# Bank Profitability by Line of Business[*]

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## Abstract

Many commercial banks are universal in the sense that they operate multiple lines of business (e.g. different lines for retail bank, commercial bank and investment bank activities). Using quarterly FR Y-9C reports, I examine how profitability covaries across business lines for U.S. commercial bank-holding companies (BHCs) over the period 2002-2020. Specifically, I partition bank revenue activity into commercial and investment bank business lines. While revenue line items are quite granular in the regulatory data, key expense categories (such as total compensation for employees) are aggregated at the BHC-level. I develop an empirical method to infer expenses by business line and therefore net income by business line, which is my main metric for profitability. Using this method, I find that commercial bank net income accounts for 55% of the aggregate banking sector net income, and this share has declined over time. In the aggregate, I find that commercial and investment bank net income are positively correlated (0.66). While commercial bank net income is pro-cyclical with the business cycle (0.44), investment bank net income is counter-cyclical (-0.09), suggesting a diversification benefit. Counter to aggregate measures, bank-level measures of net income correlation yield mixed results as to the sign and magnitude over the sampling period.

JEL Classification: G21, G28

Keywords: bank profitability, net income, business lines, commercial bank, investment bank

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# 1 Introduction

Historically, banks could be defined quite narrowly as financial intermediaries which perform liquidity and maturity transformation, using short-term stable deposits to fund long-term, profitable loans.[1] While this remains a core element of banking practices, today, banks are now more universal, managing multiple lines of business which provide a variety of retail, commercial and investment services.[2] Further, these operations exist under the umbrella of large and complex Financial Holding Companies (FHCs) and Bank Holding Companies (BHCs).

In this paper, I examine how bank profitability covaries across business lines as well as the cyclical properties of business line profitability. The motivation for this topic is twofold. First, in the U.S., there is an extensive history of regulatory reforms which have sought to broaden or narrow the scope of accepted bank practices.[3] Proponents for broadening argue that it creates a diversification benefit across the business lines, while opponents argue that traditional bank activities subsidize riskier non-traditional investments and this can destabilize the entire banking sector. Second, the majority of economic modeling of the banking sector still formulates banks as operating simple loan-deposit models. Additional research is required to understand if this assumption is innocuous when using these models to evaluate policy and industry dynamics. This paper will offer additional empirical insights in helping to address both these concerns.

In this paper, I define profitability as after-tax net income. I split banking activity into two broad categories: commercial and investment bank. In this framework, commercial banking corresponds to the more traditional business model of long assets (such as loans, leases, cash and securities) financed with short-term debt (such as deposits and wholesale funding) while investment banking corresponds to fiduciary services, trading, underwriting and other non-traditional bank activities. Lastly, I focus on bank activity at the holding company level to capture any firm coordination across bank subsidiaries, and therefore use quarterly FR Y-9C reports. While the FR Y-9C data is detailed with respect to revenue items, certain key expense categories (such as payroll costs) are reported as aggregates, at the holding company level. This then presents a challenge in inferring how expenses are allocated across business lines, which is necessary to compute net income. To address this, I develop a simple empirical method to infer how expenses, and therefore

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[1]See Diamond and Dybvig [1983], Karaken and Wallace [1978] and Calomiris and Kahn [1991]

[2]In 2020, U.S. commercial banking revenues were approximately \$500 billion while investment bank revenues were approximately \$425 billion.

[3]These include the Glass-Steagall Act of 1933, Gramm-Leach-Bliley Act of 1999 and the Dodd-Frank Act of 2010.

net income, are allocated across business lines.

I consider a sample period from 2002 to 2020 and find that, in the aggregate, commercial bank activity accounts for 55% of bank profitability and that its share has been declining over the sample period. When looking at expense, I find that commercial bank activity is more labor-intensive while investment bank activity has larger expenditures on legal fees, information technology, data processing, consulting and marketing.[4] Using my empirical method, I infer bank net income and use this to compute both cyclical and bank-level correlations. In the aggregate, I found that commercial and investment bank net income has a positive 0.66 correlation. Further, while commercial bank net income is pro-cyclical (0.44), investment bank net income is weakly counter-cyclical (-0.09), suggesting a possible diversification benefit. I consider multiple bank-level measures of business line net income correlation and find mixed results as to the sign and magnitude.

