INTERNATIONAL MONETARY FUND

STAFF DISCUSSION NOTE

Inflation and Bank Profits: Monetary Policy Trade-offs

Prepared by Katharina Bergant, Mai Hakamada, Divya Kirti, and Rui C. Mano

SDN/2025/001

2025
Feb

 SDN/2025/001

IMF Staff Discussion Notes
Research Department

Inflation and Bank Profits: Monetary Policy Trade-offs

Prepared by Katharina Bergant, Mai Hakamada, Divya Kirti, and Rui C. Mano*

Authorized for distribution by Pierre-Olivier Gourinchas
February 2025

ABSTRACT: Given the recent surge in inflation and the resulting sharp monetary tightening, this note asks whether bank profits are exposed to inflation. While most banks tend to match income and expense exposures, 5 percent of banks in advanced economies and 8 percent in emerging market and developing economies are vulnerable to changes in inflation and interest rates due to different risk management practices and business structures, with 3 percent and 6 percent of advanced and emerging market and developing economy banks, respectively, at least as exposed as Silicon Valley Bank at the onset of its failure. If losses at individual banks leave room for wider panics—despite needed improvements in bank regulation and supervision and other ex ante measures—central banks may need to weigh raising rates to contain inflation against the potential for financial instability.

RECOMMENDED CITATION: Bergant and others. 2025. *Inflation and Bank Profits: Monetary Policy Trade-offs*. Staff Discussion Note SDN/2025/001. International Monetary Fund, Washington, DC.

ISBN:	979-8-40029-472-3
JEL Classification Numbers:	G21, G32, E31, E44, E58
Keywords:	Inflation, Bank profitability, Monetary policy, Financial stability
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*Acknowledgments: The authors thank Pierre-Olivier Gourinchas, Giovanni Dell'Ariccia, and Sole Martinez Peria for guidance and feedback, and Viral Acharya for serving as an external consultant. They are also grateful to Markus Brunnermeier, John Campbell, John Cochrane, Sebastian Doerr, Thomas Drechsel, Kristin Forbes, Linda Goldberg, Sebastian Hillenbrand (discussant), Carolin Pflueger, Philipp Schnabl, and Adi Sunderam. Alex Copestake contributed to Box 1. Daniela Rojas provided editorial assistance. Suhyun Pyeon and Gianluca Gonzalez Yong provided superb research assistance.

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Executive Summary

Given the recent generational surge in inflation, this Staff Discussion Note examines how inflation affects bank profitability. Bankers—and the media—often suggest that bank profits vary significantly with inflation and interest rates. From a policy standpoint, if sharp monetary tightening in response to high inflation hampers bank profitability beyond any effects of inflation itself, central banks would be constrained in their ability to restrain inflation due to concerns about financial instability. Despite its importance, evidence on this question is scant. This note attempts to fill this gap.

Banks' income and expense tend to rise with inflation. Inflation shapes the operating environment for banks both directly and through its impact on policy rates. Unexpected inflation directly increases non-interest incomes and expenses, such as income from non-traditional banking services and operating costs, independently of the macroeconomic environment and whether central banks raise policy rates. And to the extent that higher inflation prompts central banks to raise policy rates, it increases interest income and expense derived from borrowing and lending. Exposures vary significantly across countries due to differing contracting conventions, regulatory frameworks, business models, and competitive pressures, but are typically larger in the interest-rate business.

While these large "gross" exposures create room for vulnerability, most banks tend to match income and expense exposures and see little change in profitability as inflation shifts. Most banks appear to be operationally hedged to inflation. Indeed, bank profitability shows little exposure to inflation across a wide range of banks and countries over the past three decades.

However, some banks are vulnerable to rising inflation and interest rates because of different risk management practices and business structures. Estimated bank-level exposures to simultaneous increases in inflation and policy rates seen in 2021–23 are large in both directions for some banks. Advanced economy banks appear more likely to benefit from the environment, whereas outliers among emerging market and developing economy banks are more evenly distributed. Some 3 percent of advanced economy and 6 percent of emerging market and developing economy banks, comprising 8 percent of assets in the average country, have interest-rate exposures at least as large as Silicon Valley Bank's at the onset of its failure. Accounting for non-interest exposures as well, 5 percent of advanced economy and 8 percent of emerging market and developing economy banks—comprising 9 percent of assets in the average country—could experience losses greater than 2 percent of assets. Data up to 2022 confirm this predicted dispersion in performance and suggest that some banks have already seen hits to profitability.

If losses at individual banks leave room for wider contagion—despite strengthened regulation and supervision and other ex-ante measures—central banks could face material price–financial stability trade-offs. On one hand, this note offers good news: Across a wide range of countries, there is little evidence that banks are meaningfully exposed to monetary policy tightening to tackle spikes in inflation. On the other hand, such tightening might generate large losses for outlier banks, further exacerbated by supply-driven inflation surprises that may precede tighter monetary policy, as was the case in 2022. Strengthened prudential regulation and supervision, heightened requirements for risk management governance, improved transparency, and using granular risk assessments to calibrate micro- and macroprudential capital requirements along the key dimensions highlighted in this note are important to limit the risk of such exposures. If losses do emerge—even if limited to outlier banks—concerns about individual banks could trigger a reassessment of the entire sector and lead to panic-fueled contagion with systemic consequences, within and across borders.

I. Introduction

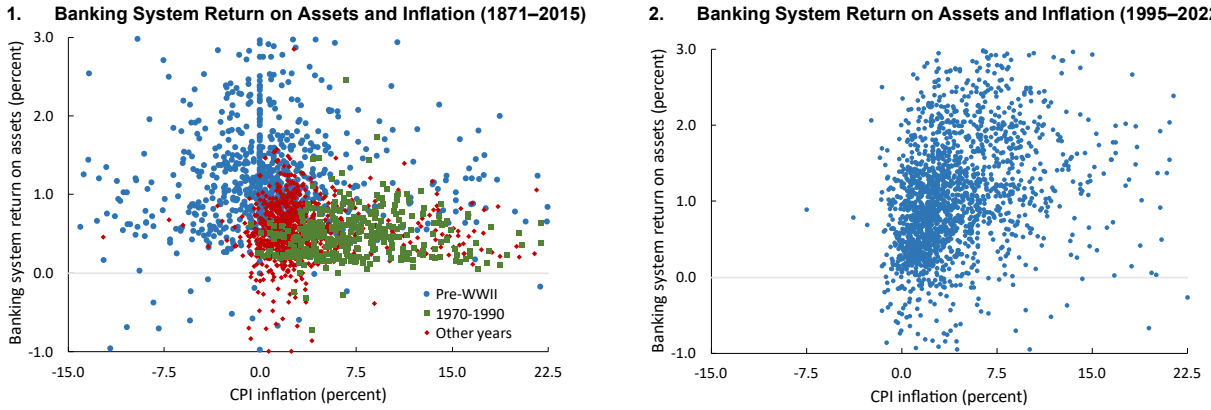
"Managing with very low interest rates is a challenge for the financial sector."—CNBC 2016
"There's no doubt the Fed's policy of very high short-term rates affects banks." —Wall Street Journal 2024

Following the COVID-19 pandemic, inflation surged to generational highs. Inflation reached levels not seen in advanced economies since the 1980s and rose significantly in emerging market and developing economies, reflecting a range of supply and demand factors. This surge in inflation triggered a sharp monetary policy response, lifting nominal policy interest rates away from the very low levels that followed the global financial crisis.

Long-voiced concerns about the resilience of bank profitability in an environment of both low and high inflation and low and high interest rates came to the fore with the bank failures of 2023. Prior to the pandemic, there were significant questions about banks' ability to operate profitably in environments with persistently low inflation and interest rates. Equally, and given the recent inflationary pressures, market participants raised concerns that high inflation and high interest rates could pose challenges for banks. A series of bank failures in the US in spring 2023, most prominently the failure of Silicon Valley Bank, seemed to confirm such concerns.

This Staff Discussion Note examines how inflation affects bank profitability to help assess whether monetary policy faces a price–financial stability trade-off. Bank profitability is an important indicator of bank health and often features prominently in stress tests.[1] If sharp monetary tightening in response to high inflation is detrimental to bank profitability beyond the effects of inflation itself, central banks would face a trade-off between ensuring price stability and maintaining financial stability. A detailed understanding of the effects of both inflation and policy rates on bank profitability is therefore relevant for the conduct of monetary policy.

Figure 1. Banking System Return on Assets and Inflation



Sources: Fitch Connect; Jordà, Schularick, and Taylor (2017); Richter and Zimmermann (2019); and IMF staff analysis.
Note: Panel 1 shows banking system return on assets for 17 advanced economies. Panel 2 shows banking system return on assets for 81 economies, 28 AEs and 53 emerging market and developing economies, aggregated from bank-level data using asset weights. In both panels individual points represent country-year pairs. CPI = consumer price index; WWII = World War II.

[1] Bank failures are often preceded by a significant deterioration in profitability, as seen in the case of Silicon Valley Bank. The large wave of bank failures in the US in the 1980s was preceded by significant declines in profitability at small banks (FDIC, 1997). Recent work finds that deteriorating accounting profitability has been strongly predictive of bank failures over the past 150 years (Correia, Luck, and Verner, 2024).

A first look at historical data does not point to an obvious link between bank profits and inflation. Over the past 150 years, inflation has varied significantly, as has aggregate bank profitability, across 17 advanced economies (Figure 1, panel 1). This period spans the significant deflation of the pre–World War II era, the high inflation of the 1970s–80s, and the low and stable inflation of the modern era. Across a wide range of institutional settings, profitability at the banking system level shows little sensitivity to inflation, and non-linearities are also not apparent. Figure 1, panel 2, confirms the lack of a discernible relationship in a broader sample of 81 countries, including many emerging market and developing economies, over the past three decades. However, income and expense individually may be highly exposed to inflation even if overall net profitability is not. Moreover, even net profitability may be exposed to inflation for individual banks.

To investigate how inflation affects bank profits, this note asks the following questions:

- **Are bank income and expense individually exposed to inflation? Is this exposure to inflation on its own or through its effect on policy rates?**

- **If bank income and expense are individually exposed to inflation, is aggregate bank profitability exposed to inflation? Or do most banks offset gross exposures?**

- **Are there pockets of vulnerability at the bank level?**

The note answers these questions by using detailed data to empirically estimate exposures of bank profitability to inflation. It combines balance sheet and income statement data for more than 6,600 banks operating in a broad cross section of advanced and emerging market and developing economies with IMF macroeconomic projections over nearly three decades. This data makes it possible to consider income and expense exposures separately for various lines of business and helps separate exposure to inflation on its own and through its impact on policy rates. The broad country and bank coverage makes it possible to examine how gross exposures offset one another and whether all banks can limit exposures to the same degree.

The note's main findings are as follows:

- **Bank income and expense are significantly exposed to inflation—that is, *gross exposures* are large.** After accounting for overall macroeconomic performance, income from banks' interest-rate and non-traditional businesses, as well as borrowing costs and general business expenses, all rise when inflation surges. Without careful risk management practices and a sound choice of business model, large gross exposures may generate bank fragility to sudden changes in inflation and interest rates.

- **Banks' interest income and expense are indirectly exposed to inflation through policy rates, whereas other income and expense are exposed directly to inflation.** The interest-rate business, tied to borrowing and lending, is exposed only indirectly to inflation, i.e. only insofar as policy rates react to rising inflation, regardless of whether it is driven by demand or supply. This is confirmed by evidence within the euro area—where all banks face common monetary policy even though inflation varies across countries. In contrast, the non-interest-rate business, including income from non-traditional banking services, salaries, rent, and all other non-interest business expenses, is exposed to inflation directly—that is, independently of policy rates. In this case, inflation directly increases major business expenses and income from non-lending services, particularly if inflation is driven by supply.

- **Still, the average bank appears to be largely hedged to inflation—that is, *net exposures* are generally small**. The return on assets (ROA) of the average bank seems largely unresponsive to either expected or unexpected inflation across a broad group of countries over the past three decades.

- **Exposures to inflation also appear generally contained at the banking system level.** The strength of exposures in the interest-rate and non-interest businesses varies significantly across countries, with little pass-through in some countries and close to one-to-one pass-through in others. These gross exposures are generally offset: Most banking systems have small but, if anything, positive *net exposures*, particularly for interest-rate businesses in emerging market and developing economies. Although gross non-interest exposures are smaller than gross interest exposures, net non-interest exposures can be meaningful if inflation spikes unexpectedly.

- **However, there are pockets of vulnerability: Some individual banks have significant net exposures.** Although most individual banks appear hedged, some may see large losses if inflation is unexpectedly large and policy rates rise rapidly, as in 2021–23. Some banks have already seen an actual hit to profitability in 2022, with 5 percent of banks experiencing a decline in net income of at least 0.5 percent of assets. More could follow. At the same time, heterogeneity is large—other banks stand to benefit from the recent inflationary and high-interest-rate environment.

This note contributes to the literature by asking how bank profitability is exposed to inflation—a question that has received little attention. Prior work has emphasized the importance of gross banking sector exposures, both for the interest-rate business and more broadly in the context of cross-border flows. In examining how inflation affects bank profitability, the note distinguishes between, on one hand, expected and unexpected inflation and, on the other, direct and indirect effects of inflation. The literature has not attempted to make these distinctions, which this note shows are important for understanding the drivers of bank profitability. The note studies a broader set of countries and uses more granular data on bank income and expense streams than previous studies, which also allows for better identification of channels. Results within a large currency union help sharpen the interpretation.

