

Skufi, Lorena; Gersl, Adam

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Does FX hedge mitigate the impact of exchange rate changes on credit risk? Evidence from a small open economy

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Faculty of Social Sciences
Charles University

DOES FX HEDGE MITIGATE THE IMPACT OF EXCHANGE RATE CHANGES ON CREDIT RISK? EVIDENCE FROM A SMALL OPEN ECONOMY

Lorena Skufi
Adam Gersl

IES Working Paper 4/2025

Institute of Economic Studies,
Faculty of Social Sciences,
Charles University in Prague

[UK FSV – IES]

Opletalova 26
CZ-110 00, Prague
E-mail : ies@fsv.cuni.cz
<http://ies.fsv.cuni.cz>

Institut ekonomických studií
Fakulta sociálních věd
Univerzita Karlova v Praze

Opletalova 26
110 00 Praha 1

E-mail : ies@fsv.cuni.cz
<http://ies.fsv.cuni.cz>

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Does FX Hedge Mitigate the Impact of Exchange Rate Changes on Credit Risk? Evidence from a Small Open Economy

Lorena Skufi^{a,b*}

Adam Gersl^a

^a Institute of Economic Studies, Faculty of Social Sciences, Charles University, Prague, Czech Republic;

^b Bank of Albania, Tirana, Albania

*Corresponding author; E-mail: lorenaskufi@hotmail.com,

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Abstract:

This study investigates the impact of exchange rate fluctuations on non-performing loans (NPLs), using a unique bank-by-bank dataset on lending to FX hedged and FX unhedged borrowers. Employing fixed effects and panel quantile regression, we analyze how changes in exchange rate affect the NPL ratio of hedged versus unhedged borrowers, differentiating between non-financial corporations and households and controlling for additional macroeconomic factors and bank-specific characteristics in Albania for the period from 2009 to 2023. Our empirical findings confirm that the sensitivity of unhedged non-financial corporations to exchange rate changes is higher than in the case of hedged borrowers. However, we find the opposite effect for households, where the risk seems to be for some reason higher for hedged borrowers.

JEL: C23, C31, E5, G3

Keywords: Nonperforming loans, hedging, exchange rate, panel quantile regression, households and non-financial corporations

1 Introduction

The international financial landscape has witnessed significant changes over the past few decades, with credit risk management playing a pivotal role in financial stability.

Understanding the determinants of non-performing loans (NPLs) among agents and currencies is crucial for policymakers, financial institutions, and borrowers alike. In this context, our study focuses on the Albanian market, where NPLs dynamics have evolved among economic fluctuations and structural reforms. The allocation of loans denominated in FC (foreign currency) constitutes a noteworthy segment within the banking sector. As mentioned by Kazinczy (2013) FC risk is particularly relevant in Albania given the floating exchange rate regime and the unhedged position of borrowers.

The fundamental question is whether FC NPL ratio of unhedged borrowers associates with higher risk to exchange rate depreciation compared to hedged borrowers. We start with a simple fixed effect model to test the heterogeneity across banks and then we expand to a panel quantile regression approach to estimate NPL ratio across various quantiles of the distribution. As stated by Kanas and Molyneux (2018) there are no solid theoretical and empirical reasons for assuming a linear relationship between risk and macroeconomic variables. Earlier, Engle and Manganelli (2004) suggested that quantile regression methods are naturally applied to risk estimation. Several studies that relate to NPLs also have used quantile regression analysis (Aydemir, Atik and Guloglu 2023, Karadima and Louri 2020, Le and Le 2023). Our dataset spans the period from 2009 to 2023, and includes both non-financial corporations and households. Importantly, we distinguish between hedged and unhedged foreign currency loans, categorizing them by both bank and borrower segment.

Our empirical results reveal two key insights: heterogeneity across borrower types and NPLs sensitivity to exchange rate. Non-financial corporations and households display asymmetric behavior across the percentiles, with borrower heterogeneity being more

pronounced in the right tail of the distribution. The NPL ratio is sensitive to exchange rate movements, whether borrowers have implemented hedging strategies or not. Unhedged non-financial corporations face a higher risk to exchange rate depreciation compared to hedged ones. Conversely, for households, the opposite holds true, particularly at the right tail of the distribution. Our research reaffirms the determinants of NPLs identified from the existing literature.

A key contribution of our study to the existing literature is the unique and detailed dataset we employ, which allows us to differentiate between hedged and unhedged FC loans. To our knowledge, no prior study has utilized such a rich dataset, particularly one that distinguishes FC loans by both bank and borrower segment (households vs. non-financial corporations). This distinction provides a valuable advantage in analyzing the dynamics of FC NPLs and its association with exchange rate depreciation. Our study is thus able to offer insights that are not only rare but also highly granular in nature, significantly advancing the understanding of FC loan exposure across different borrower types and banking institutions. Furthermore, our study contributes to the literature on credit risk by examining the conditional distribution of NPLs in the Albanian context. We differ from the literature in several fundamental respects. The previous literature appeals to the reference but does not empirically specify the precise difference between hedged and unhedged borrowers, while we exploit this distinguish feature to better capture the effect of exchange rate credit risk. Second, we find that tail risk associated with exchange rate are concentrated in periods of high NPL ratio. It is also useful to contrast our analysis with reference, who find that credit risk increases the sensitivity to exchange rate for unhedged borrowers, suggesting that the unhedged borrower contributes to a higher default risk on loan repayment. However, while depreciation can negatively impact borrowers to repay the loan, it is not clear what being hedged/unhedged implies about a borrower's vulnerability to tail risk. Thus, we extend the

literature by showing that exchange rate increases hedged/unhedged borrower's vulnerability to depreciation in the right tail of the distribution.

The remaining part of the study is organized as follows. Section 2 presents a literature review, Section 3 and 4 describes the data and methodology used, Section 5 discusses the results, and Section 6 concludes.

2 Literature review

The existing corpus of literature on the underlying factors of credit risk delves into the main macroeconomic variables, alongside specific banking and loan characteristics (Manz 2019). Notable syntheses of these determinants are presented in the works of Salas et al. (2024); Ari et al. (2021); Boumparis et al. (2019); as well as Beck et al. (2015). They suggest that bank-specific factors include factors like size and profitability. While, macroeconomic factors cover GDP growth or output gap, unemployment rates, interest rates, exchange rates, and levels of public and private debt.

The impact and the magnitude of each determinant differ among authors. This heterogeneity in the estimated outcomes across studies is attributed to the specification forms, the data types, and the periods sampled (Magkonis et al. (2019) and Macháček et al. (2017)). For example, despite the predominant empirical consensus indicating a negative correlation between macroeconomic conditions and credit quality, divergences in this relationship are evident, contingent upon specific variables such as credit type and sectors (Vazquez, Tabak and Souto 2012), economic agents (Louzis, Vouldis and Metaxas 2012), bank-specific factors [(Aydemir, Atik and Guloglu 2023) and (Gerlach, Peng and Shu 2005)], and the existence of asymmetry [(Quagliariello 2007) and (Kanas and Molyneux 2018)]. Kanas and Molyneux (2018) suggest that there are no solid theoretical and empirical reasons for assuming a linear relationship between risk and macroeconomic variables.

The discussion is more intense for the implications of exchange rate fluctuations on credit risk. A depreciation in the FC (foreign currency) impacts credit risk through different channels, creating either advantageous or detrimental outcomes.

Through the trade channel, a depreciated exchange rate boosts competitive terms. Numerous enterprises with FC debt are positively selected and often naturally hedged to exchange rate oscillations (Bleakley and Cowan 2008). For instance, Bodnár (2009) finds that Hungarian enterprises could improve the profitability of the corporate sector and its debt servicing capacity during periods of currency depreciation. Bethlendi (2011) explains that the exposure of non-financial corporations to FC is considerably less pronounced due to the economic openness of CEE countries and the different hedge opportunities compared to households. Furthermore, Verner and Gyöngyösi (2020) demonstrated that household FC exposure has larger local aggregate effects relative to firms.

Within the context of the balance-sheet channel, a weak currency increases the financial burden of FCL of unhedged borrowers. The ECB (2011) found positive evidence that countries with significant levels of FCL to unhedged borrowers experience augmented financial strain. Klein (2013) highlighted that the exchange rate depreciation has contributed to higher NPLs for CESEE countries. Similarly, Kuzucu and Kuzucu (2019) observed that exchange rate depreciation diminishes the income for households and companies, thereby inflating the volume of bad debts in emerging economies. Festić and Bekő (2008) found a direct correlation between exchange rate fluctuations and NPL ratio in Hungary, Poland and Slovakia, noting these countries' substantial exposure to FCL. Beck et al. (2013) reported a positive relationship between exchange rate and NPLs in countries with low international claims, whereas a converse relationship was noted in countries with high international claims. Fink et al. (2016) suggested that an economy's higher share of FCL in total loans is linked with an increased share of NPLs, supporting the hypothesis that the exchange rate affect

NPLs through balance-sheet channel of unhedged FC borrowers rather than through the export channel of hedged ones.

Numerous studies have recognized the impact of exchange rate on FCL credit risk, yet there is a lack of detailed analysis concerning the hedging position of borrowers. Explicit estimations on hedge and unhedged borrowers has received little attentions. For example, ECB (2011) suggested that the behavior of unhedged borrowers is reflected in the high ratio of international claims. Essentially, they utilize a dummy variable that interacts with the exchange rate, assigning a value of one to countries whose international claims to GDP exceed the median, and zero otherwise. Fink et al. (2016) also explored the share of FCL held by non-financial corporations and households, providing supportive evidence for the balance-sheet effect.

While the prevailing literature often categorizes households with FCLs as unhedged, this may not uniformly hold true, as households might partially hedge their FCL exposure through remittances (Hudecz 2013), or any FC income Brown et al. (2012). Particularly in the context of mortgage loans as indicated by Alvarez et al. (2015).

We contribute to fill the gap on FC credit risk by examining the hedging position of households and non-financial corporation across NPLs distribution. We offer insights that are highly granular in nature, significantly advancing the understanding of FC loan exposure across different borrower types and banking institutions.

3 Data

The dataset utilized in this study is collected from three principal sources: the Bank of Albania (BoA 2024), the Albanian Association of Banks (AAB 2024), and the Albanian National Institute of Statistics (INSTAT 2024). It includes data with a monthly frequency spanning from 2009 to 2023. For indicators initially reported on a quarterly basis, a linear

interpolation method is applied to convert these figures to a monthly frequency. This research focuses on second level banks within the Albanian banking sector, which comprises a total of eleven banks.

With the private sector credit risk being unobservable (the non-repayment of loan probability), we approximate it with the NPL ratio as suggested by many (Magkonis, Chortareas and Zekented 2019). The NPL ratio is the ratio of non-performing loans over 90 days overdue to granted loans. Figure 1 illustrate the NPLs trajectories for the private sector among agents and currency.¹ As indicated in the graphs there is a nice co-movement of NPLs among agents and currencies. The non-financial corporations (NFC) feature a higher NPLs compared to households (HH). While, borrowing in FC induce lightly higher credit risk overall. The distribution of NPLs is not uniform across banks. In Annex A1, we examine the heterogeneity in NPLs across banks by constructing fan-charts (see Figure A1 in Annex for the distribution of NPLs among agents and currencies).

Macroeconomic indicators are selected upon the existing literature Salas et al. (2024). Among many macroeconomic factors impacting the NPLs of private sector, we employ the economic activity, the exchange rate, and the remittances. Generally, it is acknowledged that the credit risk increases in times of economic downturns and in whenever financial burden related to the loan increases versus borrower's income [Verner and Gyöngyösi (2020); Kuzucu and Kuzucu (2019); Marcucci and Quagliariello (2008)]. In our sample, the COVID-19 pandemic period makes an exception. The measurements taken to protect the financial

¹ Since 2009 NPLs ratio feature a positive trend in Albanian banking system. The ratio of NPLs began to rise with the Global Financial Crisis and followed Greece's financial markets collapse. In 2012, four Greek-owned banks were operating in Albania, out of a total of sixteen (BoA 2013). By the end of 2015 Bank of Albania prepared the "Action plan for reducing non-performing loans", which aimed at reducing non-performing loans in the banking system (BoA 2015). As a result the non-performing loan ratio felt quickly by few percentages points (see Figure 1). Still, the credit risk remained high till 2016. In 2016, the Bank of Albania amended the law on the recovery and resolution of banks in the Republic of Albania for banks and branches of foreign banks licensed by the Bank of Albania (BoA 2016). At the end of 2016, foreign capital accounted for around 89 percent of the capital structure. The remaining of 11 percent of domestic capital was allocated in four banks out of a total of sixteen. After 2016, the NPLs ratio started to decline permanently.

sector during the lockdown and after, broke the link between the financial sector and the real economy (Skufi and Geršl 2023). Following (Demirguc-Kunt and Huizinga 2000) economic activity is approximated by the year-on-year growth in percentage of the GDP.

