Using a global sample of up to 7,368 banks over 1990-2022, we find that a range of macroprudential policies have a significant positive effect on banks' noninterest income, particularly those focused on loan supply/demand and capital measures. Similar results are found for a range of disaggregated samples for type of noninterest income, country development, bank size, pre and post crisis and three robustness checks. These positive effects may offset negative effects of macroprudential policy on other profitability components, but may also affect bank risk adversely, as highlighted widely in the literature and also with our dataset. There are important implications both for regulators and bank management.

An important aspect of recent financial change is a relative shift of banks' revenue from net interest income to noninterest income, which is in turn composed of fee income, net capital gains, dividend income and other income. Underlying factors include increased competition in loan markets due to deregulation and the rise of securities markets, growth of off-balance-sheet activities and tighter capital adequacy requirements which limit higher-risk lending.

There is an extensive literature on effects of noninterest exposure on bank risks and profitability, but relatively few papers focus on determinants of noninterest income, and none to date look at effects of macroprudential policy on noninterest income.

We seek to fill these gaps by providing an assessment of factors underlying the level of noninterest income, using a global sample of up to 7,368 banks over 1990-2022, followed by testing of effects thereon of macroprudential policy.

We assess not only the global sample but also subgroups for the effects on fees and other noninterest income, advanced and emerging market economies, large and small banks and pre and post crisis. The results are complemented by three robustness checks and estimates with our extensive dataset of the relation of noninterest income and its components to bank risk.

Bulk of work on noninterest income focuses on link to profitability and risk.

Goddard et al (2013), EU banks engaging more on non-traditional lines of business were more profitable on average, possibly due to benefits from economies of scope. Saunders et al (2020) profitability was raised by noninterest income for US banks. Saona (2016) Latin American banks showed negative relationship between revenue diversification and the net interest margin.

Elsas et al (2010) and Sanya and Wolf (2011) - diversification not only improved profitability but also reduced risk. Davis et al (2020) found both provisions/loans and non-performing loans/total loans were lower when noninterest income is higher, across over 100 national banking sectors.

Stiroh and Rumble (2006) US financial holding companies - diversification increased banks' exposure to risk and impacted the trade-off of risk and return, since noninterest activities are much more volatile but not necessarily more profitable than interest-generating activities. Chen et al (2017) both trading and non-trading noninterest revenue positively and significantly affected US bank risk. Brunnermeier et al (2019) US banks with higher noninterest income made a higher contribution to systemic risk via its subcomponents tail risk and interconnectedness risk.

Risk link also found outside US. Antao and Karnik (2022) income diversification raised risk (measured using the Z-Score) for Asian banks. Maudos (2017) European banks with a more diversified income structures riskier and had a higher probability of insolvency, notably prior to the 2008 crisis. Kamani (2019) European small banks' exposure to systemic risk rose with noninterest income.

Relatively few studies of determination of noninterest income

Hahm (2008) 662 banks in 29 OECD countries over 1992-2006; larger banks with lower net interest margins, higher impaired loan ratios, higher returns on assets and higher cost-income 40 reW* nBT/F4 27.984 Tf1

Meng et al (2018) for 88 Chinese banks over 2003-10, risk (the Z-score) as well as higher cost-asset ratios, capital adequacy, bank size and foreign ownership were positively related to the noninterest income to assets ratio.

Ammar and Boughrara (2019) in MENA countries over 1998-2015, overall profitability, liquidity, credit risk, deposits/assets, the cost-asset ratio and GDP growth had a positive effect on income diversification, while capitalisation was negatively related.

Haubrich and Young (2019) larger banks in the US over 2001-18 were more dependent on noninterest income. Before the global financial crisis, there was a positive relation of net interest income to the share of noninterest income, whereas afterwards this relation was negative. The term spread had a positive effect but only before the crisis.

Extensive literature on

Noninterest income model is derived from the references above:

$NIIAA_{ijt}$ or $NIR_{ijt} = \alpha_{it} + \beta_1 NIIAA_{ijt-1}$ or $\beta_1 NIR_{ijt-1} + \beta_2 Internal_{ijt-1} + \beta_3 Macro_{jt} + \beta_4 Industry_{ijt} + \varepsilon_{ijt}$ i indicates an individual bank, j refers to the country and t indicates time period.

Two measures used, ratio of noninterest income to average total assets (NIIAA) and ratio of noninterest income to gross operating income (NIR). Former shows the contribution of noninterest income to profitability (the other components being net interest income, noninterest costs and provisions), the latter shows income diversification. Noninterest income also divided in subsamples into fee (NIFEEAA/NIFEER) and nonfee (net capital gains, dividend income and other income – NINONFEEAA/NNNONFEER) components

Internal, bank-specific, controls are bank size (log total assets), capital adequacy (equity/assets) credit risk (provisions/gross loans), portfolio balance (gross loans/total assets), liquidity risk (deposits/total liabilities) and management efficiency (the cost-income ratio). We added profitability measures: the return on average assets (ROAA) and the net interest margin/average assets.

Industry variables are banking crisis dummy and Lerner Index showing bank-level market power.

All variables apart from crisis and macroprudential variables winsorised at 99%.

Estimation is by panel OLS with bank-level and time fixed effects; bank variables were lagged to reduce the risk of endogeneity. We clustered standard errors by country, since the effects of policy are also country-specific (Altunbas et al 2018). Given use of lags, as well as issues of lack of precision and loss of observations, we prefer this approach to GMM – used rather as robustness check.

Empirical testing used data from up to 7,368 banks from 100 advanced and developing countries sourced from the Fitch-Connect database, macro variables are from the IMF and the World Bank.

