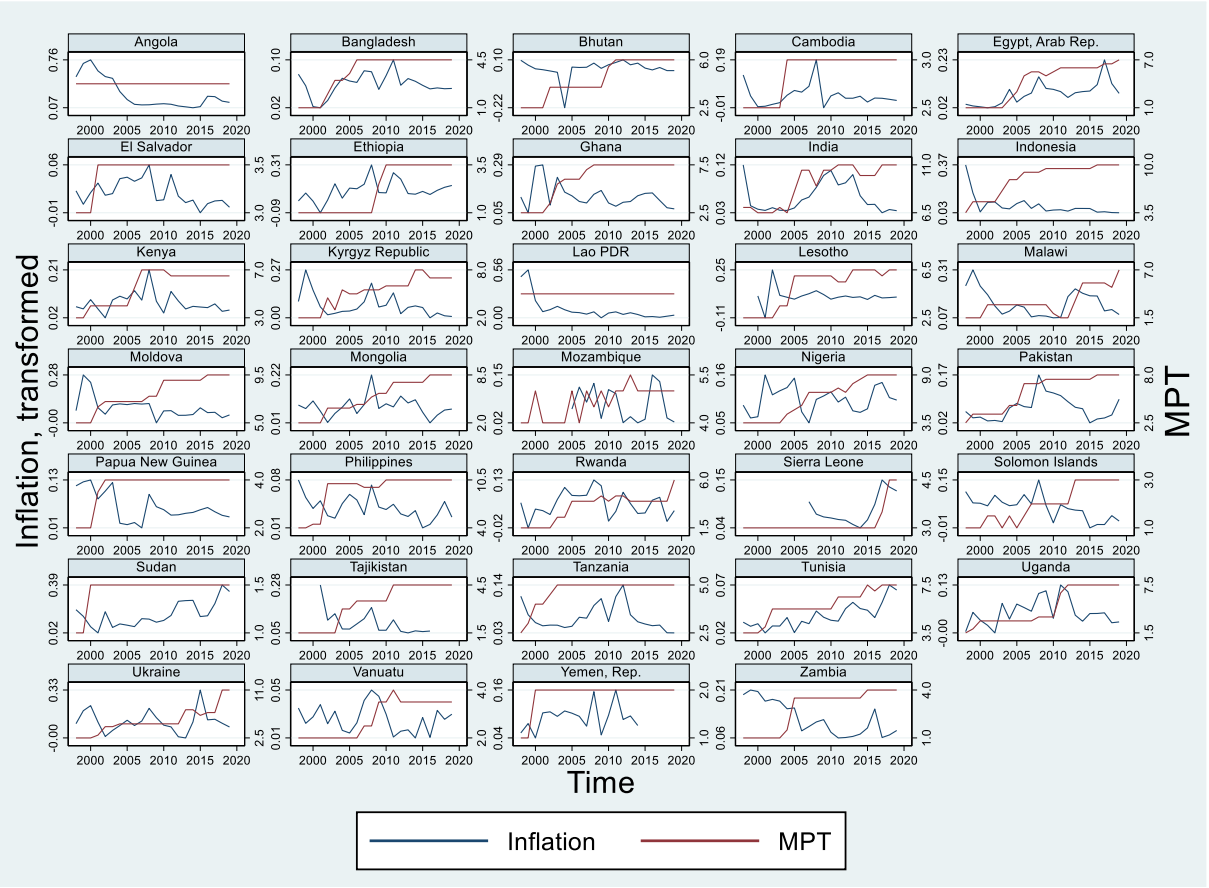
As such, a panel data sample has been constructed for 34 developing countries over the period 1998–2019, with 748 observations in total. As lagged variables are included in the models, the number of observations should decrease. Therefore, the study employs 22 variables and lags of some of them based on their correlation and multicollinearity analysis.[61]

[59] Other cut-off values will be used in the robustness checks.
[60] Please find the list of countries with the particular indicator of IT dummy in Table A 3.5 of the Appendix.
[61] Please find the related Tables A 3.1–A 3.2 in the Appendix.

3.4.1 Descriptive analysis

First, before going into empirical analysis, the study descriptively explores the relationships between *inflation* (transformed) and key variables of interest, namely *MPT* and *MPI dummy*.

Figure 3.2: Inflation and Monetary Policy Transparency across countries

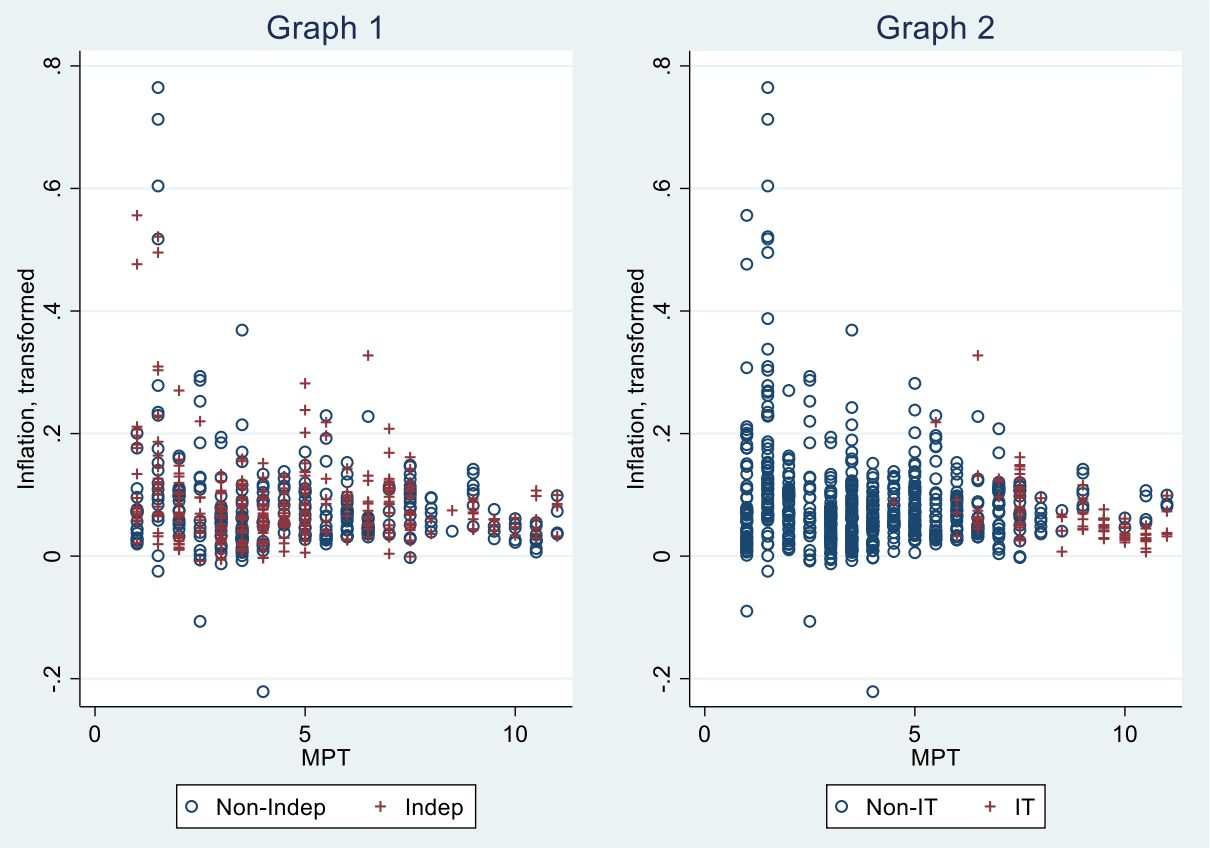


Note: Inflation is a transformed inflation rate, which is measured by the CPI annual change (%) from the World Bank's World Development Indicators. MPT stands for the composite Transparency index of Dincer et al. (2022).

Figure 3.2 illustrates the trend of inflation and MPT in sampled developing countries for 21 years starting in 1998. Several general patterns may be seen from there. Some countries, like Indonesia and Moldova, have a clear sign of an improvement in MPT and a decline in inflation in parallel. Other countries have either an inflation change/volatility with a flat MPT (like Angola and Sudan), or a simultaneous increase of both (Sierra Leone and Nigeria), or even volatility of both (like in Mozambique).

Graph 1 of Figure 3.3 illustrates that sampled countries with more transparent monetary policies tend to have lower inflation. At the same time, it is evident that countries with low inflation and high MPT are not necessarily independent from monetary policy perspectives. Meantime, Graph 2 of Figure 3.3 shows that countries that utilize an IT regime have mostly lower inflation and higher MPT. It confirms the general view of the literature that IT countries highly price MPT.

Figure 3.3: Inflation vs. Monetary Policy Transparency by Independence and IT

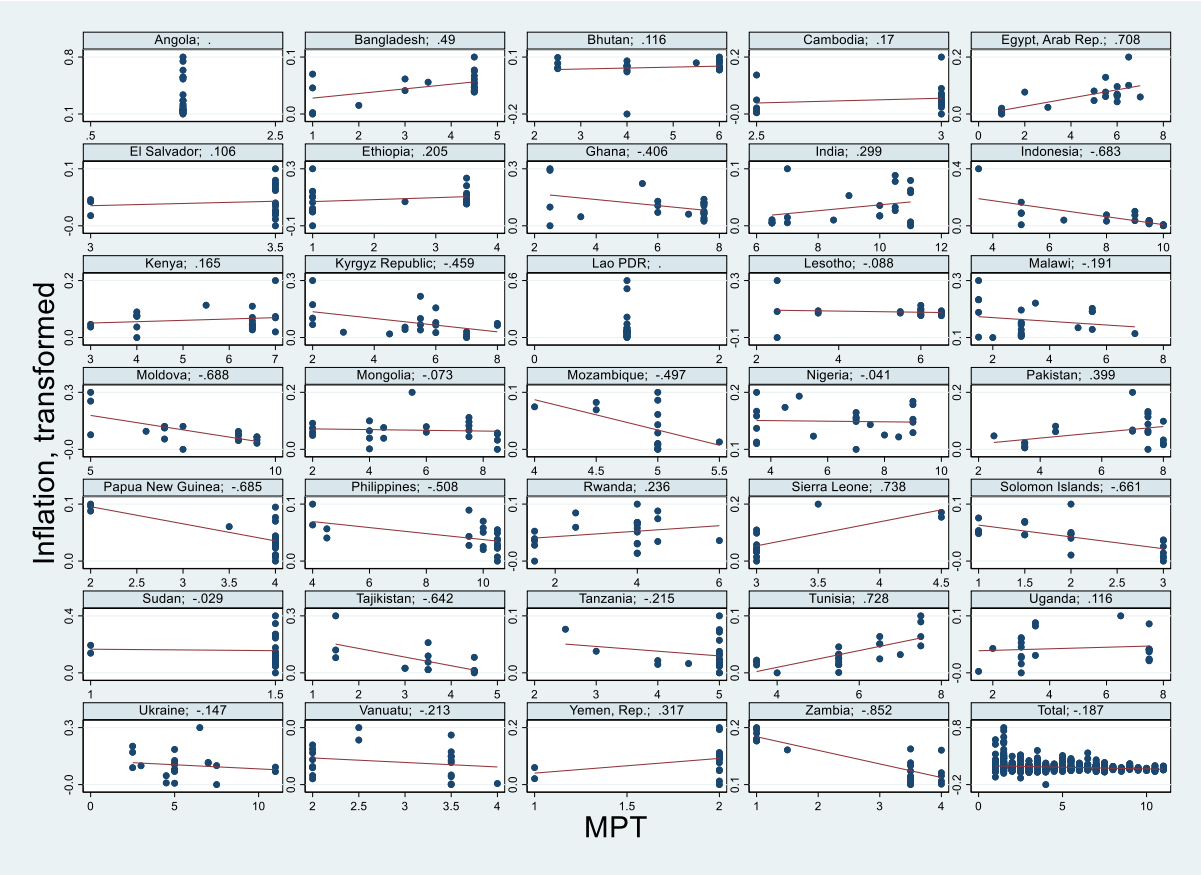


Note: Inflation is a transformed inflation rate, which is measured by the CPI annual change (%) from the World Bank's World Development Indicators. MPT stands for the composite Transparency index of Dincer et al. (2022). MPI is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index. IT stands for countries that utilize Inflation Targeting, otherwise Non-IT, based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime.

Further, the study runs simple correlation analysis by plotting scatterplot diagrams of the inflation against MPT and MPI dummy. Figure 3.4 comprises graphs of the inflation–MPT correlation for each sampled country. Although literature indicates a mostly negative (strongly negative) relationship (Dincer & Eichengreen, 2014), the figure shows that the correlation for all samples is indeed negative but weakly (-.187). Yet, there is a variation between countries.

Out of 32 countries with MPT data, 14 countries have a positive, and for some, like Sierra Leone (.738) and Tunisia (.728), even a strongly positive, correlation, which goes against general expectations from the literature. The remaining 18 countries have a canonical negative relationship, led by Zambia's (-.852) figures. To sum up, at this stage, there is no conclusive answer to whether inflation is lower in countries with more transparent monetary policy.

