NONINTEREST INCOME, MACROPRUDENTIAL POLICY AND BANK PERFORMANCE

E Philip Davis

Brunel University and NIESR

Dilruba Karim

Brunel University

Dennison Noel

Brunel University

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Noninterest Income, Macroprudential Policy and Bank Performance

E Philip Davis, Dilruba Karim and Dennison Noel[1]

Abstract

Macroprudential policies have become crucial tools for maintaining financial stability, but their effect on banks' noninterest income has not yet been examined. This is a paradox in light of results in the literature linking noninterest income to bank performance indicators such as risk and profitability. Using a global sample of 7,368 banks over 1990-2022, we find macroprudential policies have a significant positive effect on noninterest income. Similar results are found for disaggregated samples by type of noninterest income, country development, bank size and pre and post the Global Financial Crisis, and in three robustness checks. However, the extent to which such positive effects feed through to overall profitability depends on the type of noninterest income. Furthermore, stimulus from macroprudential policies to noninterest income, and especially its nonfee component, is found to affect bank risk adversely. Our findings have important implications for central bankers, regulators and commercial bank management.

Classification: E44, E58, G21, G28

Keywords Macroprudential policy, bank profitability, noninterest income, bank risk

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[1] E Philip Davis, Professor of Banking and Finance, Brunel University, Uxbridge, Middlesex, UB8 3PH, UK, and Fellow, NIESR, 2 Dean Trench Street, Smith Square, London SW1P 3HE, emails philip.davis@brunel.ac.uk and e_philip_davis@msn.com, Dilruba Karim, Senior Lecturer, Brunel University email Dilruba.karim@brunel.ac.uk and Dennison Noel, Brunel University, email dnoel@savanagrande.com.

Contents

1.   Introduction

An important aspect of the evolution of financial systems since the 1970s is a relative shift of banks' revenue from net interest income to noninterest income[1]. DeYoung and Roland (2001) and Hahm (2008) among ot4hers cite a number of factors underlying the long-term shift to noninterest income. First, there is increased competition in loan markets due to deregulation and the rise of securities markets. Second, banks have experienced liberalisation of access to nontraditional activities such as investment banking and insurance. Third, tighter capital adequacy requirements have limited higher-risk lending. Fourth there has been growth of off-balance-sheet and securitisation activities in response to these factors, as well as technological advances. Finally, there has been greater economic volatility and banking crises affecting returns from loans.

As regards the channels of transmission of these changes, reduced scope to make profitable loans due to securities market competition and capital requirements put downward pressure on bank profitability and led banks to seek to maintain their profitability via noninterest income generation. Measures of deregulation such as the 1999 Gramm-Leach-Bliley Act in the US enabled banks to enter new sectors such as investment banking and insurance, which gave them greater scope to generate noninterest income. Off-balance sheet activities such as securitisations tend to generate more value in terms of noninterest income than do on-balance sheet assets. Noninterest activities historically tended to require less or no regulatory capital enabling higher leverage (DeYoung and Roland 2001) although successive Basel agreements have narrowed the scope for such arbitrage. Banks were further encouraged to seek noninterest income by economic volatility and banking crises since 1970, given the belief among bankers that there are diversification benefits to combining interest and noninterest income generation in banks' activities, which is expected to reduce risk (as noted in Stiroh 2004)[2].

There is an extensive literature on effects of noninterest exposure on bank performance indicators, namely risks and profitability, such as Goddard et al (2013) and Stiroh and Rumble (2006). However, relatively few papers focus on determinants of noninterest income (exceptions include Hahm (2008) and Haubrich and Young (2019)). No prior studies to date examine effects of macroprudential policy on noninterest income. This is despite the potential importance of noninterest income in affecting financial stability via its effect on risk and profitability of banks.

We seek to fill this gap by providing an assessment of factors underlying the level of noninterest income and showing how noninterest income relates to macroprudential policy. To do so, we employ a global sample of 7,368 banks over 1990-2022. This enables us to assess not only results for the global sample of banks but also separate estimates for effects on fees and other noninterest income, in advanced and emerging market economies, for large and small banks and for the pre and post the Global Financial Crisis periods. The results for noninterest income and macroprudential policy are complemented by three robustness checks on the global sample.

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[1] Noninterest income is defined as the sum of fee income, net capital gains, dividend income and other income

[2] Stiroh (2004) notes belief among bankers that noninterest income may be less dependent on the economic cycle than traditional lending, thus reducing overall profit volatility, or that expanded product lines and cross selling may offer diversification benefits. His empirical analysis in that paper tends to disprove these assertions, however.

Meanwhile context is provided by complementary estimates with our extensive global dataset of the relation of noninterest income and its components to bank risk and overall profitability. These supplementary estimates complement the existing literature on these aspects by offering a more extensive and up to date dataset than existing studies, and also focusing on the differing effects of nonfee and fee income globally and in subsamples. These enable an assessment to be made of how macroprudential policy feeds through to bank risk and profitability via the specific channel of noninterest income.

Among our key results are a universal positive effect of macroprudential policies on noninterest income, including both its fee and nonfee subcomponents. We suggest that the main types of macroprudential policy, which are limits on loan supply and demand on the one hand, and tighter capital requirements on the other, have a similar effect to the long-term causes of the switch to noninterest income cited above, namely declining scope for bank lending and higher costs of lending due to capital regulations.

We also find a significant effect of noninterest income, and especially its nonfee component, on bank-level risk as shown by the Z-score, in line with prior studies such as Chen et al (2017). Nonfee income is also negatively related to overall bank profitability. These in turn suggest that the effect of macroprudential policy on bank stability via noninterest income can be counterproductive, depending on its composition.

The paper is structured as follows. After a literature survey in Section 2, we introduce the methodology in Section 3 and data in Section 4 before showing the main results in Section 5. Section 6 features three robustness checks on the main results, while Section 7 probes the potential effect of a boost to bank noninterest income driven by macroprudential policy on bank risk and overall profitability. Section 8 concludes.

2.   Literature

The bulk of work on noninterest income focuses on its link to certain bank performance indicators, namely profitability and risk. Goddard et al (2013), for example, found that banks from eight EU banks over 1992-2007 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) also found profitability was raised by noninterest income for US banks over 1984-2013. Saklain and Williams (2024) found that noninterest income raises profitability, as does a more market-based financial system. However, Saona (2016) found banks in seven Latin American during 1995-2012 showed a negative relationship between revenue diversification and the net interest margin, a component of profitability.

Concerning risks, a number of studies found income diversification not only improved profitability but also reduced risk. Examples are Elsas et al (2010) in nine countries over 2006-2008 and Sanya and Wolf (2011) looking at 11 emerging economies in 2000-2007. 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. DeYoung and Torna

(2013) found fee-based income led to a decline in failure probability of US banks, although nonfee income raised risk.

More generally, Stiroh and Rumble (2006) found that diversification increased exposure to risk, measured using risk-adjusted earnings and the Z-score for US financial holding companies over 1997-2002. Diversification also 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) analysing behaviour of US banks over 1992-2010 found both trading and non-trading noninterest revenue positively and significantly boosted both idiosyncratic and systematic risks.

Brunnermeier et al (2019) found that US banks with higher noninterest income over 1986-2017 made a higher contribution to systemic risk via its subcomponents tail risk and interconnectedness risk. Apergis (2014) provided results with implications for links from noninterest income to risk and profitability for a sample of 1725 US banks over 2000-2013. He found that high non-traditional activity, which generates noninterest income, boosts both profitability and risk measured by the inverse of the Z-score.

Such results are not confined to US samples. Antao and Karnik (2022) found income diversification raised risk (measured using the Z-Score) for Asian banks over 1996-2018. Maudos (2017) found European banks over 2002-2012 with a more diversified income structures were riskier as measured by the Z-score and income volatility, and had a higher probability of insolvency, notably prior to the 2008 crisis. Kamani (2019) found that over 2002-2016, European small banks' exposure to systemic risk rose with noninterest income.

In contrast to the extensive literature on profitability and risk, there are relatively few studies of the determination of noninterest income. Hahm (2008) sampled 662 banks in 29 OECD countries over 1992-2006. At a bank level, larger balance sheets, lower net interest margins, higher impaired loan ratios, higher returns on assets and higher cost-income ratios tended to be more dependent on noninterest income. As a country level, lower economic growth and inflation and highly developed stock markets, tended to accompany higher noninterest income shares for banks. Higher noninterest income tended to accompany higher profit volatility.

Meng et al (2018) studied data for 88 Chinese banks over 2003-10. They found that 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) found that 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) found 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.

Some recent work has also focused on the determination of noninterest income in low-interest rate periods such as 2008 to 2021. For example, Borio et al (2017) used data on 109 major international banks from 1995-2012 for the ratio of noninterest income to total assets and found a positive effect of asset price growth as well as the bank liquidity ratio, and a negative effect of asset price volatility. Furthermore, the ratio was negatively affected by the short-term interest rate and the yield curve, which the authors attributed to pressure on net interest margins when interest rates are low.

Molyneux et al (2020) reported a negative effect of the short rate on fee income for 440 Italian banks over the 2007-2016 period, along with a negative effect of size and liquidity and a positive effect of the cost to income ratio and non-performing loans. However, Altavilla et al (2019) focusing on the profitability of 288 Eurozone banks from 2000 to 2016, reported no significant interest-rate effect on noninterest income.

There is an extensive literature on the effects of macroprudential policy on banks, notably on lending and risk (see for example Claessens et al (2013) and Altunbas et al (2018)). The results generally favour a decline in lending and a reduction in risk when macroprudential policy is tightened. The research on bank income and profitability is much more limited. Davis et al (2022) studied effects on bank profitability with a global sample; capital measures tended to reduce profitability whereas loan supply/demand measures had a zero or positive effect. Meuleman and Vander Vennet (2022) found that while Eurozone banks reduced lending and risk in response to macroprudential policy tightening, net interest margins tended to decline. No extant work, to our knowledge, focuses on the effects of macroprudential policy on bank noninterest income.

The absence of empirical work on effects of macroprudential policy on noninterest income is a paradox in the light of the work cited above highlighting links to profitability and risk, not least because channels for such effects can be envisaged. The main components of noninterest income are net trading income and net fees and commissions. As macroprudential policy typically constrains the balance sheet in terms of risk and return, any reduction in profitability is likely to be met by pressure to raise such fee and trading income.

In the case of loan-targeted measures, the effect of macroprudential policy can be seen as congruent with the initial stimulus to noninterest income from the decline in corporate loan demand with the growth of securities markets. In that case, banks sought noninterest income because the demand for loans declined. Macroprudential policy can also operate on the demand for loans, notably loan-to-value and debt service to income ratios on mortgages. But it can also affect loan supply directly, with credit growth limits and other loan restrictions having a similar effect of constraining the balance sheet. As scope for lending declines, banks will seek more noninterest income to maintain profitability.

Capital measures may also encourage fee and trading income, owing to the downward pressure they exert on lending via higher costs of capital. Again, this is an extension of the initial impact of capital requirements on the shift from interest to noninterest activities, which led banks to seek increased leverage via noninterest activities. There remain counter arguments to these effects, for example that capital limits do bear on trading via the "trading book", while fee income

may be partly tied to loan emission, but we expect that the positive effects of capital measures on noninterest income are likely to be primary.

3. Methodology

Our baseline noninterest income model, within which we will test macroprudential policy effects, is derived from the references above, such as Hahm (2008) and Molyneux et al (2020):

$$NIIAA_{it} \text{ or } NIR_{it} = \alpha_{it} + \beta_1 NIIAA_{it-1} \text{ or } \beta_1 NIR_{it-1} + \beta_2 Internal_{it-1} + \beta_3 Industry_{ijt} + \beta_4 Macro_{jt} + \varepsilon_{it} \qquad (1)$$

Where i indicates an individual bank, j refers to the country and t indicates time period. We employ two measures of noninterest income as dependent variables, the ratio of noninterest income to average total assets (NIIAA) and the ratio of noninterest income to gross operating income (NIR). Whereas the former shows the contribution of noninterest income to profitability (the other components being net interest income, noninterest costs and provisions), the latter shows the degree of income diversification. In a subsequent section, we subdivide total noninterest income into fee and nonfee components, a division that is not undertaken by most of the earlier work on noninterest income determination cited above.

Internal indicates bank-specific controls. These are the log of total assets (denoted BANK SIZE in the results tables), the unadjusted capital ratio of equity/assets (CAPITAL RATIO), provisions/gross loans (CREDIT RISK), portfolio balance of gross loans/total assets (LOAN/ASSET RATIO), management efficiency as shown by the cost-income ratio (COST/INCOME) and a proxy for liquidity risk, namely deposits/total liabilities[3] (LIQUIDITY RISK). In line with previous studies such as Beck et al (2013), we consider this vector of independent variables tested at a bank level to characterize aspects of a bank's business model which contribute to profitability as well as risk. We add profitability measures, namely the return on average assets (ROAA) and the net interest margin of net interest income/average assets (as in Hahm 2008) (NET INTEREST MARGIN).

Industry variables are twofold. First there is a banking crisis dummy (BANKING CRISIS) which is set at 1 for all periods of crisis and 0 otherwise, from Laeven and Valencia (2020). Second, we have the Lerner Index (LERNER INDEX) showing bank-level market power[4]. We note that both are typically omitted from existing studies. *Macro* controls comprise real GDP growth (GDP GROWTH) and CPI Inflation (INFLATION).