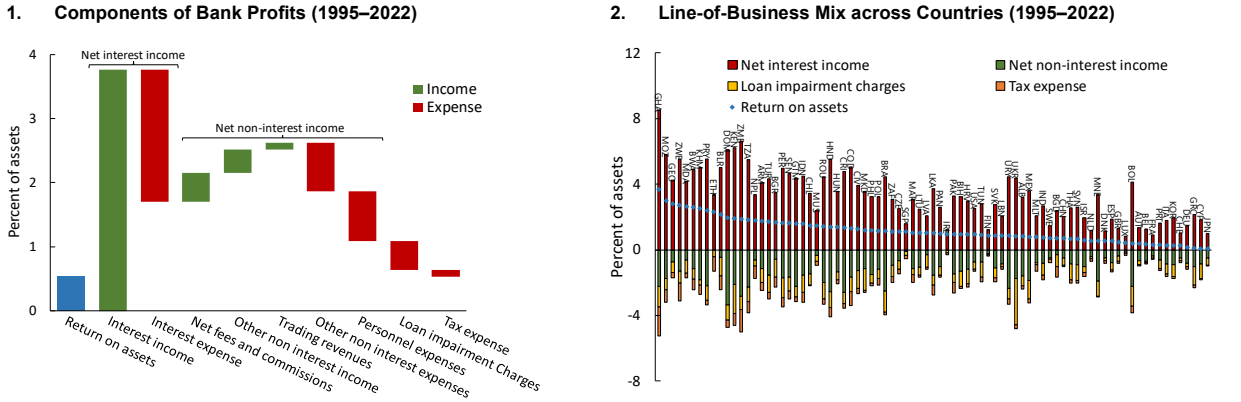
Organization. The note begins by offering key conceptual considerations and discusses how they are incorporated into the empirical framework. Next, the note provides evidence of the effects of inflation on individual sources of bank income and expense and on overall profits, documenting whether the effects are direct or indirect. It then asks whether exposures are very different for individual banks. The final section draws lessons for monetary and macroprudential policymakers.

II. Conceptual and Empirical Framework

This section discusses the complex conceptual relationship between inflation and bank profitability and presents an empirical framework motivated by this complexity. It begins by explaining that bank profits comprise several income and expense streams, which vary in importance across countries. It highlights two key conceptual dimensions: First, the difference between gross and net exposures, and second, the possibility that inflation is relevant on its own, regardless of its effect on policy rates, and/or only indirectly through its impact on policy rates. It then presents an empirical framework that appropriately captures these conceptual dimensions and quantifies their relative importance.

Bank profits encompass two main lines of business: interest and non-interest operations (Figure 2, panel 1). Net interest income, or the profits from receiving interest on assets and paying interest on liabilities, is usually close to three times larger than the return on assets. Net interest income is also the primary component of bank profits in most countries (Figure 2, panel 2), despite some cross-country variation—net interest income ranges from being similar to being about 19 times as large as the return on assets. Non-interest income, dominated by fees and non-traditional banking income, is more than offset by salaries, rent, and other operating costs. Loan impairment charges can also exert a meaningful drag on overall profitability.

Figure 2. Bank Profitability: Components and Cross-Country Heterogeneity



Sources: Fitch Connect; and IMF staff analysis.
Note: Panel 1 shows asset-weighted averages of key components of bank profits. Bank-level data are first aggregated to the year level, and then simple averages are calculated across years. Panel 2 decomposes the return on assets across countries into net interest income, net non-interest income, loan impairment charges, and tax expense. Bank-level data are first aggregated to the country-year level using asset weights, and then simple averages are calculated across years. The data for both panels include 81 countries, 28 advanced economies and 53 emerging market and developing economies. Data labels in panel 2 use International Organization for Standardization country codes.

INFLATION AND BANK PROFITS: A COMPLEX CONCEPTUAL RELATIONSHIP

Large individual exposures of income and expense—"gross" exposures—to inflation create room for vulnerability in the absence of active risk management. Some banks may disproportionately rely on income that increases more with inflation and may therefore benefit when inflation rises. Others may have expenses that are highly sensitive to inflation and may struggle to operate profitably when inflation rises.

In principle, inflation could affect banks both directly and indirectly—particularly by inducing changes in monetary policy. Shifts in monetary policy driven by inflation could be highly relevant for banks given the importance of market conditions for lending and funding rates. Moreover, nominal policy rates can be decomposed into two components: real interest rates and expected inflation. One benchmark view is that only real interest rates should matter: Any effect from expected inflation components might be seen as reflecting some kind of money illusion. On the other hand, to the extent that bank assets and liabilities are indexed, they are generally indexed to nominal policy rates, not to real interest rates. This would point to a similar role for real rates and expected inflation.

It is important to distinguish between the effects of inflation and those of changes in the broader economic outlook. Inflation dynamics themselves may reflect shocks to aggregate demand or supply. These underlying drivers of inflation could shift bank profitability, independently of their impact on inflation, by changing the scale of economic activity. Demand shocks would increase inflation and increase activity, whereas supply shocks would drive inflation while hampering activity. This implies that empirical analysis of the relationship

between inflation and bank profitability should account for overall macroeconomic performance and allow for the possibility that demand- and supply-driven inflation matter differently for bank profitability.

Because central banks generally focus on managing inflation expectations and largely "look through" temporary shocks, indirect exposures to inflation may reflect primarily shifts in inflation expectations rather than unexpected inflation. To achieve inflation targets, central banks typically shift policy rates in response to realized and forward-looking measures of inflation. Over the past three decades across a broad group of countries, policy rates have responded more than one-to-one to expected inflation but have been less sensitive to unexpected inflation (see Annex Table 3.1). In other words, central banks have focused on keeping inflation expectations anchored while looking through temporary unexpected shifts in inflation. Indirect exposures to inflation may therefore be relevant only for shifts in expected inflation, not for shifts in unexpected inflation. In contrast, direct exposures could be relevant for both expected and unexpected inflation moves.

In the interest business, maturity composition—and mismatch between income and expense—is likely to shape exposure to inflation, particularly indirectly through policy rates. Banks' interest-earning assets and interest-bearing liabilities that are not fixed in nominal terms are generally indexed to either policy rates directly or to market rates that comove with policy rates. Incomes and expenses derived from long-term assets or liabilities with contractual payments that do not regularly reprice will be unresponsive to market conditions.[2] In contrast, income and expense are likely to be highly responsive in the case of financial assets that either have short maturities or frequently reprice. Banks with different maturity distributions of assets and liabilities are likely to see very different gross exposures to inflation in the interest business. And different degrees of maturity mismatch are likely to translate to different net exposures. It thus stands to reason that indirect exposures through policy rates should be relevant in the interest business. It is less clear whether shifts in inflation that are not reflected in interest rates are relevant for the interest business.

In the non-interest business, the extent of price and wage stickiness for services offered and expenses incurred may give rise to direct exposures to inflation. Some banks may have significant fee-based income streams for which prices respond to inflation. Fee income outside of traditional banking activities—including trading and other financial services, as well as asset management and insurance, in systems with universal banking—could also play a role. Key expenses include wages, rent, procurement, and other operating expenses, which more than offset non-interest income in most banking systems (see Figure 2, panel 1). The extent to which relevant prices and wages respond to inflation is therefore likely to drive gross banking exposures in the non-interest business. Banks with unusually large non-interest income streams or significant business expenses may also see meaningful net exposures. In this case, the non-interest business may well respond directly to inflation, while the role of policy rates is less conceptually clear.

Inflation may also matter for asset quality. The sign of this impact is not theoretically clear. On one hand, when inflation rises, assuming policy rates remain fixed or increase to a smaller extent, real rates decline, which makes debt fixed in nominal terms easier to service for borrowers with growing nominal incomes. This is a potentially important direct effect of inflation. On the other hand, inflation could drive faster increases in costs than income for bank borrowers. Moreover, higher inflation prompts a monetary policy response, which typically leads to larger debt servicing costs for borrowers to the extent these are indexed to interest rates. Another indirect effect could go through overall economic activity, if inflation is driven by supply shocks, which would result in decreases in interest revenues and increases in delinquent loans—both of which are standard factors assumed

[2] Box 1 considers market exposure to interest rates and implications for the potential for bank runs and broader panic.

to undermine asset quality in standard bank stress tests (Neely 2022; Adrian, Morsink, and Schumacher 2020; Ding and others 2022).

In summary, the theoretical relationship between inflation and bank profitability is complex; neither the size nor direction of the overall exposure are clear ex ante. To the extent that gross exposures are large, net exposures may ultimately be driven by a mismatch between income and expense in both the interest and non-interest businesses. Assessing the sign and scale of exposure—both overall and across lines of business—is therefore an empirical question.

Exposure of bank profitability to inflation has received little attention in prior work. Past work on the topic has focused on the relationship between inflation and the quantity of bank lending and financial development and does not attempt to distinguish between direct and indirect effects (Agarwal and Baron 2024; Boyd, Levine, and Smith 2001; Converse and Jain 2024).[3] Indirect effects through monetary policy are related to a large amount of literature examining the impact of interest rates on bank profitability that typically does not focus on the drivers of interest rates. Starting with Samuelson (1945) and Flannery and James (1984), an extensive and dynamic body of literature has examined the effect of interest rates on bank profitability (English, Van Den Heuvel, and Zakrajšek 2018; Drechsler, Savov, and Schnabl 2021; Kirti 2020; Hoffmann and others 2019; Jiménez and others 2023). Much of this work has focused on individual countries (often the US) or a limited sample of advanced economies,[4] although Claessens, Coleman, and Donnelly (2018) represent an important exception. In addition, this work has generally not considered the distinction between real and expected inflation components of nominal rates. Gross banking sector exposures have also received attention in the context of prominent work on cross-border banking flows (for example, Cetorelli and Goldberg 2011).

EMPIRICAL APPROACH MOTIVATED BY CONCEPTUAL COMPLEXITY

This note uses granular data for a large set of banks across a broad group of countries over the past three decades to identify the channels through which bank profitability is exposed to inflation. The earlier conceptual discussion points to three key areas in need of granularity. First, it is important to separately consider gross and net exposures to inflation within both interest and non-interest businesses. This is possible only with accounting data that break down profits into corresponding components, not with market data that reflect only net profits across all businesses. Second, the implications of gross exposures for net exposures may vary across countries and banks. The analysis therefore uses annual bank-level data for more than 6,600 banks in 59 countries (28 advanced and 31 emerging market and developing economies) during 1995–2022.[5] The analysis can therefore consider country- and bank-level heterogeneity for a sample with sufficient variation in inflation across countries and over time. Finally, separating expected and unexpected inflation is essential. Doing so is possible using IMF forecasts that are available for the full sample at the country-year level. The analysis accounts for differences across banks and macroeconomic environments using panel-fixed-effect specifications. Annexes 1 and 2, respectively, discuss the data and empirical specifications in detail.

This note uses differences in the dynamics of expected and unexpected inflation and policy rates to separate direct and indirect exposures to inflation. As discussed above, exposures to expected inflation are

[3] An extensive body of literature has studied the effects of inflation on financial assets more broadly (Fama and Schwert 1977; Boudoukh and Richardson 1993; Bekaert and Wang 2010; Fama 1981; Song 2017; Fang, Liu, and Roussanov 2024). Other studies have included inflation as a control variable, such as Altavilla, Boucinha, and Peydró (2018).

[4] See for example BIS (2018); Borio and Gambacorta (2017); Elekdag, Malik, and Mitra (2020); and Chen and others (2024).

[5] This note uses unconsolidated data for all countries other than the US, for which only consolidated data are available.

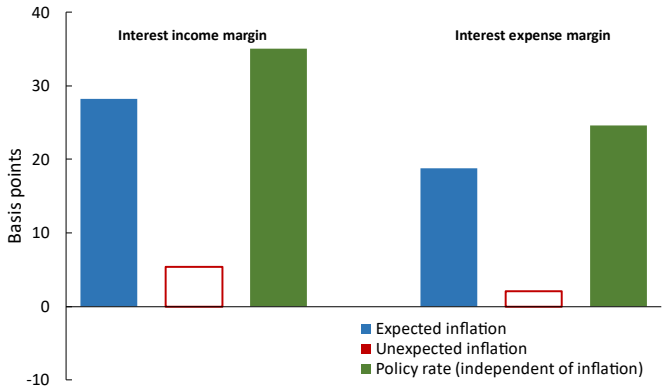
likely to be indirect exposures. The note therefore uses regressions that separately capture exposures to expected and unexpected inflation. The note also constructs two measures of inflation exposures: One includes variation in policy rates driven by inflation; the other focuses on variation in inflation unrelated to policy rates. Exposures observed in both measures can be interpreted as direct, while those observed only in the first can be interpreted as indirect, via policy rates. Results from within the euro area—within which inflation dynamics vary across countries but policy rates do not—help sharpen this interpretation. This note also isolates supply-driven instances of inflation as periods in which unexpected inflation and unexpected GDP growth move in opposite directions.

III. Banks' Income and Expense Tend to Rise with Inflation

This section studies whether banks' income and expense are individually exposed to inflation. These are known as "gross" exposures and are evaluated across several dimensions laid out in the section "Conceptual and Empirical Framework": whether effects (1) vary across interest and non-interest businesses, (2) are the result of expected or unexpected inflation, [6] and (3) are direct or indirect (via policy rates).

Gross exposures of interest income and expense to expected inflation are large. Figure 3 shows sensitivities of interest income and expense margins to expected and unexpected inflation, as well as to policy rates, independent of inflation.[7] A within-country two standard deviation rise in expected inflation for two years is estimated to increase income and expense margins by about 150 and 100 basis points, respectively, which is large relative to average margins of about 650 and 300 basis points, respectively. Interest income and expense remain elevated up to four years after the initial rise of expected inflation (see Annex Figure 4.1).

Figure 3. Exposure of Interest Income and Expense to Inflation



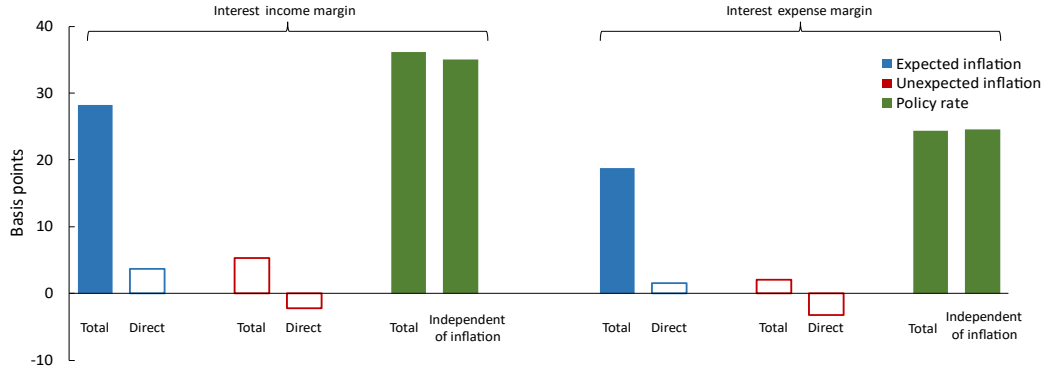
Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure shows exposure to expected and unexpected inflation when controlling for the component of policy rates that is orthogonal to inflation in specification (2.1) in Annex 2. Bars show sums of contemporaneous and lagged coefficients. Filled bars indicate statistically significant coefficients at the 10 percent level, while unfilled bars indicate statistically insignificant coefficients. Standard errors are block-bootstrapped at the country level. Regressions are weighted by 1/(number of banks in each country-year). Annex Table 3.2 in Annex 3 presents the full results behind this figure.