Figure 3.4: Inflation vs. Monetary Policy Transparency (MPT)

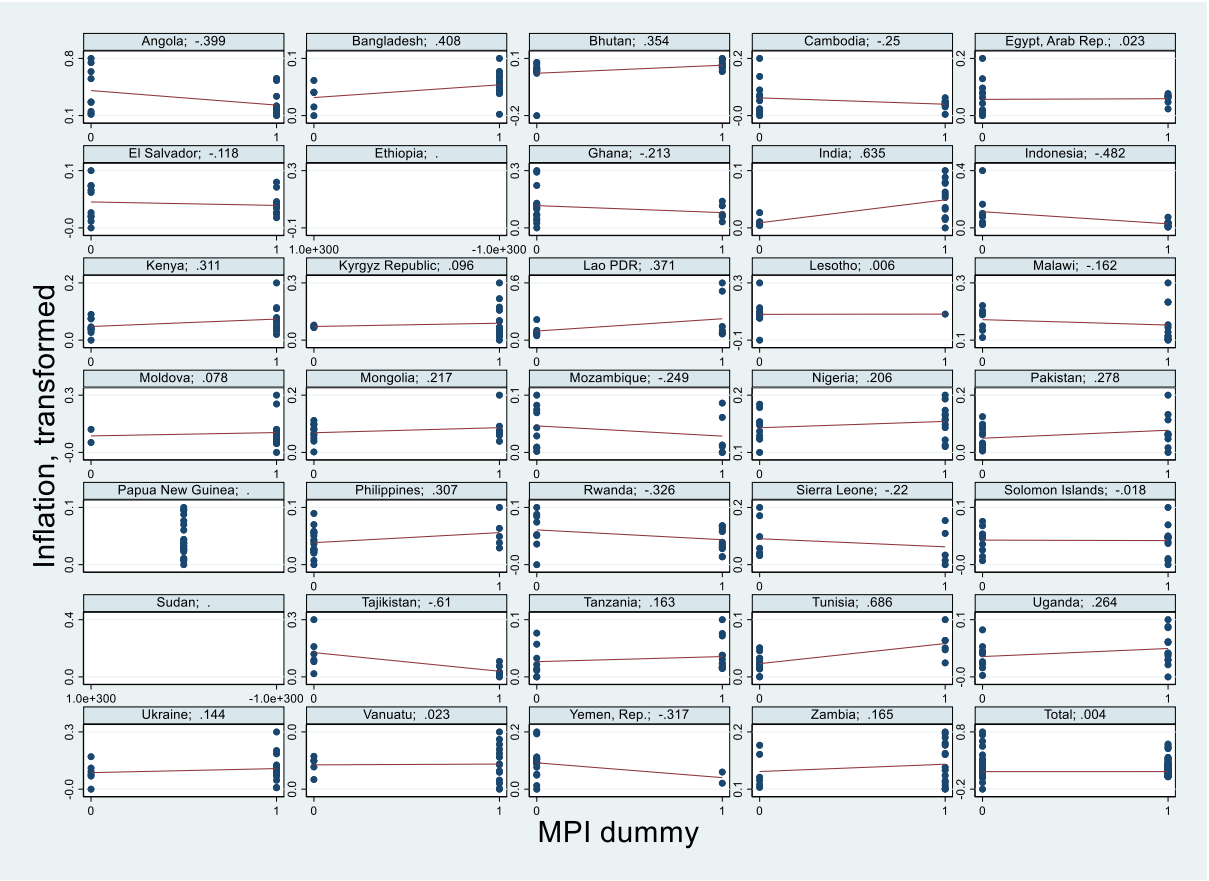


Note: Inflation is a transformed inflation rate, which is measured by the CPI annual change (%) from the World Bank's World Development Indicators. MPT stands for the composite Transparency index of Dincer et al. (2022). A particular correlation coefficient is in a graph's title. Source: results from own analysis.

Figure 3.5 shows the correlation between inflation (transformed) and the MPI dummy for the sample of developing nations. For the total sample, the relationship is ambiguous (.004). Next, out of 32 countries, 22 have a positive correlation ranging from almost zero (Egypt, .023) to a strong one (Tunisia, .686). Meanwhile, 10 countries have a negative correlation ranging from almost ambiguous (Solomon Islands, -.018) to moderate (Indonesia, -.482). As above,

there is no ultimate answer to whether inflation is lower in countries with more independent monetary policy.

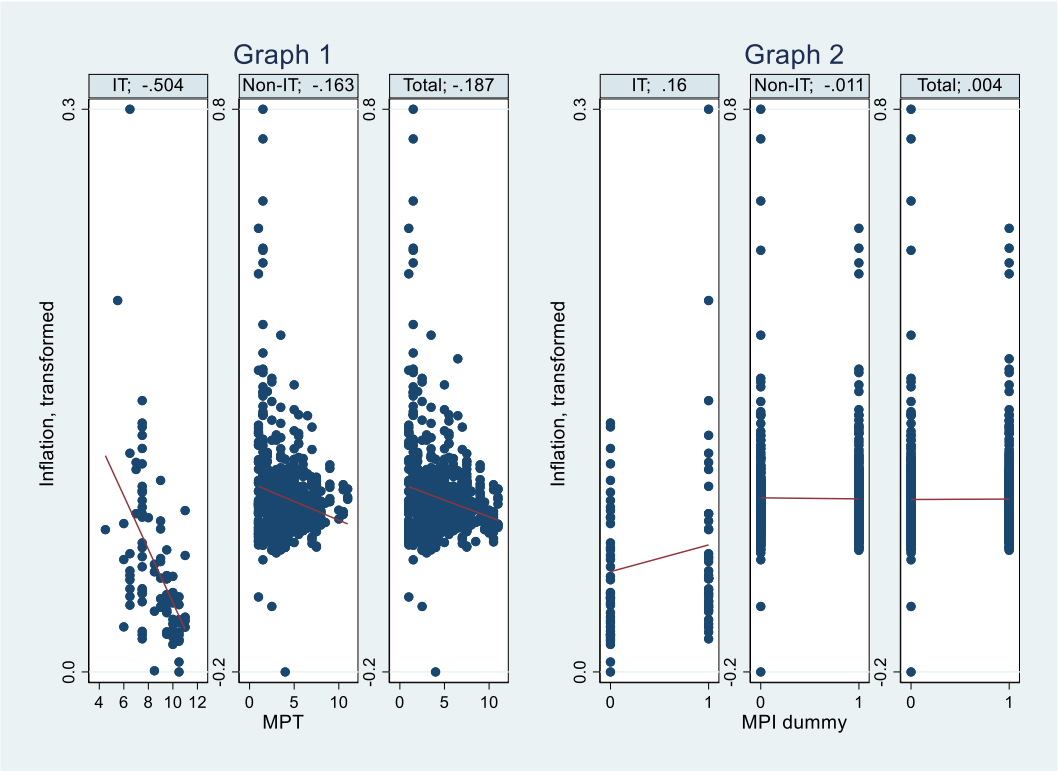
Figure 3.5: Inflation vs. Monetary Policy Independence (MPI dummy)



Note: Inflation is a transformed inflation rate, which is measured by the CPI annual change (%) from the World Bank's World Development Indicators. MPI is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index. A particular correlation coefficient is in a graph's title. Source: results from own analysis.

Nevertheless, taking into account that MPT and MPI are two important cornerstones of the inflation targeting regime of monetary policy, the following Figure 3.6 illustrates the relationship between MPT and inflation (Graph 1) and MPI and inflation (Graph 2) for IT and Non-IT countries. Graph 1 shows a moderate inverse correlation for IT countries (-.504), which is in line with the literature (Westelius, 2009). It means that countries with an IT regime in place tend to have lower inflation when their MPT increases. Meanwhile, Graph 2 shows that the correlation between MPI and the dummy is ambiguous (.004). Independence, even in the case of an IT regime, does not necessarily mean lower inflation.

Figure 3.6: Inflation vs. Monetary Policy Transparency and Independence by IT and Non-IT regimes (MPT, MPI dummy)

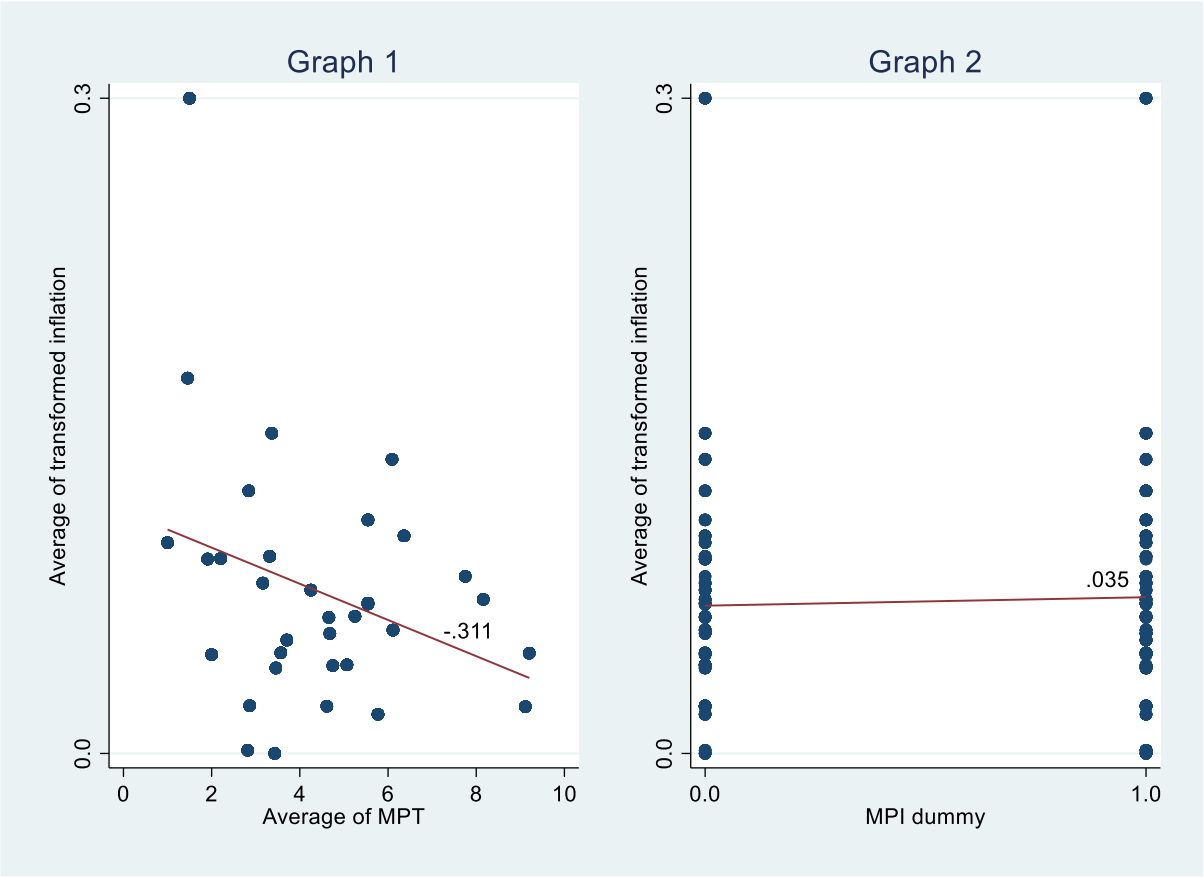


Note: Inflation is a transformed inflation rate, which is measured by the CPI annual change (%) from the World Bank's World Development Indicators. MPT stands for the composite Transparency index of Dincer et al. (2022). MPI is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index. IT stands for countries that utilize Inflation Targeting, otherwise Non-IT, based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime. A particular correlation coefficient is in a graph's title. Source: results from own analysis.

Lastly, the following correlation analysis in Figure 3.7 shows the relationships between a country's average inflation (transformed) and average MPT (Graph 1) and MPI (Graph 2), respectively. The outputs confirm the previous analysis's findings. There is a clear negative correlation between average inflation and average MPT (Graph 1). While the correlation between average inflation and MPI is close to zero (Graph 2).

As such, taking into account the uncertainty of both MPT and MPI's relationship with inflation, the study further moves to an empirical examination of their effects on inflation.

Figure 3.7: Average Inflation vs. Average Monetary Policy Transparency and Independence (average MPT, MPI dummy)



Note: Average of transformed inflation is a mean of a transformed inflation rate of each sampled country, which is measured by the CPI annual change (%) from the World Bank's World Development Indicators. MPI is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index. Particular correlation coefficients are above graph's fitted lines. Source: results from own analysis.