In line with prior studies, all continuous variables are winsorised at 1% and 99%. Estimation is by panel OLS with bank-level and time fixed effects; bank level variables were lagged to reduce the risk of endogeneity. Since the Lerner index is specific to each individual bank, the Lerner

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[3] Mergaerts and Vander Vennet (2016) suggest that this shows the degree of dependence on non-deposit funding, that are more subject to runs than deposit funding in the presence of deposit insurance. As noted by Altunbas et al (2018), this is also a measure of a bank's contractual strength. "Banks with a large amount of deposits will adjust their deposit rates by less (and less quickly) than banks whose liabilities are mainly composed of variable rate bonds that are directly affected by market movements" (ibid, p411).
[4] The Lerner index is a measure of the price-cost margin; it can be seen as a proxy for current and future profits stemming from pricing power, and it varies at the level of the individual bank. It is derived by estimation of a translog cost function as in Beck et al. (2013) and Davis and Karim (2019).

Index is also lagged like the internal variables. We clustered standard errors by country, since the effects of macroprudential policy are also country-specific (Altunbas et al 2018).

Given use of lags for bank-specific variables to limit issues of endogeneity, and clustering at country level to limit inconsistency, we contend that this panel-OLS based approach is preferable to GMM. As argued by Mirzaei et al (2013), the use of lagged instrumental variables for GMM would imply further loss of degrees of freedom that would vitiate our results by markedly reducing the size of the unbalanced panel dataset. Furthermore, Kok et al (2019) argue that dynamic panel data models which use GMM estimators are only asymptotically efficient and have poor finite sample properties when the time-dimension T is small. Hence, we prefer to retain GMM as a robustness check only.

Having estimated baseline models for noninterest income as in equation (1), we test the additional effect of the cumulative stance of macroprudential policies as shown in equation (2):

$NIIAA_{it}$ or NIR_{it} = α_{it} + $\beta_1 NIIAA_{it-1}$ or $\beta_1 NIR_{it-1}$ + $\beta_2 Internal_{it-1}$ + $\beta_3 Industry_{ijt}$ + $\beta_4 Macro_j$ + $\beta_5 Macroprudential_{jt-1}$ + ε_{it} (2)

Macroprudential denotes the stance of macroprudential, measured as discussed below by cumulation of individual policy measures. These are introduced into the baseline model one by one, in line with the standard approach in the literature on macroprudential policy such as Cerutti et al (2017), Akinci and Olmstead-Rumsey (2018), Carreras et al (2018) and Gaganis et al (2020). They are also lagged to allow for gradual adjustment of banks' behaviour to macroprudential measures. Lags also ensure the risk of endogeneity and reverse causality is not present, in case macroprudential authorities may react to bank-level developments. The remaining variables are already defined. The dataset used and the measure of cumulation are discussed in the following section.

4.   Data

Empirical testing of the model used data from 7,368 banks from a range of advanced and developing countries sourced from the Fitch-Connect database. As shown in Appendix Table A1.1, our sample is drawn from banks operating in 100 countries, comprising 35 advanced countries and 65 emerging market and developing economies (EMDE). There are 3,661 banks from advanced countries and 3,734 from emerging market and developing economies. The types of banks included are universal commercial banks and retail and consumer banks. Investment banks and private banks are excluded due to different balance sheet and income structures, as are bank holding companies, to avoid double counting.

As in Claessens et al (2013), the number of banks for each country covers at least the top 100 banks based on total assets in 1995, 2005 and 2015, or less if fewer banks exist on the Fitch-Connect database. [5] This avoids the sample being dominated by countries with many banks (such as the US, Germany, Japan and Austria). The banking data collected are unconsolidated (where

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[5] We retained all the chosen banks for each base year through the full sample, which is why some countries have more than 100 banks.

available), which also allows for the reporting of foreign bank subsidiaries in each country. All financial statement data are annual and in US dollars. The period of coverage for the banking data is 1990 to 2022, annually, in line with the IMAPP database introduced below. As noted by Altunbas et al (2018), a global sample of countries with different macroprudential policy experiences should reduce the risk of omitted-variables bias.

Data for GDP growth and inflation are from the World Bank World Development Indicators database while that for interest rates is from the IMF International Financial Statistics database and the OECD. The data for banking crises is from Laeven and Valencia (2020), updated to 2022.

Statistical analysis (Table 1) shows that the ratio of noninterest income to average assets is around half the size of the net interest margin. Of the total, around half is fee and half is nonfee income. The noninterest share in total income is an average of 33 per cent. The Lerner Index at 0.229 is in line with comparable samples. The cost-income ratio averages 64.5 per cent, while the return on average assets is just over 1.2 per cent. Estimated correlations show none of the variables are highly correlated except for the correlation between management efficiency and the Lerner Index at -0.68.

For macroprudential data, we used the IMF iMaPP database of policy actions for 1990-2021 (IMF 2023) as introduced in Alam et al (2019).[6] The database of individual macroprudential tools is in the form of dummy-style instruments These dummy indices are based on the effective date when it differs from the announcement date, because the effective date is more widely available. The dummies show tightening (+1), no-change (0) and loosening (-1) and has accordingly only categorical as opposed to numerical values for the macroprudential policies. In other words, they show simply whether the policy is tightened, unchanged or loosened, not the severity of application or easing. They are summed for calculating the summary instruments. The fact that we have categorical measures means we are estimating the impact of an average policy action, in line with the rest of the literature on macroprudential policy.

The data were annualised and cumulated (to show the policy stance) following the approach of Bergant et al (2020) and Davis et al (2022). As noted by Meuleman and Vander Vennet (2020), 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. As shown in Tables A2.1 and A2.2, we use both individual and aggregated summary measures (as in Alam et al 2019).

5. Empirical Results

5.1 Baseline equation for the global sample

Our baseline estimation results for the global sample, with dependent variables noninterest income/average assets (NIIAA) and noninterest income/total income (NIR) are shown in Table 2 below, after elimination of insignificant variables.

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[6] An updated version of the Alam et al (2019) working paper is now published in a journal (Alam et al 2024). Since we use a lag for macroprudential effects, the ending of the IMaPP data used in 2021 does not prevent estimates going up to 2022.

In each equation, the lagged dependent variable is sizeable, suggesting a high degree of persistence both in the contribution of noninterest income to profitability and its share of income. This may reflect the effect of strategic business models in line with Goddard et al (2013) and Saunders et al (2020).

Large banks are seen to be less dependent on noninterest income than smaller ones, as also found by Molyneux et al (2020). However, this is contrary to the result found in the much earlier sample used by Hahm (2008). This suggests a relative shift to noninterest income by smaller banks in more recent years. Higher loan/asset ratios tend to reduce noninterest income relative both to assets and income as in Hahm (2008), suggesting that noninterest income and loan issue are substitutes rather than complements.

A higher net interest margin relates to a higher ratio of noninterest income to assets, suggesting that banks can exploit scope economies. On the other hand, the ratio of noninterest income to total income is negatively related to the margin as in Hahm (2008) and Haubrich and Young (2019) post the Global Financial Crisis, consistent with the suggestion that pressure on margins leads banks to seek a greater share of noninterest income. Greater market power (a higher Lerner index) tends to reduce the importance of noninterest income in profitability, its growth is thus related to more intense competition. This variable is, as noted, not included in the studies we have cited, but its significance suggests considerable importance, not least as many studies show a link of bank competition to risk-taking.[7]

The other bank-specific determinants show that noninterest income rises as a proportion of assets in line with the capital ratio (as in Ammer (2008) and Meng et al (2018)), while it falls in line with credit risk and the return on average assets. Meanwhile in line with studies such as Molyneux et al (2020), the share of noninterest income in total income rises with the scope of credit risk (more risk relates to higher relative reliance on noninterest income) and the cost to income ratio (suggesting such income generation is costly in terms of staff). It also rises with the return on average assets (more profitable banks are more reliant on noninterest income).

As regards effects of macroeconomic variables, the noninterest ratio to average assets and to income rises with inflation as in Hahm (2008) while the ratio to average assets falls during banking crises. Growth of GDP does not affect either measure of noninterest income in the global sample, suggesting our results are driven more by endogenous bank decisions.

We did attempt to include the central bank interest rate as an additional variable in these equations, in line with research on the period of low interest rates following the subprime crisis such as Borio et al (2017) and Molyneux et al (2020). Note that with a global sample we could not include the yield curve as for most Emerging Market and Developing Economy (EMDE) countries there is no long-term bond market. In fact, our finding was that in the general equation set out here, the central bank rate was not significant, either for the noninterest-income ratio or the noninterest income/assets equation. This is also the case for the subperiod 2007-2022

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[7] This result is also found in our own estimates for log Z score determination discussed in Section 7 and shown in Appendix Table A3.4.

which is the focus of work on the effect of low interest rates on noninterest income. Our result is in line with Altavilla et al (2019) who also found no relationship between the level of interest rates and noninterest income.[8]

5.2 Summary macroprudential variables in the global sample

Analysing the results when we add the summary macroprudential measures one-by-one to the global baseline equations, we find in Table 3 that there are significant positive effects in the global sample of macroprudential policies on noninterest income as a ratio of average assets. This is the case for the measure of all macroprudential policies (MAPP-INDEX), the loan-targeted measure, all supply policies and their subcomponents, supply-loans and supply-capital. This is as predicted, whereby the positive effects of capital requirements may be a result of banks shifting seeking profits from lending activities to avoid "penalties" such as capital and buffer requirements which penalise loan assets. Loan limits have a direct effect on scope to generate net interest income from lending and thus stimulate noninterest activity.[9]

On the other hand, there are no significant effects on the share of noninterest income in gross income from macroprudential policies. This may suggest, on average, that the overall business approach of banks is not greatly affected by macroprudential policy (in terms of their chosen level of diversification) but it is affected according to levels of profitability generated by noninterest income.

5.3 Individual macroprudential variables in the global sample

Underlying these aggregate results for the global sample, Table 4 shows that capital measures such as the conservation buffer, capital requirements and SIFI surcharges, and loan-related measures such as loan restrictions and loan-to-value limits, together with provisioning requirements and other macroprudential measures all have positive effects on noninterest income to average assets. On the other hand, limits to the loan-deposit ratio have a negative effect. Liquidity restrictions such as lower loan-deposit ratios may directly curtail banks' ability to generate fee revenue from lending.

There are also some significant effects on the noninterest to income ratio, in contrast to the results for summary measures. Capital measures on systemic institutions, the conservation buffer, loan restrictions and liquidity measures all raise noninterest income as a share of income. We again find a negative effect on the noninterest ratio for the loan-deposit ratio.

These patterns may again reflect banks seeking to economise on capital in response to tighter capital requirements (as noted by DeYoung and Roland 2001). Meanwhile they seek to boost profits via noninterest income when constrained to hold lower-yielding assets by liquidity requirements. Loan restrictions can be seen as limiting banks' profits from the banking book and

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[8] Results are available from the authors on request.
[9] This is a contrast with the effects found for the overall return on average assets for a similar sample in Davis et al (2022), who found only a negative effect from supply-capital macroprudential policies. This suggests there are offsetting effects of macroprudential policy on other components of profitability (the net interest margin, noninterest costs and provisions).

leading to a greater focus on fees, dividends and trading as a substitute, in line with the long-term shift to non-interest income when opportunities for lending diminished when firms switched to securities markets (Hahm 2008).

5.4   Disaggregation by type of noninterest income

As noted above, noninterest income can be divided into fee income and the remainder, which comprises capital gains, dividends and other income. These can in turn be measured relative to average assets and total income. We consider this of particular interest, as this breakdown is not often considered in the literature (exceptions include DeYoung and Torna (2013), Chen et al (2017), Molyneux et al (2020) and Saklain and Williams (2024)). And as shown in Section 7, there are major contrasting effects of the noninterest subcomponents on bank performance measures, namely risk and overall profitability.

The results of estimation of the baseline equations is shown in Table 5. These are largely in line with the results for total noninterest income shown in Table 4, as discussed above. For example, each series has a significant lagged dependent variable and all show a negative relation to bank size except for the income share for nonfee income which is insignificant (as in Saklain and Williams 2024). Both fee and nonfee income are higher as a ratio to average assets for banks with higher capital ratios while a higher net interest margin is related to lower shares of both fee and nonfee income in total income. Both the income share of fee income and the ratio of nonfee income to average assets rise when competition increases and market power declines.

For fee income, the cost-income ratio is positively related to the ratio of noninterest income to assets but negatively linked to the income share (in contrast to Molyneux et al 2020). The income share of fee income is higher for banks with lower liquidity risk (a higher deposit/liability ratio). Nonfee income as a ratio to assets is lower during a banking crisis when trading is likely to be at a low ebb and regulation may impose additional limits. The loan/asset ratio is negatively related to both measures of nonfee income but has no relation to fee income (despite some fees being linked to loan issuance). Nonfee activities such as trading may more readily substitute for loans than fee income per se. Besides the return on average assets the nonfee income ratio is also positively related to credit risk and liquidity risk (as also in Saklain and Williams 2024), suggesting grounds for caution by regulators as high profitability and high risk are consistent with boom periods that may precede banking crises.