Expected inflation matters for interest income and expense primarily because it shifts policy rates. Put differently, the effects of expected inflation on the interest business reflect two facts noted in the section" Conceptual and Empirical Framework": (1) Central bankers are more likely to respond to expected inflation when setting policy rates. (2) Interest rates on securities, loans, and deposits often comove with policy rates. Figure 4 shows total and direct exposures to expected inflation, unexpected

[6] Measured using the IMF *World Economic Outlook* forecasts and differences of actual and forecasted inflation, respectively.
[7] All results are robust to excluding the COVID-19 periods and to including unemployment as an additional macroeconomic control.

inflation, and policy rates. Total exposure to expected inflation is similar in magnitude to exposure to interest rates independent of inflation. In contrast, direct exposure to expected inflation is minimal. Hence, expected inflation and real interest rates appear to matter in the same way.

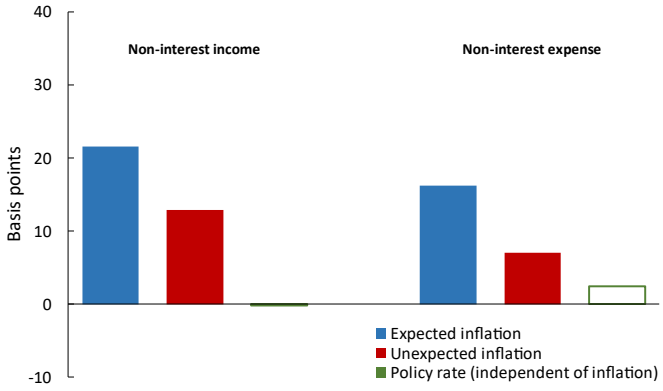
Figure 4. Total and Direct Exposure of Interest Income and Expense



Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure compares the total effects of inflation, which control for policy rates orthogonal to inflation, and direct effects of inflation, which focus on inflation orthogonal to policy rates. See specifications (2.1) and (2.2) in Annex 2. Bars are sums of contemporaneous and lagged coefficients. Filled bars indicate statistically significant coefficients at the 10 percent level, while unfilled bars indicate statistically insignificant coefficients. Standard errors are block-bootstrapped at the country-level. Regressions are weighted by 1/(number of banks in each country-year). Annex Tables 3.2 and 3.3 in Annex 3 present the full results behind this figure.

Evidence within a large currency union with common monetary policy—the euro area—sharply confirms that the interest-rate business is indirectly exposed. Although all countries in the euro area are subject to a common monetary policy set by the European Central Bank, inflation varies across countries. This sample therefore offers exogenous variation in the relationship between inflation and policy rates at the country level. Banks' interest-rate business has very similar exposures within the euro area. The implication is that expected inflation, even where different across countries, does not flow through to the interest-rate business unless it shifts nominal policy rates (see Annex Figure 4.2).[8]

Figure 5. Exposure of Non-Interest Income and Expense to Inflation



Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure shows exposure to expected and unexpected inflation when controlling for policy rates orthogonal to inflation of specification (2.1) in Annex 2. Bars show sums of contemporaneous and lagged coefficients. Filled bars indicate statistically significant coefficients at the 10 percent level, while unfilled bars indicate statistically insignificant coefficients. Standard errors are block-bootstrapped at the country-level. Regressions are weighted by 1/(number of banks in each country-year). Annex Table 3.2 in Annex 3 presents the full regression results behind this figure.

Non-interest income and expense are exposed to both expected and unexpected inflation (Figure 5). Non-interest income is more sensitive to both expected and unexpected inflation than non-interest expense. A within-country two

[8] This is also true for the low-interest period, as confirmed in Altavilla, Boucinha, and Peydró (2018).

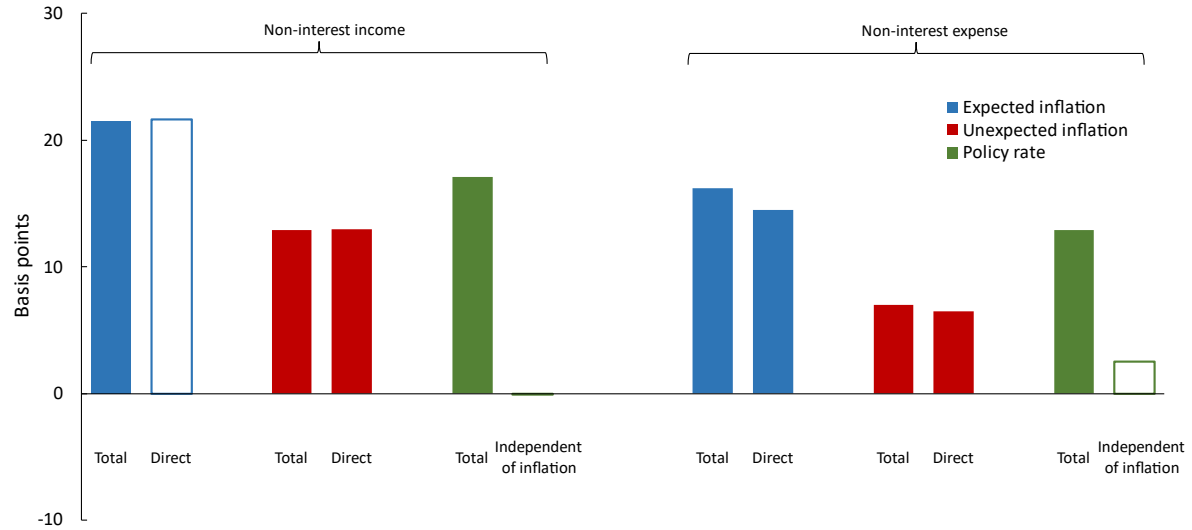
standard deviation move in expected (unexpected) inflation over two years is estimated to increase non-interest income and non-interest expense by about 100 (80) and 80 (40) basis points relative to total assets respectively, which is large relative to their respective averages of about 135 and 230 basis points. The effect of unexpected inflation is found to be short-lived and subsides within the following year, while that of expected inflation, although noisier, lingers longer (see Annex Figure 4.1).

Non-traditional sources of income drive large gross non-interest income exposures. On the income side, fees and trading income do not appear to play a significant role. In contrast, income from other lines of business, such as asset management, appears to shift with unexpected inflation, suggesting that exposure to unexpected inflation is more important than exposure to expected inflation (see Annex Figure 4.3).

Large gross exposures for non-interest expense are driven by non-wage expenses. While wages are a significant component of non-interest expense, inflation—whether expected or unexpected—does not appear to systematically shift salaries at banks. This likely reflects sluggish wage adjustment in many countries. In contrast, non-wage expenses, which include rent, for example, have meaningful exposures to expected and unexpected inflation (see Annex Figure 4.4).

Banks' non-interest business is directly exposed to both unexpected and expected inflation. Figure 6 repeats the analysis in Figure 4, for the non-interest-rate business. Non-interest income is exposed only to unexpected inflation, not expected inflation, whereas non-interest expense may be exposed to both. Importantly, the total and direct effects of unexpected inflation are similar in either case. Moreover, the total and the direct exposure to interest rates are very different. This evidence highlights the relevance of inflation for the non-interest business in its own right—prices of non-traditional banking services and business expenses rise in tandem with overall prices.

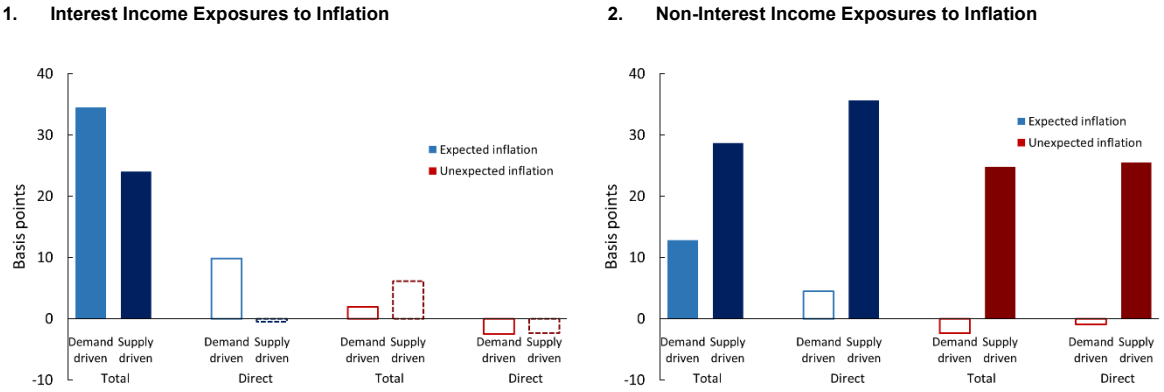
Figure 6. Total and Direct Exposure of Non-Interest Income and Expense



Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure compares the total effects of inflation, which control for policy rates orthogonal to inflation, and direct effects of inflation, which focus on inflation orthogonal to policy rates. See specifications (2.1) and (2.2) in Annex 2. Bars are sums of contemporaneous and lagged coefficients. Filled bars indicate statistically significant coefficients at the 10 percent level, while unfilled bars indicate statistically insignificant coefficients. Standard errors are block-bootstrapped at the country-level. Regressions are weighted by 1/(number of banks in each country-year). Annex Tables 3.2 and 3.3 in Annex 3 present the full results behind this figure.

The indirect exposure of the interest business reflects both demand- and supply-driven inflation, whereas the direct exposure of the non-interest business is driven primarily by supply. Figure 7, panel 1, focuses on the interest business. Here, the total exposure to expected inflation is equally strong across demand- and supply-driven episodes, whereas the direct exposure to expected inflation is insignificant for both sources. This strengthens the interpretation of banks' interest business exposures: relevant insofar as monetary policy reacts *to any source of inflation*. In contrast, the direct exposure to inflation of the non-interest business appears primarily supply driven, particularly in the case of unexpected inflation (Figure 7, panel 2), consistent with the less durable effect of unexpected inflation on the non-interest business discussed earlier.

Figure 7. Total and Direct Exposure of Interest and Non-Interest Income to Inflation by Source



Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure compares the total effects of inflation, which control for policy rates orthogonal to inflation, and direct effects of inflation, which focus on inflation orthogonal to policy rates. See specifications (2.1) and (2.2) in Annex 2. Each bar shows the effect of inflation driven by demand or supply, in which inflation is interacted with a dummy that indicates the presence of supply-driven shifts in inflation at *t*. Bars are sums of contemporaneous and lagged coefficients. Filled bars indicate statistically significant coefficients at the 10 percent level, while unfilled bars indicate statistically insignificant coefficients. Regressions are weighted by 1/(number of banks in each country-year).

IV. Overall Bank Profits Are Generally Not Exposed to Inflation

This section documents aggregate "net" exposures to inflation in general and at the country level. The previous section found large "gross" exposures of interest and non-interest income and expense to inflation. Banks and banking systems that do not match these gross exposures will have "net" exposure—that is, they would see profitability rise or fall with inflation depending on which exposure dominates.

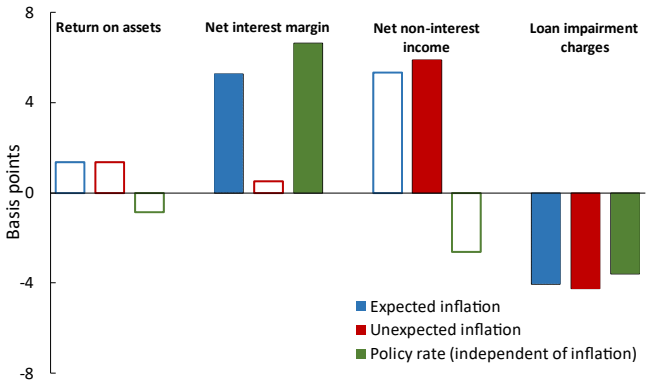
Bank returns are on average not exposed to inflation (Figure 8). A rise of 100 basis points in inflation for two consecutive years—either expected or unexpected—leads only to a little over a 1 basis point increase in ROA, compared with the average ROA of nearly 100 basis points.[9] This relationship is not statistically significant at the 10 percent level, indicated by the unfilled bars in Figure 8. Moreover, overall profitability also appears insensitive to variation in policy rates that is unrelated to inflation. Quantile panel regressions confirm the limited exposure of median ROA. Interestingly, when banks undergo periods of particularly elevated ROA, ROA appears positively

[9] Results are broadly similar in a specification that does not control for interest rates unrelated to inflation. See Annex 2 for the specification used and Annex 3 for the detailed results.

exposed to inflation, but the reverse is not true—the exposure to inflation, while negative, is not significant when banks undergo periods of low ROA (see Annex Figure 4.5).[10]

Exposures are also limited across individual lines of business. Figure 8 breaks down the overall limited effect of inflation on ROA into the effect on net interest margins (NIMs, defined as net interest income scaled by interest-earning assets), net non-interest income, and loan impairment charges (all scaled by total assets).[11] The roughly offsetting effects across lines of business result in the already discussed limited overall exposure for the average bank.[12]

Figure 8. Bank Profits across Lines of Business and Inflation



Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure shows the total effects of inflation, controlling for policy rates orthogonal to inflation. See specification (2.1) in Annex 2. Bars are sums of contemporaneous and lagged coefficients. Filled bars indicate statistically significant coefficients at the 10 percent level, while unfilled bars indicate statistically insignificant coefficients. Standard errors are block-bootstrapped at the country-level. Regressions are weighted by 1/(number of banks in each country-year). Annex Table 3.4 in Annex 3 presents the full regression results behind this analysis.