3.5 METHODOLOGY

Given the nature of the dependent variable, transformed *inflation*, to test the hypothesis, the model specifications for multivariate panel data for time *t*, country *i*, and monetary policy stance *k* are as follows: [62]

[62] The variables have been checked for unit roots. Further, Kao's (1999) cointegration test is applied to test whether non-stationary variables altogether are stationary in the long run. Tables A 3.1 and A 3.4 in the Appendix give the results of the Fisher Augmented Dickey-Fuller (ADF) test and the cointegration test, respectively.

$$Inflation_{it} = \beta_0 + \beta_1 Transparency_{it-1} + \beta_2 Independence_{it-1} + \beta_3 Stance_{kit-1} + \beta_4 Transparency_{it-1} * Independence_{it-1} * Stance_{i-1} + \beta_5 Transparency_{it-1} * Independence_{it-1} + \beta_6 Transparency_{it-1} * Stance_{i-1} + \beta_7 Controls_{it} + \varphi_i + Y_t + \varepsilon_{it}, \quad (3.4)$$

where $Inflation_{it}$ is a transformation of the inflation rate, which is based on consumer price level (CPI) annual changes in country *i*, and at year *t*. $Transparency_{it-1}$ is the composite index of MPT, lagged for a one-year period to avoid possible reverse causality (Weber, 2018). $Independence_{it-1}$ stands for lagged MPI dummy, where 1 means independent, otherwise 0. $Stance_{kit-1}$ is measured through two dummies (*k*) lagged for a one-year period each: $Tightening_{it-1}$, where 1 meaning tightening of monetary policy and otherwise 0 (i.e., tightening as opposed to easing or no changes); and $Easing_{it-1}$ with 1 means easing of monetary policy and otherwise 0 (i.e., easing as opposed to tightening or no changes). It is assumed that the monetary stance dummies reflect the information on monetary policy and price levels at a particular time. The interaction terms: (i) $Transparency_{it-1}$ and $Independence_{it-1}$, (ii) $Transparency_{it-1}$ and $Stance_{it-1}$, and (iii) $Transparency_{it-1}$, $Independence_{it-1}$, and $Stance_{it-1}$ are the main focuses of the study. By applying such interactions, the research aims to analyze the influence of the MPT depending on the monetary policy stance and MPI among developing countries. The key independent variables are lagged to account for possible reverse causality. Furthermore, a *Transparency* squared was added as an explanatory variable to account for the inflation's possible transparency nonlinearity.

$Controls_{it}$ stands for a set of various variables to account for economic, institutional, and other differences between countries as well as factors that may influence inflation, including institutional development, financial development, and so on. Due to the fact that changes in some explanatory factors may not instantly convert into increased prices, lags are added for such variables. The accuracy of the lag selection is tested using Akaike's and

Schwarz's Bayesian information criterion. Moreover, the control of the monetary policy regime of inflation targeting – *IT dummy*, 1 for countries that launched IT starting from the year of official implementation – applied based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime.[63] Furthermore, different financial crises (banking, currency, and debt) have been accounted for by adding a particular dummy, with 1 meaning a particular crisis and otherwise 0.

Lastly, country-level fixed effects are marked as φ_i to account for time-invariant countries' specifics, Y_j stands for year dummies to account for time fixed effects, while ε_{it} stands for residuals.

The research utilizes quantile regression with fixed effects and bootstrap standard errors following the Machado and Santos Silva (2019) method. Firstly introduced by Koenker and Bassett Jr (1978), the quantile regression technique allows one to account for the specificity of the studied response variable by examining the impact of explanatory variables on different quantiles of the dependent variable. Quantile regression estimates the response variable's conditional median, whereas OLS derives its conditional mean across multiple values of the characteristics. More specifically, quantile regression has two advantages over OLS regression: (i) it does not make any assumptions about the dependent variable's distribution, and (ii) it is resistant to outliers. As such, the dependent variable, $Inflation_{it}$ of Eq. (3.4) depends on the quartile value, while the beta coefficients are now functions that rely on the quantile (i.e., change depending on it) rather than being constants. In the study, the median regression (i.e., a middle quantile / a middle value of the sample; 50th percentile regression) was performed. It is often a better choice than a linear regression because it is "robust to outliers" (Yu et al., 2003). Following Weber (2018), it is assumed that the inflation culture within countries is

[63] It will help to account for the effect of the IT regime in some sampled countries, as generally such countries are the main advocates of monetary policy independence and transparency (Westelius, 2009).

unchanged over the studied period, though it may differ across countries. As such, a fixed effects application allows for control over this as well as other time-invariant factors that may affect inflation. At the same time, time-invariant characteristics and other variables "are allowed to have different impacts on different regions of the conditional distribution of Y" (Machado & Santos Silva, 2019, p. 148).

Table 35: Summary statistics for regression analysis

Variable	N	Mean	Std. Dev.	Min	Max
Dependent variables					
Inflation	719	0.08	0.08	-0.22	0.76
Independent variables					
$Inflation_{t-1}$	717	0.09	0.08	-0.22	0.76
$Transparency_{t-1}$	714	4.37	2.51	1	11
$Transparency^2_{t-1}$	714	25.43	27.33	1	121
Independence $_{t-1}$ dummy	636	0.55	0.50	0.00	1.00
Monetary policy stance dummies:					
tightening $_{t-1}$	549	0.34	0.47	0.00	1.00
easing $_{t-1}$	549	0.48	0.50	0.00	1.00
Controls					
Inflation Targeting regime dummy	748	0.13	0.33	0	1.00
GDP growth (annual %)	747	4.91	4.19	-27.99	26.42
Cereal, log	700	14.46	2.73	6.55	19.58
Food, log	714	4.38	0.28	3.27	5.03
Real Rate (%)	601	7.26	10.30	-72.58	50.98
Money growth (annual %)	717	20.49	27.42	-10.14	528.19
FX rate (LCU per US$, period average)	748	4.08	2.61	-1.46	9.56
Econ Open (%)	668	72.28	34.15	1.22	175.35
GDP per capita, log	747	7.20	0.70	5.52	8.39
Financial development index	748	0.17	0.09	0.04	0.50
Control of corruption estimates	680	-0.65	0.53	-1.68	1.64
Government effectiveness estimates	680	-0.58	0.45	-2.28	0.83
Regulatory quality estimates	680	-0.57	0.42	-2.63	0.47
Voice and accountability estimates	680	-0.49	0.64	-1.85	0.81
Banking crises dummy	748	0.04	0.20	0.00	1.00
Currency crises dummy	748	0.07	0.26	0.00	1.00
Debt crises dummy	738	0.42	0.49	0.00	1.00
For reference purposes					
Independence index	659	0.48	0.17	0.02	0.92
Central bank policy rates	585	13.54	15.39	0.83	150

Note: Inflation is calculated based on the transformation of the CPI annual change (%). Data is sourced from the World Bank's World Development Indicators, IHS Markit, IFS of the International Monetary Fund, central banks' webpages, Dincer et al. (2019, 2022); Aizenman et al. (2010, 2013, 2015); and Nguyen et al. (2022).

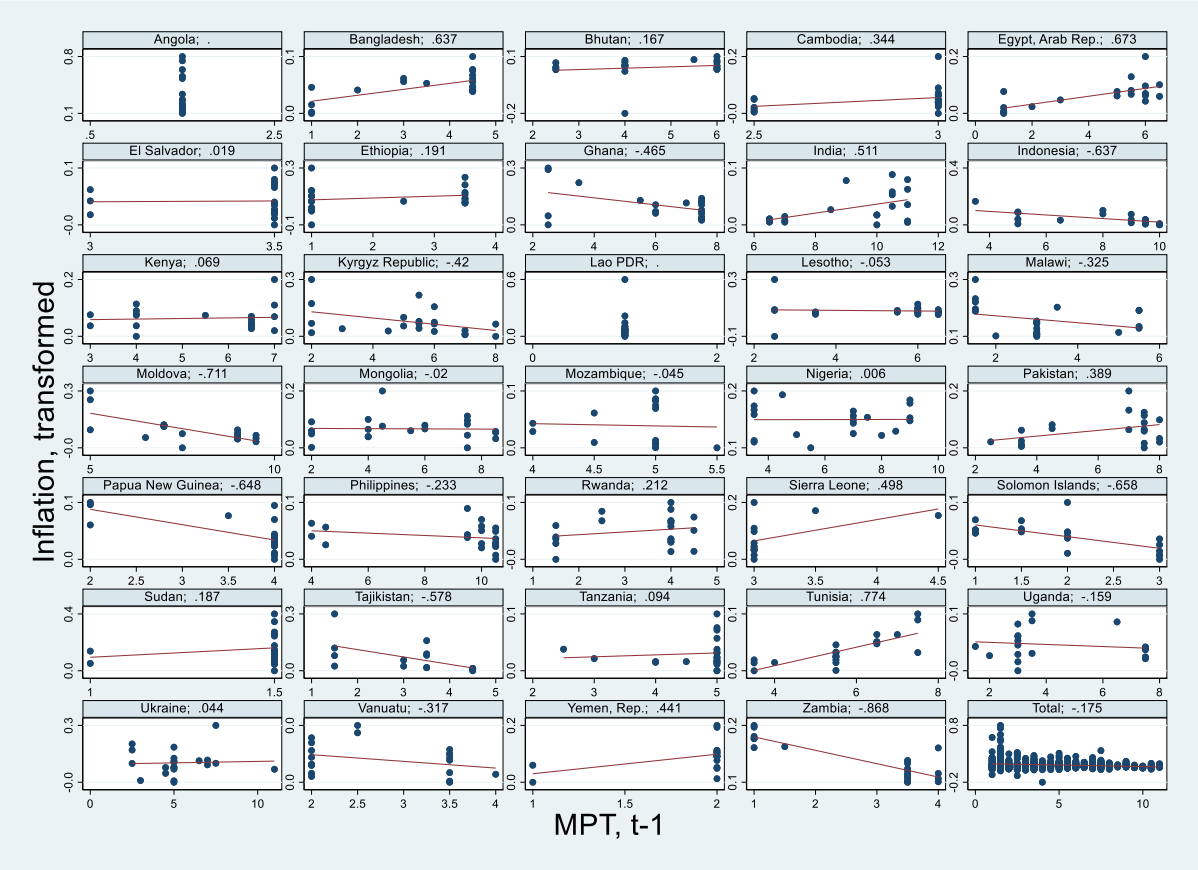
3.6 EMPIRICAL EVIDENCE AND RESULTS

First, following the initial descriptive analysis, the relationships between the dependent variable, transformed *inflation*, and lagged key independent variables, namely *MPT*, *MPI dummy,* and *monetary policy stance dummies*, have been studied. As above, it is investigated

using basic correlation analysis, which involved graphing inflation scatterplot diagrams against each of the latter variables.

Contrary to de Mendonça and de Siqueira Galveas (2013), who revealed a strong negative relationship between inflation and transparency for emerging economies, Figure 3.8 shows that such a strong or even inverse relationship is not necessarily true, especially in the case of the sampled developing countries.

Figure 3.8: Inflation vs. Monetary Policy Transparency (MPT lagged)

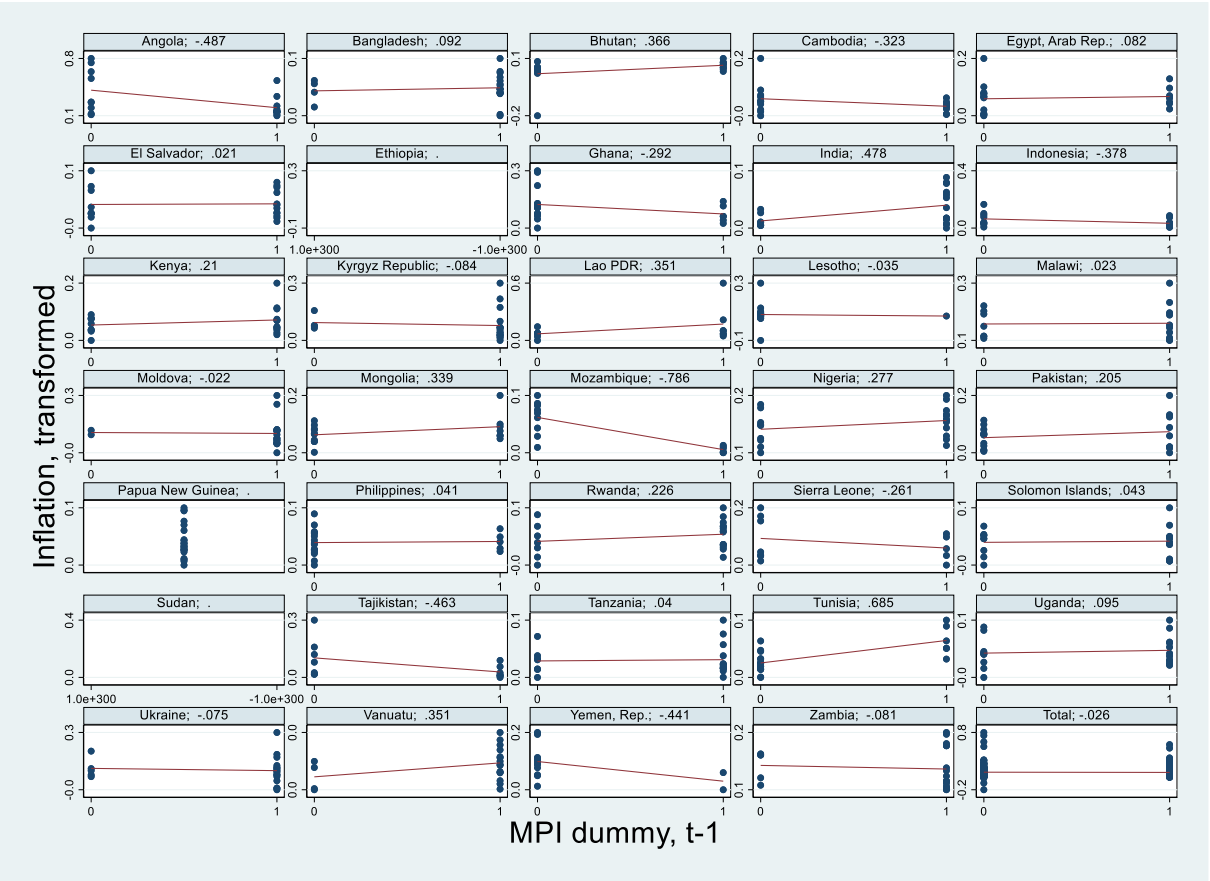


Note: Inflation is a transformed inflation rate, which is measured by the CPI annual change (%) from the World Bank's World Development Indicators. MPT stands for the composite Transparency index of Dincer et al. (2022) lagged for 1 period. A particular correlation coefficient is in a graph's title. Source: results from own analysis.