There is a contrasting cyclical pattern, whereby in periods of economic growth, fee income rises as a ratio to average assets and as a proportion of total income (as also in Stiroh 2004). On the other hand, when there is recession, the banks become more reliant on nonfee income, both as a ratio to assets and a share of income, which as discussed below implies a need for vigilance by regulators given the particular link of nonfee income to risk that we find in Section 7. Inflation on the other hand, increases all the measures except the income share of fees for which the effect is zero.

Concerning the effects of macroprudential policy, the significant summary measures of macroprudential policy for the fee and nonfee income are all positive. As for the global sample, the overall tightness of policy (MAPP-INDEX) leads to higher fee and nonfee income as a ratio

to assets, as does supply-all and supply-loans. Hence loan restrictions lead banks to raise both fee and nonfee income, despite the likely restriction they imply on loan—based fees. Fee income links positively also to loan-targeted, demand and supply-general measures, with loan restrictions and liquidity measures reducing balance sheet activity, while nonfee also relates positively to supply-capital. This suggests that tighter capital requirements stimulate trading, possibly shifting rather than reducing the degree of bank risk.

Concerning effects on the fee and nonfee shares in income, there is no effect of macroprudential policies on the share of fee income but the share of nonfee is boosted by supply-loans policies; limits on loan growth thus also stimulate trading and other noninterest income as a share of income, while fee income only rises as a ratio to assets. The contrasting effects of policies on the subcomponents suggests there is scope to tailor policies to benefit particular types of noninterest income, if that is desired.

The results for individual macroprudential measures reflect these points. Again, the majority of effects on fee and nonfee income are positive. Capital measures, namely the countercyclical buffer, the conservation buffer and SIFI surcharges boost the income share of fee income while SIFI surcharges also raise the ratio of fee income to assets. Similarly, the ratio of nonfee income to assets is raised by tighter conservation buffers and overall capital requirements. Capital requirements hence lead banks to raise exposure to both types of fee income.

Loan measures (credit growth limits and loan restrictions) boost fee income/average assets while both measures of non-fee income are also raised by loan restrictions. The income ratio of nonfee income is raised by limits on foreign currency loans, suggesting it is seen as an alternative source of diversification.

There are negative effects on all four measures from loan to deposit limits. Some measures have opposite effects on fee and non-fee income, suggesting again there is scope to vary macroprudential policy to stimulate fee or nonfee. For example, loan to value limits raise the ratio of fee income to assets while they reduce the nonfee/income ratio. Banks may raise fees on mortgages to compensate for lower interest rates on lower LTV mortgages. Tighter provisioning requirements reduce the income share of fees, possibly as they discourage loan growth, while they raise that of non-fees.

Some additional measures affect individual indicators, such as reserve requirements that boost fee income/average assets while limits on FX operations reduce the fee/income ratio. Other macroprudential measures raise the asset and income ratios of non-fee income but have no significant effect on fee income.

5.5 Three further breakdowns of the data – summary of main results

To investigate further, we examined three subdivisions of the global sample, with the dependent variable being total noninterest income/average assets and noninterest income/total income, as in Sections 5.1-5.3. The first subdivision is between advanced countries and emerging and developing economy banks, as classified by the IMF. Are differences in national economic development and income per head reflected in different behaviour of banks in respect of

noninterest income and their response to macroprudential policy? These might be a consequence of aspects such as financial development and regulatory differences.

A further disaggregation is by bank size, where the sample is split at the median level of assets. Are determinants different for large and small banks' noninterest income and do they respond differently to macroprudential policies in this regard? Note that there may be a relation of large banks to advanced countries and small ones to EMDEs.

Finally, we can divide the sample at the start of the subprime crisis (1990-2006 and 2007-2022). Did the crisis engender a differing response of noninterest income to its determinants, as suggested by Haubrich and Young (2019) for the US? That could be a consequence of the Dodd-Frank tightening of regulation in the US, and similar policies elsewhere, affecting noninterest income. Macroprudential policy itself was less widely used prior to the crisis (albeit quite heavily in East Asia and Eastern Europe) which may affect the response which is detected.

Detailed results are provided in Appendix 3, Tables A3.1 (baseline results), Table A3.2 (summary macroprudential policy effects) and Table A3.3 (individual macroprudential policy effects). For brevity, we provide a summary of key results here. A general point is that both the baseline and the macroprudential policy effects are largely in line with the global results in Tables 3-5, which underlines the robustness of the results, as is further shown by the three robustness checks shown in Section 6.

The baseline results for the subsamples (Appendix Table A3.1) are almost wholly consistent with the global baseline shown in Table 3, in the sense that there are virtually no significant effects with opposite signs to Table 3, although in some cases effects significant in Table 3 become insignificant, and vice versa in the subsamples.

The main idiosyncratic results in the subsamples compared with the global baseline are where market power in advanced countries boosts the share of noninterest income (elsewhere it reduces it), and positive effects of banking crises on the share of noninterest income in Emerging and Developing Economies, for small banks and pre-crisis.

The significant results for summary macroprudential policies (Appendix Table A3.2) are all positive, as in Table 4. The main difference is between the pre-crisis period and the other five subsamples, since in that period there are no significant summary variables. As noted, in the pre-crisis period, fewer countries operated active macroprudential policies (mainly East Asia and Eastern Europe) which may help explain this result. This does however contrast with Davis et al (2022) who found a significant negative effect of supply-capital measures on total profitability before as well as after the crisis. A further point is that while all the other subsamples show positive effect of policy on the noninterest share of assets, the ratio to income, entailing banks' strategic decisions, is not affected by the summary measures in advanced countries and for large banks.

The most common result for summary measures is a positive effect of the overall stance of macroprudential policies and of supply-loans policies. Concerning the balance between capital-based and loan-based summary variables, both tend to be significant for large banks, Emerging

and Developing Economies and in the post-crisis period. Capital effects are not significant in the Advanced Countries and for small banks. Demand-based policies (loan-to-value and debt-service-to-interest limits) are significant for Advanced Countries and for small banks. Where the policy effects are significant, the effects appear to be larger for EMDEs than advanced countries, and for small banks relative to large banks, as for the effects of macroprudential policy on measures of total profitability in Davis et al (2022).

Consistent with these results for summary measures, we find some individual capital and supply-loan effects with a positive and significant effect in all the subsamples except pre-crisis (Appendix Table A3.3). There are some negative effects of individual policies, which as noted do not emerge when the policies are aggregated into the summary measures. Consistently negative effects are found, for example, for loan-to-deposit limits and limits on FX operations.

Contrary to the results for the summary measures, some individual measures are significant pre-crisis, with generally positive effects on the ratio of noninterest income to average assets, but with some negative effects on the income share (notably capital requirements, credit growth limits and limits on FX operations). This may relate to specific aspects of the Asian crisis.

6.   Robustness Checks

We ran three robustness checks on the global sample to validate the results. First, we added summary measures for activity restrictions, capital requirement stringency and supervisory power from the series of World Bank regulation and supervision surveys (Barth et al 2013) updated using the latest survey for 2016 (Anginer et al 2019).[10] Second, we ran the baseline using bank-clustered instead of country-clustered standard errors as in Anginer et al (2018). Third, we ran the estimates using a dynamic panel approach of Two-Step Difference GMM, which should allow for any issues of endogeneity at a cost of a somewhat smaller sample.

As can be seen from Table 8, the robustness regressions are in line with the main estimate from Table 3. In the equations with the World Bank variables, it is capital stringency which is significant and negative for the ratio of noninterest income to average assets, and the activity restrictions with a negative sign for the share of income. The implication is that capital requirements have a greater effect on the profitability generated by noninterest income while leaving the strategy (choice of markets to serve as shown by the noninterest/income ratio) unchanged. Meanwhile, the strategy is affected more powerfully by activity restrictions, which may restrict the bank from entering sectors such as insurance and investment banking which generate noninterest income. The further implication is that the easing of such regulations will boost the share of noninterest income. For the income share equation, the significant variables are the same as in the baseline, whereas for the ratio to average assets, the capital ratio, credit risk and inflation become insignificant, although there is now a negative effect of GDP growth.

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[10] These data were also used in papers such as Karolyi and Tabaoda (2015), Gaganis et al (2020) and Davis et al (2022). We note that the studies themselves are dated 1999, 2003, 2007, 2011 and 2016. To cover the sample, we have interpolated between the values given in the samples and fixed the values of 1999 for 1990-8 and 2016 for 2017-22. Karolyi and Tabaoda (2015) similarly fixed their values for 2012-2015 at the 2011 level.

With bank-clustered standard errors, coefficients are virtually identical to country-clusters in the baseline, as would be expected, but we now have a significant negative effect of growth on noninterest income. The GMM equations have satisfactory diagnostics in terms of the AR(2) and Hansen statistic, and the sample size as expected is over 10,000 observations smaller. The equation for the ratio of average assets has similar significant variables and signs to Table 3, except the capital ratio and the loan/asset ratio are not significant. For the income share equation, a second lagged dependent was needed to get the appropriate AR(2). In this case it is the return on average assets and the net interest margin that are not significant.

Examining macroprudential policy effects, the World Bank robustness check has similar summary variables to the baseline (Table 9), except that the overall measure of macroprudential policies and the supply-all variables are no longer significant for the noninterest/average asset ratio. The bank-clustered standard errors make many more of the summary variables significant, always again with a positive sign. And equally, estimating by GMM, we have all the same measures significant with a positive sign as in the baseline, suggesting endogeneity issues are not serious. In this case, we also have the sum of all measures and supply-loans significant for the income share.

Looking at the individual measures (Table 10), in all three robustness checks, the earlier patterns are repeated with capital measures, loan restrictions and liquidity measures tending to boost noninterest income while loan-to-deposit measures and (in some estimates) limits on FX operations have a negative effect.

On balance, we contend that the robustness checks underpin the baseline results.

7.   Bank Risk, Profitability and Noninterest Income

Given the strong results that we have found regarding the positive effect of macroprudential policy tightening on noninterest income, we considered it relevant to assess using our extensive global dataset whether noninterest income growth that might be boosted by macroprudential policy is related to bank risk taking, and also bank profitability. As shown in Section 2, an adverse effect on risk is widely suggested in the literature, albeit typically using a much more restricted sample. This gives an important motivation for regulatory concern about possible unintended and potentially counterproductive side effects of the positive impact of macroprudential policy on noninterest income that we have discovered.

Measures of risk we use are twofold, the log of the Z-score (return on average assets plus the capital ratio divided by the standard deviation of the return on average assets) and the nonperforming loan/gross loans ratio. The former is an indicator of risk across the whole bank, while the second focuses on risk in the loan book. The Z-score is widely used in the literature such as Antao and Karnik (2022) and Saklain and Williams (2024) in the context of bank non-interest income and risk, and Altunbas et al (2018) and Chan et al (2023) for testing macroprudential policy and bank risk. Mehmood and DeLuca (2023) assess the relation of noninterest income to nonperforming loans for Asian banks over 2009-2021

We note that the nonperforming loans ratio is only a partial indicator of risk, showing that certain loans that are considered to be at default. This is effectively a discretionary accounting measure; a bank has a lot of discretion is disclosing the level of nonperforming loans in the financial reports, and there is substantial variation in the laws across countries to determine when a loan is at default. We suggest that Z-score is more reliable because it is an aggregate measure as well as a cleaner measure, especially as the return on assets used is gross (i.e. before tax, amortization and extraordinary items). As noted by Liu et al. (2013), it is appropriate to log the Z-score as the level is highly skewed, while the log is normally distributed. Accordingly, we use log Z-score as the dependent variable.

Using the same variables as in Table 2, we estimated baseline equations for the global sample, and separately for the subsamples large banks, small banks, Advanced Countries, Emerging Market and Developing Economies, as well as 1990-2006 and 2007-2022. In each case the equations were restricted to significant variables.

The results of the baseline for the global sample are shown in Appendix Table A3.4, other results are available from the authors on request. Bear in mind that the Z-score is inversely related to risk while the NPL/loans ratio is positively related. We can see that for each measure, risk is positively influenced by both credit risk (provisions/loans) and liquidity risk (which rises when deposits/liabilities is lower). Risk by both measures also increases in the context of banking crises and in recessions. Meanwhile, larger banks have lower Z scores but higher NPL/loan ratios. Risk according to the Z-score is greater when banks have more competitive conditions and with high cost-income ratios. Chan et al (2023) with a sample of Asian banks similarly found competition, crisis and credit risk were positively related to bank risk as shown by the Z-score. Gaganis et al (2020) found recession and a high cost/income ratio to be indicators of risk.

We then added in turn lags of each of the measures of noninterest income shown in the text, namely noninterest income as a proportion of average assets (NIIAA) noninterest income as a proportion of total income (NIR), noninterest fee income as a proportion of average assets (NIFEEAA), noninterest fee income as a proportion of total income (NIFEER), noninterest nonfee income as a proportion of average assets (NINONFEEAA) and noninterest nonfee income as a proportion of total income (NINONFEER).