Nevertheless, "net" exposures are qualitatively similar to "gross" exposures across lines of business. NIMs are sensitive to expected inflation, but not to unexpected inflation, and this effect is indirect, as was the case for interest income and expense.[13] In contrast, unexpected inflation is directly relevant for net non-interest income.[14] As noted in the section "Conceptual and Empirical Framework," the sign of the impact on loan impairments is not theoretically clear and depends on whether borrowers' nominal incomes rise or fall relative to their nominal expenses. Figure 8 suggests that, on net, inflation reduces borrowers' ability to repay, even after controlling for dynamics in output growth. Expected inflation appears to matter indirectly, with higher rates raising required payments for borrowers, even on existing debt. Exposure to unexpected inflation appears to be direct—with higher inflation raising bank borrowers' costs more than capacity to repay (see Annex Figure 4.7).

GROSS EXPOSURES VARY SIGNIFICANTLY ACROSS COUNTRIES; NET EXPOSURES ARE LIMITED

Banking systems in most countries tend to be operationally hedged, even if interest income exposures and expense exposures individually are sometimes sizable and vary significantly across banking

[10] Non-linearities were not found either in historical market data (Annex Figure 4.6) or in a series of tests in the panel fixed effects model including squared expected inflation, unexpected inflation, and policy rates, as well as interactions with the initial level of inflation and policy rates. No evidence was found of differential effects in periods of particularly high expected or unexpected inflation (within or across countries). Furthermore, results remain unchanged during periods of particularly low policy rates.

[11] We follow the convention of scaling net interest income by interest-earning assets. This means that the results on subcomponents do not add up exactly to the result on the overall return on assets. Conclusions are robust to scaling net interest income by total assets as well.

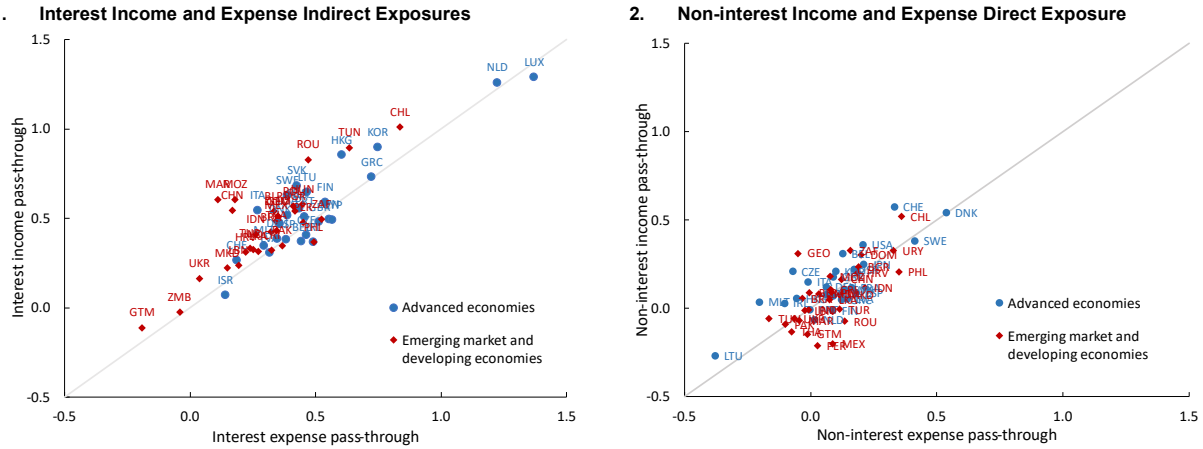
[12] Tax expense is the largest component left out of Figure 8 and does not itself appear exposed to either inflation or policy rates.

[13] The coefficient on the net interest margin does not need to equal the difference between the coefficient of the interest-income margin and interest-expense margin because these three concepts rely on different denominators—namely, total earning assets, average earning assets, and average interest-bearing liabilities for the net interest margin, interest income margin, and interest-expense margin, respectively.

[14] Net exposure to expected inflation is not statistically significant, although it was barely significant in the case of gross non-interest exposures.

systems. Figure 9, panel 1, shows indirect interest income and expense exposures to policy rates at the country level. Three important features of this joint distribution are worth highlighting. First, both income and expense gross exposures are sizable and statistically significant in most countries, as was the case for the aggregate. Second, banking systems display very different gross exposures, ranging from 0 (or no sensitivity to policy interest rates) to close to 1 (full pass-through of policy interest rates). These findings also speak to market exposure: They show that interest-bearing assets and liabilities have large and varying interest-rate exposures (duration). Asset (liability) duration is high in systems in which income (expense) pass-through is low, given that market valuations reflect present values of future cash flows. Third, income and expense exposures are very similar within banking systems, translating to net exposures that are generally much smaller than gross exposures. This applies both to incomes and to market exposures. As in the aggregate (Figure 8), banking systems generally face little duration mismatch, although many emerging market and developing economy and some advanced economy banking systems see rising incomes in response to higher rates.

Figure 9. Country-Level Heterogeneity in Interest-Rate and Non-Interest Business Exposures



Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: Both panels use specification (2.2) in Annex 2, including country interactions, weighted by 1/(number of banks in each country-year). Panel 1 shows the coefficient of the contemporaneous policy rate on interest expense (interest income) on the *x*-axis (*y*-axis). Japan and Uruguay were omitted for reasons of readability. Panel 2 shows the sum of the contemporaneous and lagged coefficient of unexpected inflation on non-interest expense (non-interest income) on the *x*-axis (*y*-axis). Cyprus and Hungary were omitted from panel 2. Data labels use International Organization for Standardization country codes.

The structure of banking liabilities appears to help explain differences in gross exposures across banking systems. Banking systems with sticky liabilities appear to enjoy market power, as they can secure larger profit margins through funding costs that are lower than market rates. Systems with greater reliance on foreign funding generally see costs of funds that align more closely with market rates. This likely reflects a combination of wholesale funding and flexibility for bankers to reallocate their funds to other countries. Greater positive exposure in emerging market and developing economy banking systems appears to be a result of two factors that provide liability market power. First, emerging market and developing economy banks tend to be more traditional on the liabilities side by relying mostly on depositors and not wholesale funding. Wholesale funding and other forms of market borrowing tend to be more responsive to interest rates. Second, financial repression is also much more prevalent in these economies, which depresses deposit rates. Moreover, emerging market and developing economy banks are also likely to extend shorter-maturity loans and hold shorter-maturity securities, to limit inflation risk and due to limited availability of long-dated assets (see Annex Figure 5.2). The extent of compliance with international regulatory standards can also vary across countries.

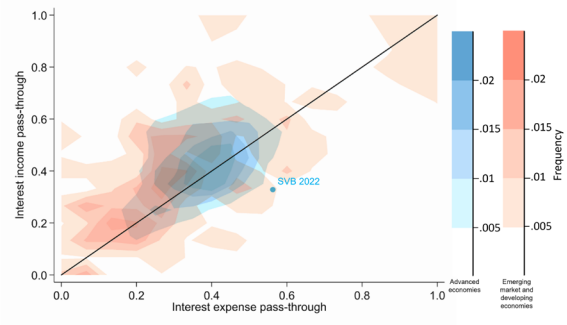
Banking systems vary significantly in their non-interest business direct exposures, although gross income and expense exposures are generally smaller than those of the interest business. Figure 9, panel 2, shows direct exposures of non-interest income and expense to unexpected inflation across countries. Net exposures for the non-interest business—while generally smaller than for the interest business—are more varied across banking systems. Gross exposures for incomes and expenses are also less closely aligned with each other than in the interest business. Expenses appear more sensitive than incomes in many emerging market and developing economy banking systems, possibly reflecting more prevalent price indexation.

V. Exposures across Banks

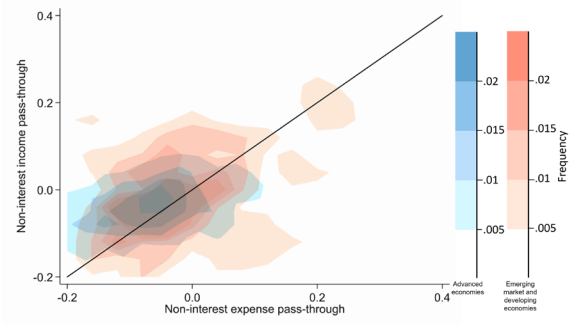
This section explores heterogeneity in exposures at the bank level. The existence of sizable gross exposures that vary across countries suggests potentially large and variable gross exposures at the bank level. Differing gross exposures with different degrees of offsetting may lead to significant variation in net exposures at the bank level, which could be relevant for conducting monetary policy, since losses for some banks could lead to wider panics. This section considers bank-level exposures for interest and non-interest business.

Figure 10. Bank-Level Heterogeneity in Exposures

1. Interest Income and Interest Expense Exposures



2. Non-interest Income and Expense Exposures



Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis .
Note: Both panels use specification (2.2) in Annex 2, but including bank interactions. Darker shading reflects higher frequencies. Panel 1 shows the joint distribution of coefficients of the contemporaneous policy rate on interest expense (interest income) on the *x*-axis (*y*-axis). Panel 2 shows the joint distribution of exposures to contemporaneous and lagged unexpected inflation of non-interest expense (*x*-axis) and income (*y*-axis). SVB = Silicon Valley Bank.

ACROSS LINES OF BUSINESS, SOME BANKS DO HAVE SIGNIFICANT NET EXPOSURES

Emerging market and developing economy banks tend to have larger indirect exposures to interest rates—in both directions—than banks in advanced economies. Figure 10, panel 1, shows indirect exposures to interest rates as in Figure 9, panel 1, but at the bank level. Some patterns remain similar at the bank level: Gross exposures are generally large, but net exposures are minimal for most banks. Moreover, and similarly to the country-level plots, emerging market and developing economy banks tend to have slightly more positive net exposures, given sluggish funding rates and consistent with reduced competition and financial repression—often due to regulation in these markets. In contrast, cash flows appear to be better matched for advanced economy banks, reflecting greater ability or interest in managing these exposures. Across advanced and emerging market and developing economies, there may be individual banks with unusually large net exposures. Figure 10 panel 1, shows that exposures for Silicon Valley Bank—which subsequently and prominently failed—were unusually large. However, such exposures are not unique to Silicon Valley Bank: About 3 percent of banks in advanced

economies and 6 percent of banks in emerging market and developing economies have larger negative exposures. For the average country, these banks account for 8 percent of banking system assets.

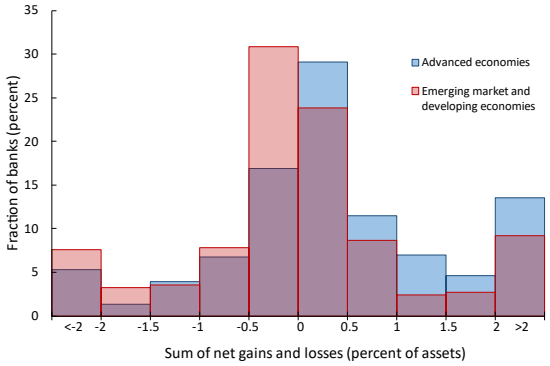
Direct exposures to unexpected inflation in the non-interest business are small for most banks, albeit with more variation within emerging market and developing economy banks. Figure 10, panel 2, shows direct exposures to unexpected inflation as in Figure 9, panel 2, but at the bank level. As seen at the level of banking systems, gross direct exposures are small for most individual banks, with less variation than in the interest business (Figure 10, panel 1). Exposures appear symmetric for emerging market and developing economy banks, whereas advanced economy banks have largely positive exposure to unexpected inflation.

Across lines of business, heterogeneity in net exposures appears to be driven by differences in bank business models, sophistication, and within-country competition, all of which are affected by differences in regulatory frameworks. Within-country heterogeneity in bank size, the reliance on deposits, and the size of non-interest expense relative to assets seem associated with more variable net exposures to inflation (see Annex Figure 5.3). These are in turn often related to regulatory differences across countries—for instance, the extent to which large banks can dominate systems or bank business is restricted. Tailoring of regulations based on size, systemic importance, and complexity can generate important differences within countries.

PROFITABILITY OF SOME BANKS MAY STILL FALL SIGNIFICANTLY IN THE COMING YEARS

The exposures estimated so far can help with examination of the scale of losses implied by recent shifts in inflation and interest rates for individual banks. Figure 11 uses the previous estimates for interest and non-interest business exposures to estimate the impact on banks of the recent increase in both unexpected inflation and interest rates. [15] Specifically, it combines estimates for changes in net interest income from country-specific changes in policy rates between 2021 and 2023 and in non-interest income as a result of unexpected inflation over the same period, scaled by total bank assets, separately for advanced and emerging market and developing economy banks. This approach provides a granular view of how recent shifts in the inflation environment impact bank profitability. The median increase in interest rates over this period was 4.5 percentage points. Unexpected inflation was even larger over this period—median unexpected inflation was 7 percent.

Figure 11. Income Gain/Loss in a High-Rate and Surprise-Inflation Environment



Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure shows the distribution of income gain/losses on interest income and non-interest income as a result both of country-specific changes in policy rates from 2021:Q4 to 2023:Q4 and of unexpected inflation in 2021–23. This is measured at the bank level by calculating the difference between bank-specific income and expense pass-through (for both interest and non-interest businesses).

The combination of sudden spikes in inflation and high interest rates can meaningfully shift profitability for some banks. Net gains and losses for most advanced and emerging market and developing economy banks appear small, with 46 and 55 percent of banks, respectively, seeing shifts within –0.5 and 0.5 percent of assets, despite the large shift in rates and unexpected inflation. However, some individual banks have large exposures

[15] Note that this illustrative scenario holds output fixed, and thus results do not reflect a full macroeconomic scenario.

to rising inflation and interest rates, with about 5 percent of advanced economy banks and 8 percent of emerging market and developing economy banks experiencing losses larger than 2 percent of assets. For the average country, these banks account for 9 percent of banking system assets. Direct exposures to inflation in the non-interest business appear to be larger and more skewed, particularly in the case of advanced economy banks, than those for the interest business. These shifts are sizable relative to average capital-to-asset ratios of 7.5 and 10.8 percent, respectively, in advanced and emerging market and developing economies. Moreover, challenges to near-term profitability could remain in place in the medium term if rates remain higher than usual or inflation resurges.