The exchange rate serves as a significant determinant in the temporal mitigation of credit risk. The sustained appreciation of Albanian Lek post-2016 is considered to have

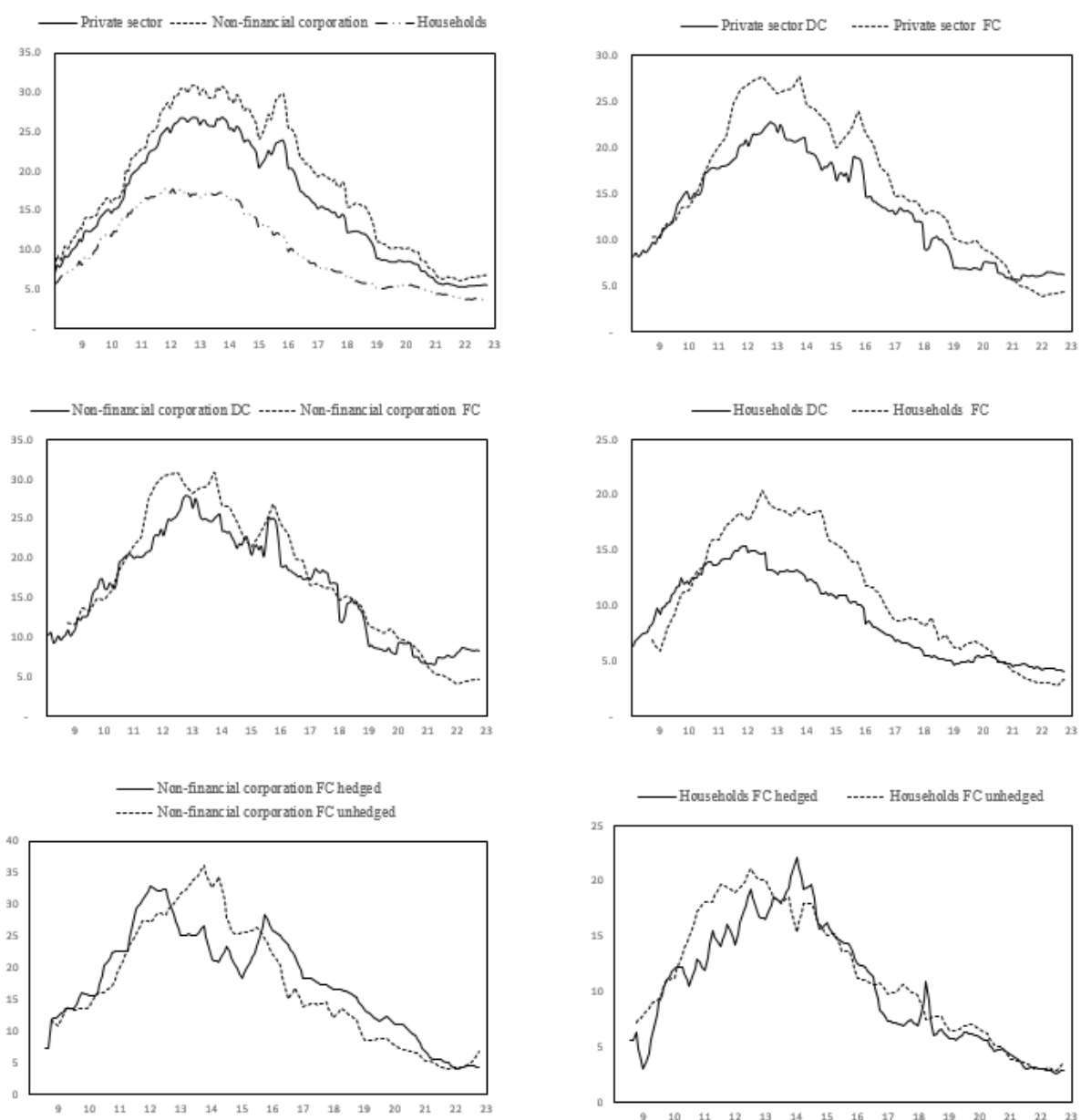


Figure 1 The NPLs developments.

Note: Figure 1 illustrate the evolution of NPLs among agents and currencies.

Source: (AAB 2024), (BoA 2024) and authors' calculations

contributed to decrease the NPLs for NFC and HH. According to Fink et al. (2016) the correlation between exchange rate fluctuations and NPLs is suggested to be stronger in the case of FC borrowing. Thus, exerting a greater influence on hedged compared to unhedged borrowers.

Remittances might reduce the credit risk of households as they provide a partial hedge for the beneficiaries as well increase the revenues Hudecz (2013) and Brown et al. (2012). As a matter of fact, most emigrants would bring money home not only to help consumption expenditures of their families, but also to buy properties (Alvarez, Briod and Ferrari 2015).

Bank and loan-specific factors include loans interest rate, capital adequacy ratio and return on assets. The interest rate is expected to have a negative relationship with the NPLs. The lower the interest rate, the lower the financial burden and therefore a lower credit risk. Capital adequacy ratio is calculated as the ratio of TIER 1 capital to risk weighted assets in percentage. Motivated by the hypothesis that banks with greater capital adequacy are safer we expect an inverse relation with the NPL ratio. The return on assets represents bank profitability, which measures the bank's ability to generate profits. We expect a negative relationship between NPLs and profitability. The greater the profits the lower the losses of the bank analyzed.

Table 1 provides a summary statistics for NPLs and its selected determinants.

Panel A: Dependent variables	N	Mean	Std.Dev.	1%	5%	10%	25%	50%	75%	90%	95%	99%
<i>NPL ratios</i>												
Private sector	1815	16	11	2.8	4.2	4.8	7.5	12.4	20.8	31.9	43.8	51.8
Private sector DC	1815	14	12	2.5	4.1	5.1	7.2	11.0	17.0	27.6	38.3	63.1
Private sector FC	1815	17	13	1.6	3.5	4.4	7.4	13.3	23.8	35.0	38.8	61.7
Private sector FC hedged	1815	16	12	1.1	2.6	3.6	6.3	12.7	21.3	33.7	41.2	54.2
Private sector FC unhedged	1815	16	13	1.4	2.2	3.1	5.9	11.7	21.7	31.2	43.8	64.0
Non-financial corporation	1815	18	13	2.8	4.0	5.0	8.3	14.6	24.5	39.5	49.6	57.8
Non-financial corporation DC	1814	17	14	1.2	3.1	4.9	7.9	12.9	21.8	36.7	46.6	70.0
Non-financial corporation FC	1815	19	14	1.2	3.3	4.3	8.0	14.5	25.8	39.6	46.0	66.0
Non-financial corporation FC hedged	1716	17	14	1.0	2.3	3.5	6.2	13.7	23.4	38.0	45.1	62.0
Non-financial corporation FC unhedged	1806	19	16	0.0	1.5	2.4	5.6	13.9	27.7	41.4	50.7	68.4
Households	1815	11	8	2.0	3.0	3.8	5.2	8.3	14.0	21.8	28.4	37.5
Households DC	1815	11	8	2.2	3.0	3.6	5.3	8.4	13.6	18.9	33.5	44.4
Households FC	1815	11	8	0.3	1.9	2.9	4.6	7.6	14.1	23.1	27.4	33.4
Households FC hedged	1716	12	14	0.4	1.3	1.9	4.4	7.8	14.5	26.6	32.6	56.8
Households FC unhedged	1815	11	9	0.2	1.0	2.1	4.1	7.8	15.3	24.2	27.5	35.7
<hr/>												
Panel B: Independent variables	N	Mean		Median		Std.Dev.		Min.		Max.		
<i>Bank indicators</i>												
Capital adequacy ratios	1492	16.7		15.5		6.8		8.1		50.0		
Return on assets	1492	0.4		0.6		1.5		-8.1		4.6		
Loans interest rate private sector	1584	7.2		6.9		2.4		2.6		16.4		
Loans interest rate private sector DC	1584	9.0		8.6		3.2		2.6		21.7		
Loans interest rate private sector FC	1584	6.2		6.1		1.9		1.2		12.6		
Loans interest rate non-financial corporation	1584	7.3		6.9		2.8		1.9		16.5		
Loans interest rate non-financial corporation DC	1584	8.4		8.1		3.3		1.6		21.5		
Loans interest rate non-financial corporation FC	1584	6.8		6.5		2.7		1.2		17.3		
Loans interest rate households	1584	7.7		7.1		3.0		2.4		19.9		
Loans interest rate households DC	1584	10.0		9.4		3.8		3.3		23.6		
Loans interest rate households FC	1584	5.7		5.3		2.4		0.8		13.0		
<i>Macroeconomic indicators</i>												
GDP growth	130	2.0		2.3		2.4		-11.2		4.4		
Exchange rate growth	132	-0.6		-0.4		2.8		-7.2		10.1		
Remittances as share of GDP	142	12.5		12.1		1.7		9.2		17.7		

Table 1 Summary statistics

Note: Table 1 provide main descriptive statistics of the variables used in the model namely: mean, median, standard deviation, minimum, maximum, and selected percentiles for the NPLs.

Source: (AAB 2024), (BoA 2024), and authors' calculations

4 Methodology

Determinants of non-performing loans can be synthesized to bank characteristics, loan-specific factors and macroeconomic events (Manz 2019). Bank and loan-specific factors aim at analyzing the failure of loan repayment under a micro approach, whereas macroeconomic events seek to the credit risk of agents under a macro approach. Our research focuses on both perspectives. We examine the relation between NPLs of hedged/unhedged borrowers, macroeconomic variables, and bank's characteristics counting for a distinguished and an asymmetric relationship. The challenge is to devise a research design powerful enough to explore the heterogeneity among agents' types and the connection with the hedging strategies.

4.1 The fixed effect model

To analyze the heterogeneity among banks we use a Fixed Effect (FE) model (Anderson and Hsiao 1981) and contrast it with the Random Effect (RE) model (Theil 1957). A FE model treats explanatory variables as non-random, while the RE model assumes that these variables are derived from random processes. As each bank's unique characteristics may influence the set of explanatory variables, FE model allows for control of variables which cannot be observed or measured, for example, management factors between banks. Our models with individual fixed effects empirical analysis is based on the following specification:

$$Y_{j,t} = \alpha Y_{j,t-1} + \beta_1 X_{1j,t} + \beta_2 X_{2,t} + \phi_{j,t} + \varepsilon_{j,t} \quad (1)$$

Where, Y_j is the dependent variable (the NPL ratio) for bank ' j '; X_{1j} comprises bank-specific variables (the capital adequacy ratios, return on assets, and the loan interest rate); X_2 includes macroeconomic indicators (economic activity, the exchange rate, and remittances); ϕ_j represent the unobserved individual bank specific effects; ε_j is the error term; and ' t ' stands for the time (a month). The RE model, follows the same specification excluding the ' ϕ_j ' term.

4.2 The quantile regression

To investigate the asymmetric relationship of NPLs, we follow the approach introduced by (Roger and Bassett 1978) and updated by (Koenker 2005). As illustrated by Engle and Manganelli (2004) regression quantile methods are naturally applied to risk estimation. We estimate conditional distributions of NPLs and examine whether macroeconomic variables and bank characteristics affect the likelihood of outcomes. Using quantile regression (QR) we estimate the conditional distribution of NPLs overall, domestic loans, foreign loans and hedged and unhedged borrowers. The downside credit risk represent the lower left hand side tail of the distribution (lower percentiles) indicating that the banking system will experience the lowest risk on loans given the macroeconomic situation and bank characteristics. Moving toward the right hand side of the distribution (higher percentiles) implies a higher risk.

We estimate the NPLs at different level of percentiles for the non-financial corporations, the households and the private sector as a whole. Especially we examine how the exchange rate impacts the NPLs for hedged versus unhedged borrowers over a defined period. Thus, if the NPLs of a bank hedged/unhedged borrower is 0.5% at the first percentile, there is only 1% chance that the NPLs will drop below 0.5% over any other percentile.