As shown in Table 11, for the log Z-score, there are consistent results of a positive relation to risk for the two measures of noninterest income, as in Stiroh and Rumble (2006) and Antao and Karnik (2022). Effects are also found for the two measures of noninterest nonfee income as in Chen et al (2017). The negative sign indicates a positive relation to risk since a lower Z-score relates to higher risk. On the other hand, there is generally either no relation or a positive relation of noninterest fee income to risk (the sole exception is for fees/average assets for advanced countries). This result is in contrast with Chen et al (2017) who found fee income boosts risk for US banks, but in line with DeYoung and Torna (2013) who found fee income as from insurance sales and brokerage reduces failure for distressed US banks, while nonfee income such as venture capital, asset securitisation and investment banking boosts it.

When we extend to the risk measure nonperforming loans/gross loans, using the same procedure for baseline equations and for noninterest income measures, the results are

somewhat different. For total noninterest income, the results show a zero relation to risk except for a weak positive effect for large banks, as in Mehmood and DeLuca (2023). The fee income results are generally also insignificant with the exception that for the 2007-2022 both measures are negatively related to risk as shown by NPLs. Nonfee income does raise risk in some limited cases, notably for large banks and with a weaker effect for the global and small-bank samples, but other effects are zero.

The overall implication is that when banks raise fee income, the effect on risk is generally zero or it is risk-reducing. The positive effect on risk found for total noninterest income is shown to derive from nonfee income, which includes net capital gains, dividends and other income. That effect is, however, less linked to the loan book since the relation to nonperforming loans is zero in most subsamples, although we do find some positive effects, particularly for large banks. Effects on the Z-score show that the impact of nonfee income is linked to the full range of bank activities. Further investigation suggested that the nonfee/asset ratio has a negative effect on all three components of the Z-score; both income level and the capital ratio are affected negatively while also income volatility has a significant positive effect. The same is the case for the nonfee/income ratio except there is no significant effect of the capital ratio.[11]

We suggest that besides their implications for the side-effects of macroprudential policy that we have found, and the differing results of subcategories of noninterest income, our results for risk effects of noninterest income are of considerable interest in themselves given the global scale, large number of banks and long period coverage of our dataset.

To complement the above investigation of the impact on risk, we also sought to briefly assess the impact of noninterest income on overall bank profitability. As noted in the introduction, this is subject to mixed results in the literature, with for example, Goddard et al (2013) and Saunders et al (2020) finding a positive effect whereas results of Saona (2016) suggested a negative impact.

As for risk, we estimated an equation for the determination of the pre-tax return on average assets, which is a common measure of bank profitability used in the literature (Appendix Table A3.4). Concerning bank-specific effects, we find evidence for the global sample of diseconomies of scale (a negative effect of bank size) and of the cost/income ratio. On the other hand, the net interest margin and the deposit/liabilities ratio have a positive impact. At a macro level, GDP growth and inflation both boost profitability, while banking crises are understandably adverse. These results are in line with those found by Davis et al (2022) with a similar dataset and Xu et al (2019) with an advanced country sample over 2004-2017.

Our interest then is to find the pattern of effects within such an equation for the measures of noninterest income including both subcomponents and the various subsamples, as for risk in Table 11. The corresponding results for profitability are shown in Table 12. Results for the aggregate measures noninterest income/assets and as a share of income are mostly not significant. The exceptions are positive effects of the ratio to assets in the global sample, for large banks and in advanced countries.

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[11] Results are available from the authors on request.

There are much more consistent results for the subcomponents fee and nonfee noninterest income. For fee income we find that for both the ratio to assets and to income, and for all the samples, there is a significant positive effect as in Mamun et al (2023) and Saklain and Williams (2024). A rise in fee income raises overall profitability. Entirely the opposite result is found for nonfee income. In most cases we find a significant negative effect. The only exception is for large banks by both measures and for advanced countries by the ratio to assets, where the effect is not significant.

Drawing together the significant results for effects of macroprudential policy on noninterest income and of noninterest income on risk, we obtain the effects shown in Table 13, for the specific example of the summary measures and the global sample (results for the subsamples and individual measures will differ). The table shows cases where the effect of macroprudential policy on noninterest income and also the effect of noninterest income on risk and profitability are both significant. The broad result is that tighter macroprudential policies tend to raise risk both via total noninterest income and nonfee noninterest income but not via fee income, where combined effects are not significant.

As regards profitability (Table 14), macroprudential policies boost it via total noninterest income and fee income while an effect via nonfee income tends to reduce it. For both risk and profitability, effects arise via the ratio to average assets and not the ratio to income in virtually all cases – the exception is the effect of supply-all measures via the ratio of nonfee income to total income which raises risk and reduces profitability.

We note that macroprudential policy may affect risk and profitability by other channels which may enhance or offset these effects (see for example Altunbas et al (2018) and Davis et al (2022) for estimates of direct effects), we nonetheless contend that they are of considerable interest in the context of our current research.

8.   Conclusion

We have found that a range of macroprudential policies have a significant positive effect on banks' noninterest income, particularly those focused on loan supply/demand restrictions and capital measures. Similar results are found for a range of disaggregated samples by type of noninterest income, country development, bank size and pre and post the Global Financial Crisis, and in three robustness checks. These positive effects can be attributed to an impact of macroprudential policy akin to that of financial change that originally generated the shift to noninterest income, notably the decline in lending and tightening of capital requirements on loans. Positive effects of macroprudential policy on total noninterest income and fee income feed through to total profitability, thus allaying concerns that macroprudential policy may inhibit scope to raise capital via retentions. But nonfee income is found to be adverse for total profitability Moreover, a boost to noninterest income, and particularly its nonfee component, may also affect bank risk adversely, as highlighted widely in the literature and also with our dataset.

Summarising the main results for 100 countries over 1990-2022, we have found 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 the capital ratio 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.

Several 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 – indeed, the latter are generally zero. This suggests a greater effect on profitability from noninterest income than from bank strategy in terms of its division with net interest 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.

The results for determinants of noninterest income are also largely apparent for samples disaggregated by type of noninterest income, region, bank size and pre and post the Global Financial Crisis, 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. Only pre-crisis were positive effects of macroprudential policy on noninterest income relatively absent.

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 macroprudential policies on net interest margins (Meuleman and Vander Vennet 2022), are at least partly offset by such diversification. This reduces concern that banks may be less able to accumulate capital when macroprudential policy is tightened.

On the other hand, there may be grounds for caution since a rise in dependence on noninterest income due to macroprudential policy increases bank risk, as has been found widely in the literature and in our own dataset. This is especially since some negative effects of the nonfee component of noninterest income on profitability is also found. We also note that banks facing higher credit and liquidity risks seek higher noninterest income. Digging deeper, we have found that nonfee noninterest income boosts risk consistently at a bank level (as measured by the log Z score) and in some cases also in the loan book (NPL/loan ratio). Nonfee income also reduces profitability, from which capital to enhance reliance against risk could be accumulated. Higher fee income on the other hand tends to lower risk or have a zero effect, albeit not in advanced countries when it raises risk. It also tends to boost profitability.

This raises further regulatory issues relating to whether it is desirable 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. Among individual measures, provisioning requirements and loan-to-value limits have opposite effects on fee and nonfee income.

Further research could investigate the effects of macroprudential policies on other components of overall bank profitability (such as the net interest margin, noninterest costs and provisions). Assessment of impacts of macroprudential policies by regions and for individual country banks could also be fruitful. Further work on risk and noninterest income could focus on the positive effects of fee income on bank risk in advanced countries.

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Table 1: Descriptive statistics for global sample 1990-2022

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
NIIAA	2.210	1.080	26.628	-1.212	3.863	103195
NIR	32.728	28.880	123.167	-49.176	27.550	110895
NIFEEAA	1.135	0.619	12.780	-0.540	1.865	95673
NIFEER	19.419	16.324	90.666	-27.541	18.833	101610
NINONFEEAA	0.841	0.282	13.366	-1.811	1.935	95673
NINONFEER	12.892	7.934	101.972	-42.760	20.281	101610
BANK SIZE	21.218	21.178	27.170	15.948	2.324	112971
CAPITAL RATIO	0.132	0.090	0.908	0.003	0.148	112936
CREDIT RISK	1.371	0.580	16.981	-2.790	2.667	92137
COST/INCOME	64.490	61.660	250.734	1.650	32.719	111144
LOAN/ASSET RATIO	0.575	0.605	0.998	0.004	0.234	109869
RETURN ON AVERAGE ASSETS	1.221	0.950	13.080	-11.150	2.742	102550
NET INTEREST MARGIN	4.128	2.840	28.850	-1.720	4.490	101854
LERNER INDEX	0.229	0.240	0.657	-0.908	0.207	94431
LIQUIDITY RISK	0.679	0.753	0.993	0.002	0.266	104144
GDP GROWTH	3.024	3.071	11.795	-10.000	3.713	241386
INFLATION	9.853	3.079	299.510	-0.923	32.956	235225
BANKING CRISIS	0.090	0.000	1.000	0.000	0.287	244068
CENTRAL BANK RATE	6.659	4.229	69.97	0.000	9.811	180379
LOG Z SCORE	3.432	3.472	6.486	-8.972	1.280	92763
NPL/LOANS	6.277	2.940	59.158	0.000	9.533	65341

Data Source: Fitch-Connect, IMF, World Bank and author calculations.

Notes: NIIAA is noninterest income as a proportion of average assets, NIR is noninterest income as a proportion of total income, NIFEEAA is noninterest fee income as a proportion of average assets, NIFEER is noninterest fee income as a proportion of total income, NINONFEEAA is noninterest nonfee income as a proportion of average assets, NINONFEER is noninterest nonfee income as a proportion of total income, BANK SIZE is the logarithm of total assets, LOAN/ASSET RATIO is bank loans as a proportion of total assets, CAPITAL RATIO is the unadjusted capital ratio (equity/total assets), CREDIT RISK is provisions/gross loans, COST/INCOME is management efficiency (total operating expenses/ total income), RETURN ON AVERAGE ASSETS is the bank profits as a proportion of average assets, NET INTEREST MARGIN is interest received minus interest paid as a proportion of average assets, LERNER INDEX is the Lerner Index calculated using a translog cost function as in Davis et al (2022), LIQUIDITY RISK is the ratio of deposits to liabilities, BANKING CRISIS is a dummy variable for banking crises and it is coded one in the year the crisis starts until the year it was over and is otherwise zero (Laeven and Valencia (2020), updated to 2022). GDP GROWTH is economic growth, the real GDP growth rate (annual %), INFLATION is the CPI inflation rate (annual %) CENTRAL BANK RATE is the policy rate (annual %), LOG Z SCORE is the log of the bank Z-score measured as (return on average assets plus unadjusted capital ratio)/standard deviation of return on average assets, NPL/LOANS is the ratio of nonperforming loans to gross loans. The values are a ratio unless otherwise stated. Max – maximum, Min – minimum, StdDev - standard deviation. The variables other than banking crisis are winsorised at 99% and in levels.

Table 2: Results for noninterest income for global sample (1990-2022)

DEPENDENT	NIIAA	NIR
C	5.83*** (7.7)	34.8*** (5.4)
LAGGED DEPENDENT (-1)	0.551*** (17.7)	0.394*** (22.9)
BANK SIZE (-1)	-0.25*** (7.2)	-0.96*** (3.2)
CAPITAL RATIO (-1)	0.62* (1.9)	
CREDIT RISK (-1)	-0.0221* (1.9)	0.303*** (4.3)
COST/INCOME (-1)		0.0674*** (5.6)
ROAA (-1)	-0.052*** (3.8)	0.316** (2.5)
NET INTEREST MARGIN (-1)	0.0403*** (3.3)	-0.5*** (4.1)
LOAN-ASSET RATIO (-1)	-0.232** (2.4)	-6.395*** (5.3)
LERNER INDEX (-1)	-0.614*** (4.2)	
BANKING CRISIS	-0.0818* (1.8)	
INFLATION	0.0084* (1.9)	0.0419** (2.0)
GROWTH		
R^2	0.65	0.57
SE	1.57	13.5
PERIODS	31	32
OBS	73637	82598
BANKS	5862	6211

Notes: NIIAA is noninterest income as a proportion of average assets and NIR is noninterest income as a proportion of total income. Estimated by panel OLS with time and bank dummies and country-clustered standard errors. For variable definitions see Table 1. Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Table 3: Results for summary macroprudential instruments for global sample (1990-2022)

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)

Notes: NIIAA is noninterest income as a proportion of average assets and NIR is noninterest income as a proportion of total income. Estimated by panel OLS with time and bank dummies and country-clustered standard errors. Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. Each equation includes all the control variables shown in Table 2, with cumulated summary macroprudential variables added one at a time. MAPP INDEX is the sum of dummies for all of 17 categories shown in Appendix Table A2.1. The LOAN TARGETED group consists of the "Demand" and the "Supply-loans" instruments. DEMAND comprises loan-to-value and debt-service-to-interest limits. 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. See Appendix Table A2.2 for more details on summary variables.