For the remainder of the paper, Section 2 covers the related literature and my corresponding contribution. Section 3 reviews my definitions for commercial and investment bank business lines and provides a data overview. Section 4 covers my empirical method to infer bank net income. Section 5 provides results on the cyclical and bank-level correlation measures, across the business lines. Section 6 concludes the paper.

## 2 Related Literature

Looking at trends in income activity from 2001 to 2018, Haubrich and Young [2019] document that a large fraction of banks' revenue comes from non-interest income. The authors show that larger banks (which are a part of a bank holding company) tend to have a higher proportion of non-interest income. Further, they find mixed results as to the relationship between non-interest income activity and both net interest margin and the term spread, before and after the financial crisis of 2007. Stiroh [2004] documents that the U.S. banking industry is steadily increasing its reliance on nontraditional business activities, captured through the increase in non-interest income. The author documents that, in the aggregate and at the bank-level, noninterest income is quite volatile and has become more correlated with net interest income and that non-interest income activity increases bank default risk, suggesting little diversification benefit. The author utilizes a

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[4]Here I refer to *labor expense* as costs associated with payroll and compensation of employees, which does not capture the cost of externally contracting out labor (e.g. hiring a marketing firm to develop a new advertising campaign).

cross-sectional and intra-bank measure of business line correlation which I employ in this paper, as well.[5]

DeYoung and Roland [2001] test whether and how increases in fee-based activities at commercial banks affect overall earnings volatility, using quarterly revenue and earnings data from 472 U.S. commercial banks between 1988 and 1995. They find that tilting business activity towards fee-based services leads to an increase in earnings volatility as well as bank leverage.[6] De Jonghe [2010] uses a market-based approach to measure a bank's exposure to systemic risk and investigates the contribution to this exposure based upon the bank's use of both interest income and non-interest income activity. The author finds non-interest income activity increases a bank's exposure to systemic risk and, therefore, utilization of multiple lines of business does not present a diversification benefit. Using prominent measures of systemic risk, Brunnermeier et al. [2020] find that non-interest income is positively correlated with systemic risk. Particularly, higher shares of non-interest income are positively correlated with the bank's tail risk and interconnectedness risk. Oppositely, looking at the banking systems of EU countries from 1994 to 1998, Smith et al. [2003] find that non-interest income stabilized profits. Looking at a similar panel of European banks, Lepetit et al. [2008] find that increased risk from non-interest income activity is primarily driven by fee- and commission-based activity whereas trading activity can lead to a reduction in asset and default risk.

Demirguc-Kunt and Huizinga [2010] provide cross-country evidence, looking at a sample of 1,334 banks in 101 countries, leading up to the 2007 financial crisis. They find that reliance upon non-interest income activity increases the return on assets and may provide some diversification benefit but, ultimately, leads to an increased risk of bank default. Albertazzi and Gambacorta [2009] also provide cross-country evidence on the relationship between GDP and both net-interest income as well as non-interest income. They find that net-interest income is positively related to GDP while the relationship between GDP and non-interest income is insignificant.

My contribution to this literature is twofold. First, while the majority of preexisting work focuses on revenues (e.g. non-interest income from insurance underwriting), I focus upon net income which is a more accurate metric for bank profitability, as it accounts for the expense of each activity. Second, while it is common practice to to divide bank activity into interest-based

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[5]See also Stiroh [2006] and Stiroh and Rumble [2006] for related work.
[6]See DeYoung and Rice [2004] for an empirical investigation of how banks expand into fee-based services and what key factors are correlated with non-interest income.

and non-interest-based activity, this is an inaccurate depiction of the actual business lines banks employ. For example, while overdraft and ATM fees are non-interest revenues, they are directly related to customer deposit accounts and the net interest activities of the bank.[7] Therefore, in my framework, I construct revenue and expense measures according to my definition of commercial and investment bank business lines.[8]

# 3    Lines of Business

In this section, I formalize my definitions for bank business lines and provide the data analogues from the FR Y-9C forms, as well as provide summary data for bank revenues and expense, by business line.