Formally, Y represent the NPLs and $F(y)$ its probability distribution function (Eq. (2)). For $\tau \in] 0; 1[$, the first quantile of NPLs ($\tau = 1\%$) is defined as the inverse cumulative distribution function of NPLs satisfying $F(y) \geq 1\%$ (Eq. (3)). Given n observations of Y , the sample quantile ' Q_τ ' is obtained by sorting the NPLs series in ascending order or by optimizing for the smallest deviation (Eq. (4)), where $\rho_\tau(u) = u(\tau - I(u < 0))$, is the so-called check function that weights positive and negative values asymmetrically.

$$F(y) = \text{probability } (Y \leq y) \quad (2)$$

$$Q(\tau) = \inf \{y: F(y) \geq \tau\} \quad (3)$$

$$Q_n(\tau) = \underset{\xi}{\operatorname{argmin}} \{\sum_i \rho_\tau(Y_i - \xi)\} \quad (4)$$

The QR allows for explanatory variables X , in our study namely the economic activity, the exchange rate, the loan interest rate, the capital adequacy ratios, and return on assets. Where the conditional quantile of NPLs is linearly related to explanatory variables. Therefore, the quantile minimization is the conditional QR estimator (Eq. (5))

$$\hat{\beta}_n(\tau) = \underset{\beta(\tau)}{\operatorname{argmin}} \{\sum_i \rho_\tau(Y_i - X_i' \beta(\tau))\} \quad (5)$$

To address the main question whether FC NPLs of unhedged borrowers is associated with a higher risk to exchange rate depreciation compared to hedged borrowers, we initially estimate the β_n parameters using the standard QR across various quantiles. Next, we estimate again the QR (Eq. (5)) by incorporating the additional explanatory variable remittances. In this context, X comprises economic activity, the exchange rate, the loan interest rate, the capital adequacy ratios, return on assets and remittances, solely for the households.

5 Results and discussion

The results from both the fixed effects and random effects models are presented in Table 2. The estimated parameters are similar across both models. The Hausman test (Hausman 1978) does not reject the null hypothesis of no significant difference between the models, indicating that bank-specific effects are not correlated with the explanatory variables (see Table A1 in the Annex for the Hausman test results). The variation in fixed effects, printed in Table A2 in Annex, suggests that each bank has unique unobserved characteristics that affect its NPL ratio such as management quality and risk management practices. However, given that the Hausman test fails to reject the null hypothesis, these unobserved effects do not significantly correlate with the regressors, ensuring that the estimated parameters remain representative

across banks. Nevertheless, panel quantile regression yields distinct parameters estimates across different quantiles, thereby reintroducing some degree of heterogeneity.

The results of the NPLs conditional on economic activity, exchange rate, loan interest rate, capital adequacy ratio, and the return on assets are presented in Table 3 for the private sector, Table 4 for non-financial corporations, and Table 5 for households, with distinctions made based on currency types and hedging positions.

The influence of macroeconomic variables on NPLs is statistically significant across most quantiles, demonstrating an asymmetric relationship, particularly at the higher percentiles. This observation corroborates the findings of Kanas et Molyneux (2018), who contend that there is no strong theoretical or empirical foundation for assuming a linear relationship between risk and macroeconomic variables.

Economic activity exerts a marginal and nearly flat impact on the lower percentiles of the NPLs, up to the 25th percentile for non-financial corporations and up to the 50th percentile for households. As we move towards higher percentiles, NPLs becomes increasingly sensitive to economic performance. At the 99th percentile, the relationship reverses, potentially due to the COVID-19 pandemic, which disrupted the connection between the financial and macroeconomic sectors (Skufi and Geršl 2023).

The depreciation of the exchange rate positively impacts private sector NPLs, consistent with Klein (2013), by Festić and Bekő (2008), and Kuzucu et Kuzucu (2019), who analyzed respectively CESEE countries, CE countries, and emerging economies. Exchange rate oscillations are statistically significant across most percentiles, exhibiting variability that confirms the presence of asymmetry as noted by Quagliariello (2007). As NPLs increase, credit risk becomes more sensitive to exchange rate volatility, corroborating the findings of Aydemir et al. (2023) for the Turkish banking system. Up to the 50th percentile, there is a homogenous response to exchange rate among currencies and hedging position, while the

	<i>Private sector</i>			<i>Non-financial corporations</i>			<i>Households</i>		
	FE		RE	FE		RE	FE		RE
<i>NPLs</i>									
Gross domestic product growth	-0.4	(0.1)	[-4.7]	-0.4	(0.1)	[-4.7]	-0.5	(0.1)	[-5.3]
Exchange rate growth	0.4	(0.1)	[3.5]	0.4	(0.1)	[3.6]	0.3	(0.1)	[1.8]
Loans interest rate	1.4	(0.1)	[10.7]	1.3	(0.1)	[10.5]	1.4	(0.2)	[9.0]
Capital adequacy ratios	0.3	(0.0)	[5.5]	0.3	(0.0)	[5.7]	0.2	(0.1)	[4.1]
Return on assets	-1.0	(0.2)	[-4.4]	-1	(0.2)	[-4.5]	-1.3	(0.3)	[-5.0]
Remittances							-1.3	(0.3)	[-5.1]
							-0.6	(0.1)	[-4.3]
							-1.5	(0.2)	[-6.5]
<i>NPLs DC</i>									
Gross domestic product growth	-0.3	(0.1)	[-4.1]	-0.3	(0.1)	[-4.1]	-0.5	(0.1)	[-5.2]
Exchange rate growth	0.4	(0.1)	[3.6]	0.4	(0.1)	[3.6]	-0.5	(0.1)	[-5.2]
Loans interest rate	0.8	(0.1)	[6.8]	0.8	(0.1)	[6.7]	0.1	(0.1)	[1.0]
Capital adequacy ratios	0.4	(0.0)	[7.6]	0.4	(0.0)	[7.6]	0.9	(0.2)	[6.0]
Return on assets	-1.2	(0.2)	[-5.9]	-1.3	(0.2)	[-6.0]	0.9	(0.2)	[6.0]
Remittances							0.3	(0.1)	[2.8]
							0.6	(0.0)	[13.3]
							-1.4	(0.2)	[-8.3]
							-1.4	(0.3)	[-5.5]
<i>NPLs FC</i>									
Gross domestic product growth	-0.4	(0.1)	[-5.1]	-0.4	(0.1)	[-5.0]	-0.6	(0.1)	[-5.0]
Exchange rate growth	0.3	(0.1)	[2.8]	0.4	(0.1)	[2.9]	-0.5	(0.1)	[-5.0]
Loans interest rate	1.4	(0.1)	[11.1]	1.4	(0.1)	[11.0]	0.9	(0.1)	[8.3]
Capital adequacy ratios	0.3	(0.1)	[6.0]	0.3	(0.1)	[6.2]	1.0	(0.1)	[7.3]
Return on assets	-0.8	(0.2)	[-3.6]	-0.8	(0.2)	[-3.7]	0.5	(0.1)	[5.7]
Remittances							0.0	(0.0)	[1.0]
							-0.3	(0.1)	[-2.2]
							-1.1	(0.2)	[-5.1]
<i>NPLs FC hedged</i>									
Gross domestic product growth	-0.4	(0.1)	[-4.2]	-0.4	(0.1)	[-4.1]	-0.4	(0.1)	[-3.8]
Exchange rate growth	0.3	(0.1)	[2.0]	0.3	(0.1)	[2.1]	-0.4	(0.1)	[-3.8]
Loans interest rate	1.3	(0.1)	[9.6]	1.3	(0.1)	[9.5]	0.6	(0.2)	[2.5]
Capital adequacy ratios	0.3	(0.1)	[5.4]	0.3	(0.1)	[5.6]	0.9	(0.3)	[2.7]
Return on assets	-1.5	(0.2)	[-6.2]	-1.5	(0.2)	[-6.2]	0.4	(0.2)	[1.8]
Remittances							-0.2	(0.1)	[-2.8]
							-1.0	(0.3)	[-3.4]
							-0.1	(0.5)	[-0.3]
<i>NPLs FC unhedged</i>									
Gross domestic product growth	-0.4	(0.1)	[-4.2]	-0.4	(0.1)	[-4.1]	-0.6	(0.1)	[-4.3]
Exchange rate growth	0.4	(0.1)	[2.7]	0.4	(0.1)	[2.8]	-0.6	(0.1)	[-4.3]
Loans interest rate	1.8	(0.2)	[11.5]	1.7	(0.2)	[11.4]	0.7	(0.2)	[4.3]
Capital adequacy ratios	0.4	(0.1)	[6.5]	0.4	(0.1)	[6.8]	0.7	(0.1)	[6.0]
Return on assets	0.3	(0.3)	[1.3]	0.3	(0.3)	[1.2]	0.4	(0.1)	[5.2]
Remittances							0.1	(0.0)	[3.3]
							-0.2	(0.2)	[-1.4]
							-1.2	(0.3)	[-4.4]

Table 2 Results of FE and RE models

Note: Table 2 provides the sensitivity of NPLs on macroeconomics and bank variables for FE and RE models, with standard errors in () and t-statistics in [].

Source: Authors' calculations

heterogeneity becomes more pronounced at the 95th and 99th percentiles. Indicating that exchange rate credit risk is higher in the right tail of the NPLs distribution.

Focusing on the hedging position, our findings indicate that for non-financial corporations, the balance sheet effect surpasses the trade channel, especially at higher percentiles, aligning with Fink et al. (2016), who noted that exchange rates affect NPLs primarily through the balance sheet effect. Also, currency depreciation increases the NPLs for the unhedged compared to the hedged one. This outcome is more pronounced in the right-hand side of the distribution. On the left-hand side of the distribution, hedged borrowers are slightly more sensitive to exchange rate fluctuations compared to unhedged borrowers, particularly up to 25th percentile. Also we find that the trade channel is not predominant, contrary to the findings of Bodnár (2009) and Bleakley et al. (2008).

In contrast to expectations, households exhibit an opposite trend. From the 5th percentile onwards, unhedged households demonstrate a lower sensitivity to exchange rate fluctuations compared to their hedged counterparts. This finding contradicts the balance sheet effect, which posits that exchange rate depreciation should theoretically exert a lesser impact on the incomes and solvency of hedged borrowers. While Brown et al. (2012), Hudecz (2013), and Alvarez et al. (2015) attribute this phenomenon to the presence of foreign income in foreign currencies, our analysis does not yield statistically significant evidence supporting this claim (see Table A3 in Annex). We propose that this behavior may instead be attributed to the increased prudence exercised by banks when granting foreign currency loans to unhedged households.

When comparing non-financial corporations with households, it is observed that hedged households exhibit greater sensitivity to exchange rate depreciation, particularly above the median percentiles. This finding aligns with the arguments Bethlendi (2011) and Verner et al. (2020), who suggest that firms are less affected by depreciation due to

their distinct hedging strategies. Conversely, the opposite trend is noted among unhedged borrowers. In our opinion this result may be attributed to households representing a safer profile compared to non-financial corporations. Most household loans are mortgages, which are considered significant life decisions, typically involving less risky borrower profiles and often accompanied by collateral. Furthermore, our results indicate that the hedging strategies affect differently the NPLs at the tails of the distribution concerning exchange rate depreciation.

The relationship between the NPLs and various bank indicators exhibits significant variation across different quantiles. For the lower percentiles, both loan interest rates and the capital adequacy ratio display the expected signs. However, these parameters become statistically insignificant at higher percentiles.

Regarding interest rates, we hypothesize that the observed results may be influenced by the “Action Plan for Reducing Non-Performing Loans” implemented by the Bank of Albania in 2015 (BoA 2015). This initiative aimed to mitigate the prevalence of non-performing loans within the banking system, potentially affecting the sensitivity of interest rates to NPLs.

In the case of the capital adequacy ratio, it is logical to infer that an increase in this ratio would lead to a reduction in the number of loans issued, thereby resulting in a higher NPLs. This outcome aligns with the theoretical expectation that a more robust capital base would constrain lending activities, thus increasing the proportion of non-performing loans.

Furthermore, our analysis suggests that return on assets plays a crucial role during periods characterized by high NPLs. Specifically, higher credit risk appears to incentivize better bank performance in efforts to reduce NPLs. This finding indicates that profitability, as measured by return on assets, becomes a significant factor in managing credit risk when

NPLs ratios are elevated. Conversely, at lower percentiles of NPLs, return on assets does not exhibit the expected sign, suggesting a different dynamic at play in less risky environments.

To assess the robustness of the observed asymmetry in quantile regressions, we employ panel least squares (LS) estimation (see Table A4 in the Annex). Initially, we use the full sample (Model 1) and subsequently divide the sample into pre- and post-2016 periods (Models 2 and 3), considering the decline in NPLs and the sustained appreciation of the Albanian Lek after 2016. The results reveal considerable variability, suggesting a non-linear relationship between NPLs and their determinants. Notably, the LS estimations confirm an asymmetric relationship with the exchange rate, as the pre- and post-2016 periods align with the depreciation and appreciation of the Lek, respectively.