Meaningful losses—even if concentrated at individual banks—could lead to broader panics. The analysis in this note focuses on cash flow exposures. Silicon Valley Bank's prominent failure might not have been relevant for aggregate financial stability had it not triggered concerns about the entire banking system. This constitutes a form of information-based contagion, which could spread beyond national borders. Another related reason that losses at individual banks can be systemically relevant is that large changes in inflation and policy rates can impair the market value of bank assets, increasing run risk. Box 1 discusses the potential for such interactions between market and liquidity risk.

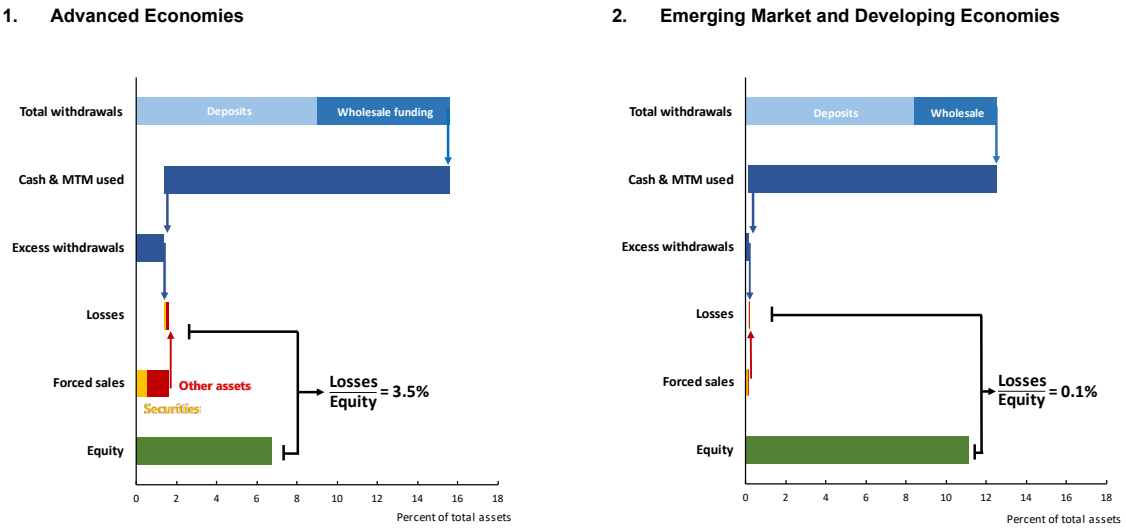
Box 1. Potential Interactions between Market and Liquidity Risk

A sharp increase in interest rates can significantly reduce the market value of fixed-rate, long-dated bank assets. Accounting guidelines generally allow banks to hold such assets at book value to reduce the impact of market volatility. However, if banks are faced with significant withdrawals that exhaust liquid assets, they may be forced to realize losses on high-duration securities, which would weaken their capital position. Banks with uninsured liabilities and sufficiently large market exposure could then face the risk of runs (Jiang and others 2024). Prompted by the failure of Silicon Valley Bank in March 2023, recent empirical work explores this channel in the US (Jiang and others 2024) and globally (IMF 2023; Copestake, Kirti, and Liu 2023).

Copestake, Kirti, and Liu (2023) estimate exposure for more than 1,200 banks across 47 countries. They begin by calculating indicative losses on the market value of securities, using observed changes in the prices of local currency sovereign bonds in advanced economies, and by combining the duration of sovereign bonds with changes in spreads and risk-free interest rates in emerging market and developing economies. They assume that other asset classes, such as loans, face larger losses, reflecting greater risk premia. Next, they consider scenarios in which there is a run on liabilities that forces sales of high-duration assets. Withdrawals that cannot be met by cash must be funded by asset sales at market prices, generating losses, which are then compared with bank equity.

Exposure is higher in advance than in emerging market and developing economies (Figure 1.1), reflecting primarily greater use of wholesale funding and tighter cash and capital buffers. Since the focus is bank-level exposure, these estimates do not presuppose any policy support. The availability of central bank funding facilities to replace lost deposits could substantially mitigate such losses (Jiang and others 2024; IMF 2023).

Figure 1.1. Estimated Losses in Liability Run Scenarios for Advanced and Emerging Market and Developing Economies



Sources: Bloomberg Back Office; IMF, Sovereign Debt Monitor; S&P Capital IQ Pro; and IMF staff calculations.
Note: Results shown are for central scenario (20 percent withdrawals in vulnerable banks). Bars are aggregates of bank-level results across all banks within advanced and emerging market and developing economies. MTM = mark-to-market securities (which are exhausted before any non-MTM securities are sold). See Copestake, Kirti, and Liu (2023).

IV. Conclusions and Policy Implications

Conceptually, the relationship between inflation and bank profitability is complex. Gross exposures may be very different from net exposures. Both direct effects of inflation and indirect effects (through policy rates) could be relevant. Empirical evidence on how bank profitability is exposed to inflation is therefore important.

Gross exposures are typically large and vary widely across countries and banks. The interest business, tied to borrowing and lending, is exposed indirectly to both demand- and supply-driven inflation, whereas the non-interest business, comprising fee-based income and business expenses such as salaries and rent, is exposed directly to both unexpected and, to some extent, expected components of supply-driven inflation. In both cases, incomes and expenses increase with inflation. Asset quality deteriorates due to direct and indirect channels. This means bank borrowers and creditors often bear significant exposure to inflation and interest rates.

And yet aggregate bank profitability generally does not appear to shift significantly with inflation. Both at the bank level and at the banking system level across a broad range of countries, overall profits show little exposure to inflation. Banks' overall lack of exposure therefore appears to reflect active matching of income and expense exposures, particularly in the interest business. Continued efforts to hedge dynamically are likely needed to maintain this lack of exposure. In the non-interest business, net exposures are more significant in both directions across countries, although gross income and expense exposures are generally smaller than for the interest business. This may suggest room for optimism: Tight monetary policy to tackle inflation may not hinder banks' ability to generate profits and continue to lend to the wider economy.

Importantly, differences in risk management practices and business structures create pockets of vulnerability at individual banks. Indirect interest-rate-business exposures via policy rates are contained for most banks—Silicon Valley Bank appears to be an outlier, particularly relative to other banks in advanced economies. However, in both advanced and emerging market and developing economies, outlier banks have large net exposures in both directions. Moreover, direct exposures to unexpected inflation in the non-interest business—which have received little attention in earlier work—mean that unexpected spikes in inflation can meaningfully shift profits for some banks, particularly in emerging market and developing economies. This is likely because of greater price and wage flexibility coupled with reliance on non-traditional income sources, in some cases.

Strengthened prudential regulation and supervision are important ex ante to minimize trade-offs between price and financial stability. Heightened requirements for risk management governance within banks would support active management of gross exposures to inflation in both interest and non-interest businesses, as would improved transparency in the form of better public reporting and granular auditing. Using ongoing, granular risk assessments that account for the key dimensions highlighted in this note—differences in exposure across bank businesses, expected and unexpected inflation, direct and indirect effects, among others—to calibrate micro- and macroprudential capital requirements could also help alleviate the trade-off (see Adrian and others 2023).

If losses at individual banks leave room for broader panics despite improved ex ante prudential policies, monetary policy may face financial stability trade-offs. Faced with high inflation, tighter monetary policy, although needed, could generate meaningful losses for some banks. The inflation surprises that often precede tighter monetary policy—as in 2022—can further exacerbate losses for some banks through their non-interest business. Even when limited to outlier banks, such losses could lead to panics with systemic consequences to the extent that macro- or microprudential settings do not adequately mitigate such risks. Concerns about a trade-off between fighting inflation and maintaining financial stability are therefore relevant in both advanced and emerging market and developing economies, and specific banks particularly exposed to inflation and policy rates should be monitored carefully. Even where all banks are well hedged, the presence of significant gross exposures calls for careful monitoring of how policy rates transmit to bank borrowers and lenders.

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Annex 1. Data

This note uses primarily a combined dataset of three types of data: (1) bank balance sheets and income statements, (2) macroeconomic variables, and (3) policy rates.

Annual bank-level balance sheet and income statement data are obtained from Fitch Connect.[16] The note uses unconsolidated bank data, given its focus on the effects of domestic inflation and interest rates, except for the United States, for which consolidated data are used because of data availability.

The bank sample is restricted in several ways to arrive at the main panel dataset. Only banks whose main business is either "co-operative banks", "commercial banks", "retail banks", "consumer banks" and "bank holding companies" are included.[17] The data include banks with (1) positive total assets, average earning assets, and total securities; (2) greater total liabilities than total deposits; (3) larger total assets than average earning assets; (4) total equity ratios larger than -15 percent of total assets; and (5) total assets exceeding $100 million. The sample includes banks with at least five years of data and country years with at least five banks. Data based on regulatory accounting standards are used for the US. One of the following—(1) local generally accepted accounting practices, (2) regulatory requirements, or (3) International Financial Reporting Standards—is used within the sample of countries other than the US.

Expected and realized inflation and expected and realized real GDP growth are obtained from the IMF World Economic Outlook (WEO) Database. Expected inflation is the log change of the consumer price index (CPI) as predicted in the October forecast of the previous year (i.e., forecast for $t + 1$ in October publication of the WEO in year t). Realized inflation is calculated using log differences in CPI.[18] Unexpected inflation is calculated by subtracting expected inflation from realized inflation. Expected real GDP growth is the log difference in GDP at constant prices taking the previous year's October forecast. Realized real GDP growth is the log change in GDP at constant prices.[19] Unexpected real GDP growth is calculated by subtracting expected real GDP growth for the year from realized real GDP growth.

Policy rates are sourced from the Bank for International Settlements, Haver Analytics, Bloomberg Finance L.P., and the IMF's *International Financial Statistics* to cover as many countries and years as possible. To obtain annual data, this note averages quarterly values.

While most variables are available for 81 countries (consisting of 28 advanced economies [AEs] and 53 emerging market and developing economies [EMDEs]), the regression sample is confined to 59 countries (28 AEs and 31 EMDEs) because of data availability for policy rates. This final annual panel consists of 5,496 banks in AEs and 1,149 banks in EMDEs and offers unbalanced coverage from 1995 to 2022. Coverage before 2000 is available for 37 countries.

[16] Update from November 1, 2023.

[17] We only include bank holding companies for the US.

[18] CPI data can undergo large revisions. For this reason, for inflation in t, we use data confirmed in $t + 2$.

[19] As with CPI, we use data confirmed in $t + 2$.

Annex Table 1.1. Summary Statistics

Variable	Mean	Median	Standard Deviation	Min	Max
Bank Statistics					
Return on assets	0.5	0.3	0.9	-3.6	5.3
Net interest margin	2.7	2.4	1.7	0.2	13.6
Net non-interest income	-1.3	-1.2	1.4	-32.8	155.1
Loan impairment charge	0.4	0.2	1	-27.1	75.4
Deposits over liabilities	88.4	94.5	15.2	0	100
Equity over assets	8.9	8	5.6	-14.5	99.3
Securities over assets	20.1	18.6	13.7	0	99.8
General Economic Indicators					
Inflation shock	0.5	0.0	4.4	-10.0	45.2
Realized inflation	4.6	2.8	7.8	-1.4	109.9
Policy rate	5.4	3.9	6.2	-0.8	49.3
Expected real GDP growth	3.4	3.3	1.9	-4.1	9.5
Unexpected real GDP growth	-0.5	-0.1	3.0	-13.2	6.9

Note: Net non-interest income and loan impairment charge are scaled by total assets.

Annex Table 1.2. Key Variables and Data Sources

Variable	Sources
Bank Statistics	
Return on assets (ROA)	Fitch Connect
Net interest margin (NIM)	Fitch Connect
Deposits over liabilities	Calculated, using Fitch Connect
Equity over assets	Calculated, using Fitch Connect
Securities over assets	Calculated, using Fitch Connect
General Economic Indicators	
Expected, unexpected Inflation	Calculated, using *World Economic Outlook*
Policy rates	Bank for International Settlements (BIS); Haver Analytics; Bloomberg Finance N.A.; and IMF, *International Financial Statistics*
Expected, unexpected real GDP growth	Calculated, using *World Economic Outlook*

Note: This table presents data sources for key variables in the main regression dataset.

Annex 2: Empirical Specifications

This section explains the sequential approach to separate direct and indirect (through policy rates) effects of inflation. The note uses two specifications capturing the total and direct effect of inflation, respectively.

The first specification includes interest rates orthogonalized with respect to inflation and hence controls only for the component of interest rates unrelated to inflation. Hence, it captures the total effect of inflation.

$$Y_{b,i,t} = \alpha^1 \pi^f_{i,t} + \alpha^2 \pi^f_{i,t-1} + \sigma^1 \pi^s_{i,t} + \sigma^2 \pi^s_{i,t-1} + \beta i^o_{i,t} + \varphi GDP^f{}_{i,t} + \chi GDP^s{}_{i,t} + \eta X_{b,t} + \gamma_b + \gamma_t + \varepsilon_{b,i,t} \quad (2.1)$$

where the orthogonalized component of interest rates is obtained by running the following regression:

$$i_{i,t} = \alpha^1 \pi^f_{i,t} + \alpha^2 \pi^f_{i,t-1} + \sigma^1 \pi^s_{i,t} + \sigma^2 \pi^s_{i,t-1} + \varphi GDP^f{}_{i,t} + \chi GDP^s{}_{i,t} + \eta X_{b,t} + \gamma_b + \gamma_t + i^o_{i,t}$$

and specific variables are defined as follows:

- $Y_{b,i,t}$ for bank *b*, country *i,* year *t,* is
  - ROA, and non-interest-related subcomponents as well as loan impairment charges
  - NIM and splits of interest income and expense margins;
- $\pi^f_{i,t}$ is expected inflation;
- $\pi^s_{i,t}$ is unexpected inflation (realized inflation – expected inflation);
- $GDP^f_{i,t}$ and $GDP^s_{i,t}$ are expected and unexpected real GDP growth, respectively;
- $\boldsymbol{X_{b,t}}$ are bank-level controls: deposits over liabilities, equity over assets, and securities over assets;
- γ_b and γ_t are bank and time fixed effects, respectively.