Although some countries, like Moldova and Zambia, may indeed have some strong inverse relationships (i.e., below -.70) between MPT and inflation (when there is a higher *MPT* in the previous period, then there is lower *inflation* in the following period). About half of the sampled countries had a positive relationship between *inflation* and *MPT* for the preceding

period. Nevertheless, the last graph in Figure 3.6 demonstrates that the correlation is weakly inverse (-.175) for the whole sample. These go in line with the Figure 3.4 findings.

Figure 3.9: Inflation vs. Monetary Policy Independence (MPI dummy, lagged)

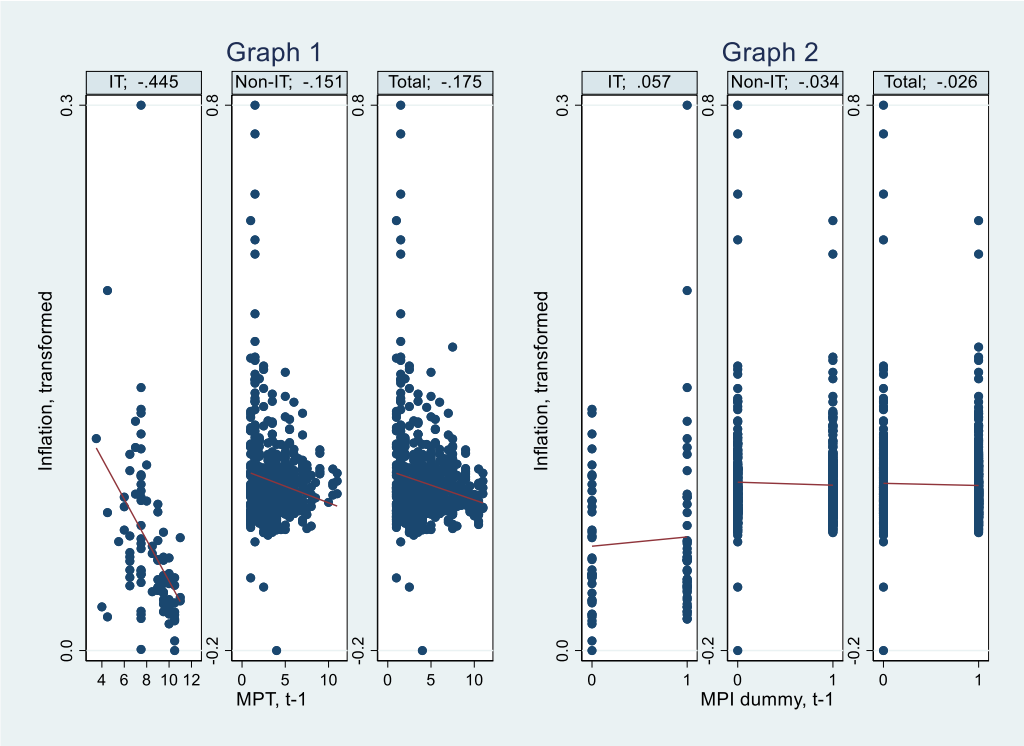


Note: Inflation is a transformed inflation rate, which is measured by the CPI annual change (%) from the World Bank's World Development Indicators. MPI is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index lagged for 1 period. A particular correlation coefficient is in a graph's title. Source: results from own analysis.

Next, Figure 3.9 contains the analysis of scatterplot diagrams of the relationship between inflation and the *MPI dummy* in the sampled countries. According to the literature, the MPI has a diminishing impact on inflation. Hence, a negative correlation was expected. Yet, the last graph of the figure shows that for the total sample, the relationship is weakly negative (-.025, which is even closer to being ambiguous), like in Figure 3.5, as some countries have positive while others have negative relationships. It means that the independent monetary policy of the previous period is not necessarily followed by lower inflation in the next period. To exclude the chance that this may be connected to the way the MPI dummy has been constructed, Figure A 3.1 in the Appendix contains the per-country illustrations for transformed

inflation and the original MPI of Aizenman et al. (2008, 2010, 2013). It shows that the relationship is indeed ambiguous for the sample of developing countries.

Figure 3.10: Inflation vs. Monetary Policy Transparency and Independence by IT and Non-IT regimes (MPT lagged, MPI dummy lagged)



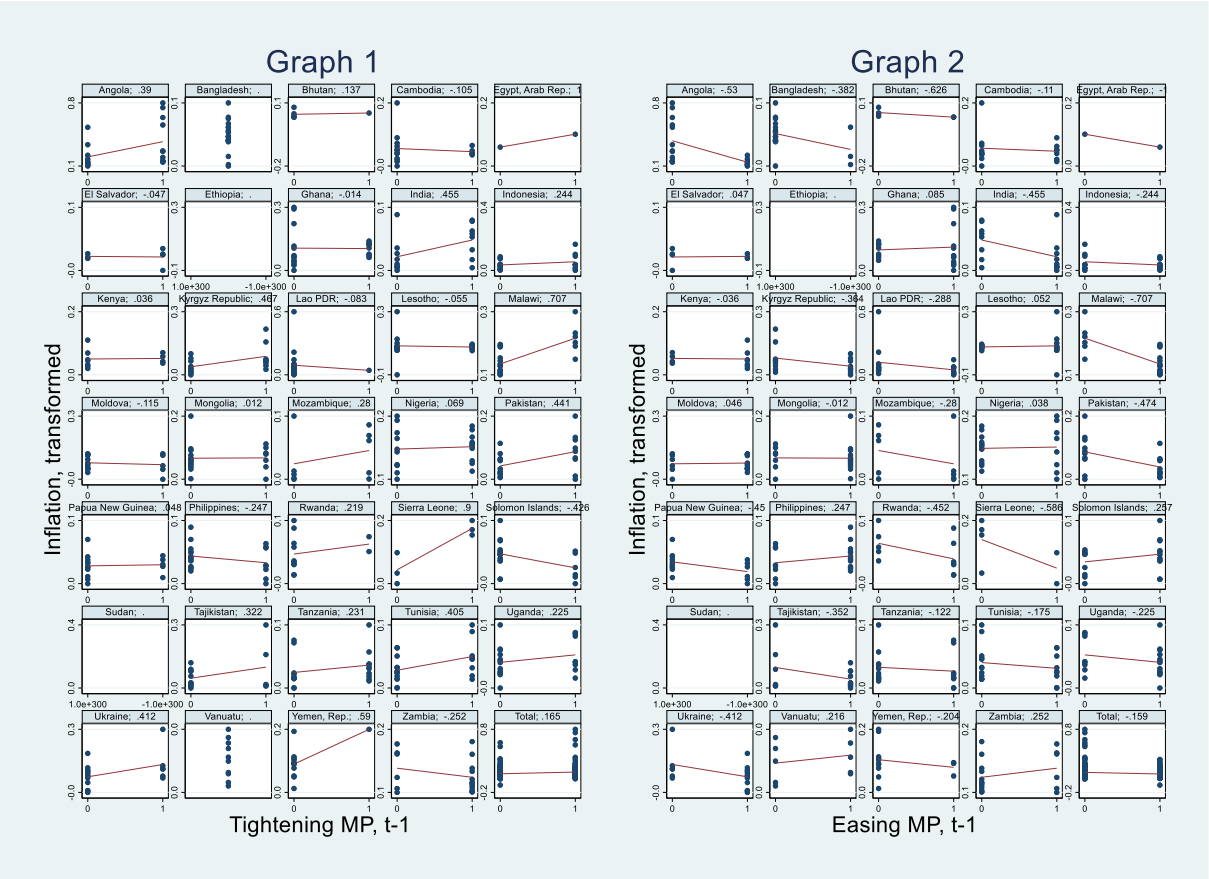
Note: Inflation is a transformed inflation rate, which is measured by the CPI annual change (%) from the World Bank's World Development Indicators. MPT stands for the composite Transparency index of Dincer et al. (2022) lagged for 1 period. MPI is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index lagged for 1 period. IT stands for countries that utilize Inflation Targeting, otherwise Non-IT, based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime. A particular correlation coefficient is in a graph's title. Source: results from own analysis.

As in Figure 3.6, Figure 3.10 shows the inflation-MPT (Graph 1) and inflation-MPI (Graph 2) relationship for IT and Non-IT countries. Graph 1 demonstrates a moderate inverse correlation (-.445) for IT nations, which matches Figure 3.6 and the literature. Meanwhile, Graph 2 demonstrates that the relationship between the MPI dummy and inflation in the subsequent period is equivocal (.057).

Lastly, Figures 3.11–3.12 include the scatterplot diagrams for the relationship between *inflation* and *monetary policy stance*. The conventional view is that when a central bank increases its policy rate, i.e., sets contractionary monetary policy/tightening (or decreases, i.e.,

expansionary monetary policy/easing) the inflation should decrease (increase).[64] The important element for this to happen is a workable transmission mechanism of monetary policy. Yet, developing countries, for a number of reasons, including underdeveloped institutions and financial markets and uncompetitive banking systems, may have weak transmission.

Figure 3.11: Inflation vs. Monetary Policy Stance (dummies, lagged)



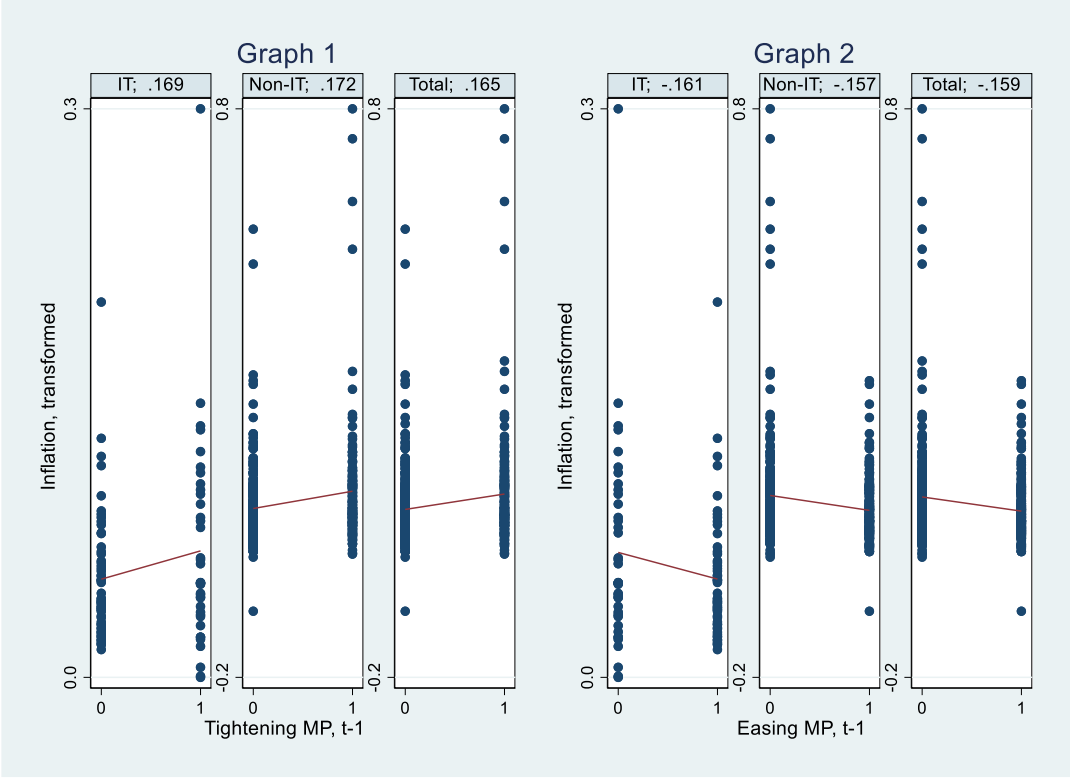
Note: Inflation is a transformed inflation rate, which is measured by the CPI annual change (%) from the World Bank's World Development Indicators. Tightening is a dummy for monetary policy tightening (1 means rate increase, 0 otherwise), and easing is a dummy for monetary policy easing (1 means rate decrease, 0 otherwise) both lagged for 1 period based on the annual data on central bank policy rates (average of the period) from IHS Markit. A particular correlation coefficient is in a graph's title. Source: results from own analysis.

As Fischer (2015) stated, "…*even though some central banks use policy rates, changes to these policy rates have only limited effect on other interest rates and on the economy more generally*" (Fischer, 2015, p. 12). As a matter of anecdotal evidence, central banks of developing countries tend to decide to change their policy stance too late or miscalculate the

[64] Please see, for example, The Economics of Money, Banking and Financial Markets Global Edition of Mishkin (2019) for more details.

needed size of the intervention, for example, when inflation has already started speeding up and the central bank's policy rate increase only slows the inflation growth but not reverse that.