	$\tau = 1\%$	$\tau = 5\%$	$\tau = 10\%$	$\tau = 25\%$	$\tau = 50\%$	$\tau = 75\%$	$\tau = 90\%$	$\tau = 95\%$	$\tau = 99\%$
<i>Gross domestic product growth</i>									
Private sector	0.0 (0.0) [-0.7]	-0.1 (0.0) [-2.8]	-0.1 (0.0) [-3.2]	-0.2 (0.0) [-5.3]	-0.4 (0.1) [-4.0]	-1.4 (0.2) [-8.1]	-2.0 (0.2) [-9.5]	-2.5 (0.3) [-9.4]	-0.4 (2.3) [-0.2]
Private sector DC	0.0 (0.0) [-2.0]	-0.1 (0.0) [-3.3]	-0.1 (0.0) [-4.3]	-0.1 (0.0) [-3.7]	-0.4 (0.1) [-6.0]	-0.9 (0.1) [-6.8]	-1.7 (0.3) [-6.5]	-2.7 (0.7) [-4.0]	-4.7 (0.2) [-21.5]
Private sector FC	0.0 (0.0) [-1.1]	-0.1 (0.0) [-3.0]	-0.1 (0.0) [-4.1]	-0.2 (0.0) [-4.0]	-0.3 (0.1) [-3.7]	-1.4 (0.2) [-8.6]	-1.9 (0.2) [-11.5]	-0.2 (4.5) [0.0]	3.1 (0.1) [21.3]
Private sector FC hedged	-0.1 (0.0) [-5.0]	-0.1 (0.0) [-2.7]	-0.1 (0.0) [-3.4]	-0.1 (0.0) [-3.1]	-0.3 (0.1) [-2.7]	-1.0 (0.2) [-4.2]	-1.3 (0.7) [-2.0]	-0.9 (3.2) [-0.3]	1.2 (4.9) [0.2]
Private sector FC unhedged	-0.1 (0.0) [-3.9]	-0.1 (0.0) [-2.4]	-0.1 (0.0) [-2.2]	-0.1 (0.1) [-2.5]	-0.5 (0.1) [-4.5]	-1.4 (0.2) [-7.0]	-2.2 (0.2) [-12.0]	-2.8 (0.3) [-10.0]	4.5 (0.5) [9.4]
<i>Exchange rate growth</i>									
Private sector	0.5 (0.0) [14.4]	0.3 (0.0) [5.7]	0.3 (0.1) [4.7]	0.2 (0.1) [2.9]	0.6 (0.1) [4.4]	1.0 (0.2) [4.3]	1.9 (0.3) [6.4]	3.0 (0.2) [14.6]	4.0 (0.5) [8.6]
Private sector DC	0.4 (0.1) [5.9]	0.3 (0.1) [4.3]	0.2 (0.1) [3.4]	0.2 (0.1) [2.5]	0.5 (0.1) [5.6]	0.8 (0.2) [4.0]	0.9 (0.4) [2.2]	2.7 (0.6) [4.5]	4.3 (0.3) [14.0]
Private sector FC	0.3 (0.0) [11.4]	0.2 (0.0) [5.0]	0.2 (0.1) [4.3]	0.4 (0.1) [4.4]	0.7 (0.2) [4.2]	1.2 (0.3) [4.8]	1.4 (0.3) [4.1]	2.0 (1.7) [1.2]	3.3 (0.2) [18.1]
Private sector FC hedged	0.2 (0.0) [7.4]	0.2 (0.0) [5.5]	0.3 (0.1) [5.8]	0.4 (0.1) [4.6]	1.0 (0.1) [7.3]	0.4 (0.2) [1.8]	1.1 (0.3) [3.6]	1.8 (0.7) [2.6]	3.0 (1.1) [2.7]
Private sector FC unhedged	0.3 (0.0) [7.4]	0.2 (0.1) [3.8]	0.2 (0.1) [2.8]	0.1 (0.1) [0.7]	0.4 (0.1) [3.1]	1.9 (0.2) [10.5]	1.9 (0.5) [3.6]	2.9 (0.6) [5.1]	4.9 (0.5) [10.4]
<i>Loans interest rate</i>									
Private sector	0.1 (0.0) [4.8]	0.3 (0.0) [9.2]	0.4 (0.0) [10.3]	0.5 (0.1) [8.1]	0.6 (0.2) [3.2]	0.4 (0.6) [0.7]	-1.0 (0.6) [-1.7]	-1.5 (0.5) [-2.8]	-0.6 (0.3) [-2.0]
Private sector DC	0.0 (0.1) [0.3]	0.3 (0.0) [7.1]	0.3 (0.0) [8.0]	0.4 (0.1) [6.2]	0.6 (0.2) [3.1]	0.4 (0.4) [0.9]	-1.5 (0.4) [-3.3]	-3.6 (0.9) [-4.2]	-5.6 (0.3) [-18.8]
Private sector FC	0.0 (0.1) [0.5]	0.3 (0.1) [5.9]	0.4 (0.0) [9.8]	0.4 (0.1) [6.3]	0.7 (0.2) [2.9]	-0.4 (0.4) [-1.2]	0.4 (0.5) [0.8]	1.3 (1.1) [1.2]	2.1 (0.3) [7.7]
Private sector FC hedged	0.1 (0.0) [5.5]	0.2 (0.0) [3.6]	0.3 (0.0) [7.0]	0.3 (0.1) [4.0]	1.0 (0.3) [3.4]	1.7 (0.6) [3.0]	0.9 (0.8) [1.1]	0.7 (0.9) [0.7]	2.4 (1.4) [1.7]
Private sector FC unhedged	0.1 (0.1) [1.6]	0.2 (0.1) [1.7]	0.4 (0.1) [2.8]	0.7 (0.1) [7.2]	0.7 (0.1) [6.1]	0.4 (0.4) [1.1]	-1.5 (0.3) [-5.0]	-2.3 (0.5) [-4.6]	0.9 (1.2) [0.7]
<i>Capital adequacy ratios</i>									
Private sector	-0.1 (0.0) [-3.4]	-0.1 0.0 [-2.0]	-0.1 (0.0) [-1.8]	-0.2 (0.1) [-2.4]	0.1 (0.1) [1.6]	0.7 (0.1) [11.6]	0.8 (0.0) [18.7]	0.8 (0.1) [15.7]	0.6 (0.1) [7.5]
Private sector DC	-0.1 (0.1) [-1.0]	-0.2 (0.1) [-2.5]	-0.1 (0.1) [-2.1]	-0.1 (0.1) [-1.4]	0.0 0.0 [0.8]	0.5 (0.1) [13.4]	1.0 (0.3) [3.1]	1.3 (0.5) [2.5]	0.4 (0.4) [1.0]
Private sector FC	-0.2 (0.0) [-5.3]	-0.1 0.0 [-2.7]	-0.1 (0.1) [-2.3]	0.0 (0.1) [0.5]	0.4 (0.1) [4.4]	0.9 (0.1) [19.8]	1.1 (0.0) [24.8]	0.9 (0.1) [10.4]	0.8 (0.0) [31.3]
Private sector FC hedged	0.0 (0.0) [0.2]	-0.1 0.0 [-2.6]	-0.1 (0.1) [-1.2]	0.1 (0.1) [0.9]	0.5 (0.1) [6.2]	0.7 (0.1) [9.4]	0.9 (0.1) [13.2]	0.8 (0.1) [11.3]	0.9 (1.0) [0.9]
Private sector FC unhedged	0.0 (0.0) [-0.7]	0.0 (0.1) [-0.8]	0.0 (0.1) [-0.5]	0.2 (0.1) [2.5]	0.4 (0.1) [3.9]	1.0 (0.1) [13.2]	1.3 (0.0) [31.0]	1.2 (0.1) [23.3]	1.4 (0.4) [4.0]
<i>Return on assets</i>									
Private sector	0.6 (0.1) [4.5]	0.7 (0.2) [3.1]	0.7 (0.3) [2.7]	0.9 (0.3) [3.4]	0.0 (0.3) [0.1]	-2.1 (0.5) [-4.6]	-3.5 (0.4) [-9.3]	-2.7 (0.4) [-6.2]	-2.0 (0.7) [-2.8]
Private sector DC	-0.1 (0.2) [-0.3]	0.7 (0.2) [3.7]	0.7 (0.2) [3.4]	0.3 (0.2) [1.3]	-1.0 (0.3) [-3.6]	-2.8 (0.3) [-10.9]	-4.3 (0.9) [-4.8]	-5.3 (0.5) [-10.2]	-2.7 (0.6) [-4.4]
Private sector FC	0.4 (0.2) [2.3]	0.3 (0.3) [1.1]	0.7 (0.3) [2.2]	0.8 (0.3) [3.1]	-0.1 (0.3) [-0.4]	-2.6 (0.3) [-7.9]	-2.2 (0.3) [-7.0]	-1.3 (0.4) [-3.7]	-1.1 (0.1) [-7.6]
Private sector FC hedged	0.9 (0.1) [6.4]	1.1 (0.2) [4.9]	1.1 (0.2) [5.3]	1.3 (0.2) [6.1]	0.7 (0.4) [1.7]	-1.7 (0.4) [-4.7]	-2.3 (0.4) [-5.1]	-2.2 (0.6) [-3.8]	-1.3 (1.0) [-1.3]
Private sector FC unhedged	-0.1 (0.2) [-0.5]	-0.3 (0.3) [-1.0]	-0.3 (0.4) [-1.0]	-1.4 (0.3) [-5.4]	-0.7 (0.2) [-2.8]	-1.4 (0.3) [-4.3]	-1.6 (0.4) [-4.5]	-0.2 (0.5) [-0.5]	0.5 (0.5) [1.1]

Table 3 Results of multivariate QR models for private sector

Note: Table 3 provide the sensitivity of NPLs condition on macroeconomics and bank variables for selected percentiles, with standard errors in () and t-statistics in [].