The second specification controls for all variation in interest rates and focuses on inflation that is unrelated to interest rates, capturing only the direct effect of inflation:

$$Y_{b,i,t} = \lambda^1 \pi^{o,f}_{i,t} + \lambda^2 \pi^{o,f}_{i,t-1} + \mu^1 \pi^{o,s}_{i,t} + \mu^2 \pi^{o,s}_{i,t-1} + \sigma\, i_{i,t} + \varphi GDP^f{}_{i,t} + \chi GDP^s{}_{i,t} + \eta X_{b,t} + \gamma_b + \gamma_t + \varepsilon_{b,i,t} \quad (2.2)$$

where the orthogonalized component of inflation is obtained by running the following regressions:

$$\pi^f_{i,t} = \beta i_{i,t} + \varphi GDP^f{}_{i,t} + \chi GDP^s{}_{i,t} + \eta X_{b,t} + \gamma_b + \gamma_t + \pi^{o,f}_{i,t}$$
$$\pi^f_{i,t-1} = \beta i_{i,t} + \varphi GDP^f{}_{i,t} + \chi GDP^s{}_{i,t} + \eta X_{b,t} + \gamma_b + \gamma_t + \pi^{o,f}_{i,t-1}$$

$$\pi^s_{i,t} = \beta i_{i,t} + \varphi GDP^f{}_{i,t} + \chi GDP^s{}_{i,t} + \eta X_{b,t} + \gamma_b + \gamma_t + \pi^{o,s}_{i,t}$$
$$\pi^s_{i,t-1} = \beta i_{i,t} + \varphi GDP^f{}_{i,t} + \chi GDP^s{}_{i,t} + \eta X_{b,t} + \gamma_b + \gamma_t + \pi^{o,s}_{i,t-1}$$

All regressions use an unbalanced panel of 6,645 banks from 59 countries for 1995–2022 (see Annex 1). Standard errors are block-bootstrapped at the country level to account for generated regressors. 20,000 draws are used.

Separating supply- from demand-driven inflation. A dummy indicating that real GDP growth and inflation surprises are of opposite signs is used to proxy for the presence of supply-driven inflation at time *t*. The dummy is then interacted with the key macroeconomic variables of interest in the two specifications of interest:

$$Y_{b,i,t} = \alpha^1 \pi^f_{i,t} + \alpha^2 \pi^f_{i,t-1} + \sigma^1 \pi^s_{i,t} + \sigma^2 \pi^s_{i,t-1} + \beta i^o_{i,t} + \varphi GDP^f{}_{i,t} + \chi GDP^s{}_{i,t} + \mathrm{BD}_{i,t}{}^s(\pi^f_{i,t} + \pi^f_{i,t-1} + \pi^s_{i,t} + \pi^s_{i,t-1} + \varphi GDP^f{}_{i,t} + \chi GDP^s{}_{i,t} + 1) + \eta X_{b,t} + \gamma_b + \gamma_t + \varepsilon_{b,i,t}$$

$$Y_{b,i,t} = \lambda^1 \pi^{o,f}_{i,t} + \lambda^2 \pi^{o,f}_{i,t-1} + \mu^1 \pi^{o,s}_{i,t} + \mu^2 \pi^{o,s}_{i,t-1} + \sigma i_{i,t} + \varphi GDP^f{}_{i,t} + \chi GDP^s{}_{i,t} + \mathrm{BD}_{i,t}{}^s(\pi^{o,f}_{i,t} + \pi^{o,f}_{i,t-1} + \pi^{o,s}_{i,t} + \pi^{o,s}_{i,t-1} + \varphi GDP^f{}_{i,t} + \chi GDP^s{}_{i,t} + 1) + \eta X_{b,t} + \gamma_b + \gamma_t + \varepsilon_{b,i,t}$$

Annex 3: Detailed Empirical Results

Annex Table 3.1. Taylor Rule Estimates

	Policy rate	
Inflation, expected	0.9***	0.8***
	(0.09)	(0.1)
Inflation, expected (lagged)		0.2***
		(0.02)
Inflation, unexpected	0.3**	0.3**
	(0.09)	(0.10)
Inflation, unexpected (lagged)		-0.1
		(0.10)
rGDP growth, expected	0.2	0.2
	(0.1)	(0.1)
rGDP growth, unexpected	-0.02	-0.04
	(0.08)	(0.09)
Constant	1.2	0.8
	(0.6)	(0.6)
Country FE	Y	Y
Country-Years observation	1,380	1,373

Note: This table captures results of modified Taylor rule regressions applied to an unbalanced panel of 59 countries from 1995 to 2022, with country fixed effects. The dependent variable is the nominal policy rate. Standard errors clustered at time and country level are listed below each point estimate. *, **, and *** indicate significance at the 0.1, 0.05, and 0.01 level, respectively. FE = fixed effects.

Annex Table 3.2. Gross Measures of Bank Profitability (Total Effect of Inflation)

	Interest components			Non interest components		
	Net	Income	Expense	Net	Income	Expense
Inflation, expected	4.5*	29.3***	21.2***	7.7	23.7	16.1
	(1.7)	(4.6)	(3.4)	(6.8)	(15.8)	(9.5)
	[2.0]	[6.4]	[4.7]	[6.7]	[15.4]	[9.0]
Inflation, expected (lagged)	0.8	-1.1	-2.4	-2.3	-2.2	0.2
	(0.6)	(1.5)	(1.7)	(2.4)	(3.5)	(1.7)
	[1.0]	[4.8]	[3.7]	[2.0]	[3.7]	[2.3]
Inflation, unexpected	1.5	10.6***	6.2***	8.7	22.8	14.1
	(1.7)	(2.4)	(1.1)	(5.0)	(12.8)	(8.1)
	[1.7]	[2.7]	[1.3]	[5.1]	[12.6]	[7.7]
Inflation, unexpected (lagged)	-1.0	-5.2*	-4.1*	-2.8	-9.9	-7.1
	(0.9)	(2.5)	(1.5)	(2.5)	(8.1)	(5.8)
	[1.2]	[4.8]	[3.3]	[2.5]	[7.6]	[5.4]
Policy rate	6.6**	35.0***	24.6***	-2.6	-0.1	2.5
	(2.0)	(4.8)	(4.0)	(1.6)	(3.7)	(2.7)
	[2.1]	[4.8]	[3.9]	[1.8]	[3.9]	[2.9]
rGDP growth, expected	0.8	-15.1**	-16.4***	-1.7	-6.6	-4.9
	(2.7)	(4.6)	(4.3)	(2.3)	(6.5)	(5.0)
rGDP growth, unexpected	-2.3*	-7.9***	-7.9***	-2.6	-6.5	-3.9
	(1.1)	(1.7)	(1.9)	(2.2)	(6.3)	(4.3)
Deposits over liabilities	0.5*	0.9	-0.2	-0.3	-0.2	0.1
	(0.2)	(0.8)	(0.5)	(0.3)	(0.4)	(0.6)
Equity over assets	7.4***	2.5**	-0.5	-0.1	4.1**	4.3***
	(0.7)	(0.7)	(0.9)	(0.7)	(1.4)	(1.1)
Securities over assets	-1.0***	-1.0	0.3	0.9*	1.0	0.1
	(0.2)	(0.6)	(0.4)	(0.4)	(1.1)	(0.8)
Constant	231.4***	603.7***	369.5***	-147.8***	52.7	200.5*
	(22.5)	(64.6)	(43.7)	(37.6)	(92.6)	(78.2)
Bank FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
Bank-Years observations	101,768	101,768	101,768	101,768	101,768	101,768
Adjusted R^2	0.83	0.87	0.83	0.56	0.54	0.60
Within R^2	0.11	0.24	0.23	0.05	0.05	0.03

Note: This table reports regression results for specification (2.1), using an unbalanced panel of 6,645 banks in 59 countries from 1995 to 2022. The dependent variables are at the top of each column in the table. The coefficient on the policy rate indicates the effect of policy rates independent of inflation. For each right-side variable, the first line comes from panel-fixed-effects ordinary least squares regressions with corresponding standard errors (in parentheses) on the second line, which are clustered by year and country. The third line shows the standard errors (in brackets) from country-level bootstraps (20,000 draws). The dependent variables are in basis points. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively.

Annex Table 3.3. Gross Measures of Bank Profitability (Direct Effect of Inflation)

	Interest components			Non interest components		
	Net	Income	Expense	Net	Income	Expense
Inflation, expected	-0.1	5.1	4.2	9.5	23.8	14.3
	(1.5)	(5.9)	(4.8)	(7.5)	(17.2)	(10.3)
	[2.0]	[5.0]	[4.0]	[7.5]	[16.8]	[9.7]
Inflation, expected (lagged)	0.8	-1.4	-2.6	-2.3	-2.2	0.2
	(0.6)	(1.5)	(1.7)	(2.4)	(3.6)	(1.9)
	[0.8]	[3.0]	[2.3]	[2.1]	[3.7]	[2.2]
Inflation, unexpected	-0.5	-0.3	-1.4	9.5	22.8	13.3
	(1.8)	(2.7)	(1.0)	(5.4)	(13.5)	(8.4)
	[1.7]	[3.0]	[1.5]	[5.4]	[13.2]	[8.0]
Inflation, unexpected (lagged)	-0.4	-1.9	-1.8	-3.0	-9.9	-6.8
	(0.9)	(2.7)	(1.7)	(2.6)	(8.3)	(5.9)
	[1.1]	[3.1]	[2.1]	[2.6]	[7.8]	[5.4]
Policy rate	6.5**	36.2***	24.3***	4.2	17.1*	12.9*
	(2.2)	(3.3)	(2.7)	(3.3)	(8.2)	(5.1)
	[2.3]	[3.6]	[2.9]	[4.3]	[10.4]	[6.2]
rGDP growth, expected	1.9	-9.4*	-12.4**	-1.8	-5.6	-3.8
	(2.6)	(4.5)	(4.2)	(2.2)	(6.2)	(4.9)
rGDP growth, unexpected	-1.2	-2.3	-3.5	-4.9	-10.9	-6.0
	(0.9)	(1.6)	(1.8)	(3.2)	(8.7)	(5.7)
Deposits over liabilities	0.5*	0.9	-0.2	-0.3	-0.2	0.1
	(0.2)	(0.8)	(0.5)	(0.3)	(0.4)	(0.6)
Equity over assets	7.4***	2.1**	-0.8	-0.3	3.6*	4.0**
	(0.7)	(0.8)	(0.9)	(0.8)	(1.4)	(1.1)
Securities over assets	-1.0***	-1.3*	0.1	0.8*	0.7	-0.10
	(0.2)	(0.6)	(0.4)	(0.3)	(0.9)	(0.7)
Constant	216.1***	518.1***	310.2***	-142.5***	58.5	201.0*
	(23.8)	(64.3)	(41.7)	(35.7)	(83.4)	(73.3)
Bank FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
Bank-Years observations	101,768	101,768	101,768	101,768	101,768	101,768
Adjusted R^2	0.83	0.87	0.83	0.56	0.54	0.60
Within R^2	0.11	0.24	0.23	0.05	0.05	0.03

Note: This table reports regression results for specification (2.2), using an unbalanced panel of 6,645 banks in 59 countries from 1995 to 2022. The dependent variables are at the top of each column in the table. The coefficient on the policy rate indicates the impact of policy rates independent of inflation. For each right-side variable, the first line comes from panel-fixed-effects ordinary least squares regressions with corresponding standard errors (in parentheses) on the second line, which are clustered by year and country. The third line shows the standard errors (in brackets) from country-level bootstraps (20,000 draws). The dependent variables are in basis points. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 level, respectively.

Annex Table 3.4. Net Measures of Bank Profitability (Total Effect of Inflation)

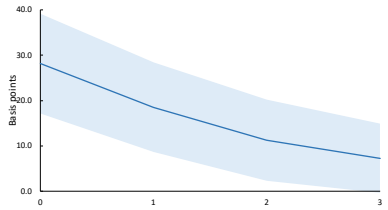
	Return on assets (ROA)	Net interest margin (NIM)	Net non-interest income	Loan impairment charges
Inflation, expected	0.8	4.5*	7.7	5.3
	(1.9)	(1.7)	(6.8)	(3.5)
	[2.0]	[2.0]	[6.7]	[3.3]
Inflation, expected (lagged)	0.5	0.8	-2.3	-1.3
	(0.9)	(0.6)	(2.4)	(1.2)
	[0.9]	[1.0]	[2.0]	[1.3]
Inflation, unexpected	1.3	1.5	8.7	6.1*
	(1.0)	(1.7)	(5.0)	(2.6)
	[1.3]	[1.7]	[5.1]	[2.7]
Inflation, unexpected (lagged)	0.005	-1.0	-2.8	-1.9
	(1.1)	(0.9)	(2.5)	(2.6)
	[1.3]	[1.2]	[2.5]	[2.4]
Policy rate	-0.9	6.6**	-2.6	3.6*
	(1.2)	(2.0)	(1.6)	(1.4)
	[1.2]	[2.1]	[1.8]	[1.3]
rGDP growth, expected	9.0***	0.8	-1.7	-12.0***
	(2.2)	(2.7)	(2.3)	(2.4)
rGDP growth, unexpected	4.6***	-2.3*	-2.6	-11.1***
	(1.1)	(1.1)	(2.2)	(2.2)
Deposits over liabilities	-0.03	0.5*	-0.3	-0.04
	(0.2)	(0.2)	(0.3)	(0.2)
Equity over assets	5.9***	7.4***	-0.1	-2.3**
	(0.7)	(0.7)	(0.7)	(0.7)
Securities over assets	0.4	-1.0***	0.9*	-0.4
	(0.2)	(0.2)	(0.4)	(0.3)
Constant	-9.8	231.4***	-147.8***	119.5***
	(26.4)	(22.5)	(37.6)	(30.4)
Bank FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Bank-Years observations	101,768	101,768	101,768	101,768
Adjusted R^2	0.50	0.83	0.56	0.36
Within R^2	0.08	0.11	0.05	0.08

Note: This table reports regression results for specification (B.1), defined in Annex B, using an unbalanced panel of 6,645 banks in 59 countries from 1995 to 2022. The dependent variable is reported on the top of each column. For each right-hand-side variable, the first line comes from panel FE OLS regressions with corresponding standard errors in the second line, which are clustered by year and country. The third line shows the standard error from country-level bootstraps (20,000 draws). The unit of the dependent variables is in basis points. *, **, and *** indicate significance at the 0.1, 0.05, and 0.01 level, respectively.