Figure 3.12: Inflation vs. Monetary Policy Stance (dummies, lagged) by IT and Non-IT regimes



Note: Inflation is a transformed inflation rate, which is measured by the CPI annual change (%) from the World Bank's World Development Indicators. Tightening is a dummy for monetary policy tightening (1 means rate increase, 0 otherwise), and easing is a dummy for monetary policy easing (1 means rate decrease, 0 otherwise) both lagged for 1 period based on the annual data on central bank policy rates (average of the period) from IHS Markit. IT stands for countries that utilize Inflation Targeting, otherwise Non-IT, based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime. A particular correlation coefficient is in a graph's title. Source: results from own analysis.

Mishra and Montiel (2013) discovered that developing nations' monetary policy transmission appears to be weak. Although some studies argue that some channels of transmission may work well in developing countries too (Abuka et al., 2019). Yet, in line with Mishra et al. (2016) for the case of India, Figure 3.5 shows that a monetary policy shock may have no effect on the following period's inflation in the sampled developing countries, or such an effect may be ambiguous. Furthermore, it confirms Huh and Lee (2021), who found that in Bangladesh "*…increasing the reserve money and lowering the repo rate does not increase M2 or inflation …. Such results are not consistent with the monetary easing effects in monetary theory*" (Huh & Lee, 2021, p. 16). Figure 3.6 elaborates more on this, showing that even for IT

countries the relationship between policy rate increase/decrease and following period's inflation is weak and its direction is not consistent with the monetary theory.

Next, the empirical examination of Eq. (3.4) has been started by testing it through various specifications, taking into consideration the *tightening* of the monetary policy stance (i.e., an increase in the policy rate as opposed to its decrease and no changes in it) and the application of the IT regime in some countries. Table 3.2 contains the results of quintile regression panel fixed effects estimation, which, overall, confirm the study's hypotheses.

The negative impact of *Transparency* (MPT) on the following period's *inflation* is revealed across almost all specifications, which confirms Hypothesis 1, though statistically not significant. This is as expected from the Figure 3.7 findings and goes in line with the empirical literature in the field. At the same time, the *quadratic term of MPT* has mostly a positive sign, which is in line with Weber (2018). Next, the coefficients of interaction between *MPT* and *Tightening* show the diminishing impact on inflation in the following period at a 10% significance level mostly. As such, if a country's monetary policy is in tight mode, a 1-unit increase in *MPT* will decrease the following period's inflation by about 0.6 pp. This is in line with Hypothesis 2. Furthermore, the results of *MPT* and *Independence* (MPI) interaction term advocate for the contracting effect of increased transparency on inflation for the countries with an independent monetary policy, which confirms Hypothesis 3. Hence, an increase in *MPT* will curb inflation by about 0.4 pp for countries with independent monetary policy, at a 10% significance level. To check the effect of transparency on following period inflation, provided that monetary policy is independent and in a tightening stance, Hypothesis 4, the coefficients of the interaction term between *MPT*, the *MPI dummy* and the *monetary policy tightening dummy* have been estimated. Contrary to the author's expectations, all estimates are positive. The coefficients imply that, with a 5–10% level of significance, a 1-unit increase in the *MPT* index is associated with an inflation increase of about 0.9 pp in the following period for

countries with independent monetary policy in a tightening stance. At the same time, the total impact of *MPT* on *inflation*, after controlling for a large number of factors, ranges from -0.7 pp to 0.05 pp based on specifications (3)-(5) estimates.[65]

Importantly, statistically significant estimates for *MPI* and *Tightening dummies* have a positive sign after controlling for all other factors. It means that monetary policy transmission may work against theoretical expectations in non-IT, non-MPI countries, which confirms Huh and Lee's (2021) findings. Yet, the overall effect of both *MPI* and *Tightening* on *inflation* in the following period for the sampled developing countries is negative across specifications (3)-(5), which goes in line with the previous empirical findings in the field.[66]

Table 36: Quantile Panel FE model. Regressions output for tight monetary policy

	(1)	(2)	(3)	(4)	(5)
$Transparency_{t-1}$	0.025	-0.002	-0.001	-0.008	-0.007
	(0.029)	(0.012)	(0.013)	(0.014)	(0.012)
$Transparency^2_{t-1}$	-0.001	0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Tightening_{t-1}$	0.020***	0.010**	0.047*	0.056***	0.059**
	(0.006)	(0.004)	(0.025)	(0.020)	(0.024)
$Independence_{t-1}$	-0.006	0.009*	0.037**	0.033**	0.034***
	(0.009)	(0.005)	(0.015)	(0.013)	(0.011)
Inflation Targeting	0.002	-0.002	0.004	0.017	0.014
	(0.015)	(0.013)	(0.014)	(0.012)	(0.013)
$Transparency_{t-1}$*$Tightening_{t-1}$			-0.005	-0.006*	-0.006*
			(0.004)	(0.003)	(0.003)
$Transparency_{t-1}$*$Independence_{t-1}$			-0.004*	-0.004*	-0.004**
			(0.002)	(0.002)	(0.002)
$Tightening_{t-1}$*$Independence_{t-1}$			-0.070*	-0.074***	-0.077**
			(0.039)	(0.027)	(0.034)
$Transparency_{t-1}$*$Tightening_{t-1}$*			0.009*	0.009**	0.009**
*$Independence_{t-1}$			(0.006)	(0.004)	(0.004)
Controls	No	13	13	19	22
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Bootstrap SE	Yes	Yes	Yes	Yes	Yes
Countries	32	27	27	27	27
Observations	505	362	362	342	342

Notes: The dependent variable, Inflation, transformed inflation rate, measured by the CPI annual change (%) from the World Bank's World Development Indicators (WDI); Transparency stands for the composite index of MPT of Dincer et al. (2014, 2022); Tightening is a dummy for monetary policy tightening (1 means tight monetary policy stance, 0 otherwise) based on the annual data on central bank policy rate (average of the period) from IHS

[65] The derivative with respect to MPT was taken to get -0.006 from (-0.007+2*0.001*1-0.006*1-0.004*1+0.009*1) for Specification (5) and then transformed back to the initial inflation scale.

[66] The derivative with respect to MPI was taken to get -0.028 from (0.037-0.004*min(MPT)-0.07*1+0.009*1* min(MPT)) for Specification (3) with minimum MPT value of 1 applied, and then transformed back to the initial inflation scale. Similar procedure with respect to monetary policy tightening gives – 0.015 for Specification (5).

Markit; Independence is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index, where the cut-off of MPI index mean value (i.e., 0.5494875) applied. Inflation Targeting stands for an IT dummy (1 means a country with an IT regime) based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime. Controls include, for specifications (2)-(3) current and 1-period lagged: GDP growth (annual %), log of cereal production (metric tons), log of food production index; real interest rate (%), a broad money growth (annual %); an official exchange rate (LCU per US$, period average); economic openness based on exports of goods and services (% of GDP) and import of goods and services (% of GDP) from WDI; for specification (4): all previous plus, financial development index, log of GDP per capita, control of corruption estimates, government effectiveness estimates, regulatory quality estimates, voice and accountability estimates; for Specification (5): all previous plus banking crises, currency crises and debt crises from Nguyen et al. (2022). Each model uses panel estimations, controls for year-fixed effects, accounts for fixed effects for each country. Bootstrap standard errors by nations, clustered, with parenthesis. Significance levels of 10%, 5%, and 1% are indicated, respectively, by the symbols *, **, and ***.

Then, Eq. (3.4) has been tested by the same specification as above while considering the *easing* of the monetary policy stance (i.e., a decrease in the policy rate as opposed to its increase and no changes in it) and an application of the IT regime in some countries. The quintile regression panel fixed-effects estimates are presented in Table 3.3. The *MPT* estimates, though statistically not significant, show the negative effect of transparency on the following period's *inflation* across almost all specifications, even after controlling for a large number of factors. This is consistent with the findings in Figure 3.7, the estimates in Table 3.2, and Hypothesis 1. All other coefficients of main interest (i.e., estimations of interaction terms) are statistically not significant, though with mostly expected signs as in the correlation analysis above and in the literature. The overall effect of transparency on inflation is negative across almost all specifications, though not statistically significant.

Table 37: Quantile Panel FE model. Regressions output for ease monetary policy

	(1)	(2)	(3)	(4)	(5)
$Transparency_{t-1}$	0.023	-0.003	-0.004	-0.008	-0.008
	(0.027)	(0.012)	(0.013)	(0.013)	(0.015)
$Transparency^2_{t-1}$	-0.001	0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Easing_{t-1}$	-0.024***	-0.013***	-0.027	-0.026	-0.027*
	(0.006)	(0.004)	(0.021)	(0.020)	(0.014)
$Independence_{t-1}$	-0.007	0.008*	0.002	-0.002	-0.002
	(0.009)	(0.004)	(0.015)	(0.016)	(0.014)
Inflation Targeting	0.002	-0.001	0.001	0.013	0.009
	(0.015)	(0.014)	(0.014)	(0.013)	(0.015)
$Transparency_{t-1}$*$Easing_{t-1}$			0.002	0.001	0.002
			(0.003)	(0.003)	(0.002)
$Transparency_{t-1}$*$Independence_{t-1}$			0.000	0.000	-0.000
			(0.002)	(0.002)	(0.002)
$Easing_{t-1}$*$Independence_{t-1}$			0.025	0.018	0.019
			(0.024)	(0.018)	(0.017)

$Transparency_{t-1}$*$Easing_{t-1}$*			-0.004	-0.002	-0.002
*$Independence_{t-1}$			(0.003)	(0.002)	(0.002)
Controls	No	13	13	19	22
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Bootstrap SE	Yes	Yes	Yes	Yes	Yes
Countries	32	27	27	27	27
Observations	505	362	362	342	342

Notes: The dependent variable, Inflation, transformed inflation rate, measured by the CPI annual change (%) from the World Bank's World Development Indicators (WDI); Transparency stands for the composite index of MPT of Dincer et al. (2014, 2022); Easing is a dummy for monetary policy easing (1 means ease monetary policy stance, 0 otherwise) based on the annual data on central bank policy rate (average of the period) from IHS Markit; Independence is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index, where the cut-off of MPI index mean value (i.e., 0.5494875) applied. Inflation Targeting stands for an IT dummy (1 means a country with an IT regime) based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime. Controls include, for specifications (2)-(3) current and 1-period lagged: GDP growth (annual %), log of cereal production (metric tons), log of food production index; real interest rate (%), a broad money growth (annual %); an official exchange rate (LCU per US$, period average); economic openness based on exports of goods and services (% of GDP) and import of goods and services (% of GDP) from WDI; for specification (4): all previous plus, financial development index, log of GDP per capita, control of corruption estimates, government effectiveness estimates, regulatory quality estimates, voice and accountability estimates; for specification (5): all previous plus banking crises, currency crises and debt crises from Nguyen et al. (2022). Each model uses panel estimations, controls for year-fixed effects, accounts for fixed effects for each country. Bootstrap standard errors by nations, clustered, with parenthesis. Significance levels of 10%, 5%, and 1% are indicated, respectively, by the symbols *, **, and ***.

The study first utilizes a panel fixed effects estimator multivariate regression approach for the robustness check of the finding. Although there are outliers in the data that may influence both the coefficients' magnitude and standard deviation, the estimation results in Tables A 3.6 and A 3.7 in the Appendix are generally in line with the output in Tables 3.2 and 3.3. Second, the cut-off to identify a country with an independent monetary policy has been changed to check the sensitivity of the results to the MPI dummy. Two options are considered: higher and lower cut-offs for identifying the MPI dummy. As such, now MPI dummy equals 1 for countries with an MPI index higher than the average of the cut-offs at .75 and .50 percentiles, 0.598975; and higher than the average of the cut-offs at .50 and .25 percentiles, 0.4349765.[67] The Appendix Tables A 3.8 – A 3.11 show that the results for the main coefficients of interest remain qualitatively the same, though some become statistically less or more significant. It means that the estimates are not generally sensitive to the change in cut-offs for MPI dummy settings.

[67] The percentile cut-offs for MPI .25, .50, and .75 are 0.369953, 0.500000, and 0.598975, respectively.

As with almost any study on developing countries' issues, this paper's findings are limited to the available data. Variables not included in Eq. (3.4) may be the ones that matter the most for inflation performance in developing nations. The lack of persistence of some estimates might be due to monetary transmission instability in developing countries or empirical methodology constraints. Future studies should look at these issues.

3.7 CONCLUSION AND POLICY IMPLICATIONS

The main goal of this study was to examine the effect of monetary policy transparency (MPT) on inflation in developing countries, given their monetary policy independence (MPI) and stance. Previous literature on this matter is scarce. For the sake of the analysis, the research employed a panel data set on MPT, MPI, and MP stance together with a large number of controls for 34 developing nations from 1998 to 2019.

First, the graphical examination of correlations has revealed that the relationship between MPT and the following period's inflation is weakly negative for the sampled countries, while the correlations of either MPI or MP stance with inflation are ambiguous. It confirms a set of findings on the weak institutional capacity and unstable monetary policy transmission in developing countries. At the same time, the correlation between MPT and inflation is moderately negative for Inflation Targeting (IT) countries.

Second, the quantile regression fixed effects estimations elaborate on these findings. The study revealed that MPT has a diminishing effect on the following period's inflation for countries with tight monetary policy. Furthermore, it is found that increased transparency has a contracting effect on inflation in nations with independent monetary policy while controlling for a tight monetary policy stance, among other factors. Surprisingly, the increase in MPT in the developing countries with independent monetary policies in tight mode may be associated with the increase in the following period's inflation. The overall effect of transparency on

inflation is mainly negative for the sampled countries with either tight or easy monetary policy stances. In addition, the study revealed that monetary policy transmission may work against theoretical expectations in non-IT non-MPI countries, which confirms some related literature. Several robustness checks have been conducted to assess the sensitivity of the results, which generally confirm the findings.