Source: Authors' calculations

	$\tau = 1\%$	$\tau = 5\%$	$\tau = 10\%$	$\tau = 25\%$	$\tau = 50\%$	$\tau = 75\%$	$\tau = 90\%$	$\tau = 95\%$	$\tau = 99\%$
<i>Gross domestic product growth</i>									
Non-financial corporations	0.0 (0.0) [0.0]	-0.1 (0.0) [-3.6]	-0.1 0.0 [-3.9]	-0.2 0.0 [-5.2]	-0.5 (0.1) [-4.3]	-1.6 (0.2) [-6.8]	-2.9 (0.3) [-10.8]	-3.2 (0.2) [-13.1]	-0.9 (2.2) [-0.4]
Non-financial corporations DC	0.0 (0.0) [-2.2]	-0.1 (0.0) [-3.3]	-0.2 0.0 [-5.0]	-0.3 0.0 [-5.7]	-0.5 (0.1) [-4.5]	-1.4 (0.2) [-8.9]	-2.7 (0.5) [-5.0]	-3.4 (0.8) [-4.2]	-5.0 (0.5) [-9.8]
Non-financial corporations FC	0.0 (0.0) [-1.2]	-0.1 (0.0) [-3.5]	-0.2 0.0 [-4.1]	-0.3 (0.1) [-3.8]	-0.4 (0.1) [-3.7]	-1.4 (0.3) [-5.4]	-2.2 (0.2) [-9.7]	-1.8 (2.7) [-0.6]	3.0 (3.7) [0.8]
Non-financial corporations FC hedged	0.0 (0.0) [2.0]	-0.1 (0.0) [-3.0]	-0.1 0.0 [-2.8]	-0.2 (0.1) [-3.0]	-0.2 (0.1) [-2.1]	-0.9 (0.3) [-3.5]	-1.6 (0.6) [-2.6]	-1.7 (0.7) [-2.3]	2.3 (4.4) [0.5]
Non-financial corporations FC unhedged	-0.1 (0.0) [-2.1]	0.0 (0.0) [-0.8]	-0.1 0.0 [-1.5]	-0.2 (0.1) [-2.7]	-0.9 (0.2) [-5.0]	-1.7 (0.4) [-4.2]	-1.8 (-1.0) [-1.9]	-1.4 (0.7) [-2.1]	2.5 (1.7) [1.5]
<i>Exchange rate growth</i>									
Non-financial corporations	0.4 (0.1) [8.7]	0.2 (0.1) [3.3]	0.2 (0.1) [2.3]	0.2 (0.1) [2.4]	0.9 (0.2) [5.4]	0.7 (0.3) [2.0]	2.3 (0.3) [7.7]	2.9 (0.3) [10.6]	3.9 (0.5) [7.4]
Non-financial corporations DC	0.4 (0.1) [6.1]	0.3 (0.1) [3.3]	0.1 (0.1) [1.0]	0.0 (0.1) [0.2]	0.6 (0.1) [4.2]	0.9 (0.2) [3.8]	1.9 (0.4) [4.8]	3.2 (0.4) [8.4]	3.7 (0.6) [6.2]
Non-financial corporations FC	0.5 (0.0) [11]	0.2 (0.1) [3.8]	0.2 (0.1) [2.5]	0.5 (0.1) [4.3]	0.8 (0.2) [4.3]	0.7 (0.5) [1.6]	1.4 (0.4) [3.3]	1.2 (1.0) [1.2]	4.1 (1.2) [3.4]
Non-financial corporations FC hedged	0.3 (0.0) [8.6]	0.2 (0.1) [3.1]	0.3 (0.1) [4.1]	0.4 (0.1) [4.1]	1.0 (0.2) [5.6]	0.1 (0.2) [0.6]	1.2 (0.3) [4.2]	2.1 (0.3) [6.7]	2.6 (1.4) [1.9]
Non-financial corporations FC unhedged	0.0 (0.0) [0.6]	0.0 (0.1) [0.5]	0.1 (0.1) [1.1]	0.2 (0.1) [1.7]	1.0 (0.2) [4.1]	0.9 (0.5) [2.0]	1.6 (0.6) [2.8]	2.1 (0.5) [4.1]	4.1 (1.1) [3.7]
<i>Loans interest rate</i>									
Non-financial corporations	0.0 (0.0) [0.1]	0.2 0.0 [4.9]	0.3 0.0 [6.5]	0.4 (0.1) [5.9]	0.7 (0.3) [2.8]	-0.4 (0.7) [-0.6]	-3.1 (0.4) [-6.9]	-2.4 (0.6) [-3.9]	-1.0 (0.4) [-2.7]
Non-financial corporations DC	0.0 (0.1) [0.6]	0.1 (0.1) [1.0]	0.2 (0.1) [3.7]	0.3 (0.1) [4.3]	0.6 (0.2) [2.5]	-0.2 (0.4) [-0.4]	-3.7 (0.4) [-9.3]	-5.2 (0.6) [-9.3]	-6.1 (1.2) [-5.1]
Non-financial corporations FC	-0.1 (0.0) [-1.5]	0.2 (0.1) [3.9]	0.4 (0.1) [6.7]	0.3 (0.1) [4.0]	1.2 (0.3) [3.6]	1.2 (0.9) [1.3]	1.3 (0.8) [1.5]	2.9 (0.9) [3.2]	0.7 (1.2) [0.6]
Non-financial corporations FC hedged	0.1 (0.0) [4.0]	0.1 (0.1) [1.9]	0.3 0.0 [6.1]	0.4 (0.1) [6.1]	1.5 (0.5) [3.0]	2.3 (0.6) [3.6]	1.0 (0.6) [1.6]	1.1 (0.8) [1.4]	4.9 (1.6) [3.2]
Non-financial corporations FC unhedged	-0.2 (0.1) [-2.1]	0.0 (0.2) [0.2]	0.1 (0.2) [0.6]	0.4 (0.1) [3.8]	0.2 (0.2) [1.1]	-0.5 (0.5) [-1.0]	-2.0 (0.5) [-3.6]	-2.4 (0.6) [-4.1]	-1.1 (1.5) [-0.7]
<i>Capital adequacy ratios</i>									
Non-financial corporations	0.0 (0.0) [0.7]	-0.1 (0.1) [-1.1]	-0.1 (0.1) [-1.3]	-0.2 (0.1) [-2.0]	0.2 (0.1) [1.7]	0.7 (0.1) [10.5]	0.9 (0.1) [16.9]	0.7 (0.1) [11.4]	0.5 (0.1) [8.4]
Non-financial corporations DC	-0.2 (0.1) [-2.3]	-0.1 (0.1) [-1.0]	-0.1 (0.1) [-0.7]	0.1 (0.1) [1.5]	0.1 (0.1) [2.1]	0.4 (0.1) [7.6]	1.4 (0.4) [3.8]	1.9 (0.6) [3.3]	0.8 (1) [0.7]
Non-financial corporations FC	-0.2 (0.0) [-5.1]	-0.2 (0.1) [-3.8]	-0.2 (0.1) [-3.3]	-0.1 (0.1) [-0.5]	0.2 (0.1) [2.1]	1.0 (0.1) [12.8]	0.7 (0.1) [8.0]	0.7 (0.1) [10.5]	0.8 (0.1) [7.2]
Non-financial corporations FC hedged	-0.1 (0.0) [-2.0]	-0.2 (0.1) [-2.7]	-0.1 (0.1) [-1.5]	-0.1 (0.1) [-0.8]	0.5 (0.1) [5.4]	0.6 (0.1) [9.1]	0.8 (0.1) [10.0]	0.7 (0.1) [10.6]	0.2 (0.1) [1.8]
Non-financial corporations FC unhedged	0.0 (0.0) [1.0]	0.0 (0.1) [-0.4]	0.0 (0.1) [-0.3]	0.2 (0.1) [2.3]	0.2 (0.1) [1.6]	1.0 (0.2) [4.5]	1.1 (0.1) [19.0]	1.0 (0.1) [19.7]	0.7 (0.1) [5.4]
<i>Return on assets</i>									
Non-financial corporations	0.0 (0.2) [-0.2]	1.3 (0.3) [4.2]	1.3 (0.3) [4.2]	1.4 (0.3) [5.0]	0.3 (0.3) [0.8]	-2.9 (0.5) [-5.9]	-4.0 (0.3) [-13.2]	-2.5 (0.5) [-5.6]	-2.1 (0.7) [-3.1]
Non-financial corporations DC	0.3 (0.2) [1.5]	0.8 (0.3) [2.5]	1.2 (0.3) [4.0]	0.8 (0.3) [2.6]	0.0 (0.3) [0.0]	-2.7 (0.3) [-10.4]	-3.6 (0.8) [-4.8]	-4.3 (0.4) [-11.6]	-2.2 (0.6) [-3.7]
Non-financial corporations FC	0.7 (0.2) [3.3]	0.8 (0.3) [2.6]	1.2 (0.3) [3.5]	1.5 (0.3) [5.1]	-0.4 (0.5) [-0.8]	-2.1 (0.6) [-3.6]	-2.0 (0.5) [-3.8]	-1.6 (0.5) [-3.1]	-3.2 (1.1) [-3]
Non-financial corporations FC hedged	0.9 (0.2) [5.5]	1.2 (0.2) [4.7]	1.0 (0.2) [4.3]	1.4 (0.2) [5.8]	1.0 (0.5) [2.1]	-2.1 (0.4) [-4.8]	-2.2 (0.4) [-5.7]	-2.1 (0.5) [-4.1]	-0.9 (0.6) [-1.4]
Non-financial corporations FC unhedged	0.0 (0.1) [0.4]	0.6 (0.2) [3.4]	0.6 (0.2) [2.6]	-0.2 (0.4) [-0.6]	0.4 (0.5) [0.8]	-2.8 (0.7) [-4.0]	-3.0 (0.4) [-7.1]	-2.5 (0.4) [-6.4]	-1.1 (1.0) [-1.1]

Table 4 Results of multivariate QR models for non-financial corporations

Note: Table 4 provide the sensitivity of NPLs condition on macroeconomics and bank variables for selected percentiles, with standard errors in () and t-statistics in [].

Source: Authors' calculations

	$\tau = 1\%$	$\tau = 5\%$	$\tau = 10\%$	$\tau = 25\%$	$\tau = 50\%$	$\tau = 75\%$	$\tau = 90\%$	$\tau = 95\%$	$\tau = 99\%$
<i>Gross domestic product growth</i>									
Households	0.0 (0.0) [-0.3]	0.0 (0.0) [-1.6]	0.0 (0.0) [-0.4]	-0.1 (0.0) [-4.0]	-0.3 (0.1) [-4.7]	-1.1 (0.1) [-11.1]	-1.2 (0.2) [-5.6]	-1.4 (0.3) [-5.4]	-1.8 (0.7) [-2.8]
Households DC	0.0 (0.0) [0.8]	0.0 (0.0) [1.0]	0.0 (0.0) [0.5]	-0.1 (0.0) [-2.3]	-0.2 (0.1) [-2.6]	-0.4 (0.2) [-2.6]	-0.7 (0.2) [-3.4]	-1.2 (0.2) [-5.3]	-2.5 (0.1) [-16.7]
Households FC	-0.1 (0.0) [-7.1]	-0.1 (0.0) [-5.0]	-0.1 (0.0) [-3.4]	-0.1 (0.0) [-3.8]	-0.2 (0.1) [-3.0]	-1.1 (0.1) [-8.3]	-1.5 (0.2) [-9.8]	-1.6 (0.2) [-6.5]	-1.3 (0.5) [-2.9]
Households FC hedged	-0.1 (0.0) [-3.9]	-0.1 (0.0) [-3.0]	-0.1 (0.0) [-4.2]	-0.1 (0.0) [-3.1]	-0.3 (0.1) [-5.0]	-1.0 (0.2) [-5.0]	-1.6 (0.2) [-7.3]	-2.2 (0.2) [-8.9]	-3.5 (0.3) [-12.8]
Households FC unhedged	-0.1 (0.0) [-8.3]	-0.1 (0.0) [-3.4]	-0.1 (0.0) [-4.3]	-0.2 (0.0) [-5.0]	-0.3 (0.1) [-2.3]	-0.8 (0.2) [-3.6]	-1.2 (0.2) [-5.3]	-1.3 (0.2) [-5.3]	0.4 (2.5) [0.2]
<i>Exchange rate growth</i>									
Households	0.4 (0.0) [12.4]	0.2 (0.0) [7.3]	0.3 (0.0) [8.2]	0.2 (0.0) [6.2]	0.5 (0.1) [6.0]	1.4 (0.1) [12.3]	1.8 (0.1) [22.3]	2.2 (0.2) [13.8]	2.5 (0.3) [7.6]
Households DC	0.3 (0.0) [8.3]	0.4 (0.1) [5.9]	0.4 (0.0) [8.4]	0.4 (0.0) [7.4]	0.6 (0.1) [8.1]	0.7 (0.1) [4.9]	1.2 (0.2) [7.1]	1.6 (0.2) [8.6]	2.8 (0.2) [11.6]
Households FC	0.3 (0.0) [13.1]	0.3 (0.0) [8.6]	0.3 (0.0) [7.5]	0.2 (0.1) [3.0]	0.3 (0.1) [3.8]	1.4 (0.1) [10.4]	2.0 (0.1) [16.0]	2.3 (0.1) [16.6]	2.2 (0.2) [9.7]
Households FC hedged	0.1 (0.0) [2.4]	0.2 (0.0) [3.3]	0.2 (0.1) [4.2]	0.4 (0.1) [6.3]	0.7 (0.1) [8.0]	1.6 (0.1) [10.7]	2.4 (0.1) [18.0]	2.7 (0.2) [15.2]	4.8 (0.5) [9.9]
Households FC unhedged	0.1 (0.0) [4.8]	0.2 (0.0) [5.2]	0.1 (0.0) [2.7]	0.0 (0.1) [0.5]	0.3 (0.1) [2.9]	1.1 (0.2) [6.0]	1.7 (0.2) [10.1]	1.7 (0.3) [6.5]	2.6 (0.5) [5.0]
<i>Loans interest rate</i>									
Households	0.3 (0.1) [5.3]	0.6 (0.1) [11.2]	0.6 (0.1) [13.9]	0.6 (0.1) [14.3]	0.4 (0.1) [4.4]	-0.6 (0.1) [-4.0]	-0.8 (0.2) [-4.6]	-0.9 (0.5) [-1.9]	-1.1 (2.1) [-0.5]
Households DC	0.2 (0.0) [8.1]	0.2 (0.0) [4.2]	0.3 (0.1) [5.5]	0.4 (0.1) [6.7]	0.5 (0.1) [5.3]	0.7 (0.2) [3.0]	0.1 (0.3) [0.5]	-0.6 (0.3) [-2.0]	-2.0 (0.6) [-3.6]
Households FC	0.3 (0.0) [11.9]	0.4 (0.0) [9.9]	0.5 (0.1) [9.9]	0.5 (0.1) [9.1]	0.7 (0.1) [6.4]	-0.4 (0.1) [-3.3]	-1.3 (0.1) [-11.5]	-1.5 (0.2) [-9.2]	-0.4 (0.9) [-0.4]
Households FC hedged	0.0 (0.0) [0.9]	0.1 (0.1) [1.0]	0.3 (0.1) [4.7]	0.4 (0.1) [5.6]	0.1 (0.1) [1.5]	-1.0 (0.2) [-4.5]	-1.6 (0.3) [-5.5]	-2.1 (0.4) [-5.7]	0.5 (1.9) [0.3]
Households FC unhedged	0.3 (0.0) [6.0]	0.5 (0.1) [8.6]	0.5 (0.1) [8.8]	0.6 (0.1) [6.9]	0.9 (0.1) [6.2]	0.1 (0.2) [0.6]	-0.7 (0.2) [-4.8]	-1.2 (0.2) [-7.6]	1.3 (1.1) [1.2]
<i>Capital adequacy ratios</i>									
Households	0.0 (0.0) [1.5]	0.0 (0.0) [1.6]	0.0 0.0 [-0.3]	-0.1 (0.1) [-2.0]	0.2 (0.1) [2.6]	0.6 (0.1) [21.7]	0.7 (0.0) [15.9]	1.2 (0.3) [4.1]	1.1 (1.2) [0.9]
Households DC	0.0 (0.0) [2.2]	0.0 (0.0) [-0.1]	-0.1 0.0 [-3.2]	-0.1 (0.1) [-4.0]	0.0 (0.1) [-0.2]	0.7 (0.1) [10.2]	0.9 (0.0) [32.7]	0.9 (0.1) [10.3]	0.7 (0.1) [5.8]
Households FC	0.1 (0.0) [5.6]	0.1 (0.0) [2.8]	0.0 0.0 [1.6]	0.0 (0.1) [0.9]	0.2 (0.0) [4.8]	0.3 (0.1) [7.5]	0.9 (0.1) [7.0]	1.0 (0.2) [5.8]	1.1 (0.5) [2.5]
Households FC hedged	0.0 (0.0) [-0.7]	0.0 (0.0) [-0.2]	0.0 0.0 [0.6]	0.2 (0.1) [2.8]	0.4 (0.0) [9.0]	0.6 (0.1) [6.5]	1.2 (0.2) [5.6]	1.4 (0.2) [5.8]	2.2 (0.4) [6.0]
Households FC unhedged	0.1 (0.0) [5.1]	0.1 (0.0) [2.7]	0.1 0.0 [2.2]	0.1 (0.1) [1.5]	0.2 (0.0) [4.9]	0.3 (0.2) [1.9]	0.9 (0.2) [4.4]	1.1 (0.2) [6.0]	1.8 (0.6) [3.3]
<i>Return on assets</i>									
Households	0.7 (0.2) [4.5]	0.6 (0.2) [2.9]	0.5 (0.2) [2.5]	0.1 (0.1) [1.0]	-0.8 (0.2) [-3.4]	-2.0 (0.2) [-12.3]	-2.0 (0.2) [-12.3]	-2.0 (0.4) [-4.7]	-2.5 (1.1) [-2.3]
Households DC	0.4 (0.2) [2.2]	0.2 (0.3) [0.6]	0.0 (0.2) [0.1]	-0.3 (0.2) [-2.2]	-1.0 (0.2) [-5.9]	-2.6 (0.2) [-12.5]	-3.8 (0.2) [-18.0]	-4.2 (0.3) [-15.3]	-3.7 (0.5) [-7.6]
Households FC	0.1 (0.1) [0.7]	0.3 (0.2) [2.0]	0.4 (0.2) [2.3]	-0.1 (0.2) [-0.8]	-0.7 (0.2) [-3.8]	-0.8 (0.2) [-4.2]	-1.2 (0.3) [-4.9]	-1.1 (0.3) [-3.2]	-1.2 (0.5) [-2.2]
Households FC hedged	0.5 (0.1) [3.5]	0.5 (0.2) [2.2]	0.5 (0.3) [1.6]	0.0 (0.2) [-0.1]	-0.2 (0.2) [-0.8]	-1.5 (0.3) [-4.4]	-3.8 (0.3) [-12.9]	-4.2 (0.3) [-13.9]	-7.8 (0.8) [-9.6]
Households FC unhedged	-0.4 (0.1) [-3.2]	-0.3 (0.2) [-1.9]	-0.2 (0.2) [-1.0]	-0.3 (0.2) [-1.5]	-0.6 (0.2) [-2.6]	-0.1 (0.3) [-0.5]	-0.9 (0.5) [-1.7]	-0.7 (0.6) [-1.2]	-0.4 (0.8) [-0.5]