Macroprudential data are from the IMF IMAPP database of policy actions for 1990-2021 as introduced in Alam et al (2019). We use both individual measures and their aggregated summary measures.

Data annualised and cumulated (to show the policy stance) following approach of Bergant et al (2020). Meuleman and Vander Vennet (2020) noted cumulation is important since macroprudential measures can have effects not just initially but also in the longer term, and the specific point at which the policy becomes binding is not observable.

Macroprudential policy measures are also lagged, to limit risk of endogeneity and reverse causality, as macroprudential authorities may react to bank-level developments. This also allows for lags in the adjustment of banks' behaviour to macroprudential measures.

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
NIIAA						

DEPENDENT	NIIAA	NIR
MAPP-INDEX (-1)	0.0098*** (3.7)	0.0531 (1.1)
LOAN-TARGETED (-1)	0.021*** (3.0)	0.0628 (0.6)
DEMAND (-1)	0.024** (2.3)	-0.0781 (0.5)
SUPPLY-ALL (-1)	0.0099*** (3.0)	0.0702 (0.2)
SUPPLY-LOANS (-1)	0.0342*** (3.1)	0.239 (1.4)
SUPPLY-GENERAL (-1)	0.0056 (0.7)	0.0844 (0.8)
SUPPLY-CAPITAL (-1)	0.0214** (2.7)	0.09 (0.9)

Note - MAPP INDEX is the sum of dummies for all of 17 categories. The LOAN TARGETED group consists of the "Demand" and the "Supply-loans" instruments. DEMAND comprises: LTV and DSTI. SUPPLY-LOANS is loan growth limits, provision measures, loan measures, limits to the loan to deposit ratio, and limits to foreign currency loans. SUPPLY-GENERAL is reserve requirements, liquidity requirements, and limits to FX positions. SUPPLY-CAPITAL is leverage, countercyclical buffers, conservation buffers, and capital requirements. Equations include the control variables in the baseline

DEPENDENT	NIIAA	NIR

REGION	FEE INCOME		NON-FEE NONINTEREST INCOME
DEPENDENT	NIFEEAA	NIFEER	

	Fee Income		Non-fee noninterest income		Memo: Total noninterest income	
DEPENDENT	NIFEEAA	NIFEER	NIRESAA	NIRESR	NIIAA	NIR

DEPENDENT	1990-2007		2008-2022	
	NIIAA	NIR	NIIAA	NIR
MAPP-INDEX (-1)	0.001 (0.1)	-0.0561 (0.3)	0.0138*** (3.6)	0.0932** (2.2)
LOAN-TARGETED (-1)	0.029 (0.1)	-0.226 (0.4)	0.0231** (2.4)	0.15 (1.5)
DEMAND (-1)	0.0395 (0.9)	-0.326 (0.4)	0.0173 (1.1)	-0.0198 (0.1)
SUPPLY-ALL (-1)	-0.005 (0.3)	-0.0724 (0.3)	0.016*** (4.0)	0.124** (2.2)
SUPPLY-LOANS (-1)	0.0373 (1.0)	-0.271 (0.5)	0.0467*** (3.5)	0.432*** (2.7)
SUPPLY-GENERAL (-1)	-0.0053 (0.4)	-0.021 (0.1)	0.014 (1.4)	0.0753 (0.6)
SUPPLY-CAPITAL (-1)	-0.118 (1.2)	-1.147 (1.6)	0.0277*** (3.1)	0.225* (1.9)

REGION: GLOBAL	WITH WORLD BANK REGULATION VARIABLES	WITH BANK CLUSTERED STANDARD ERRORS	WITH DIFFERENCE GMM

DEPENDENT: LOG Z SCORE	NIIAA	NIR	NIFEEAA

Global results for 100 countries show noninterest income is persistent over time and negatively related to bank size and the loan/asset ratio. The ratio to average assets links positively to capital adequacy and the net interest margin, and negatively to credit risk the return on average assets, market power, bank crises and inflation. The ratio to total income links positively to credit risk, the cost/income ratio, the return on average assets and inflation, and negatively to the net interest margin.

A number of measures of macroprudential policy influence noninterest income, and the significant effects are positive. From the summary measure results, the effects appear to be stronger for the measure noninterest income/average assets than for noninterest income's share in total income.

In terms of individual measures, loan-targeted policies have a positive effect across global banks, while capital measures also boost noninterest income in a number of cases. Only tighter loan/deposit ratios have a consistently negative effect.

These results for determinants are also largely apparent for disaggregation by type of noninterest income, region and bank size, and also in three robustness checks. One interesting contrast, however, is that fee income is boosted by economic growth whereas nonfee income rises in recession..

Especially for the summary measures, macroprudential policy effects are also similar and positive across subsamples. Unlike the global sample, there are a number of positive effects of macroprudential policy categories on the share of noninterest income, notably for EMDE banks, nonfee income and small banks. We also find the effects of macroprudential are mainly from the period since 2008 – summary effects are insignificant although a number of individual measures were effective before 2008

These results are of considerable relevance to regulators. Notably, the results for the ratio of noninterest income to average assets suggest that negative effects of

This raises further regulatory issues in terms of a possible need to encourage fee as opposed to nonfee income generation, both when macroprudential policy is tightened and in general terms and how that could be accomplished. Given the inverse relation of nonfee income to economic growth, recessions would need particular vigilance for this reason also.

Choice of macroprudential policy is also relevant in this context since we find both types of noninterest income are boosted by macroprudential policy tightening, although fee income is raised by both demand and supply measures while nonfee is largely affected by supply measures.

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