Overall, the paper's major policy implication is that developing nations may benefit more from increased monetary policy transparency when they have an independent monetary policy. At the same time, the role of monetary policy instruments and characteristics in combating inflation may be limited in the case of developing nations due to various factors, including the lack of key policy rate transmission. For monetary policy to be effective, some prerequisites related to countries' economies, markets, and institutions' development should be achieved.

This research opens the floor for discussion on the monetary policy issues faced by developing countries.

APPENDIX

Table A 38: Correlation: used variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
(1) Inflation	1.00																					
(2) Transparency $_{t-1}$	-0.21	1.00																				
(3) Tightening $_{t-1}$	0.18	0.15	1.00																			
(4) Easing $_{t-1}$	-0.19	0.01	-0.77	1.00																		
(5) Independence $_{t-1}$	-0.07	-0.04	-0.10	0.01	1.00																	
(6) Inflation targeting	-0.10	0.58	0.01	0.10	-0.03	1.00																
(7) GDP growth	-0.02	-0.03	-0.17	0.16	0.06	0.02	1.00															
(8) Cereal	0.03	0.54	0.08	-0.02	0.02	0.23	0.10	1.00														
(9) Food	-0.36	0.42	0.07	-0.01	0.08	0.21	-0.22	0.07	1.00													
(10) Real Int Rate	-0.47	-0.07	-0.09	0.06	0.12	-0.05	0.04	-0.06	0.11	1.00												
(11) Money growth	0.58	-0.25	0.05	-0.04	-0.02	-0.15	0.23	-0.03	-0.47	-0.37	1.00											
(12) FX rate	-0.06	0.06	-0.02	-0.03	-0.02	0.24	0.09	0.21	-0.05	0.20	-0.10	1.00										
(13) Econ Open	0.14	-0.15	-0.00	0.08	-0.04	-0.08	-0.05	-0.48	-0.12	-0.03	0.24	-0.41	1.00									
(14) Government effectiveness	-0.36	0.55	-0.04	0.12	-0.05	0.40	0.11	0.27	0.27	0.05	-0.25	0.18	-0.15	1.00								
(15) Regulatory quality	-0.36	0.55	0.05	0.17	0.02	0.45	0.05	0.24	0.38	0.14	-0.28	0.19	-0.06	0.73	1.00							
(16) Voice and accountability	-0.28	0.42	0.04	0.05	0.01	0.32	-0.14	-0.10	0.21	-0.13	-0.28	-0.11	0.08	0.40	0.34	1.00						
(17) Control of corruption	-0.28	0.12	-0.05	0.03	-0.08	-0.01	0.01	-0.38	0.22	0.01	-0.20	-0.05	0.09	0.59	0.35	0.46	1.00					
(18) Financial development	-0.12	0.72	0.03	0.04	-0.10	0.44	0.05	0.58	0.15	-0.18	-0.14	0.06	-0.21	0.53	0.33	0.43	0.08	1.00				
(19) GDP per capita	0.12	0.21	0.03	0.00	-0.02	0.35	-0.10	-0.07	0.12	-0.20	0.02	-0.05	0.16	0.02	-0.06	0.26	-0.00	0.42	1.00			
(20) Banking crises	0.13	0.14	-0.01	0.05	0.12	0.19	-0.22	0.14	0.05	-0.10	-0.10	-0.07	0.09	-0.03	0.12	0.11	-0.10	0.13	0.22	1.00		
(21) Currency crises	0.16	-0.02	0.05	-0.01	-0.12	-0.05	-0.32	0.00	0.07	-0.11	-0.06	-0.11	0.07	-0.11	-0.05	0.05	-0.05	-0.02	0.08	0.29	1.00	
(22) Debt crises	0.21	-0.29	0.04	0.02	0.12	-0.17	0.01	-0.13	-0.23	-0.01	0.18	-0.14	0.13	-0.27	-0.11	0.01	-0.05	-0.38	-0.24	0.08	0.12	1.00

Table A 39: VIF test

Variable	**VIF**	**1/VIF**
Transparency $_{t-1}$	4.75	0.21045
Tightening $_{t-1}$	3.24	0.308759
Easing $_{t-1}$	3.12	0.320026
Independence $_{t-1}$	1.27	0.789569
Inflation targeting	2.47	0.405456
GDP growth	1.53	0.65269
Cereal	5.92	0.168932
Food	2.75	0.362984
Real Rate	1.64	0.611399
Money growth	2.12	0.471325
FX rate	1.54	0.647358
Econ Open	2.02	0.494276
Banking crises	1.46	0.685908
Currency crises	1.43	0.697686
Debt crises	1.88	0.531978
GDP per capita	2.2	0.455509
Control of corruption	5.21	0.191806
Government effectiveness	6.77	0.147819
Regulatory quality	3.56	0.280596
Voice and accountability	2.53	0.39474
Financial development	6.15	0.162474
Mean VIF	**3.38**	

Table A 40: ADF Panel Unit Root Test results

Variables	**chi2**	**p-value**
Inflation	321.773	0.000
D. Inflation	813.827	0.000
$Inflation_{t-1}$	277.042	0.000
D. $Inflation_{t-1}$	806.776	0.000
$Transparency_{t-1}$	106.135	0.002
D. $Transparency_{t-1}$	221.341	0.000
GDP growth	320.112	0.000
D. GDP growth	686.195	0.000
Financial Development	72.188	0.341
D. Financial Development	417.075	0.000
Cereal	160.571	0.000
D. Cereal	611.768	0.000
Food	80.003	0.151
D. Food	325.447	0.000
Real Rate	475.517	0.000
D. Real Rate	574.990	0.000
Money growth	495.663	0.000
D. Money growth	772.572	0.000
FX rate	226.723	0.000
D. FX rate	320.957	0.000
Econ Open	82.562	0.082
D. Econ Open	400.799	0.000
GDP per capita	41.966	0.995
D. GDP per capita	201.407	0.000
D. Control of corruption	223.026	0.000
Government effectiveness	129.373	0.000
D. Government effectiveness	421.851	0.000
Regulatory quality	103.055	0.004
D. Regulatory quality	360.003	0.000
Voice and accountability	113.341	0.000
D. Voice and accountability	368.291	0.000

Significance levels of 10%, 5%, and 1% are indicated, respectively, by the symbols *, **, and ***

Table A 41: Cointegration test results

	Statistic	p-value
Modified Dickey–Fuller t	-3.1342	0.0009
Dickey–Fuller t	-6.7692	0.0000
Augmented Dickey–Fuller t	-4.5507	0.0000
Unadjusted modified Dickey–Fuller t	-11.2084	0.0000
Unadjusted Dickey–Fuller t	-10.3721	0.0000

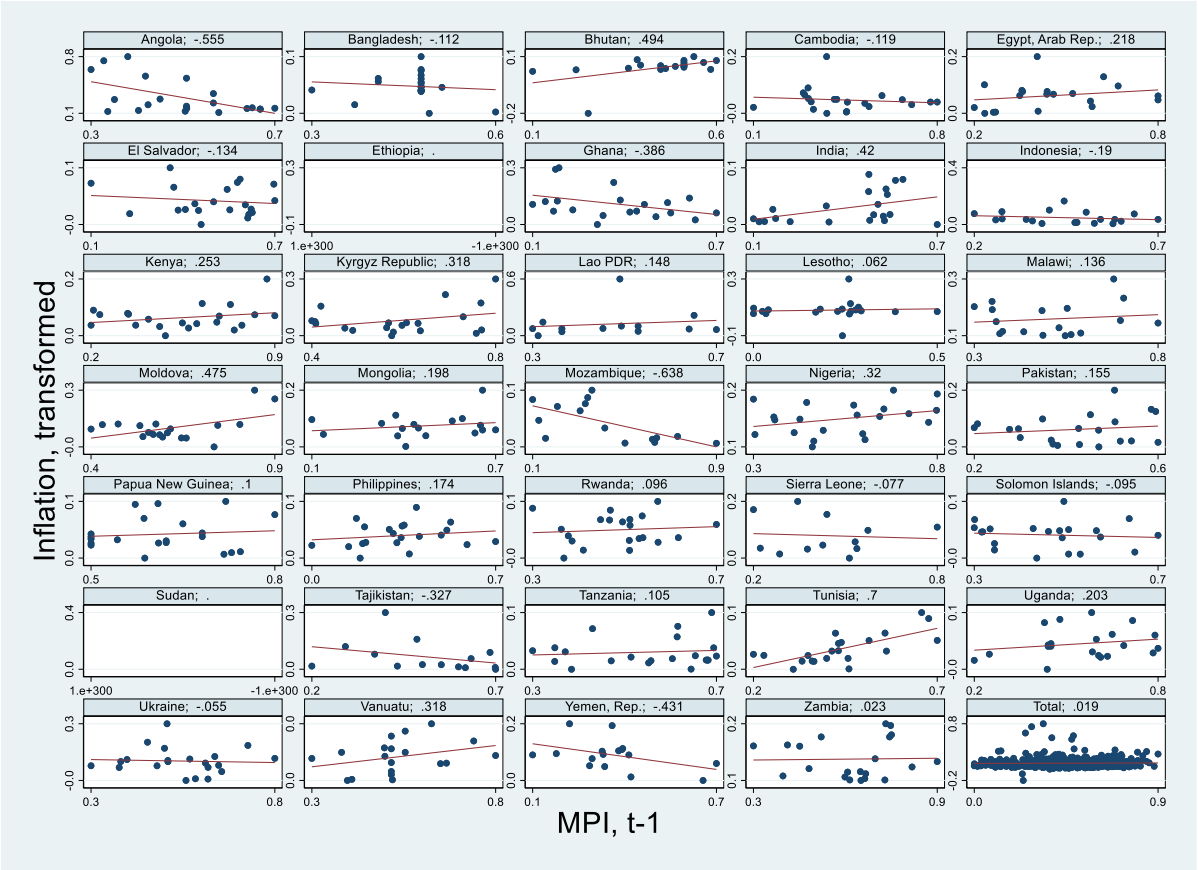
Notes: Cointegration between Inflation, log of Food, log of GDP per capita, Financial Development index.

Table A 42: Inflation Targeting countries

#	Country	IT	Since
1	Angola	0	
2	Bangladesh	0	
3	Bhutan	0	
4	Cambodia	0	
5	Egypt, Arab Rep.	0	
6	El Salvador	0	
7	Ethiopia	0	
8	Ghana	1	2007
9	India	1	2016
10	Indonesia	1	2005
11	Kenya	1	2013
12	Kyrgyz Republic	0	
13	Lao PDR	0	
14	Lesotho	0	
15	Malawi	0	
16	Moldova	1	2010
17	Mongolia	1	2007
18	Mozambique	0	
19	Nigeria	0	
20	Pakistan	0	
21	Papua New Guinea	0	
22	Philippines	1	2002
23	Rwanda	1	2019
24	Sierra Leone	0	
25	Solomon Islands	0	
26	Sudan	0	
27	Tajikistan	0	
28	Tanzania	0	
29	Tunisia	0	
30	Uganda	1	2011
31	Ukraine	1	2015
32	Vanuatu	0	
33	Yemen, Rep.	0	
34	Zambia	0	

Notes: IT stands for Inflation Targeting regime dummy, 1 for countries that launched IT starting from the year of official implementation, based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime.

Figure A 3.13: Inflation vs Monetary Policy Independence (MPI index lagged)



Note: Inflation is a transformed inflation rate, which is measured by the CPI annual change (%) from the World Bank's World Development Indicators. MPI stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index.

Table A 43: Panel FE model. Regressions output for tight monetary policy

	(1)	(2)	(3)	(4)	(5)
$Transparency_{t-1}$	0.025	-0.002	-0.001	-0.009	-0.007
	(0.027)	(0.011)	(0.011)	(0.010)	(0.011)
$Transparency^2_{t-1}$	-0.001	0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Tightening_{t-1}$	0.020***	0.010**	0.047*	0.058***	0.059***
	(0.006)	(0.004)	(0.023)	(0.019)	(0.017)
$Independence_{t-1}$	-0.007	0.009	0.037**	0.034**	0.034**
	(0.008)	(0.006)	(0.016)	(0.014)	(0.013)
Inflation Targeting	0.003	-0.002	0.004	0.017	0.014
	(0.014)	(0.012)	(0.011)	(0.010)	(0.010)
$Transparency_{t-1}$*$Tightening_{t-1}$			-0.005	-0.006**	-0.006**
			(0.003)	(0.003)	(0.002)
$Transparency_{t-1}$*$Independence_{t-1}$			-0.004**	-0.004*	-0.004**
			(0.002)	(0.002)	(0.002)
$Tightening_{t-1}$*$Independence_{t-1}$			-0.070*	-0.075**	-0.078**
			(0.040)	(0.032)	(0.030)
$Transparency_{t-1}$*$Tightening_{t-1}$*			0.009	0.009**	0.009**
*$Independence_{t-1}$			(0.005)	(0.004)	(0.004)
Controls	No	13	13	19	22
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes	Yes	Yes
Observations	505.000	362.000	362.000	342.000	342.000
Countries	32.000	27.000	27.000	27.000	27.000
R^2	0.192	0.739	0.751	0.756	0.760

Notes: The dependent variable, Inflation, transformed inflation rate, measured by the CPI annual change (%) from the World Bank's World Development Indicators (WDI); Transparency stands for the composite index of MPT of Dincer et al. (2014, 2022); Tightening is a dummy for monetary policy tightening (1 means tight monetary policy stance, 0 otherwise) based on the annual data on central bank policy rate (average of the period) from IHS Markit; Independence is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index, where the cut-off of MPI index mean value (i.e., 0.5494875) applied. Inflation Targeting stands for an IT dummy (1 means a country with an IT regime) based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime. Controls include, for Specifications (2)-(3) current and 1-period lagged: GDP growth (annual %), log of cereal production (metric tons), log of food production index; real interest rate (%), a broad money growth (annual %); an official exchange rate (LCU per US$, period average); economic openness based on exports of goods and services (% of GDP) and import of goods and services (% of GDP) from WDI; for Specification (4): all previous plus, financial development index, log of GDP per capita, control of corruption estimates, government effectiveness estimates, regulatory quality estimates, voice and accountability estimates; for Specification (5): all previous plus banking crises, currency crises and debt crises from Nguyen et al. (2022)). Each model uses panel estimations, controls for year-fixed effects, accounts for fixed effects for each country. Bootstrap standard errors by nations, clustered, with parenthesis. Significance levels of 10%, 5%, and 1% are indicated, respectively, by the symbols *, **, and ***.