Table 5 Results of multivariate QR models for households

Note: Table 5 provide the sensitivity of NPLs condition on macroeconomics and bank variables for selected percentiles, with standard errors in () and t-statistics in [].

Source: Authors' calculations

6 Conclusions

The banking sector is pivotal in economic development, primarily through its role in financial intermediation between savers and borrowers. The discourse on NPL ratio is critical, as defaults pose a threat to economic growth. Existing literature on this topic has limitations, particularly concerning the hedging positions of borrowers. Additionally, many previous works call to the reference, but do not take into account the difference in distribution among the different percentiles of NPLs related to currency depreciation.

Our research reaffirms the key determinants of NPLs by employing fixed effect model and Panel Quantile Regression, thereby contributing to a deeper understanding and extension of existing models through insights into borrowers' hedging profiles. By analyzing data from 11 banks in Albania, we differentiate between hedged and unhedged foreign currency loans and categorize them by borrower segment (households vs. non-financial corporations). We construct a Panel Quantile Regression model with the NPL ratio as the dependent variable, enabling us to investigate the determinants of credit risk across various quantiles. For this analysis, we select six macroeconomic and banking factors, drawn from existing literature, to examine their influence on NPLs.

Among the analyzed percentiles, the majority of determinants yielded statistically significant results. The relationship between NPLs and its determinants is asymmetric across the percentiles, with borrower heterogeneity being more pronounced in the right tail of the distribution.

Regarding hedging strategies, FC credit risk of unhedged borrowers is associated with a higher risk of exchange rate depreciation compared to hedged borrowers in the case of non-financial corporations. Conversely, for households, the opposite holds true. Furthermore, our results indicates that the hedging strategies affects differently the NPLs at the tails of the distribution concerning exchange rate depreciation.

Our findings indicate that during periods of elevated NPLs, credit risk exhibits heightened sensitivity to macroeconomic developments and financial conditions. Consequently, it is imperative for policymakers to promote market competition to enhance efficiency. Policymakers and financial institutions can utilize these insights to refine risk assessment frameworks and devise targeted interventions. Regulatory frameworks should underscore the significance of rigorous credit risk assessment and implement optimal capital adequacy requirements for banks to achieve a balance between growth and risk.

We identify the primary limitation of this study as the absence of a comparative analysis with other countries. How might hedging strategies have influenced the impact of exchange rate depreciation across varying levels of non-performing loan (NPL) ratios in other euroized economies? For future research, we recommend investigating time-varying distributions with additional determinants of NPLs and evaluating the effectiveness of risk mitigation strategies in a dynamic environment.

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Annex

In Figure A1 we illustrate the heterogeneity across banks by constructing fan-charts for the NPLs among agents and currencies. In each graph we show the median and three bands for the respective quantiles [0.05-0.95 quantiles; 0.10-0.90 quantiles; and 0.35-0.65 quantiles]. The bands for outer quantiles are much wider and asymmetric compared to 0.35-0.65 quantiles band. This outcome indicates that the distribution of NPLs across banks is not uniform. At the same time, the culminating points reflect the presence of outliers. Outliers seems to be more dominant in the case of households borrowing in FC.

The fan-charts are wider and more asymmetric during the high NPLs period 2012-2016, showing a high credit risk at the time and a lot of variability among banks. The variation across banks is more pronounced in the case of non-financial corporation compared to households. This heterogeneity, in our opinion, may be related to the business sector that each banks target. Banks heterogeneity appears with no distinguishing trait amongst currencies.

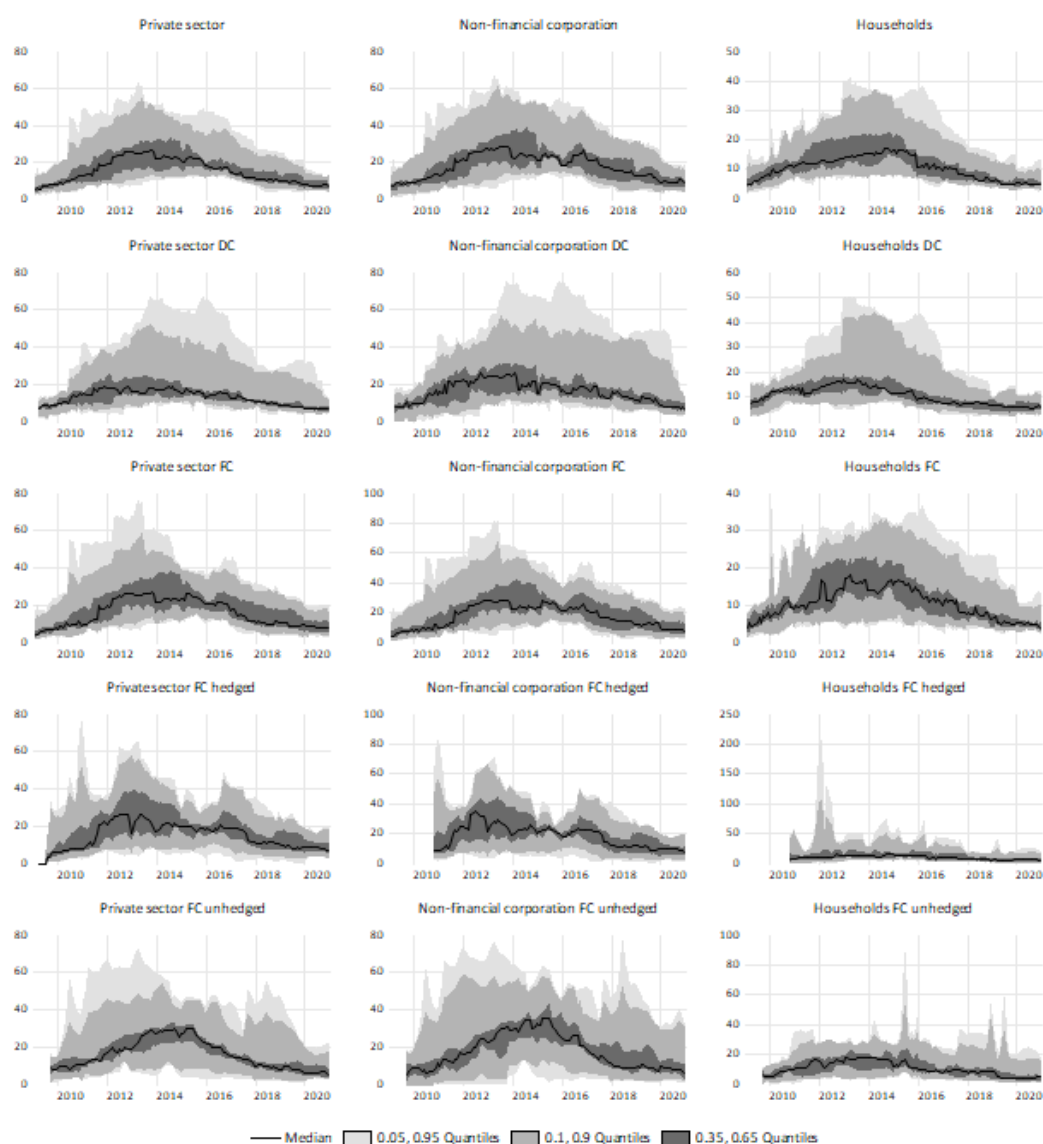


Figure A1 The NPLs fan-charts

Note: Figure A1 presents fan-charts for the NPLs among agents and currencies for the bands: [0.05-0.95], [0.10-0.90], [0.35-0.65] and the median.

Source: Authors' calculations

	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
<i>Private sector</i>			
NPLs	4.5	5.0	0.5
NPLs DC	2.1	5.0	0.8
NPLs FC	5.0	5.0	0.4
NPLs FC hedged	5.2	5.0	0.4
NPLs FC unhedged	4.9	5.0	0.4
<i>Non-financial corporations</i>			
NPLs	3.4	5.0	0.6
NPLs DC	2.3	5.0	0.8
NPLs FC	0.0	5.0	1.0
NPLs FC hedged	0.0	5.0	1.0
NPLs FC unhedged	0.0	5.0	1.0
<i>Households</i>			
NPLs	0.0	6.0	1.0
NPLs DC	0.0	6.0	1.0
NPLs FC	0.0	6.0	1.0
NPLs FC hedged	0.0	6.0	1.0
NPLs FC unhedged	0.0	6.0	1.0

Table A1 Results of Hausman test

Note: Table A3 provide the Hausman test statistic value along with the associated p-value.