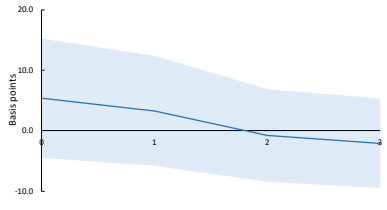
Annex 4. Additional Figures

Annex Figure 4.1. Local Projections for Income and Expenses

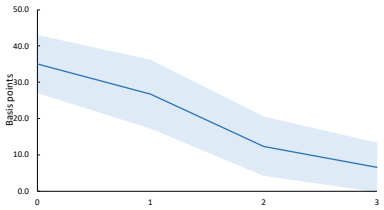
A. Interest income margin to expected inflation



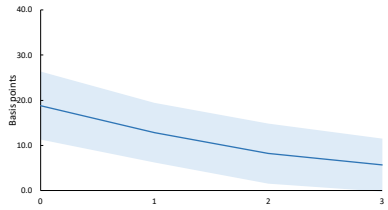
B. Interest income margin to unexpected inflation



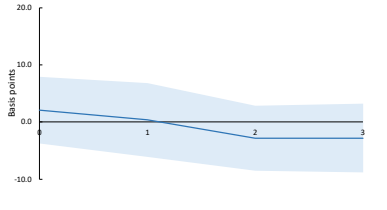
C. Interest income margin to policy rates



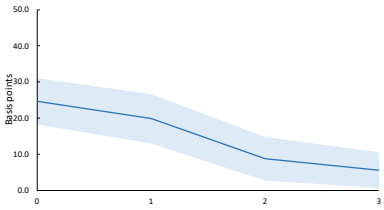
D. Interest expense margin to expected inflation



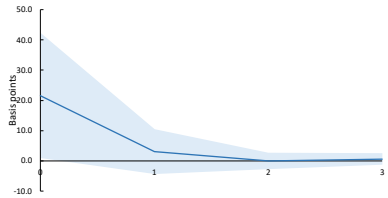
E. Interest expense margin to unexpected inflation



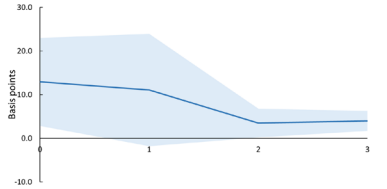
F. Interest expense margin to policy rates



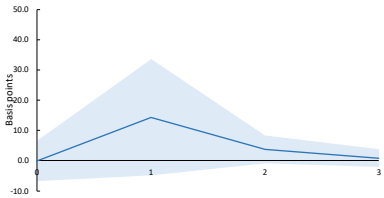
G. Non-interest income to expected inflation



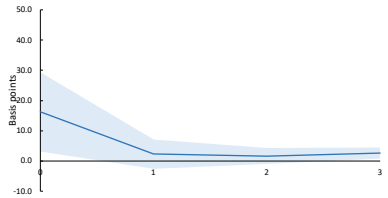
H. Non-interest income to unexpected inflation



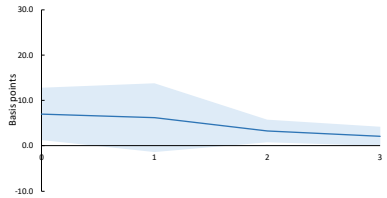
I. Non-interest income to policy rates



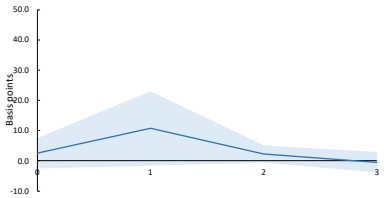
J. Non-interest expense to expected inflation



K. Non-interest expense to unexpected inflation

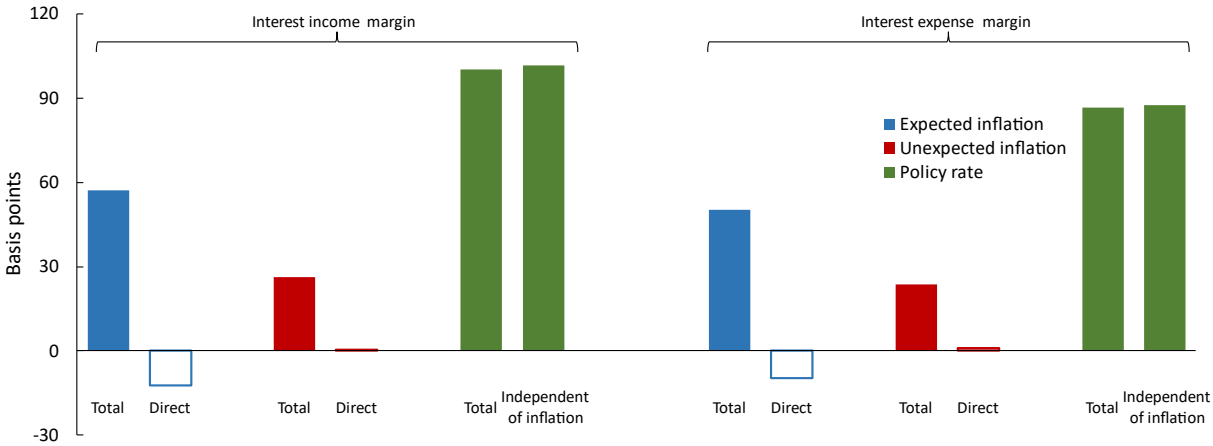


L. Non-interest expense to policy rates



Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure shows local projections on interest income margin, interest expense margin, non-interest income, and non-interest expense (in each row, respectively) to expected, unexpected, and policy rates independent of inflation (in each column, respectively), using specification (2.1) defined in Annex 2. Regressions are weighted by 1/(number of banks in each country year). Each point on the line indicates the sum of contemporaneous and lagged coefficients. The shaded area shows the confidence interval at the 10 percent significance level, using standard errors that are block-bootstrapped at the country level.

Annex Figure 4.2. Figure 4 Repeated within Euro Area Countries

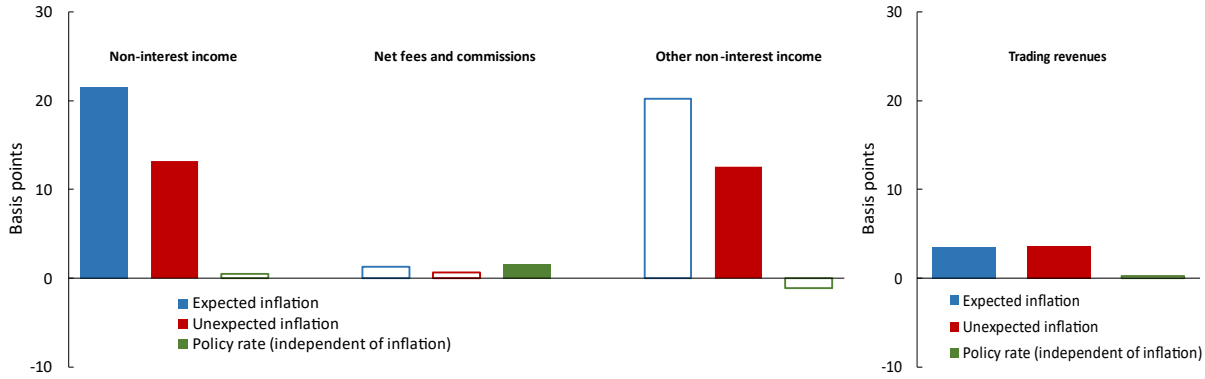


Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure compares the total effects of inflation, which control for policy rates orthogonal to inflation, and direct effects of inflation, which focus on inflation orthogonal to policy rates. See specifications (2.1) and (2.2) defined in Annex 2. For the euro area, we also control for the euro area's expected and unexpected real GDP growth and exclude time fixed effects. The sample includes 17 euro area countries. Bars are sums of contemporaneous and lagged coefficients. Filled bars indicate statistically significant coefficients at the 10 percent level, while unfilled bars indicate statistically insignificant coefficients. Standard errors are block-bootstrapped at the country level. Regressions are weighted by 1/(number of banks in each country year).

Annex Figure 4.3. Breakdown of Non-Interest Income

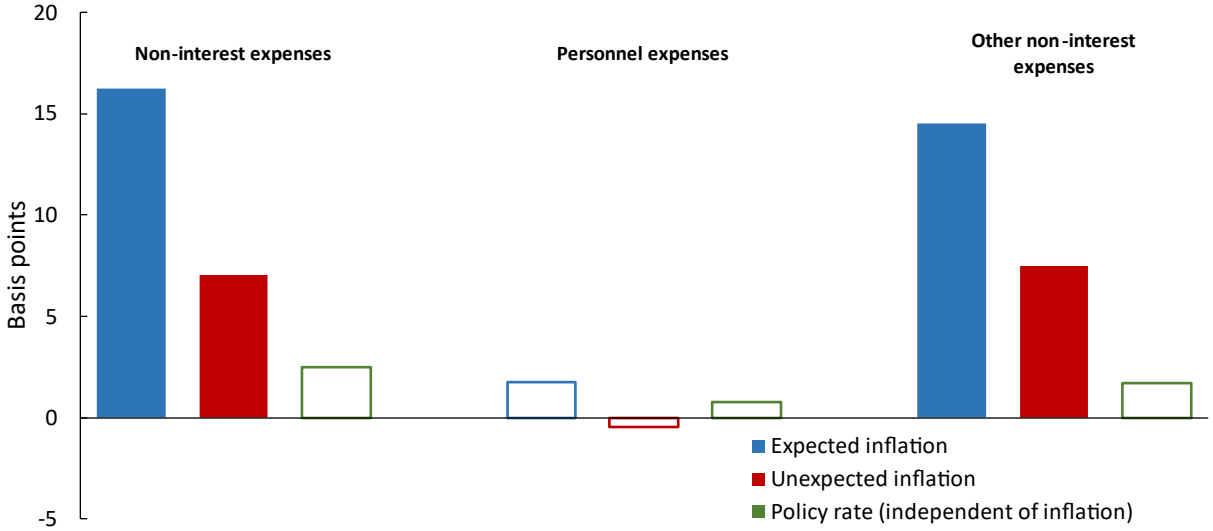
1. Exposure of Net Fees and Commissions and Other Non-Interest Income

2. Exposure of Trading Revenues



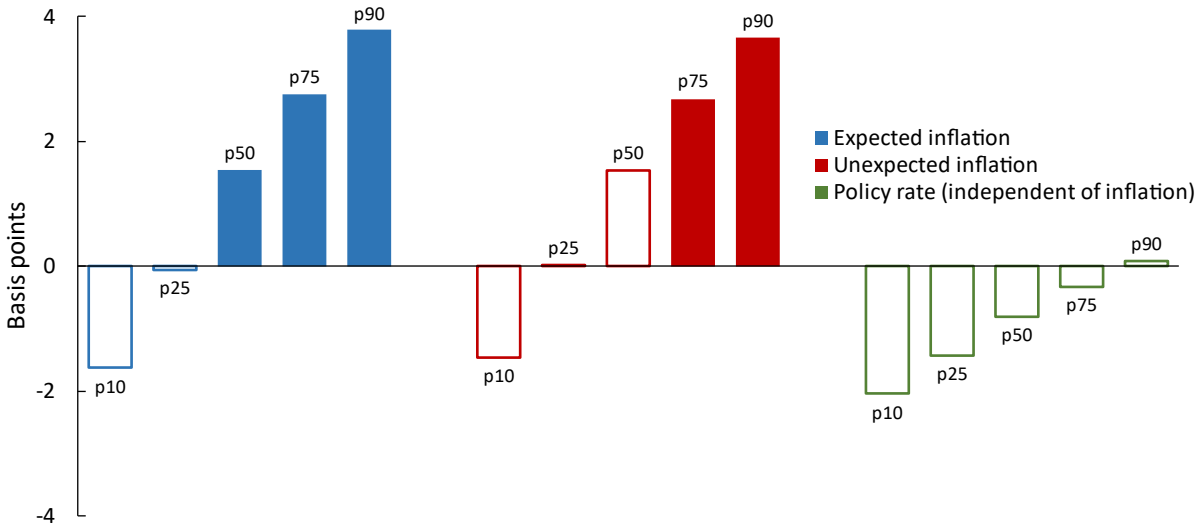
Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure shows exposure to expected and unexpected inflation when controlling for the component of policy rates that is orthogonal to inflation of specification (2.1) defined in Annex 2, for the components of non-interest income. Other non-interest income in panel 1 includes trading revenues. Results for trading revenues are shown separately in panel 2 because of lower data coverage. Bars show sums of contemporaneous and lagged coefficients. Filled bars indicate statistically significant coefficients at the 10 percent level, while unfilled bars indicate statistically insignificant coefficients. Standard errors are block-bootstrapped at the country level. Regressions are weighted by 1/(number of banks in each country year).