Table A 44: Panel FE model. Regressions output for easing monetary policy

	(1)	(2)	(3)	(4)	(5)
$Transparency_{t-1}$	0.024	-0.003	-0.004	-0.009	-0.008
	(0.026)	(0.011)	(0.012)	(0.012)	(0.013)
$Transparency^2_{t-1}$	-0.001	0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Easing_{t-1}$	-0.024***	-0.013***	-0.027	-0.029*	-0.029*
	(0.007)	(0.004)	(0.020)	(0.015)	(0.015)
$Independence_{t-1}$	-0.008	0.008	0.002	-0.003	-0.003
	(0.008)	(0.005)	(0.014)	(0.010)	(0.011)
Inflation Targeting	0.003	-0.001	0.000	0.012	0.009
	(0.014)	(0.012)	(0.012)	(0.011)	(0.012)
$Transparency_{t-1}$*$Easing_{t-1}$			0.002	0.002	0.002
			(0.003)	(0.002)	(0.002)
$Transparency_{t-1}$*$Independence_{t-1}$			0.000	0.001	0.000
			(0.003)	(0.002)	(0.002)
$Easing_{t-1}$*$Independence_{t-1}$			0.025	0.020	0.020
			(0.023)	(0.015)	(0.014)
$Transparency_{t-1}$*$Easing_{t-1}$*			-0.004	-0.002	-0.002
*$Independence_{t-1}$			(0.003)	(0.002)	(0.002)
Controls	No	13	13	19	22
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Robust SE	Yes	Yes	Yes	Yes	Yes
Observations	505.000	362.000	362.000	342.000	342.000
Countries	32.000	27.000	27.000	27.000	27.000
R^2	0.202	0.742	0.744	0.746	0.750

Notes: The dependent variable, Inflation, transformed inflation rate, measured by the CPI annual change (%) from the World Bank's World Development Indicators (WDI); Transparency stands for the composite index of MPT of Dincer et al. (2014, 2022); Easing is a dummy for monetary policy easing (1 means ease monetary policy stance, 0 otherwise) based on the annual data on central bank policy rate (average of the period) from IHS Markit; Independence is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index, where the cut-off of MPI index mean value (i.e., 0.5494875) applied. Inflation Targeting stands for an IT dummy (1 means a country with an IT regime) based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime. Controls include, for Specifications (2)-(3) current and 1-period lagged: GDP growth (annual %), log of cereal production (metric tons), log of food production index; real interest rate (%), a broad money growth (annual %); an official exchange rate (LCU per US$, period average); economic openness based on exports of goods and services (% of GDP) and import of goods and services (% of GDP) from WDI; for Specification (4): all previous plus, financial development index, log of GDP per capita, control of corruption estimates, government effectiveness estimates, regulatory quality estimates, voice and accountability estimates; for Specification (5): all previous plus banking crises, currency crises and debt crises from Nguyen et al. (2022)). Each model uses panel estimations, controls for year-fixed effects, accounts for fixed effects for each country. Bootstrap standard errors by nations, clustered, with parenthesis. Significance levels of 10%, 5%, and 1% are indicated, respectively, by the symbols *, **, and ***.

Table A 45: Quantile Panel FE model. Regressions output for tight MP with changed cut-off (1) for MPI dummy

	(1)	(2)	(3)	(4)	(5)
$Transparency_{t-1}$	0.025	-0.002	-0.002	-0.007	-0.006
	(0.028)	(0.012)	(0.011)	(0.014)	(0.014)
$Transparency^2_{t-1}$	-0.001	0.000	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Tightening_{t-1}$	0.021***	0.009**	0.015	0.021*	0.022
	(0.007)	(0.004)	(0.014)	(0.012)	(0.013)
$Independence_{t-1}$	-0.010	-0.003	-0.000	-0.005	-0.004
	(0.010)	(0.004)	(0.016)	(0.015)	(0.013)
Inflation Targeting	0.003	0.001	0.003	0.014	0.010
	(0.015)	(0.013)	(0.013)	(0.013)	(0.014)
$Transparency_{t-1}$*$Tightening_{t-1}$			-0.001	-0.002	-0.002
			(0.002)	(0.002)	(0.002)
$Transparency_{t-1}$*$Independence_{t-1}$			-0.001	0.000	-0.000
			(0.003)	(0.002)	(0.002)
$Tightening_{t-1}$*$Independence_{t-1}$			-0.030	-0.028	-0.029
			(0.030)	(0.026)	(0.028)
$Transparency_{t-1}$*$Tightening_{t-1}$*			0.006	0.005	0.005
*$Independence_{t-1}$			(0.004)	(0.003)	(0.004)
Controls	No	13	13	19	22
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Bootstrap SE	Yes	Yes	Yes	Yes	Yes
Countries	32	27	27	27	27
Observations	505	362	362	342	342

Notes: The dependent variable, Inflation, transformed inflation rate, measured by the CPI annual change (%) from the World Bank's World Development Indicators (WDI); Transparency stands for the composite index of MPT of Dincer et al. (2014, 2022); Tightening is a dummy for monetary policy tightening (1 means tight monetary policy stance, 0 otherwise) based on the annual data on central bank policy rate (average of the period) from IHS Markit; Independence is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index, when the cut-off (1) of 0.5494875 applied. Inflation Targeting stands for an IT dummy (1 means a country with an IT regime) based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime. Controls include, for Specifications (2)-(3) current and 1-period lagged: GDP growth (annual %), log of cereal production (metric tons), log of food production index; real interest rate (%), a broad money growth (annual %); an official exchange rate (LCU per US$, period average); economic openness based on exports of goods and services (% of GDP) and import of goods and services (% of GDP) from WDI; for Specification (4): all previous plus, financial development index, log of GDP per capita, control of corruption estimates, government effectiveness estimates, regulatory quality estimates, voice and accountability estimates; for Specification (5): all previous plus banking crises, currency crises and debt crises from Nguyen et al. (2022)). Each model uses panel estimations, controls for year-fixed effects, accounts for fixed effects for each country. Bootstrap standard errors by nations, clustered, with parenthesis. Significance levels of 10%, 5%, and 1% are indicated, respectively, by the symbols *, **, and ***.

Table A 46: Quantile Panel FE model. Regressions output for ease MP with changed cut-off (1) for MPI dummy

	(1)	(2)	(3)	(4)	(5)
$Transparency_{t-1}$	0.024	-0.003	-0.004	-0.009	-0.009
	(0.027)	(0.012)	(0.012)	(0.012)	(0.014)
$Transparency^2_{t-1}$	-0.001	0.000	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Easing_{t-1}$	-0.024***	-0.013***	-0.022	-0.023	-0.023*
	(0.006)	(0.004)	(0.016)	(0.018)	(0.014)
$Independence_{t-1}$	-0.009	-0.003	-0.029	-0.026	-0.025
	(0.010)	(0.004)	(0.025)	(0.021)	(0.022)
Inflation Targeting	0.003	0.002	0.003	0.014	0.011
	(0.015)	(0.014)	(0.013)	(0.014)	(0.015)
$Transparency_{t-1}$*$Easing_{t-1}$			0.002	0.002	0.002
			(0.002)	(0.002)	(0.002)
$Transparency_{t-1}$*$Independence_{t-1}$			0.004	0.004	0.004
			(0.004)	(0.003)	(0.003)
$Easing_{t-1}$*$Independence_{t-1}$			0.037	0.026	0.025
			(0.026)	(0.023)	(0.026)
$Transparency_{t-1}$*$Easing_{t-1}$*			-0.006*	-0.004	-0.004
*$Independence_{t-1}$			(0.003)	(0.003)	(0.003)
Controls	No	13	13	19	22
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Bootstrap SE	Yes	Yes	Yes	Yes	Yes
Countries	32	27	27	27	27
Observations	505	362	362	342	342

Notes: The dependent variable, Inflation, transformed inflation rate, measured by the CPI annual change (%) from the World Bank's World Development Indicators (WDI); Transparency stands for the composite index of MPT of Dincer et al. (2014, 2022); Easing is a dummy for monetary policy easing (1 means ease monetary policy stance, 0 otherwise) based on the annual data on central bank policy rate (average of the period) from IHS Markit; Independence is a dummy where 1 stand for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index, where the cut-off (1) of 0.5494875 applied. Inflation Targeting stands for an IT dummy (1 means a country with IT regime) based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime. Controls include, for Specifications (2)-(3) current and 1-period lagged: GDP growth (annual %), log of cereal production (metric tons), log of food production index; real interest rate (%), a broad money growth (annual %); an official exchange rate (LCU per US$, period average); economic openness based on exports of goods and services (% of GDP) and import of goods and services (% of GDP) from WDI; for Specification (4): all previous plus, financial development index, log of GDP per capita, control of corruption estimates, government effectiveness estimates, regulatory quality estimates, voice and accountability estimates; for Specification (5): all previous plus banking crises, currency crises and debt crises from Nguyen et al. (2022)). Each model uses panel estimations, controls for year-fixed effects, accounts for fixed effects for each country. Bootstrap standard errors by nations, clustered, with parenthesis. Significance levels of 10%, 5%, and 1% are indicated, respectively, by the symbols *, **, and ***.

Table A 470: Quantile Panel FE model. Regressions output for tight MP with changed cut-off (2) for MPI dummy

	(1)	(2)	(3)	(4)	(5)
$Transparency_{t-1}$	0.025	-0.002	-0.001	-0.008	-0.007
	(0.029)	(0.012)	(0.013)	(0.014)	(0.014)
$Transparency^2_{t-1}$	-0.001	0.000	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Tightening_{t-1}$	0.020***	0.010**	0.047**	0.062***	0.063***
	(0.006)	(0.004)	(0.020)	(0.017)	(0.018)
$Independence_{t-1}$	-0.009	0.004	0.022*	0.028**	0.028**
	(0.008)	(0.004)	(0.013)	(0.014)	(0.014)
Inflation Targeting	0.002	-0.000	0.003	0.015	0.013
	(0.015)	(0.014)	(0.013)	(0.014)	(0.015)
$Transparency_{t-1}$*$Tightening_{t-1}$			-0.005	-0.006**	-0.006**
			(0.003)	(0.003)	(0.003)
$Transparency_{t-1}$*$Independence_{t-1}$			-0.002	-0.003	-0.003
			(0.002)	(0.002)	(0.002)
$Tightening_{t-1}$*$Independence_{t-1}$			-0.063**	-0.074***	-0.074***
			(0.027)	(0.024)	(0.026)
$Transparency_{t-1}$*$Tightening_{t-1}$*			0.008*	0.009***	0.008**
*$Independence_{t-1}$			(0.005)	(0.003)	(0.003)
Controls	No	13	13	19	22
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Bootstrap SE	Yes	Yes	Yes	Yes	Yes
Countries	32	27	27	27	27
Observations	505	362	362	342	342

Notes: The dependent variable, Inflation, transformed inflation rate, measured by the CPI annual change (%) from the World Bank's World Development Indicators (WDI); Transparency stands for the composite index of MPT of Dincer et al. (2014, 2022); Tightening is a dummy for monetary policy tightening (1 means tight monetary policy stance, 0 otherwise) based on the annual data on central bank policy rate (average of the period) from IHS Markit; Independence is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index, where the cut-off (2) of 0.369953 applied. Inflation Targeting stands for an IT dummy (1 means a country with an IT regime) based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime. Controls include, for Specifications (2)-(3) current and 1-period lagged: GDP growth (annual %), log of cereal production (metric tons), log of food production index; real interest rate (%), a broad money growth (annual %); an official exchange rate (LCU per US$, period average); economic openness based on exports of goods and services (% of GDP) and import of goods and services (% of GDP) from WDI; for Specification (4): all previous plus, financial development index, log of GDP per capita, control of corruption estimates, government effectiveness estimates, regulatory quality estimates, voice and accountability estimates; for Specification (5): all previous plus banking crises, currency crises and debt crises from Nguyen et al. (2022)). Each model uses panel estimations, controls for year-fixed effects, accounts for fixed effects for each country. Bootstrap standard errors by nations, clustered, with parenthesis. Significance levels of 10%, 5%, and 1% are indicated, respectively, by the symbols *, **, and ***.