Source: Authors' calculations

	<i>Private sector</i>	<i>Non-financial corporations</i>	<i>Households</i>
<i>NPLs</i>			
Bank 1	4.9	9.1	-4.1
Bank 2	-2.0	-3.6	-2.7
Bank 3	-9.7	-11.7	-4.0
Bank 4	-3.5	-2.0	-4.2
Bank 5	11.7	12.8	10.2
Bank 6	-6.1	-9.6	-0.1
Bank 7	-4.4	-3.3	-5.4
Bank 8	2.6	1.3	-0.9
Bank 9	0.2	-1.8	4.6
Bank 10	6.4	10.8	3.5
Bank 11	-0.1	-1.9	3.0
<i>NPLs DC</i>			
Bank 1	-2.2	-1.0	-1.7
Bank 2	-0.4	-2.8	0.1
Bank 3	-7.5	-10.5	-4.5
Bank 4	-3.8	-3.4	-2.9
Bank 5	18.8	22.8	11.8
Bank 6	-4.6	-8.6	2.9
Bank 7	-3.4	-2.4	-3.4
Bank 8	-0.4	-2.0	-1.3
Bank 9	-4.3	-5.3	-3.6
Bank 10	6.5	13.0	0.3
Bank 11	1.1	0.3	2.3
<i>NPLs FC</i>			
Bank 1	8.6	11.5	-6.6
Bank 2	-2.6	-1.7	-5.2
Bank 3	-9.0	-12.8	-2.2
Bank 4	-4.8	-0.3	-1.8
Bank 5	7.8	6.3	11.5
Bank 6	-5.5	-8.6	-6.2
Bank 7	-4.4	-3.7	-6.0
Bank 8	4.2	3.1	-0.2
Bank 9	1.1	-1.1	9.4
Bank 10	5.3	10.0	3.8
Bank 11	-0.6	-2.7	3.3
<i>NPLs FC hedged</i>			
Bank 1	9.7	12.4	-3.8
Bank 2	-2.4	-3.5	-8.1
Bank 3	-10.0	-10.9	-5.4
Bank 4	1.4	1.5	-4.4
Bank 5	5.1	3.7	13.3
Bank 6	-9.7	-10.6	-10.2
Bank 7	-4.6	-3.9	-8.2
Bank 8	4.1	3.8	14.0
Bank 9	2.4	2.1	10.7
Bank 10	7.2	8.2	9.0
Bank 11	-3.2	-2.7	-6.9
<i>NPLs FC unhedged</i>			
Bank 1	9.4	11.6	-7.9
Bank 2	-5.2	-4.5	-3.3
Bank 3	-7.2	-8.5	0.6
Bank 4	-11.5	-14.6	-5.3
Bank 5	9.1	5.5	8.2
Bank 6	-2.3	-4.1	-6.6
Bank 7	-4.0	3.9	-6.1
Bank 8	4.1	2.5	-0.5
Bank 9	0.0	-3.7	11.7
Bank 10	5.1	11.3	2.0
Bank 11	2.5	0.8	7.2

Table A2 Results of fixed effects

Note: Table A2 provides the estimated fixed effects across banks.

Source: Authors' calculation

	$\tau = 1\%$	$\tau = 5\%$	$\tau = 10\%$	$\tau = 25\%$	$\tau = 50\%$	$\tau = 75\%$	$\tau = 90\%$	$\tau = 95\%$	$\tau = 99\%$
<i>Gross domestic product growth</i>									
Households	0.1 (0.0) [3.2]	0.3 (0.1) [5.0]	0.4 (0.1) [4.9]	0.4 (0.1) [5.9]	1.1 (0.1) [9.3]	1.8 (0.3) [7.3]	1.9 (0.4) [4.3]	-0.1 (2.5) [0.0]	-0.9 (2.0) [-0.5]
Households DC	0.3 (0.1) [5.4]	0.3 (0.1) [4.3]	0.4 (0.1) [4.5]	0.6 (0.1) [7.4]	0.8 (0.1) [7.9]	1.1 (0.2) [5.5]	1.2 (0.2) [7.1]	1.8 (0.4) [4.7]	-0.9 (5.1) [-0.2]
Households FC	0.1 (0.0) [3.4]	0.2 (0.1) [3.2]	0.3 (0.1) [3.6]	0.4 (0.1) [5.2]	1.2 (0.1) [8.7]	2.1 (0.2) [10.8]	2.6 (0.2) [12.2]	0.2 (2.1) [0.1]	-0.8 (1.5) [-0.5]
Households FC hedged	0.3 (0.1) [3.7]	0.4 (0.1) [3.3]	0.5 (0.1) [4.3]	0.7 (0.1) [7.7]	1.0 (0.1) [6.7]	1.7 (0.2) [8.5]	2.5 (0.3) [7.5]	3.3 (0.3) [12.2]	5.9 (0.8) [7.1]
Households FC unhedged	0.3 (0.1) [3.7]	0.4 (0.1) [3.3]	0.5 (0.1) [4.3]	0.7 (0.1) [7.7]	1.0 (0.1) [6.7]	1.7 (0.2) [8.5]	2.5 (0.3) [7.5]	3.3 (0.3) [12.2]	5.9 (0.8) [7.1]
<i>Exchange rate growth</i>									
Households	0.1 (0.1) [2.1]	0.4 (0.1) [4.4]	0.5 (0.1) [4.3]	0.6 (0.1) [5.4]	1.4 (0.2) [7.6]	3.0 (0.2) [15.1]	3.1 (0.2) [12.3]	2.2 (1.0) [2.2]	3.6 (0.6) [5.8]
Households DC	0.7 (0.1) [7.4]	0.6 (0.1) [5.1]	0.6 (0.1) [4.7]	1.0 (0.1) [8.2]	1.2 (0.2) [6.8]	1.8 (0.2) [7.6]	1.6 (0.3) [5.9]	2.1 (0.5) [4.1]	4.1 (1.8) [2.2]
Households FC	0.3 (0.1) [4.6]	0.2 (0.1) [2.2]	0.3 (0.1) [2.4]	0.5 (0.1) [3.9]	1.6 (0.2) [6.9]	3.0 (0.3) [10.9]	3.5 (0.2) [19.7]	2.5 (0.9) [2.6]	3.1 (0.6) [5.0]
Households FC hedged	0.3 (0.1) [1.9]	0.5 (0.2) [2.2]	0.7 (0.2) [3.7]	1.0 (0.1) [7.7]	1.5 (0.2) [7.2]	2.3 (0.3) [8.0]	3.4 (0.3) [10.0]	4.2 (0.4) [10.0]	8.5 (1.7) [5.0]
Households FC unhedged	0.3 (0.1) [1.9]	0.5 (0.2) [2.2]	0.7 (0.2) [3.7]	1.0 (0.1) [7.7]	1.5 (0.2) [7.2]	2.3 (0.3) [8.0]	3.4 (0.3) [10.0]	4.2 (0.4) [10.0]	8.5 (1.7) [5.0]
<i>Loans interest rate</i>									
Households	0.6 (0.1) [10.3]	0.2 (0.1) [2.1]	0.2 (0.1) [1.9]	0.1 (0.1) [1.7]	-0.1 (0.1) [-1.4]	-0.7 (0.1) [-7.4]	-1.3 (0.1) [-10.3]	-1.4 (0.5) [-2.6]	-1.4 (0.9) [-1.6]
Households DC	0.2 (0.0) [4.7]	0.1 (0.1) [1.6]	0.0 (0.1) [0.0]	-0.2 (0.1) [-3.4]	0.0 (0.1) [-0.2]	0.2 (0.2) [0.7]	0.0 (0.2) [0.1]	-1.0 (0.5) [-2.0]	-1.2 (1.5) [-0.8]
Households FC	0.1 (0.1) [2.0]	0.0 (0.1) [0.2]	0.0 (0.1) [0.2]	0.0 (0.1) [0.0]	0.0 (0.1) [-0.1]	-0.8 (0.1) [-6.3]	-1.4 (0.1) [-18.9]	-1.5 (0.2) [-7.8]	-0.7 (0.7) [-1.0]
Households FC hedged	-0.3 (0.1) [-5.0]	-0.5 (0.1) [-3.9]	-0.1 (0.1) [-1.4]	-0.1 (0.1) [-0.7]	-0.3 (0.1) [-3.0]	-1.3 (0.1) [-8.8]	-2.1 (0.2) [-11.3]	-2.6 (0.2) [-10.4]	0.1 (3.2) [0.0]
Households FC unhedged	-0.3 (0.1) [-5.0]	-0.5 (0.1) [-3.9]	-0.1 (0.1) [-1.4]	-0.1 (0.1) [-0.7]	-0.3 (0.1) [-3.0]	-1.3 (0.1) [-8.8]	-2.1 (0.2) [-11.3]	-2.6 (0.2) [-10.4]	0.1 (3.2) [0.0]
<i>Capital adequacy ratios</i>									
Households	0.1 (0.0) [3.6]	0.0 (0.0) [-1.1]	0.0 (0.0) [-1.7]	-0.1 (0.0) [-1.8]	0.4 (0.1) [5.8]	0.7 (0.0) [19.7]	0.8 (0.1) [8.2]	1.2 (0.3) [4.6]	1.5 (0.5) [3.0]
Households DC	0.0 (0.0) [-0.5]	-0.1 (0.0) [-3.0]	-0.1 (0.0) [-3.1]	-0.1 (0.0) [-4.3]	0.2 (0.1) [4.4]	0.9 (0.0) [17.4]	0.9 (0.0) [29.9]	0.9 (0.0) [21.8]	1.8 (0.8) [2.2]
Households FC	0.0 (0.0) [-0.1]	0.0 (0.0) [-0.5]	0.0 (0.0) [-0.4]	0.1 (0.0) [2.7]	0.3 (0.0) [8.5]	0.3 (0.0) [6.7]	1.0 (0.1) [8.8]	1.0 (0.2) [6.5]	1.2 (0.3) [4.6]
Households FC hedged	-0.1 (0.1) [-1.4]	-0.1 (0.1) [-0.7]	0.1 (0.1) [0.7]	0.3 (0.0) [8.7]	0.5 (0.0) [12.9]	1.0 (0.1) [8.2]	1.2 (0.2) [7.0]	1.5 (0.4) [4.1]	2.2 (0.4) [5.4]
Households FC unhedged	-0.1 (0.1) [-1.4]	-0.1 (0.1) [-0.7]	0.1 (0.1) [0.7]	0.3 (0.0) [8.7]	0.5 (0.0) [12.9]	1.0 (0.0) [8.2]	1.2 (0.2) [7.0]	1.5 (0.4) [4.1]	2.2 (0.4) [5.4]
<i>Return on assets</i>									
Households	0.5 (0.1) [4.3]	0.2 (0.2) [0.8]	-0.2 (0.2) [-0.9]	-0.5 (0.1) [-3.3]	-1.4 (0.2) [-8.3]	-2.3 (0.2) [-10.4]	-2.3 (0.3) [-8.4]	-2.1 (0.6) [-3.5]	-1.9 (0.7) [-2.6]
Households DC	0.0 (0.2) [0.2]	0.0 (0.2) [0.0]	0.0 (0.2) [-0.1]	-0.8 (0.1) [-5.5]	-1.6 (0.1) [-14.1]	-3.3 (0.2) [-16.2]	-4.1 (0.3) [-14.1]	-5.4 (0.6) [-8.8]	-3.5 (0.9) [-4.0]
Households FC	0.1 (0.1) [2.0]	-0.3 (0.1) [-3.0]	-0.2 (0.1) [-1.9]	-0.4 (0.1) [-2.8]	-0.6 (0.2) [-2.7]	-1.2 (0.2) [-5.2]	-1.9 (0.2) [-7.7]	-1.1 (0.6) [-1.9]	-1.1 (0.6) [-1.7]
Households FC hedged	-0.1 (0.1) [-0.8]	0.2 (0.2) [1.0]	0.0 (0.2) [-0.2]	-0.2 (0.2) [-1.5]	-0.4 (0.3) [-1.4]	-2.8 (0.3) [-8.1]	-4.8 (0.3) [-14.2]	-6.9 (0.6) [-11.5]	-11.1 (1.5) [-7.4]
Households FC unhedged	-0.1 (0.1) [-0.8]	0.2 (0.2) [1.0]	0.0 (0.2) [-0.2]	-0.2 (0.2) [-1.5]	-0.4 (0.3) [-1.4]	-2.8 (0.3) [-8.1]	-4.8 (0.3) [-14.2]	-6.9 (0.6) [-11.5]	-11.1 (1.5) [-7.4]
<i>Remittances</i>									
Households	-0.2 (0.1) [-1.3]	-0.1 (0.2) [-0.8]	-0.2 (0.2) [-1.2]	-0.2 (0.2) [-1.1]	-0.6 (0.3) [-1.8]	-1.6 (0.4) [-3.8]	0.3 (0.7) [0.4]	2.3 (1.3) [1.8]	-0.9 (1.3) [-0.7]
Households DC	-0.1 (0.2) [-0.8]	0.2 (0.2) [1.2]	0.3 (0.2) [1.3]	0.0 (0.2) [0.2]	-0.6 (0.3) [-2.3]	-1.4 (0.3) [-4.3]	0.5 (0.7) [0.7]	1.2 (0.7) [1.6]	-1.5 (2.6) [-0.6]
Households FC	-0.3 (0.1) [-3.2]	-0.1 (0.2) [-0.6]	-0.1 (0.2) [-0.4]	0.0 (0.2) [0.0]	-1.2 (0.4) [-3.2]	-1.0 (0.5) [-1.9]	0.0 (0.4) [0.1]	1.9 (1.2) [1.5]	0.2 (0.9) [0.2]
Households FC hedged	-0.1 (0.3) [-0.4]	0.0 (0.5) [0.1]	-0.4 (0.3) [-1.3]	-1.0 (0.2) [-4.4]	-0.4 (0.4) [-0.9]	1.0 (0.5) [2.1]	1.8 (0.7) [2.5]	2.1 (0.9) [2.4]	-3.1 (3.1) [-1.0]
Households FC unhedged	-0.1 (0.3) [-0.4]	0.0 (0.5) [0.1]	-0.4 (0.3) [-1.3]	-1.0 (0.2) [-4.4]	-0.4 (0.4) [-0.9]	1.0 (0.5) [2.1]	1.8 (0.7) [2.5]	2.1 (0.9) [2.4]	-3.1 (3.1) [-1.0]

Table A3 Results of multivariate QR models for household with remittances

Note: Table A3 provide the sensitivity of NPLs condition on macroeconomics and bank variables for selected percentiles, with standard errors in () and t-statistics in [].