Table 4: Results for individual macroprudential instruments for global sample (1990-2022)

DEPENDENT	NIIAA	NIR
COUNTERCYCLICAL BUFFER (-1)	0.035	0.179
	(1.5)	(0.7)
CONSERVATION BUFFER (-1)	0.044**	0.727***
	(2.6)	(3.9)
CAPITAL REQUIREMENTS (-1)	0.017*	-0.152
	(1.9)	(1.1)
LEVERAGE REQUIREMENTS (-1)	0.02	0.178
	(0.7)	(0.3)
PROVISIONING REQUIREMENTS (-1)	0.0464*	0.325
	(1.7)	(1.1)
CREDIT GROWTH LIMITS (-1)	0.109	-0.3
	(1.2)	(0.3)
LOAN RESTRICTIONS (-1)	0.055***	0.419*
	(3.9)	(1.7)
LIMITS ON FOREIGN CURRENCY LOANS (-1)	0.0187	0.477
	(1.2)	(1.4)
LOAN TO VALUE LIMITS (-1)	0.0254**	-0.054
	(2.1)	(0.2)
DEBT TO INCOME LIMITS (-1)	0.057	-0.267
	(1.5)	(1.1)
LEVY/TAX ON FINANCIAL INSTITUTION (-1)	0.0106	-0.174
	(0.8)	(0.7)
LIQUIDITY MEASURES(-1)	0.0203	0.36**
	(1.6)	(2.2)
LOAN TO DEPOSIT LIMITS (-1)	-0.144***	-2.81***
	(3.3)	(4.6)
LIMITS ON FX OPERATIONS (-1)	-0.044	-0.661
	(0.9)	(1.5)
RESERVE REQUIREMENTS (-1)	0.004	0.051
	(0.4)	(0.4)
SIFI SURCHARGES (-1)	0.042*	0.539**
	(2.2)	(2.2)
OTHER MACROPRUDENTIAL MEASURES (-1)	0.03*	0.32
	(1.8)	(1.4)

Notes: NIIAA is noninterest income as a proportion of average assets and NIR is noninterest income as a proportion of total income. Estimated by panel OLS with time and bank dummies and country-clustered standard errors Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. Each equation includes all the control variables shown in Table 2, with cumulated macroprudential variables added one at a time. See Appendix Table A2.1 for more details on individual variables.

Table 5: Results for disaggregated noninterest income on global sample (1990-2022)

TYPE OF INCOME	FEE INCOME		NON-FEE NONINTEREST INCOME	
DEPENDENT	NIFEEAA	NIFEER	NIINONFEEAA	NINONFEER
C	2.69*** (6.6)	33.42*** (9.6)	2.588*** (6.8)	9.628*** (4.7)
LAGGED DEPENDENT (-1)	0.665*** (29.8)	0.564*** (27.7)	0.416*** (19.0)	0.342*** (18.3)
BANK SIZE (-1)	-0.119*** (6.4)	-1.144*** (6.7)	-0.101*** (5.8)	
CAPITAL RATIO (-1)	0.256* (1.8)		0.649* (2.2)	
CREDIT RISK (-1)				0.257*** (3.9)
COST/INCOME (-1)	0.00081*** (3.3)	-0.0647*** (7.2)		0.0653*** (7.2)
ROAA (-1)				0.204** (2.1)
NET INTEREST MARGIN (-1)		-0.186*** (3.3)		-0.27** (2.3)
LOAN-ASSET RATIO (-1)			-0.192** (2.6)	-6.513*** (6.2)
LERNER INDEX (-1)		-4.506*** (4.1)	-0.547*** (4.8)	
DEPOSITS/LIABILITIES (-1)		1.777*** (2.8)		-2.33*** (3.6)
BANKING CRISIS			-0.0911* (1.9)	
INFLATION	0.002* (2.0)		0.00716** (2.1)	0.0487** (2.2)
GROWTH	0.00821* (1.8)	0.137*** (4.5)	-0.015*** (2.7)	-0.194*** (3.2)
R^2	0.822	0.697	0.487	0.4
SE	0.682	8.407	1.026	10.51
PERIODS	31	32	31	32
OBS	85521	73658	68265	74409
BANKS	6274	5732	5477	5681

Notes: NIFEEAA is fee income as a proportion of average assets and NIFEER is fee income as a proportion of total income NINONFEEAA is nonfee noninterest income as a proportion of average assets and NINONFEER is nonfee noninterest income as a proportion of total income. Estimated by panel OLS with time and bank dummies and country-clustered standard errors For variable definitions see Table 1. Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Table 6: Results for summary macroprudential instruments for disaggregated noninterest income on global sample (1990-2022)

TYPE OF INCOME	FEE INCOME		NON-FEE NONINTEREST INCOME	
DEPENDENT	NIFEEAA	NIFEER	NINONFEEAA	NINONFEER
MAPP-INDEX (-1)	0.00477*** (2.7)	0.0203 (0.6)	0.0039* (2.0)	0.0167 (0.9)
LOAN-TARGETED (-1)	0.00829* (1.9)	0.0175 (0.2)	0.008 (1.6)	0.047 (0.9)
DEMAND (-1)	0.0103* (1.8)	0.0472 (0.4)	0.0025 (0.3)	-0.118 (1.3)
SUPPLY-ALL (-1)	0.00546** (2.2)	0.02 (0.5)	0.0046* (1.7)	0.169 (0.8)
SUPPLY-LOANS (-1)	0.013* (1.7)	0.0027 (0.1)	0.0191** (2.6)	0.224** (2.6)
SUPPLY-GENERAL (-1)	0.00884** (2.2)	0.037 (0.5)	-0.00003 (0.1)	-0.0334 (0.7)
SUPPLY-CAPITAL (-1)	0.0059 (1.3)	0.037 (0.7)	0.0129** (2.5)	0.0345 (0.5)

Notes: NIFEEAA is fee income as a proportion of average assets and NIFEER is fee income as a proportion of total income NINONFEEAA is nonfee noninterest income as a proportion of average assets and NINONFEER is nonfee noninterest income as a proportion of total income. Estimated by panel OLS with time and bank dummies and country-clustered standard errors. Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. Each equation includes all the control variables shown in Table 2, with cumulated summary macroprudential variables added one at a time. MAPP INDEX is the sum of dummies for all of 17 categories shown in Appendix Table A2.1. The LOAN TARGETED group consists of the "Demand" and the "Supply-loans" instruments. DEMAND comprises loan-to-value and debt-service-to-interest limits. 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. See Appendix Table A2.2 for more details on summary variables.

Table 7: Results for individual macroprudential instruments for disaggregated noninterest income on global sample (1990-2022)

TYPE OF INCOME	FEE INCOME		NON-FEE NONINTEREST INCOME	
DEPENDENT	NIFEEAA	NIFEER	NINONFEEAA	NINONFEER
COUNTERCYCLICAL BUFFER (-1)	0.02 (1.4)	0.34** (2.0)	0.0078 (0.5)	-0.222 (0.1)
CONSERVATION BUFFER (-1)	0.017 (1.7)	0.297** (2.5)	0.0219* (1.9)	0.236 (1.5)
CAPITAL REQUIREMENTS (-1)	0.000268 (0.1)	-0.066 (0.8)	0.0137** (2.1)	-0.0018 (0.1)
LEVERAGE REQUIREMENTS (-1)	0.0183 (0.6)	-0.098 (0.4)	0.0171 (1.0)	0.079 (0.3)
PROVISIONING REQUIREMENTS (-1)	0.00672 (0.5)	-0.345** (2.3)	0.0344 (1.6)	0.627** (2.6)
CREDIT GROWTH LIMITS (-1)	0.0682* (1.8)	0.0363 (0.1)	0.031 (0.8)	-0.469 (1.1)
LOAN RESTRICTIONS (-1)	0.024** (2.4)	0.153 (0.9)	0.0249*** (2.7)	0.169* (1.7)
LIMITS ON FOREIGN CURRENCY LOANS (-1)	-0.00078 (0.1)	0.131 (0.8)	0.0161 (1.3)	0.442** (2.3)
LOAN TO VALUE LIMITS (-1)	0.0184** (2.0)	0.141 (0.7)	-0.0054 (0.7)	-0.263*** (2.9)
DEBT TO INCOME LIMITS (-1)	0.0029 (0.3)	-0.124 (0.6)	0.0262 (0.8)	0.119 (0.4)
LEVY/TAX ON FINANCIAL INSTITUTION (-1)	0.0063 (0.8)	-0.038 (0.2)8	-0.002 (0.2)	0.0191 (0.1)
LIQUIDITY MEASURES (-1)	0.0103 (0.5)	0.214 (1.3)	0.0053 (0.5)	0.0331 (0.3)
LOAN TO DEPOSIT LIMITS (-1)	-0.0527** (2.3)	-0.679** (2.1)	-0.0581** (2.4)	-0.862* (1.8)
LIMITS ON FX OPERATIONS (-1)	-0.0114 (0.5)	-0.215** (2.6)	-0.0188 (0.7)	-0.489 (1.6)
RESERVE REQUIREMENTS (-1)	0.00952** (2.0)	0.034 (0.4)	-0.0006 (0.1)	-0.032 (0.7)
SIFI SURCHARGES (-1)	0.0215** (2.2)	0.37** (2.1)	0.016 (1.3)	0.167 (1.2)
OTHER MACROPRUDENTIAL MEASURES (-1)	0.0113 (1.1)	-0.096 (0.8)	0.0193* (1.7)	0.445*** (3.7)

Notes: NIFEEAA is fee income as a proportion of average assets and NIFEER is fee income as a proportion of total income NINONFEEAA is nonfee noninterest income as a proportion of average assets and NINONFEER is nonfee noninterest income as a proportion of total income. Estimated by panel OLS with time and bank dummies and country-clustered standard errors. Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. Each equation includes all the control variables shown in Table 2, with cumulated macroprudential variables added one at a time. See Appendix Table A2.1 for more details on individual variables.

Table 8: Robustness checks - baseline results for noninterest income using global sample (1990-2022)

ESTIMATION METHOD	WITH WORLD BANK REGULATION VARIABLES		WITH BANK CLUSTERED STANDARD ERRORS		WITH DIFFERENCE GMM	
DEPENDENT	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR
C	8.27*** (8.6)	33.9*** (5.0)	5.93*** (12.3)	35.8*** (8.1)		
LAGGED DEPENDENT (-1)	0.551*** (17.8)	0.385*** (21.1)	0.551*** (29.2)	0.394*** (33.7)	0.822*** (13.9)	0.454*** (17.1)
LAGGED DEPENDENT (-2)						0.101*** (6.5)
BANK SIZE (-1)	-0.349*** (8.2)	-0.872*** (3.2)	-0.253*** (11.2)	-0.997*** (5.1)	-0.372*** (2.8)	-0.651** (2.4)
CAPITAL RATIO (-1)			0.624** (2.0)			
CREDIT RISK (-1)		0.323*** (4.0)	-0.023** (2.4)	0.296*** (4.7)	-0.216*** (7.0)	0.116* (1.9)
COST/INCOME (-1)		0.0754*** (6.7)		0.0675*** (8.4)		0.053*** (5.2)
ROAA (-1)	-0.202* (1.8)	0.421*** (3.2)	-0.0519*** ((3.6)	0.322*** (3.5)	-0.396*** (9.1)	
NET INTEREST MARGIN (-1)		0.466*** (3.8)	0.04*** (4.1)	-0.522*** (7.1)	0.295*** (10.8)	
LOAN-ASSET RATIO (-1)	-0.251** (2.6)	-6.495*** (5.4)	-0.238** (2.4)	-6.393*** (7.5)		-6.35*** (4.4)
LERNER INDEX (-1)	-0.692*** (6.4)		-0.614*** (5.2)		-1.215*** (2.9)	
BANKING CRISIS	-0.134** (2.2)		-0.106*** (3.1)		-0.219** (2.0)	
INFLATION		0.045* (1.8)		0.353*** (3.1)	0.022** (2.1)	0.0176* (1.7)
GROWTH	-0.0176** (2.0)		-0.0091*** (2.4)	-0.68** (2.1)		
ACTREST	-0.0063 (0.7)	-0.276* (1.7)				
CAPREQ	-0.0209* (1.8)	-0.215 (1.3)				
SUPERV	0.0051 (0.6)	0.141 (0.8)				
R^2	0.649	0.577	0.648	0.569		
SE	1.77	13.3	1.57	13.5		
PERIODS	31	32	31	32	30	30
OBS	71883	75104	73570	82415	64563	65664
BANKS	5937	5980	5862	6211	5557	5376

Notes: For variable definitions see Table 1. ACTREST is the World Bank's summary variable for activity restrictions, CAPREQ is the summary variable for stringency of capital requirements and SUPERV is the summary variable for supervisory power, source Barth et al (2013), Anginer et al (2019) and authors' calculations. The World Bank Regulation Variables equations are estimated by panel OLS with bank and time dummies and country clustered standard errors. The Bank Clustered Standard Errors equations are estimated by panel OLS with bank clustered standard errors and time and bank dummies. The Difference GMM equations are estimated with two-step Difference GMM with time dummies and country clustered standard errors. Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. The NIIAA equation has AR(2) p value of 0.27 and Hansen test p-value of 0.15. The NIR equation has AR(2) p value of 0.333 and Hansen test p-value of 0.208.