Annex Figure 4.4. Breakdown of Non-Interest Expense



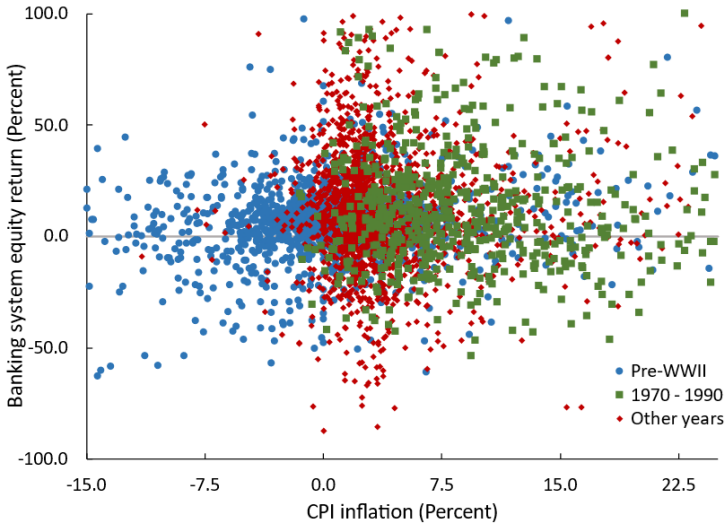
Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure shows exposure to expected and unexpected inflation when controlling for the component of policy rates that is orthogonal to inflation of specification (2.1) defined in Annex 2, for non-interest expense components. Bars show sums of contemporaneous and lagged coefficients. Filled bars indicate statistically significant coefficients at the 10 percent level, while unfilled bars indicate statistically insignificant coefficients. Standard errors are block-bootstrapped at the country level. Regressions are weighted by 1/(number of banks in each country year).

Annex Figure 4.5. Quantile Regressions for Return on Assets



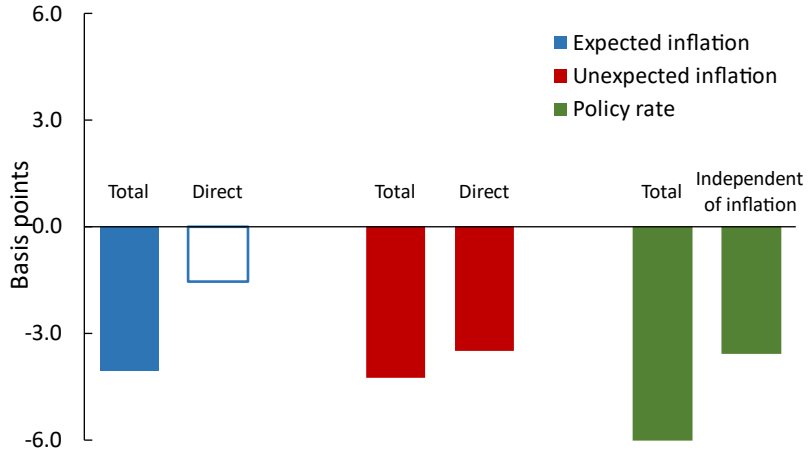
Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure shows coefficients of expected inflation, unexpected inflation, and policy rate independent of inflation from quantile regressions on the 10th, 25th, 50th, 75th, and 90th percentiles using specification (2.1) in Annex 2. Bars show sums of contemporaneous and lagged coefficients. Filled bars indicate statistically significant coefficients at the 10 percent level, while unfilled bars indicate statistically insignificant coefficients. Regressions are weighted by 1/(number of banks in each country and year).

Annex Figure 4.6. Banking System Equity Return and Inflation (1870–2016)



Source: Baron, Verner, and Xiong 2021.
Note: This figure shows nominal banking sector equity returns together with the annual consumer price index inflation. Blue dots show Pre-WWII period (from 1870 to 1944), green dots indicate years from 1970 to 1990, and red dots indicate all other years from 1870 to 2016. WWII = World War II.

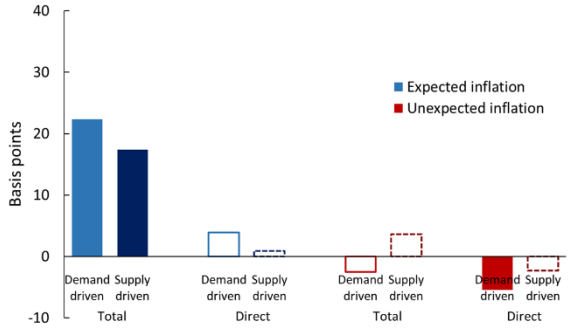
Annex Figure 4.7. Total and Direct Exposure of Loan Impairments



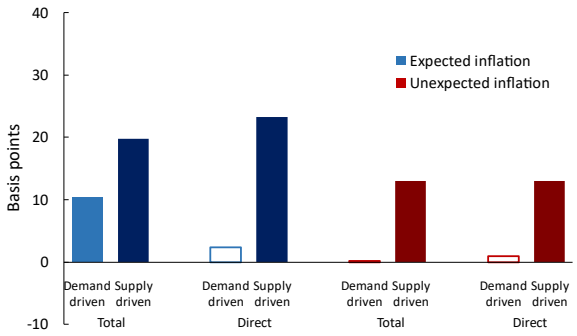
Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure compares the total effects of inflation, which control for policy rates orthogonal to inflation, and direct effects of inflation, which focus on inflation orthogonal to policy rates. See specifications (2.1) and (2.2) defined in Annex 2. Bars are sums of contemporaneous and lagged coefficients. Filled bars indicate statistically significant coefficients at the 10 percent level, while unfilled bars indicate statistically insignificant coefficients. Standard errors are block-bootstrapped at the country level. Regressions are weighted by 1/(number of banks in each country year).

Annex Figure 4.8. Total and Direct Exposure of Interest and Non-Interest Expense to Inflation by Source

1. Interest Expense Exposures to Inflation



2. Non-Interest Expense Exposures to Inflation

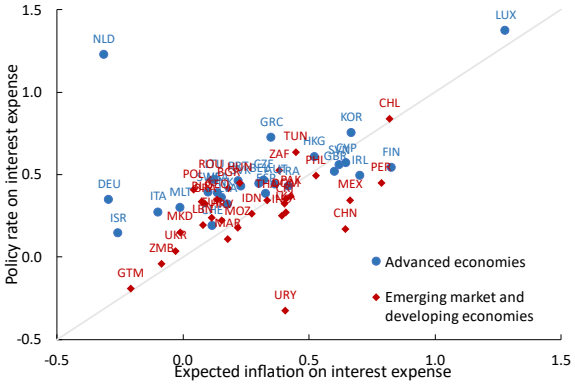


Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure compares the total effects of inflation, which control for policy rates orthogonal to inflation, and direct effects of inflation, which focus on inflation orthogonal to policy rates. See specification (2.1) and (2.2) defined in Annex 2. Each bar shows the effect of inflation driven by demand or supply, in which inflation is interacted with a dummy that indicates the presence of supply-driven inflation at *t*. Bars are sums of contemporaneous and lagged coefficients. Filled bars indicate statistically significant coefficients at the 10 percent level, while unfilled bars indicate statistically insignificant coefficients. Regressions are weighted by 1/(number of banks in each country year).

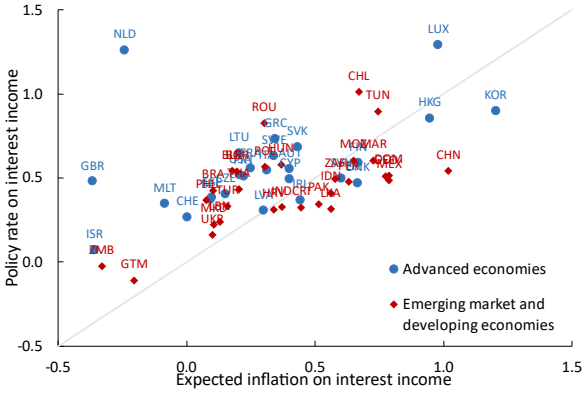
Annex 5. Cross-Country Heterogeneity

Annex Figure 5.1. Cross-Country Heterogeneity: Policy Rates and Inflation Expectations

1. Interest Expense



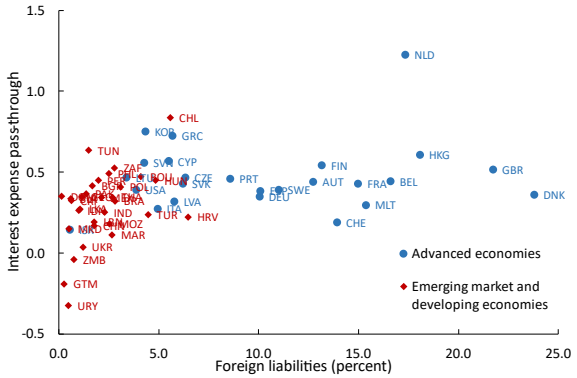
2. Interest Income



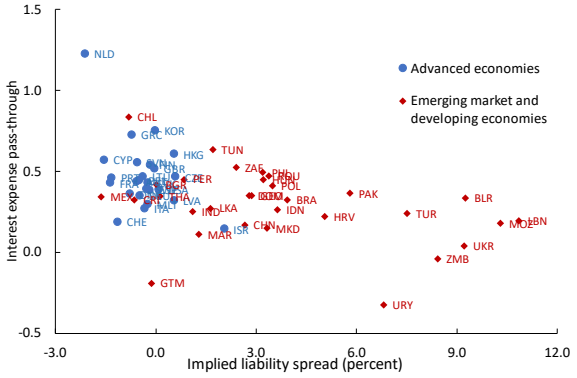
Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: Panel 1 shows the coefficient of expected inflation (*x*-axis) and policy rate (*y*-axis) on interest expense, using specification (2.1) for the former and specification (2.2) for the latter, capturing the total effect of each, respectively. The correlation between the *x*-axis and *y*-axis is 0.31 and significant at the 1.7 percent significance level. Japan was omitted for readability. Panel 2 shows the coefficient of inflation expectation (*x*-axis) and policy rates (*y*-axis) on interest income, using specification (2.1) for the former and specification (2.2) for the latter, capturing the total effect of each, respectively. The correlation between the *x*-axis and *y*-axis is 0.23 and significant at the 8 percent level. Japan, Germany, and Uruguay were omitted for readability. Both specifications include country interactions with an unbalanced panel sample of 59 countries from 1995 to 2022. The scatter plot depicts the coefficient estimated for each country. The regressions are weighted by 1/(number of banks in each country and year). Data labels use International Organization for Standardization country codes.

Annex Figure 5.2. Interest Expense Pass-Through and Competition

1. **Interest Expense Pass-Through and Composition of Liabilities**



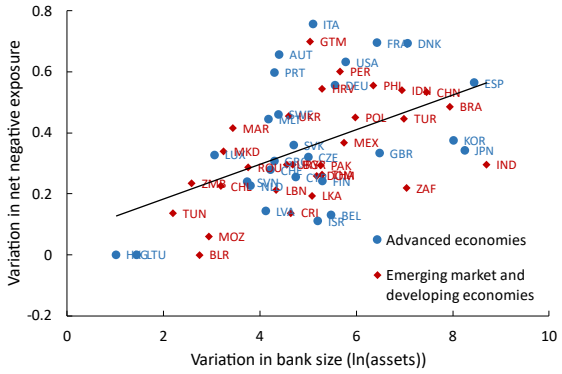
2. **Interest Expense Pass-Through and Liability Spreads**



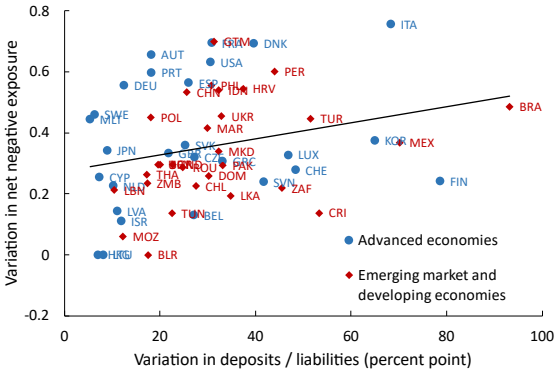
Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: Panel 1 shows interest expense pass-through and composition of foreign liabilities, and panel 2 shows interest expense pass-through and implied liability spreads at the country level. Interest expense pass-through is defined as the coefficient of the policy rate on interest expense using specification (2.2) defined in Annex 2, but including country interactions using the same unbalanced panel of 59 countries from 1995 to 2022. The regressions are weighted by 1/(number of banks in each country and year). Banks' foreign liabilities are shown as percent of GDP on an ultimate risk basis. Liability spread is calculated by subtracting interest expense margin from the policy rate. The following outliers are omitted from the graphs for readability: Luxembourg, Ireland, and Japan. Data labels use International Organization for Standardization country codes.

Annex Figure 5.3. Net Negative Exposure to Unexpected Inflation and Bank Characteristics across Countries

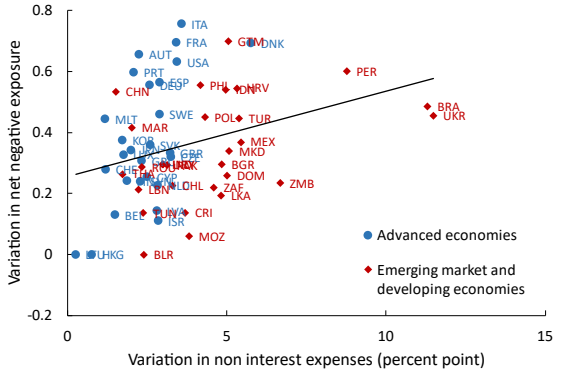
1. **Variation in Net Negative Exposure and Bank Size**



2. **Variation in Net Negative Exposure and Deposit Reliance**



3. **Variation in Net Negative Exposure and Non-interest Expenses**



Sources: Bank for International Settlements; Bloomberg Finance L.P.; Fitch Connect; Haver Analytics; and IMF staff analysis.
Note: This figure shows the within-country variation or range in net negative exposure against variation or range in bank size, deposit reliance, and size of non-interest expenses. The range is defined as 1.5 times the interquartile range of the bank-level data for each country. Net negative exposure is the difference between bank-specific income and expense pass-throughs for non-interest business on unexpected inflation, based on specification (2.2) defined in Annex 2. Panel 1 shows a correlation of 0.5 with a 0 *p* value. Panel 2 shows a correlation of 0.26 with a 0.025 *p* value, and panel 3 shows a 0.3 correlation with a 0.02 *p* value. Data labels use International Organization for Standardization country codes.

PUBLICATIONS

Inflation and Bank Profits: Monetary Policy Trade-offs
Staff Discussion Note No. SDN/2025/001