Source: Authors' calculations

	<i>Private sector</i>			<i>Non-financial corporations</i>			<i>Households</i>								
	Model I	Model II	Model III	Model I	Model II	Model III	Model I	Model II	Model III						
<i>NPLs</i>															
Gross domestic product growth	-0.4 (0.1) [-3.6]	-2.1 (0.5) [-4.5]	-0.1 (0.1) [-2.0]	-0.5 (0.1) [-3.9]	-2.8 (0.5) [-5.2]	-0.2 (0.1) [-2.2]	-0.2 (0.1) [-2.7]	-1.2 (0.4) [-3.5]	0.0 (0.0) [0.1]						
Exchange rate growth	0.8 (0.1) [6.2]	-0.7 (0.3) [-2.2]	0.1 (0.1) [0.7]	0.8 (0.2) [4.9]	-0.9 (0.4) [-2.6]	0.0 (0.2) [0.1]	0.6 (0.1) [5.6]	-0.3 (0.2) [-1.4]	0.0 (0.1) [-0.3]						
Loans interest rate	0.5 (0.1) [3.7]	-2.5 (0.2) [-14.9]	1.0 (0.2) [4.5]	0.3 (0.2) [1.9]	-3.2 (0.2) [-16.3]	1.2 (0.3) [4.3]	0.2 (0.1) [2.1]	-1.5 (0.1) [-12.5]	-0.8 (0.2) [-5.1]						
Capital adequacy ratios	0.5 (0.0) [10.8]	0.7 (0.0) [14.3]	0.0 (0.1) [0.7]	0.4 (0.1) [8.1]	0.6 (0.1) [10.8]	0.1 (0.1) [0.9]	0.4 (0.0) [13.3]	0.5 (0.0) [16.5]	0.0 (0.0) [0.8]						
Return on assets	-1.6 (0.2) [-7.3]	-2.8 (0.3) [-11]	1.2 (0.3) [4.7]	-1.6 (0.3) [-6.1]	-3.7 (0.3) [-12.5]	2.5 (0.3) [7.5]	-1.3 (0.2) [-8.7]	-1.5 (0.2) [-8.7]	-0.2 (0.2) [-1.3]						
Remittances							0.1 (0.0) [3.9]	0.0 (0.0) [0.5]	0.3 (0.0) [10.7]						
<i>NPLs DC</i>															
Gross domestic product growth	-0.3 (0.1) [-3.1]	-1.5 (0.5) [-2.9]	-0.2 (0.1) [-2.2]	-0.5 (0.1) [-3.8]	-2.2 (0.6) [-3.7]	-0.3 (0.1) [-2.9]	-0.2 (0.1) [-2.3]	-1.0 (0.4) [-2.4]	0.0 (0.0) [-0.3]						
Exchange rate growth	0.7 (0.1) [4.9]	-0.3 (0.3) [-0.8]	-0.1 (0.1) [-0.6]	0.6 (0.2) [3.4]	-0.5 (0.4) [-1.2]	-0.4 (0.2) [-1.9]	0.6 (0.1) [4.9]	-0.1 (0.2) [-0.4]	0.0 (0.1) [0.0]						
Loans interest rate	0.0 (0.1) [0.2]	-2.4 (0.2) [-12.5]	0.1 (0.3) [0.3]	-0.3 (0.2) [-1.8]	-3.1 (0.2) [-14.3]	-0.4 (0.4) [-1.0]	0.3 (0.1) [3.0]	-1.3 (0.1) [-8.7]	-0.6 (0.2) [-3.7]						
Capital adequacy ratios	0.4 (0.0) [9.2]	0.5 (0.1) [9.7]	0.2 (0.1) [2.7]	0.4 (0.1) [7.0]	0.4 (0.1) [6.1]	0.4 (0.1) [4.2]	0.5 (0.0) [15.0]	0.7 (0.0) [17.8]	-0.1 (0.0) [-1.9]						
Return on assets	-2.3 (0.2) [-10.3]	-3.6 (0.3) [-12.9]	0.5 (0.3) [1.7]	-1.8 (0.3) [-6.2]	-3.9 (0.3) [-12]	2.3 (0.4) [5.5]	-2.2 (0.2) [-13.6]	-2.3 (0.2) [-10.9]	-1.1 (0.2) [-6.6]						
Remittances							0.1 (0.0) [2.9]	0.0 (0.0) [0.3]	0.2 (0.0) [9.2]						
<i>NPLs FC</i>															
Gross domestic product growth	-0.4 (0.1) [-3.9]	-2.2 (0.5) [-4.6]	-0.2 (0.1) [-2.0]	-0.5 (0.1) [-4.0]	-3.0 (0.6) [-5.0]	-0.2 (0.1) [-2.0]	-0.2 (0.1) [-2.6]	-1.1 (0.4) [-2.7]	0.0 (0.1) [-0.3]						
Exchange rate growth	0.8 (0.1) [5.5]	-1.0 (0.3) [-3.2]	0.2 (0.1) [1.6]	0.8 (0.2) [4.3]	-1.2 (0.4) [-3.1]	0.2 (0.2) [1.1]	0.5 (0.1) [4.3]	-0.4 (0.2) [-1.8]	-0.1 (0.1) [-1.0]						
Loans interest rate	0.6 (0.1) [5.2]	-2.0 (0.2) [-11.6]	1.0 (0.2) [4.5]	0.7 (0.2) [4.2]	-2.9 (0.2) [-13.4]	2.2 (0.3) [7.5]	0.0 (0.1) [0.4]	-1.6 (0.1) [-11.7]	-0.7 (0.2) [-3.7]						
Capital adequacy ratios	0.6 (0.0) [12.8]	0.8 (0.0) [15.8]	0.1 (0.1) [1.1]	0.5 (0.1) [9.1]	0.8 (0.1) [13.4]	-0.1 (0.1) [-1.8]	0.2 (0.0) [7.2]	0.3 (0.0) [6.8]	0.2 (0.0) [3.5]						
Return on assets	-1.3 (0.2) [-5.8]	-2.5 (0.3) [-9.7]	1.6 (0.3) [6.1]	-1.4 (0.3) [-5.0]	-3.4 (0.3) [-10.5]	2.7 (0.3) [8.3]	-0.5 (0.2) [-3.1]	-1.1 (0.2) [-5.3]	0.8 (0.2) [4.3]						
Remittances							0.1 (0) [5.4]	0.0 (0.0) [1.2]	0.3 (0.0) [10.0]						
<i>NPLs FC hedged</i>															
Gross domestic product growth	-0.3 (0.1) [-3.0]	-1.5 (0.5) [-2.8]	-0.1 (0.1) [-1.5]	-0.3 (0.1) [-2.8]	-1.7 (0.6) [-2.6]	-0.1 (0.1) [-1.3]	-0.2 (0.1) [-2.0]	-1.9 (0.9) [-2.0]	-0.1 (0.1) [-1.7]						
Exchange rate growth	0.7 (0.1) [5.0]	-0.9 (0.4) [-2.6]	0.3 (0.1) [2.3]	0.8 (0.2) [4.6]	-1.1 (0.4) [-2.4]	0.3 (0.2) [1.7]	0.8 (0.2) [3.9]	-0.1 (0.6) [-0.2]	0.0 (0.1) [0.0]						
Loans interest rate	0.6 (0.1) [4.4]	-2.1 (0.2) [-10.5]	1.6 (0.2) [6.3]	0.8 (0.2) [5.1]	-2.4 (0.2) [-10.1]	1.9 (0.3) [6.8]	-0.3 (0.2) [-1.8]	-2.5 (0.3) [-7.7]	-0.1 (0.2) [-0.5]						
Capital adequacy ratios	0.6 (0.0) [11.9]	0.8 (0.1) [13.7]	0.1 (0.1) [1.9]	0.5 (0.1) [9.4]	0.8 (0.1) [11.4]	0.0 (0.1) [0.1]	0.5 (0.1) [9.6]	0.4 (0.1) [5.2]	0.8 (0.1) [13.3]						
Return on assets	-1.2 (0.2) [-5.2]	-3.2 (0.3) [-10.7]	2.5 (0.3) [8.7]	-1.4 (0.3) [-5.3]	-3.5 (0.4) [-10.0]	2.7 (0.3) [8.6]	-1.8 (0.3) [-6.3]	-2.8 (0.5) [-5.9]	0.3 (0.2) [1.1]						
Remittances							0.3 (0.0) [5.4]	0.3 (0.1) [2.6]	0.3 (0.0) [7.9]						
<i>NPLs FC unhedged</i>															
Gross domestic product growth	-0.4 (0.1) [-3.2]	-2.5 (0.6) [-4.2]	-0.1 (0.1) [-1.3]	-0.5 (0.1) [-3.6]	-3.1 (0.8) [-4.0]	-0.2 (0.1) [-1.7]	-0.3 (0.1) [-3.3]	-0.3 (0.5) [-0.7]	-0.1 (0.1) [-1.8]						
Exchange rate growth	0.8 (0.2) [4.9]	-1.2 (0.4) [-3.0]	0.1 (0.2) [0.6]	0.7 (0.2) [3.2]	-1.6 (0.5) [-3.2]	0.1 (0.2) [0.3]	0.2 (0.1) [1.3]	-0.5 (0.3) [-1.7]	-0.4 (0.1) [-2.7]						
Loans interest rate	0.8 (0.1) [5.7]	-1.5 (0.2) [-6.8]	0.0 (0.3) [-0.1]	0.4 (0.2) [2.2]	-2.3 (0.3) [-8.1]	0.1 (0.4) [0.3]	0.4 (0.1) [3.4]	-0.8 (0.2) [-4.7]	-0.7 (0.2) [-3.1]						
Capital adequacy ratios	0.7 (0.1) [12.9]	0.8 (0.1) [13.1]	0.2 (0.1) [3.1]	0.5 (0.1) [8.4]	0.7 (0.1) [9.1]	0.1 (0.1) [0.9]	0.3 (0.0) [8.2]	0.3 (0.0) [6.9]	0.2 (0.1) [3.8]						
Return on assets	-0.7 (0.3) [-2.8]	-1.3 (0.3) [-3.9]	1.2 (0.3) [3.7]	-0.7 (0.3) [-2.2]	-1.8 (0.4) [-4.3]	2.0 (0.4) [4.6]	-0.4 (0.2) [-2.4]	-1.2 (0.2) [-5.1]	1.1 (0.2) [4.3]						
Remittances							0.1 (0.0) [3.0]	-0.1 (0.1) [-2.0]	0.2 (0.0) [7.0]						

Table A4 Results of panel least square models for different samples

Note: Table A4 provide the estimated parameters using least square technique for different samples (Model I: 2009-2023; Model II: 2009-2015; Model III: 2016-2023), with standard errors in () and t-statistics in [].

Source: Authors' calculations

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Univerzita Karlova v Praze, Fakulta sociálních věd

Institut ekonomických studií [UK FSV – IES] Praha 1, Opletalova 26

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