Table 9: Robustness checks - results for summary macroprudential instruments (1990-2022)

ESTIMATION METHOD	WITH WORLD BANK REGULATION VARIABLES		WITH BANK CLUSTERED STANDARD ERRORS		WITH DIFFERENCE GMM	
DEPENDENT	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR
MAPP-INDEX (-1)	0.004 (1.1)	0.315 (0.7)	0.0095*** (5.2)	0.0529*** (3.3)	0.0058*** (2.7)	0.0726* (1.8)
LOAN-TARGETED (-1)	0.0173*** (4.1)	0.054 (0.7)	0.0207*** (5.6)	0.0627* (1.7)	0.0126*** (2.8)	0.112 (1.2)
DEMAND (-1)	0.0192** (2.4)	-0.0853 (0.8)	0.0245*** (4.4)	-0.076 (1.3)	0.0159** (2.2)	0.0131 (0.1)
SUPPLY-ALL (-1)	0.0031 (0.6)	0.046 (0.9)	0.00944*** (3.8)	0.0696*** (3.3)	0.0059* (1.9)	0.0872 (1.6)
SUPPLY-LOANS (-1)	0.028*** (3.3)	0.229 (1.6)	0.0335*** (4.9)	0.238*** (3.8)	0.02*** (2.7)	0.284* (2.0)
SUPPLY-GENERAL (-1)	-0.0082 (0.6)	0.246 (0.3)	0.0049 (1.2)	0.0829*** (2.4)	0.0023 (0.3)	0.108 (1.1)
SUPPLY-CAPITAL (-1)	0.0121* (1.7)	0.0585 (0.6)	0.0206*** (3.6)	0.089* (1.8)	0.0146*** (2.8)	0.104 (1.2)

Notes: NIIAA is noninterest income as a proportion of average assets and NIR is noninterest income as a proportion of total income. The World Bank Regulation Variables equations are estimated by panel OLS with bank and time dummies and country clustered standard errors. The Bank Clustered Standard Errors equations are estimated by panel OLS with bank clustered standard errors and time and bank dummies. The Difference GMM equations are estimated with two-step Difference GMM with time dummies and country clustered standard errors. Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. Each equation includes all the control variables shown in Table 2, with cumulated summary macroprudential variables added one at a time. 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 loan-to-value and debt-service-to-interest limits. 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. See Appendix Table A2.2 for more details on summary variables.

Table 10: Robustness checks -results for individual macroprudential instruments (1990-2022)

ESTIMATION METHOD	WITH WORLD BANK REGULATION VARIABLES		WITH BANK CLUSTERED STANDARD ERRORS		WITH DIFFERENCE GMM	
DEPENDENT	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR
COUNTERCYCLICAL BUFFER (-1)	0.033 (1.3)	0.044 (0.2)	0.0352** (2.5)	0.179 (1.2)	0.0121 (0.6)	0.25 (0.9)
CONSERVATION BUFFER (-1)	0.0352* (1.9)	0.635*** (3.7)	0.0437*** (4.7)	0.719*** (7.8)	0.0157 (1.1)	0.525*** (2.8)
CAPITAL REQUIREMENTS (-1)	0.0059 (0.7)	-0.151 (1.2)	0.0158* (1.8)	-0.149** (2.0)	0.0147** (2.0)	-0.076 (0.6)
LEVERAGE REQUIREMENTS (-1)	-0.00457 (0.1)	0.139 (0.3)	0.0251 (1.4)	0.154 (0.9)	0.051 (1.3)	0.362 (0.7)
PROVISIONING REQUIREMENTS (-1)	0.0408* (1.9)	0.269 (1.0)	0.0439*** (3.2)	0.324** (2.5)	0.0336* (1.8)	0.237 (0.8)
CREDIT GROWTH LIMITS (-1)	0.0638 (1.0)	0.0067 (0.1)	0.109* (1.7)	-0.2 (0.5)	0.0126 (0.2)	0.162 (0.2)
LOAN RESTRICTIONS (-1)	0.052*** (3.8)	0.377* (1.7)	0.0542*** (6.3)	0.412*** (4.6)	0.0389*** (3.4)	0.47** (2.4)
LIMITS ON FOREIGN CURRENCY LOANS (-1)	-0.00596 (0.2)	0.4 (1.1)	0.0176 (0.9)	0.465*** (2.6)	0.0031 (0.2)	0.403 (1.5)
LOAN TO VALUE LIMITS (-1)	0.0231* (2.0)	-0.107 (0.5)	0.0235*** (3.8)	-0.054 (0.7)	0.0146 (1.3)	0.055 (0.3)
DEBT TO INCOME LIMITS (-1)	0.0396 (1.5)	-0.162 (0.7)	0.0584*** (3.5)	-0.256** (2.0)	0.0449** (2.2)	-0.079 (0.3)
LEVY/TAX ON FINANCIAL INSTITUTION (-1)	-0.0028 (0.1)	-0.406 (1.6)	0.00971 (1.0)	-0.184 (1.4)	0.008 (0.7)	-0.045 (0.2)
LIQUIDITY MEASURES (-1)	-0.016 (0.8)	0.315* (1.9)	0.0202*** (3.1)	0.353*** (5.0)	0.0037 (0.3)	0.224 (1.4)
LOAN TO DEPOSIT LIMITS (-1)	-0.0978** (2.3)	-2.31*** (5.9)	-0.138*** (6.1)	-2.77*** (8.5)	-0.105*** (2.8)	-1.825*** (4.0)
LIMITS ON FX OPERATIONS (-1)	-0.0832 (1.3)	-0.789** (2.0)	-0.464* (1.9)	-0.675*** (3.7)	-0.0146 (0.3)	-0.478 (1.2)
RESERVE REQUIREMENTS (-1)	0.001 (0.1)	-0.0289 (0.2)	0.0032 (0.6)	0.051 (1.2)	0.0027 (0.2)	0.107 (0.9)
SIFI SURCHARGES (-1)	0.0336 (1.6)	0.357 (1.5)	0.043*** (3.8)	0.545*** (5.3)	0.024 (1.3)	0.541** (2.0)
OTHER MACROPRUDENTIAL MEASURES (-1)	0.001 (0.1)	0.289 (1.5)	0.0306*** (3.7)	0.328*** (3.4)	0.0168 (1.2)	0.3 (1.6)

Notes: NIIAA is noninterest income as a proportion of average assets and NIR is noninterest income as a proportion of total income. The World Bank Regulation Variables equations are estimated by panel OLS with bank and time dummies and country clustered standard errors. The Bank Clustered Standard Errors equations are estimated by panel OLS with bank clustered standard errors and time and bank dummies. The Difference GMM equations are estimated with two-step Difference GMM with time dummies and country clustered standard errors. Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. Each equation includes all the control variables shown in Table 2, with cumulated macroprudential variables added one at a time. See Appendix Table A2.1 for more details on individual variables.

Table 11: Results for effects of noninterest income measures on risk (log Z-score and nonperforming loans/loans)

RISK MEASURE (dependent) – LOG Z-SCORE						
MEASURE OF NONINTEREST INCOME	NIIAA	NIR	NIFEEAA	NIFEER	NINONFEEAA	NINONFEER
GLOBAL SAMPLE	-0.016*** (4.4)	-0.0015*** (3.7)	-0.0051 (0.8)	0.0014** (2.1)	-0.0338*** (5.2)	-0.0024*** (5.2)
LARGE BANKS	-0.00878 (1.6)	-0.00127** (2.0)	0.0163 (1.3)	0.00189 (1.6)	-0.0282*** (3.4)	-0.00242*** (4.3)
SMALL BANKS	-0.0191*** (4.3)	-0.00159*** (2.9)	-0.0137 (1.7)	0.00053 (0.8)	-0.0359*** (5.8)	-0.00214*** (3.5)
ADVANCED COUNTRIES	-0.0223*** (4.2)	-0.00231*** (4.5)	-0.0228** (2.5)	0.001 (1.2)	-0.0494*** (5.5)	-0.00302*** (7.1)
EMERGING MARKET AND DEVELOPING COUNTRIES	-0.0145*** (3.4)	-0.00131** (2.5)	0.00254 (0.4)	0.00235*** (3.1)	-0.0288*** (4.3)	-0.00252*** (4.2)
1990-2006	-0.0228*** (4.3)	-0.00156*** (3.2)	0.01 (0.9)	0.0024*** (2.8)	-0.0411*** (5.9)	-0.00284*** (4.8)
2007-2022	-0.0182*** (3.6)	-0.00154** (2.4)	-0.011 (1.3)	0.00143* (1.9)	-0.0321*** (3.8)	-0.00219*** (3.1)
RISK MEASURE (dependent) – NONPERFORMING LOANS/GROSS LOANS						
NPL/LOANS	NIIAA	NIR	NIFEEAA	NIFEER	NIRESAA	NIRESR
GLOBAL SAMPLE	0.0384 (1.2)	0.00264 (0.8)	-0.0746 (1.3)	-0.0035 (0.6)	0.0981* (1.7)	0.006 (1.4)
LARGE BANKS	0.145* (2.0)	0.00783 (0.9)	-0.195 (1.1)	-0.00242 (0.2)	0.252*** (2.7)	0.119* (1.9)
SMALL BANKS	0.0394 (1.1)	0.00834 (1.6)	-0.0763 (1.3)	0.00173 (0.2)	0.12 (1.5)	0.0136* (2.0)
ADVANCED COUNTRIES	0.0417 (0.2)	-0.0021 (0.6)	-0.0404 (0.4)	-0.001 (0.1)	0.0653 (0.9)	-0.0002 (0.1)
EMERGING MARKET AND DEVELOPING COUNTRIES	0.0345 (0.8)	0.00363 (0.8)	-0.111 (1.3)	-0.0128 (1.3)	0.0975 (1.3)	0.00882 (1.5)
1990-2006	-0.0524 (1.1)	0.00478 (0.9)	0.0458 (0.4)	0.00664 (0.6)	-0.109 (1.4)	0.00592 (0.8)
2007-2022	0.032 (0.6)	0.00491 (1.4)	-0.157** (2.5)	-0.174*** (3.0)	0.108 (1.6)	0.00283 (0.6)

Notes: NIIAA is noninterest income as a proportion of average assets and NIR is noninterest income as a proportion of total income. NIFEEAA is fee income as a proportion of average assets and NIFEER is fee income as a proportion of total income NINONFEEAA is nonfee noninterest income as a proportion of average assets and NINONFEER is nonfee noninterest income as a proportion of total income. Estimated by panel OLS with time and bank dummies and country-clustered standard errors Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. Each equation includes the control variables shown in Table 2, restricted for each subsample to significant variables. The global estimates are shown in Appendix Table A3.4, other results are available from the authors on request.

Table 12: Results for effects of noninterest income measures on profitability (return on average assets)

MEASURE OF NONINTEREST INCOME	NIIAA	NIR	NIFEEAA	NIFEER	NINONFEEAA	NINONFEER
GLOBAL SAMPLE	0.0207** (2.0)	0.00067 (0.7)	0.1*** (4.3)	0.0073*** (4.4)	-0.0378*** (3.2)	-0.003*** (3.1)
LARGE BANKS	0.028* (1.9)	0.0015 (1.2)	0.118*** (4.0)	0.00572*** (3.1)	-0.0266 (1.3)	-0.00115 (1.0)
SMALL BANKS	0.013 (1.0)	-0.00062 (0.4)	0.102*** (3.6)	0.0093*** (4.8)	-0.039* (1.9)	-0.00483*** (2.8)
ADVANCED COUNTRIES	0.0409** (2.3)	0.00037 (0.4)	0.112*** (3.7)	0.00554*** (3.1)	-0.0264 (1.1)	-0.00254** (2.3)
EMERGING MARKET AND DEVELOPING COUNTRIES	0.0112 (1.0)	0.00224 (1.6)	0.114*** (4.0)	0.0117*** (5.6)	-0.0356** (2.4)	-0.00282** (2.1)
1990-2006	-0.0104 (0.6)	-0.00151 (1.0)	0.106** (2.2)	0.00641*** (2.8)	-0.0873*** (3.5)	-0.00467** (2.5)
2007-2022	0.017 (1.2)	0.00019 (0.1)	0.12*** (4.0)	0.00606*** (2.8)	-0.03* (1.7)	-0.00242* (1.7)

Notes: NIIAA is noninterest income as a proportion of average assets and NIR is noninterest income as a proportion of total income. NIFEEAA is fee income as a proportion of average assets and NIFEER is fee income as a proportion of total income NINONFEEAA is nonfee noninterest income as a proportion of average assets and NINONFEER is nonfee noninterest income as a proportion of total income. Estimated by panel OLS with time and bank dummies and country-clustered standard errors Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. Each equation includes the control variables shown in Table 2, restricted for each subsample to significant variables. The global estimates are shown in Appendix Table A3.4, other results are available from the authors on request.

Table 13: Direction of significant effects of macroprudential policy on risk via noninterest income for global sample

EFFECTS ON RISK (Z-SCORE)						
NONINTEREST MEASURE	NIIAA	NIR	NIFEEAA	NIFEER	NINONFEEAA	NINONFEER
MAPP-INDEX	Increase				Increase	
LOAN-TARGETED	Increase					
DEMAND	Increase					
SUPPLY-ALL	Increase				Increase	Increase
SUPPLY-LOANS	Increase				Increase	
SUPPLY-GENERAL						
SUPPLY-CAPITAL	Increase				Increase	

Notes: NIIAA is noninterest income as a proportion of average assets and NIR is noninterest income as a proportion of total income. NIFEEAA is fee income as a proportion of average assets and NIFEER is fee income as a proportion of total income NINONFEEAA is nonfee noninterest income as a proportion of average assets and NINONFEER is nonfee noninterest income as a proportion of total income. Results are derived from the significant effects of macroprudential policy on noninterest income (Table 3) and its components (Table 6), and significant effects of noninterest income and its components on risk (Table 11) where both variables are significant. Blanks are cases where one or both effects are insignificant.