Table A 481: Quantile Panel FE model. Regressions output for ease MP with changed cut-off (2) for MPI dummy

	(1)	(2)	(3)	(4)	(5)
$Transparency_{t-1}$	0.024	-0.003	-0.005	-0.008	-0.007
	(0.028)	(0.012)	(0.014)	(0.015)	(0.016)
$Transparency^2_{t-1}$	-0.001	0.000	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Easing_{t-1}$	-0.024***	-0.013***	-0.029	-0.025	-0.025*
	(0.006)	(0.004)	(0.018)	(0.016)	(0.015)
$Independence_{t-1}$	-0.009	0.004	-0.013	-0.006	-0.005
	(0.008)	(0.004)	(0.014)	(0.015)	(0.017)
Inflation Targeting	0.002	0.001	0.002	0.013	0.009
	(0.015)	(0.014)	(0.013)	(0.015)	(0.015)
$Transparency_{t-1}$*$Easing_{t-1}$			0.002	0.001	0.001
			(0.003)	(0.002)	(0.002)
$Transparency_{t-1}$*$Independence_{t-1}$			0.003	0.001	0.001
			(0.002)	(0.002)	(0.002)
$Easing_{t-1}$*$Independence_{t-1}$			0.025	0.015	0.014
			(0.024)	(0.023)	(0.025)
$Transparency_{t-1}$*$Easing_{t-1}$*			-0.004	-0.001	-0.001
*$Independence_{t-1}$			(0.004)	(0.003)	(0.004)
Controls	No	13	13	19	22
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Bootstrap SE	Yes	Yes	Yes	Yes	Yes
Countries	32	27	27	27	27
Observations	505	362	362	342	342

Notes: The dependent variable, Inflation, transformed inflation rate, measured by the CPI annual change (%) from the World Bank's World Development Indicators (WDI); Transparency stands for the composite index of MPT of Dincer et al. (2014, 2022); Easing is a dummy for monetary policy easing (1 means ease monetary policy stance, 0 otherwise) based on the annual data on central bank policy rate (average of the period) from IHS Markit; Independence is a dummy where 1 stand for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index, where the cut-off (2) of 0.369953 applied. Inflation Targeting stands for an IT dummy (1 means a country with an IT regime) based on Dincer et al. (2019) and publicly available information on official announcements about invoking the IT regime. Controls include, for Specifications (2)-(3) current and 1-period lagged: GDP growth (annual %), log of cereal production (metric tons), log of food production index; real interest rate (%), a broad money growth (annual %); an official exchange rate (LCU per US$, period average); economic openness based on exports of goods and services (% of GDP) and import of goods and services (% of GDP) from WDI; for Specification (4): all previous plus, financial development index, log of GDP per capita, control of corruption estimates, government effectiveness estimates, regulatory quality estimates, voice and accountability estimates; for Specification (5): all previous plus banking crises, currency crises and debt crises from Nguyen et al. (2022)). Each model uses panel estimations, controls for year-fixed effects, accounts for fixed effects for each country. Bootstrap standard errors by nations, clustered, with parenthesis. Significance levels of 10%, 5%, and 1% are indicated, respectively, by the symbols *, **, and ***.

Table A 492: Summary statistics of original (non-transformed) variables

Variable	N	Mean	Std. Dev.	Min	Max
	Dependent variables				
Inflation	719	10.55	19.40	-18.11	325.00
	Independent variables				
$Inflation_{t-1}$	717	10.69	19.74	-18.11	325.00
Transparency	714	4.44	2.54	1.00	11.00
$Transparency^2_{t-1}$	714	26.19	27.94	1.00	121.00
Independence dummy	636	0.54	0.50	0.00	1.00
Monetary policy stance dummies:					
tightening	549	0.35	0.48	0.00	1.00
easing	549	0.49	0.50	0.00	1.00
	Controls				
Inflation Targeting regime dummy	748	0.13	0.33	0	1.00
GDP growth (annual %)	747	4.91	4.19	-27.99	26.42
Cereal, metric tons	700	18000000	47100000	700.00	318000000
Food, index	714	82.65	20.01	26.20	152.22
Real Rate (%)	601	7.26	10.30	-72.58	50.98
Money growth (annual %)	717	20.49	27.42	-10.14	528.19
FX rate (LCU per US$, period average)	748	4.08	2.61	-1.46	9.56
Econ Open (%)	668	72.28	34.15	1.22	175.35
GDP per capita, constant 2015 US$	747	1665.15	1033.10	248.87	4394.99
Financial development index	748	0.17	0.09	0.04	0.50
Control of corruption estimates	680	-0.65	0.53	-1.68	1.64
Government effectiveness estimates	680	-0.58	0.45	-2.28	0.83
Regulatory quality estimates	680	-0.57	0.42	-2.63	0.47
Voice and accountability estimates	680	-0.49	0.64	-1.85	0.81
Banking crises dummy	748	0.04	0.20	0.00	1.00
Currency crises dummy	748	0.07	0.26	0.00	1.00
Debt crises dummy	738	0.42	0.49	0.00	1.00
	For reference purposes				
Independence index	659	0.48	0.17	0.02	0.92
Central bank policy rates	585	13.54	15.39	0.83	150

Note: Inflation is calculated based on the transformation of the CPI annual change (%). Data is sourced from the World Bank's World Development Indicators, IHS Markit, IFS of the International Monetary Fund, central banks' webpages, Dincer et al. (2019, 2022); Aizenman et al. (2010, 2013, 2015); and Nguyen et al. (2022).

Annex 3.1 Variability of inflation (Inflation Volatility)

To assess the impact of MPT on inflation volatility, inflation volatility was first measured by calculating an annual standard deviation of the current change in monthly CPI from the IMF's IFS.[68] Due to the data limitation, there are only 457 observations for inflation volatility for 32 countries with an average of 14 years (with a 0.96 mean, 0.91 standard deviation, 0.09 minimum, and 7.57 maximum). Second, the methodology from Section 5 is applied.[69]

The estimation results in Table A 3.13 show that, on average, an MPT improvement has a diminishing effect on the inflation volatility in the subsequent year, though statistically not significant, for the countries with tight monetary policy. In general, this is consistent with the findings for the inflation level in Table 3.2. The estimates of interaction terms are ambiguous.

Table A 503: Quantile Panel FE model for Inflation volatility. Regressions output for tight monetary policy

	(1)	(2)	(3)	(4)	(5)
Transparency $_{t-1}$	-0.177	-0.148	-0.114	-0.125	-0.074
	(0.118)	(0.143)	(0.149)	(0.203)	(0.161)
Transparency^2 $_{t-1}$	0.011	0.005	0.001	0.002	-0.001
	(0.008)	(0.010)	(0.010)	(0.013)	(0.012)
Tightening $_{t-1}$	0.053	0.006	0.066	0.003	0.065
	(0.068)	(0.082)	(0.277)	(0.364)	(0.332)
Independence $_{t-1}$	-0.021	0.057	-0.012	-0.043	-0.048
	(0.062)	(0.060)	(0.222)	(0.224)	(0.231)
Inflation Targeting	0.325	0.409*	0.451**	0.439**	0.400
	(0.207)	(0.234)	(0.222)	(0.199)	(0.248)
Transparency $_{t-1}$*Tightening $_{t-1}$			0.001	0.012	0.008
			(0.040)	(0.050)	(0.047)
Transparency $_{t-1}$*Independence $_{t-1}$			0.020	0.024	0.023
			(0.033)	(0.036)	(0.034)
Tightening $_{t-1}$*Independence $_{t-1}$			-0.307	-0.172	-0.237
			(0.332)	(0.422)	(0.407)
Transparency $_{t-1}$*Tightening $_{t-1}$*			0.029	0.008	0.017
*Independence $_{t-1}$			(0.043)	(0.057)	(0.052)
Controls	No	13	13	19	22
Country FE	Yes	Yes	Yes	Yes	Yes

[68] IMF data series PCPI_PC_PP_PT, titled "Prices, Consumer Price Index, All Items, Percentage Change, Previous Period, Percentage."

[69] The unit root test proves that inflation volatility is non-stationary. The VIF test was performed to check for multicollinearity. The outputs are available upon request.

Year FE	Yes	Yes	Yes	Yes	Yes
Bootstrap SE	Yes	Yes	Yes	Yes	Yes
Countries	30	25	25	25	25
Observations	348	256	256	254	254

Notes: The dependent variable, Inflation volatility, measured by an annual standard deviation of the present change of the monthly CPI calculated by author based on IMF IFS; Transparency stands for the composite index of MPT of Dincer et al. (2014, 2022); Tightening is a dummy for monetary policy tightening (1 means tight monetary policy stance, 0 otherwise) based on the annual data on central bank policy rate (average of period) from IHS Markit; Independence is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index, where the cut-off of MPI index mean value (i.e., 0.5494875) applied. Controls include, for Specifications (2)-(3) current and 1-period lagged: GDP growth (annual %), log of cereal production (metric tons), log of food production index; real interest rate (%), a broad money growth (annual %); an official exchange rate (LCU per US$, period average); economic openness based on exports of goods and services (% of GDP) and import of goods and services (% of GDP) from WDI; for Specification (4): all previous plus, financial development index, log of GDP per capita, control of corruption estimates, government effectiveness estimates, regulatory quality estimates, voice and accountability estimates; for Specification (5): all previous plus banking crises, currency crises and debt crises from Nguyen et al. (2022)). Each model uses panel estimations, controls for year-fixed effects, accounts for fixed effects for each country. Bootstrap standard errors by nations, clustered, with parenthesis. Significance levels of 10%, 5%, and 1% are indicated, respectively, by the symbols *, **, and ***.

For the countries with eased monetary policy, as Table A 3.14 indicates, the overall improvement in MPT has a decreasing effect on the volatility of inflation in the subsequent year, though statistically not significant. This generally agrees with the findings for the inflation level in Table 3.3. The interaction term estimations are vague.

Table A 514: Quantile Panel FE model for Inflation volatility. Regressions output for ease monetary policy

	(1)	(2)	(3)	(4)	(5)
$Transparency_{t-1}$	-0.174	-0.148	-0.128	-0.136	-0.101
	(0.120)	(0.142)	(0.172)	(0.228)	(0.181)
$Transparency^2_{t-1}$	0.010	0.005	0.002	0.004	0.001
	(0.008)	(0.010)	(0.011)	(0.015)	(0.012)
$Easing_{t-1}$	-0.070	-0.003	-0.195	-0.137	-0.209
	(0.061)	(0.072)	(0.317)	(0.430)	(0.355)
$Independence_{t-1}$	-0.019	0.056	-0.296	-0.222	-0.282
	(0.059)	(0.060)	(0.339)	(0.378)	(0.370)
Inflation Targeting	0.317	0.409*	0.436**	0.434**	0.401
	(0.209)	(0.236)	(0.222)	(0.181)	(0.245)
$Transparency_{t-1}$*$Easing_{t-1}$			0.020	0.012	0.019
			(0.047)	(0.062)	(0.050)
$Transparency_{t-1}$*$Independence_{t-1}$			0.050	0.039	0.046
			(0.046)	(0.052)	(0.050)
$Easing_{t-1}$*$Independence_{t-1}$			0.364	0.265	0.309
			(0.475)	(0.611)	(0.546)
$Transparency_{t-1}$*$Easing_{t-1}$*			-0.042	-0.029	-0.036
*$Independence_{t-1}$			(0.063)	(0.083)	(0.070)
Controls	No	13	13	19	22
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Bootstrap SE	Yes	Yes	Yes	Yes	Yes
Countries	30	25	25	25	25
Observations	348	256	256	254	254

Notes: The dependent variable, Inflation volatility, measured by an annual standard deviation of the present change of the monthly CPI calculated by author based on IMF IFS; Transparency stands for the composite index of MPT of Dincer et al. (2014, 2022); Easing is a dummy for monetary policy easing (1 means ease monetary policy stance, 0 otherwise) based on the annual data on central bank policy rate (average of period) from IHS Markit; Independence is a dummy where 1 stands for independent monetary policy based on Aizenman et al. (2010, 2013, 2015) monetary independence index, where the cut-off of MPI index mean value (i.e., 0.5494875) applied. Controls include, for Specifications (2)-(3) current and 1-period lagged: GDP growth (annual %), log of cereal production (metric tons), log of food production index; real interest rate (%), a broad money growth (annual %); an official exchange rate (LCU per US$, period average); economic openness based on exports of goods and services (% of GDP) and import of goods and services (% of GDP) from WDI; for Specification (4): all previous plus, financial development index, log of GDP per capita, control of corruption estimates, government effectiveness estimates, regulatory quality estimates, voice and accountability estimates; for Specification (5): all previous plus banking crises, currency crises and debt crises from Nguyen et al. (2022)). Each model uses panel estimations, controls for year-fixed effects, accounts for fixed effects for each country. Bootstrap standard errors by nations, clustered, with parenthesis. Significance levels of 10%, 5%, and 1% are indicated, respectively, by the symbols *, **, and ***.

In a nutshell, at this moment, the examination of the relationship between MPT and inflation volatility given MPI and stance is problematic due to data availability. Further study may be performed, provided that the mentioned constraints are successfully addressed.

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