Table 14: Direction of significant effects of macroprudential policy on profitability via noninterest income for global sample

EFFECTS ON PROFITABILITY (RETURN ON AVERAGE ASSETS)						
NONINTEREST MEASURE	NIIAA	NIR	NIFEEAA	NIFEER	NINONFEEAA	NINONFEER
MAPP-INDEX	Increase		Increase		Reduce	
LOAN-TARGETED	Increase		Increase			
DEMAND	Increase		Increase			
SUPPLY-ALL	Increase		Increase		Reduce	Reduce
SUPPLY-LOANS	Increase		Increase		Reduce	
SUPPLY-GENERAL			Increase			
SUPPLY-CAPITAL	Increase				Reduce	

Notes: NIIAA is noninterest income as a proportion of average assets and NIR is noninterest income as a proportion of total income. NIFEEAA is fee income as a proportion of average assets and NIFEER is fee income as a proportion of total income NINONFEEAA is nonfee noninterest income as a proportion of average assets and NINONFEER is nonfee noninterest income as a proportion of total income. Results are derived from the significant effects of macroprudential policy on noninterest income (Table 3) and its components (Table 6), and significant effects of noninterest income and its components on profitability (Table 12) where both variables are significant. Blanks are cases where one or both effects are insignificant.

APPENDIX 1: SAMPLE DETAILS

Table A1.1: List of countries and number of banks

Country	IMF Category	Region	Number of banks in IMF category ADV	Number of banks in IMF category EMDE
Algeria	EMDE	Africa		16
Angola	EMDE	Africa		26
Argentina	EMDE	South America		157
Australia	ADV	Oceania	172	
Austria	ADV	Europe	162	
Bahamas	EMDE	Caribbean		55
Bahrain	EMDE	Middle East		26
Bangladesh	EMDE	Asia		52
Barbados	EMDE	Caribbean		8
Belgium	ADV	Europe	130	
Belize	EMDE	Caribbean		5
Bolivia	EMDE	South America		24
Brazil	EMDE	South America		161
Bulgaria	EMDE	Europe		36
Canada	ADV	North America	137	
Chile	EMDE	South America		50
China	EMDE	Asia		145
Colombia	EMDE	South America		88
Costa Rica	EMDE	Central America		90
Cote D'Ivoire	EMDE	Africa		23
Croatia	EMDE	Europe		82
Cyprus	ADV	Europe	37	
Czech Republic	ADV	Europe	62	
Denmark	ADV	Europe	117	
Ecuador	EMDE	South America		64
Egypt	EMDE	Africa		36
El Salvador	EMDE	Central America		34
Estonia	ADV	Europe	19	
Ethiopia	EMDE	Africa		24
Finland	ADV	Europe	94	
France	ADV	Europe	163	
Germany	ADV	Europe	158	
Ghana	EMDE	Africa		49

Country	Category	Region	Value1	Value2
Greece	ADV	Europe	39	
Guatemala	EMDE	Central America		49
Guyana	EMDE	Caribbean		7
Honduras	EMDE	Central America		35
Hong Kong	ADV	Asia	128	
Hungary	EMDE	Europe		123
Iceland	ADV	Europe	47	
India	EMDE	Asia		129
Indonesia	EMDE	Asia		130
Ireland	ADV	Europe	89	
Israel	ADV	Europe	23	
Italy	ADV	Europe	184	
Jamaica	EMDE	Caribbean		18
Japan	ADV	Asia	151	
Jordan	EMDE	Middle East		17
Kenya	EMDE	Africa		72
Korea	ADV	Asia	123	
Kuwait	EMDE	Middle East		18
Latvia	ADV	Europe	34	
Lithuania	ADV	Europe	20	
Luxembourg	ADV	Europe	164	
Malaysia	EMDE	Asia		79
Malta	ADV	Europe	26	
Mexico	EMDE	Central America		115
Mongolia	EMDE	Asia		13
Morocco	EMDE	Africa		33
Mozambique	EMDE	Africa		19
Netherlands	ADV	Europe	107	
New Zealand	ADV	Oceania	45	
Nicaragua	EMDE	Central America		21
Nigeria	EMDE	Africa		103
Norway	ADV	Europe	148	
Oman	EMDE	Middle East		14
Pakistan	EMDE	Asia		51
Panama	EMDE	Asia		105
Paraguay	EMDE	South America		48
Peru	EMDE	South America		46
Philippines	EMDE	Asia		96

Country	Type	Region	ADV	EMDE
Poland	EMDE	Europe		138
Portugal	ADV	Europe	135	
Qatar	EMDE	Middle East		8
Romania	EMDE	Europe		51
Russia	EMDE	Europe		166
Saudi Arabia	EMDE	Middle East		15
Senegal	EMDE	Africa		16
Serbia	EMDE	Europe		56
Singapore	ADV	Asia	55	
Slovak Republic	ADV	Europe	37	
Slovenia	ADV	Europe	40	
South Africa	EMDE	Africa		66
Spain	ADV	Europe	202	
Sri Lanka	EMDE	Asia		36
Suriname	EMDE	Caribbean		4
Sweden	ADV	Europe	85	
Switzerland	ADV	Europe	173	
Tanzania	EMDE	Africa		50
Thailand	EMDE	Asia		50
Trinidad and Tobago	EMDE	Caribbean		21
Turkey	EMDE	Europe		106
Uganda	EMDE	Africa		40
UK	ADV	Europe	169	
Ukraine	EMDE	Europe		134
United Arab Emirates	EMDE	Middle East		31
Uruguay	EMDE	South America		60
USA	ADV	North America	186	
Vietnam	EMDE	Asia		62
Zambia	EMDE	Africa		32
Total			**3661**	**3734**

Data sources: Fitch-Connect and IMF. Note: ADV – Advanced countries, EMDE – Emerging market and developing economies.

APPENDIX 2: MACROPRUDENTIAL VARIABLES

Table A2.1: Instruments in the IMF IMAPP integrated Macroprudential Policy Database (2020)

Individual macroprudential instruments	Abbreviation	Definition
Countercyclical buffer	CCB	A requirement for banks to maintain a countercyclical capital buffer. Implementations at 0% are not considered as a tightening in dummy-type indicators.
Conservation buffer	CONSERVATION	Requirements for banks to maintain a capital conservation buffer, including the one established under Basel III.
Capital requirements	CAPITAL	Capital requirements for banks, which include risk weights, systemic risk buffers, and minimum capital requirements. Countercyclical capital buffers and capital conservation buffers are captured in the above measures respectively and thus not included here.
Leverage requirements	LVR	A limit on leverage of banks, calculated by dividing a measure of capital by the bank's non-risk-weighted exposures (e.g., Basel III leverage ratio).
Provisioning requirements	LLP	Loan-loss provision requirements for macroprudential purposes, which include dynamic provisioning and sectoral provisions (e.g., housing loans).
Credit growth limits	LCG	Limits on growth or the volume of aggregate credit, the household-sector credit, or the corporate-sector credit by banks, and penalties for high credit growth.
Loan restrictions	LOANR	Loan restrictions, that are more tailored than those captured in "LCG". They include loan limits and prohibitions, which may be conditioned on loan characteristics (e.g., the maturity, the size, the LTV ratio and the type of interest rate of loans), bank characteristics (e.g., mortgage banks), and other factors.
Limits on Foreign Currency Loans	LFC	Limits on foreign currency (FC) lending, and rules or recommendations on FC loans.
Loan-to-value limits	LTV	Limits to the loan-to-value ratios, including those mostly targeted at housing loans, but also includes those targeted at automobile loans, and commercial real estate loans.
Debt-to-income limits	DSTI	Limits to the debt-service-to-income ratio and the loan-to-income ratio, which restrict the size of debt services or debt relative to income. They include those targeted at housing loans, consumer loans, and commercial real estate loans.
Levy/Tax on Financial Institutions	TAX	Taxes and levies applied to specified transactions, assets, or liabilities, which include stamp duties, and capital gain taxes.
Liquidity measures	LIQUIDITY	Measures taken to mitigate systemic liquidity and funding risks, including minimum requirements for liquidity coverage ratios, liquid asset ratios, net stable funding ratios, core funding ratios and external debt restrictions that do not distinguish currencies.
Loan to deposit limits	LTD	Limits to the loan-to-deposit (LTD) ratio and penalties for high LTD ratios.
Limits on FX operations	LFX	Limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, and currency mismatch regulations.
Reserve requirements	RR	Reserve requirements (domestic or foreign currency) for macroprudential purposes. This category may currently include those for monetary policy as distinguishing those for macroprudential or monetary policy purposes is often not clear-cut.
SIFI surcharges	SIFI	Measures taken to mitigate risks from global and domestic systemically important financial institutions (SIFIs), which includes capital and liquidity surcharges.
Other macroprudential measures	Other	Macroprudential measures not captured in the above categories—e.g., stress testing, restrictions on profit distribution, and structural measures (e.g., limits on exposures between financial institutions).

Source: Alam et al (2019), IMF (2023). The database covers a sample from 1990 to 2021, with monthly data which we have cumulated over time and annualised.

Table A2.2: Summary instruments derived from the IMF IMAPP integrated Macroprudential Policy Database (2020)

Summary macroprudential instruments	Abbreviation	Definition
All measures	MAPP-INDEX	Sum-total of the instruments listed in Table 2
Loan-targeted measures	LOAN-TARGETED	Sum of the "Demand" and the "Supply-loans" instruments.
Demand-targeted measures	DEMAND	Sum of loan-to-value limits and debt-to-income limits
Supply-targeted measures	SUPPLY-ALL	Sum of all the instruments listed in Table 2 except loan-to-value limits and debt-to-income limits
Loan-supply targeted measures	SUPPLY-LOANS	Sum of provisioning requirements, credit growth limits, loan restrictions, limits to the loan to deposit ratio, and limits to foreign currency loans
General supply targeted measures	SUPPLY-GENERAL	Sum of reserve requirements, liquidity requirements, and limits to FX positions.
Capital-related supply measures	SUPPLY-CAPITAL	Sum of leverage, countercyclical buffers, conservation buffers, and capital requirements.

Source: Alam et al (2019), IMF (2023). The database covers a sample from 1990 to 2021 with monthly data, which we have cumulated over time and annualised.

APPENDIX THREE – THREE FURTHER BREAKDOWNS OF THE DATA

- **Advanced countries and emerging market and developing countries**
- **Large and small banks**
- **Pre and post Global Financial Crisis (1990-2006 and 2007-2022)**

Table A3.1: Results for noninterest income (1990-2022), subdivided by country-development, bank size and pre and post Global Financial Crisis

SAMPLE	ADVANCED COUNTRIES		EMERGING AND DEVELOPING ECONOMIES		LARGE BANKS		SMALL BANKS		1990-2006		2007-2022	
DEPENDENT	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR
C	4.898*** (7.0)	31.8*** (8.0)	7.575*** (5.6)	53.3*** (5.3)	5.07*** (5.7)	13.36*** (4.4)	8.668*** (7.1)	41.04*** (4.7)	12.36*** (8.5)	54.07*** (5.9)	9.58*** (8.1)	66.67*** (5.7)
LAGGED DEPENDENT (-1)	0.696*** (21.0)	0.421*** (17.3)	0.439*** (24.5)	0.342*** (15.1)	0.558*** (11.6)	0.409*** (19.6)	0.486*** (20.7)	0.308*** (16.4)	0.323*** (9.7)	0.271*** (10.3)	0.489*** (16.6)	0.321*** (15.1)
BANK SIZE (-1)	-0.21*** (6.7)	-1.11*** (3.4)	-0.32*** (4.9)	-1.089** (2.4)	-0.195*** (5.2)		-0.427*** (6.6)	-1.063** (2.4)	-0.538*** (7.9)	-1.311*** (3.1)	-0.385*** (7.0)	-2.034*** (4.0)
CAPITAL RATIO (-1)										-9.272*** (3.0)		
CREDIT RISK (-1)	-0.5*** (3.8)	0.327** (2.1)		0.228*** (3.9)		0.568*** (4.1)	-0.0292** (2.1)	0.123* (1.8)				-0.357*** (3.0)
COST/INCOME (-1)		0.139*** (7.1)				0.0903*** (5.2)		0.0409*** (3.9)				0.0872*** (5.4)
ROAA(-1)	-0.08*** (2.7)	0.73*** (3.3)				0.713*** (2.9)	-0.05*** (2.7)					0.4*** (3.3)
NET INTEREST MARGIN (-1)	0.0468** (2.5)	-1.12*** (5.6)	0.039*** (3.0)	-0.56*** (3.0)		-1.09*** (4.5)	0.452*** (2.7)	-0.348*** (3.6)				-1.035*** (4.2)
LOAN-ASSET RATIO (-1)		-5.6*** (3.6)		-9.7*** (4.4)	-0.188* (1.8)	-5.828*** (3.9)		-7.77*** (4.9)		-9.273*** (5.0)	-0.451*** (3.4)	-9.64*** (6.2)
LERNER INDEX (-1)	-0.56*** (4.3)	6.426*** (3.0)	-1.17*** (4.8)	-4.88*** (3.6)	-0.66*** (4.1)		-0.628*** (3.1)		-0.662** (2.5)	-8.211*** (4.6)	-0.787*** (4.6)	5.403*** (2.7)
BANKING CRISIS				2.659** (2.7)	-0.11*** (2.8)			1.904** (2.2)		2.932* (2.6)		-1.926** (2.4)
INFLATION			0.0083* (1.8)				0.0183*** (5.1)	0.0862*** (3.4)	0.0073* (1.7)		0.0126** (2.2)	
R²	0.775	0.63	0.57	0.46	0.712	0.623	0.631	0.514	0.442	0.459	0.619	0.478
SE	0.953	12.7	2.397	14.5	1.11	12.12	2.081	17.13	2.371	17.3	1.815	14.42
PERIODS	30	31	30	31	31	32	31	32	15	16	16	16
OBS	41554	42170	31017	30604	45792	47656	31181	35496	31232	35548	48779	46784
BANKS	3051	3055	2877	2890	3402	3480	3972	4325	4143	4574	4719	4671

Notes: For variable definitions see Table 1. NIIAA is noninterest income as a proportion of average assets, NIR is noninterest income as a proportion of total income,. Estimated by panel OLS with time and bank dummies and country-clustered standard errors. Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. GDP growth was not significant in these regressions.

Table A3.2: Results for summary macroprudential instruments (1990-2022), subdivided by country-development, bank size and pre and post Global Financial Crisis

SUBSAMPLE	ADVANCED COUNTRIES		EMERGING AND DEVELOPING ECONOMIES		LARGE BANKS		SMALL BANKS		1990-2006		2007-2022	
DEPENDENT	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR
MAPP-INDEX (-1)	0.0042* (1.9)	-0.018 (0.3)	0.0117** (2.4)	0.105* (1.8)	0.00555* (1.8)	0.0243 (0.4)	0.0104* (1.8)	0.0944 (1.5)	0.0151 (1.1)	-0.0569 (0.2)	0.0128*** (4.1)	0.0948** (2.4)
LOAN-TARGETED (-1)	0.0109*** (2.9)	0.0366 (0.4)	0.0241 (1.4)	0.135 (0.8)	0.00982* (1.7)	-0.009 (0.1)	0.031** (2.3)	0.265* (1.7)	0.0451 (1.4)	-0.295 (0.5)	0.0186** (2.5)	0.162* (1.9)
DEMAND (-1)	0.0184*** (3.0)	-0.014 (0.1)	0.008 (0.2)	-0.1 (0.3)	0.00526 (0.7)	-0.2 (1.1)	0.0515** (2.3)	0.297 (1.2)	0.0729 (1.2)	-0.411 (0.4)	0.0141 (1.0)	0.028 (0.2)
SUPPLY-ALL (-1)	0.003 (0.8)	-0.001 (0.1)	0.0131** (2.4)	0.123* (1.7)	0.00683* (1.7)	0.046 (0.7)	0.0055 (0.8)	0.0793 (1.0)	0.0108 (0.7)	-0.0647 (0.4)	0.0148*** (4.4)	0.123** (2.4)
SUPPLY-LOANS (-1)	0.012* (1.7)	0.162 (0.8)	0.045** (2.1)	0.329 (1.4)	0.0213** (2.0)	0.142 (0.7)	0.0333 (1.5)	0.431** (2.0)	0.045 (1.0)	-0.331 (0.5)	0.0378*** (3.4)	0.431*** (3.0)
SUPPLY-GENERAL (-1)	-0.00149 (0.1)	-0.152 (0.5)	0.0098 (0.8)	0.136 (1.0)	0.0056 (0.7)	0.0671 (0.6)	-0.0062 (0.5)	0.0409 (0.3)	0.0073 (0.5)	-0.0281 (0.1)	0.0166* (1.8)	0.083 (0.7)
SUPPLY-CAPITAL (-1)	0.004 (0.7)	0.142 (0.1)	0.0349** (2.0)	0.274** (2.3)	0.0161** (2.2)	0.0621 (0.5)	0.0121 (0.9)	0.0329 (0.2)	0.0223 (0.3)	-0.781 (0.8)	0.0255*** (3.2)	0.216** (2.1)

Notes: NIIAA is noninterest income as a proportion of average assets and NIR is noninterest income as a proportion of total income. Estimated by panel OLS with time and bank dummies and country-clustered standard errors. Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. Each equation includes all the control variables shown in Table 2, with cumulated summary macroprudential variables added one at a time. MAPP INDEX is the sum of dummies for all of 17 categories shown in Appendix Table A2.1. The LOAN TARGETED group consists of the "Demand" and the "Supply-loans" instruments. DEMAND comprises loan-to-value and debt-service-to-interest limits. 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. See Appendix Table A2.2 for more details on summary variables.

Table A3.3: Results for individual macroprudential instruments (1990-2022) , subdivided by country-development, bank size and pre and post Global Financial Crisis

SUBSAMPLE	ADVANCED COUNTRIES		EMERGING AND DEVELOPING ECONOMIES		LARGE BANKS		SMALL BANKS		1990-2006		2007-2022	
DEPENDENT	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR	NIIAA	NIR
COUNTERCYCLICAL BUFFER (-1)	0.0094 (0.4)	0.078 (0.3)	0.0015 (0.1)	0.0837 (0.2)	0.0015 (0.1)	0.0837 (0.2)	0.0616* (1.7)	0.372 (1.1)	Na	Na	0.0188 (0.8)	0.196 (0.9)
CONSERVATION BUFFER (-1)	0.0059 (0.4)	0.54* (1.9)	0.0455*** (3.1)	0.683*** (4.2)	0.0455*** (3.1)	0.683*** (4.2)	0.05 (1.4)	0.698* (1.8)	Na	Na	0.0394** (2.3)	0.671*** (3.5)
CAPITAL REQUIREMENTS (-1)	0.005 (0.6)	-0.159 (0.8)	0.0077 (0.6)	-0.182 (1.2)	0.0077 (0.6)	-0.182 (1.2)	-0.0007 (0.1)	-0.209 (0.9)	-0.0628 (1.1)	-0.95 (0.8)	0.0242** (2.6)	0.0598 (0.5)
LEVERAGE REQUIREMENTS (-1)	-0.106 (0.4)	-0.355 (0.6)	0.0252 (0.7)	0.0793 (0.1)	0.0252 (0.7)	0.0793 (0.1)	-0.0095 (0.1)	-0.373 (0.5)	0.346** (2.1)	0.0709 (0.1)	-0.0106 (0.4)	0.402 (0.7)
PROVISIONING REQUIREMENTS (-1)	0.0332 (1.4)	0.442 (0.9)	0.027 (1.2)	0.0327 (0.1)	0.027 (1.2)	0.0327 (0.1)	0.018 (0.4)	0.654 (1.6)	-0.019 (0.5)	-0.59 (0.7)	0.0728* (1.8)	0.937*** (3.0)
CREDIT GROWTH LIMITS (-1)	-0.076 (0.4)	-0.361 (0.1)	0.119* (1.8)	0.398 (0.3)	0.119* (1.8)	0.398 (0.3)	0.0077 (0.1)	-1.463 (1.2)	-0.0462 (0.3)	-3.445* (1.8)	-0.0759 (0.4)	0.253 (0.3)
LOAN RESTRICTIONS (-1)	0.0206 (1.2)	0.071 (0.2)	0.0344** (2.4)	0.253 (1.0)	0.0344** (2.4)	0.253 (1.0)	0.091*** (3.2)	0.715 (1.5)	0.135 (0.3)	1.127 (0.7)	0.0592*** (4.5)	0.602*** (2.7)
LIMITS ON FOREIGN CURRENCY LOANS (-1)	0.004 (0.5)	0.273 (1.2)	0.0016 (0.1)	0.283 (0.6)	0.0016 (0.1)	0.283 (0.6)	-0.0137 (0.4)	0.892** (2.5)	0.256** (2.4)	0.006 (0.0)	-0.018 (0.6)	0.495 (1.1)
LOAN TO VALUE LIMITS (-1)	0.0313*** (2.8)	0.09 (0.3)	0.0118 (1.1)	-0.163 (0.6)	0.0118 (1.1)	-0.163 (0.6)	0.037 (1.3)	0.287 (0.7)	0.0671 (1.0)	-0.16 (0.1)	0.00619 (0.5)	-0.013 (0.1)
DEBT TO INCOME LIMITS (-1)	0.0189 (1.3)	-0.316 (0.9)	-0.00531 (0.3)	-0.651*** (2.7)	-0.00531 (0.3)	-0.65*** (2.7)	0.155** (2.4)	0.741 (1.6)	0.151 (1.0)	-2.201 (1.3)	0.0582 (1.1)	0.181 (0.5)
LEVY/TAX ON FINANCIAL INSTITUTION (-1)	0.01 (0.8)	-0.488 (1.5)	0.0075 (0.6)	-0.275 (1.0)	0.0075 (0.6)	-0.275 (1.0)	0.0121 (0.5)	-0.316 (0.8)	0.0747 (1.4)	5.931*** (10.2)	0.0041 (0.3)	-0.388 (1.6)
LIQUIDITY MEASURES (-1)	0.0127 (0.8)	0.507 (1.3)	-0.0058 (0.5)	0.172 (1.5)	-0.0058 (0.5)	0.172 (1.5)	0.0362 (1.5)	0.637** (2.4)	0.0178 (0.3)	-0.752 (0.7)	0.00653 (0.4)	0.203 (1.1)
LOAN TO DEPOSIT LIMITS (-1)	-0.127** (2.6)	-2.8*** (3.4)	-0.927** (2.5)	-1.668*** (3.6)	-0.927** (2.5)	-1.67*** (3.6)	-0.0928* (1.7)	-2.6*** (2.8)	-0.135 (0.3)	0.305 (0.1)	-0.146*** (3.2)	-2.02*** (3.8)
LIMITS ON FX OPERATIONS (-1)	-0.154*** (9.2)	-2.1*** (8.9)	-0.0597** (2.3)	-0.886*** (3.0)	-0.0597** (2.3)	-0.8*** (3.90)	0.009 (0.1)	-0.55 (0.9)	-0.141* (2.0)	-4.75*** (2.6)	-0.02 (0.4)	-0.762 (1.4)
RESERVE REQUIREMENTS (-1)	-0.0073 (0.6)	-0.54** (2.1)	0.0117 (1.5)	0.0818 (0.7)	0.0117 (1.5)	0.0818 (0.7)	-0.0286* (1.8)	-0.219 (1.1)	0.0094 (0.6)	0.078 (0.4)	0.0237** (2.3)	0.108 (0.8)
SIFI SURCHARGES (-1)	0.006 (0.3)	0.128 (0.3)	0.0176 (1.1)	0.244 (1.0)	0.0176 (1.1)	0.244 (1.0)	0.0637** (2.1)	0.938** (2.3)	Na	Na	0.0449*** (2.5)	0.466** (2.2)
OTHER MACROPRUDENTIAL MEASURES (-1)	-0.007 (0.4)	-0.18 (0.5)	0.0111 (0.7)	0.238 (1.4)	0.0111 (0.7)	0.238 (1.4)	0.0532 (1.2)	0.248 (0.5)	0.322 (1.4)	0.606 (0.3)	0.0446** (2.5)	0.378* (1.9)

Notes: NIIAA is noninterest income as a proportion of average assets and NIR is noninterest income as a proportion of total income. Estimated by panel OLS with time and bank dummies and country-clustered standard errors. Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. Each equation includes all the control variables shown in Table 2, with cumulated macroprudential variables added one at a time. See Appendix Table A2.1 for more details on individual variables.

Table A3.4: Results for risk (Z-score and NPL ratio) and profitability (ROAA) for global sample (1990-2022)

DEPENDENT	Log Z Score	NPL/loan ratio	Return on average assets
C	0.453 (1.2)	-5.42*** (2.7)	3.867*** (4.5)
LAGGED DEPENDENT (-1)	0.451*** (68.4)	0.68*** (31.9)	0.379*** (17.7)
BANK SIZE (-1)	0.0478*** (2.8)	0.349*** (3.4)	-0.178*** (4.7)
CREDIT RISK (-1)	-0.0373*** (9.1)	0.158*** (3.4)	
COST/INCOME (-1)	-0.0016*** (3.5)		-0.00404*** (4.4)
ROAA (-1)		-0.142*** (4.0)	NA
NET INTEREST MARGIN (-1)			0.0569*** (4.7)
LOAN-ASSET RATIO (-1)		4.536*** (6.6)	
LIQUIDITY RISK (-1)	0.197*** (4.2)	-1.534*** (3.3)	0.24* (1.9)
LERNER INDEX (-1)	0.131* (1.9)		
BANKING CRISIS	-0.23*** (4.6)	0.558** (2.3)	-0.318*** (3.2)
INFLATION		0.0184* (1.7)	0.00846** (2.8)
GROWTH	0.021*** (5.4)	-0.222*** (6.4)	0.0792*** (5.4)
R^2	0.489	0.712	0.392
SE	0.823	4.055	1.559
PERIODS	31	32	32
OBS	66238	50772	82622
BANKS	5572	4506	6178

Notes: Estimated by panel OLS with time and bank dummies and country-clustered standard errors. For variable definitions see Table 1. Coefficient values are reported and the t-statistics are reported in parenthesis. *** Significant at 1%, ** significant at 5%, * significant at 10%. Capital ratios were not significant in these equations.