**Definition.** I split bank activity into two business lines: commercial bank (cbank) and investment bank (ibank) activity. Generally, commercial banking is defined as the traditional intermediation practice of financing long-term assets with short-term debt. As an example, one can think of a simple loan-deposit model: bank deposits are instantly redeemable at face value but are used to finance loans with a long maturity where there is a relatively illiquid secondary market.[9] On the other hand, investment banking is defined as activities associated with fiduciary services, trading, underwriting and other non-traditional banking practices. As an example, one can think of the trading desk of an investment bank which has many functions, one simply being proprietary trading to generate profits for the firm.[10]

I define commercial bank revenues as total interest revenues (less net trading interest revenue) minus total interest expense plus several non-interest items, including deposit charges, loan loss provisions, gains on securities, net servicing fees and ATM fees.[11] Notice in this definition that

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[7]As another example, banks manage assets and liabilities which correspond to their trading desks. While trading assets generate interest revenue, the trade desk also generates non-interest trade revenue. Therefore, an empirical framework that splits activity according to *interest* and *non-interest* would break apart these two revenue sources which are tightly connected.

[8]See Section 3 for a detailed definition.

[9]In this sense, commercial bank activity performs both maturity and liquidity transformation.

[10]In practice, this dichotomy of business lines is quite crude, especially for the investment bank side, where activities could be further decomposed into mergers & acquisitions, corporate advice, IPOs, restructurings, insurance underwriting, sales/trading, etc. In future work, I plan to pursue a more granular framework for capturing these separate lines.

[11]Specifically, using the FR Y-9C income statement, Commercial Bank Revenue = total int inc [BHCK 4107] - trading int inc [BHCK 4069] + trading int exp [BHCK 4185] + deposit charge [BHCK 4483] - loan provisions [BHCK 4230] + gains on securities [BHCK 3521,3196] + net servicing fees [BHCK B492] + checks [BHCK C013] + safe deposit [BHCK C015] + ATMs [BHCK C016] - total int exp [BHCK 4073].

a large component of commercial bank revenues are from net interest margin (i.e. the spread between interest revenues from lending & securities and interest expense from deposits & other debt). Thus, similar to the empirical literature, I treat net interest margin as a revenue source for banks: collecting the spread between its assets and debt funding. In this way, the associated expense of commercial banking isn't debt expense, but instead costs associated with personnel, fixed assets, premises and other categories. I define investment bank revenues as total non-interest revenues (less commercial bank revenues) plus net trading interest revenues.[12]

While the revenue line items in the FR Y-9Cs are quite granular and easy to allocate to the defined business lines, expenses are reported at the aggregate bank-level. I define three main expense categories: labor, fixed assets and other.[13] The labor expense category uses all salaries and benefits spent on bank personnel and does not include the associated costs of labor for externally hired sources (such as contracted labor for consulting or legal work). The fixed asset category includes all non-interest expenditures on premises, equipment, furniture and fixtures. Lastly, the *other* expense category includes expenditures related to data processing, advertising & marketing, legal fees, consulting & advisory fees, goodwill impairment losses, amortization expense (and impairment losses) for intangible assets and other non-interest expenditures.

**Summary Data.** In this section, I document trends in commercial and investment banking activity, as well as the trends for the defined expense categories. For all the analysis in this paper, I utilize FR Y-9C quarterly reports for U.S. commercial bank holding companies and consider a sample period from 2002 to 2020. In Figure 1, I plot aggregate revenues by lines of business (in levels and in quarter-over-quarter change) as well as total expense. A couple observations can be made. First, investment bank revenue shares have grown: at the beginning of the sample, commercial bank revenues accounted for approximately 63% of total revenue but have since declined to approximately 55%. Second, commercial bank revenues reached their peak in 2005 and continued their decline through the financial crisis of 2008 and ensuing recession.[14]

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[12]Specifically, using the FR Y-(C income statement, Investment Bank Revenue = total nonint inc [BHCK 4079] - deposit charge [BHCK 4483] + trading int inc [BHCK 4069] - trading int exp [BHCK 4185] - checks [BHCK C013] - ATMs [BHCK C016] - net servicing fees [BHCK B492].

[13]Specifically, for labor expense I use [BHCK 4135], for fixed asset expense I use [BHCK 4217] and for the other category I use [BHCK C216] + [BHCK C232] + [BHCK 4092].

[14]The spike in investment bank revenues in 2009 is likely due to the inclusion of investment banks Goldman Sachs and Morgan Stanley as chartered commercial banks in that time period.
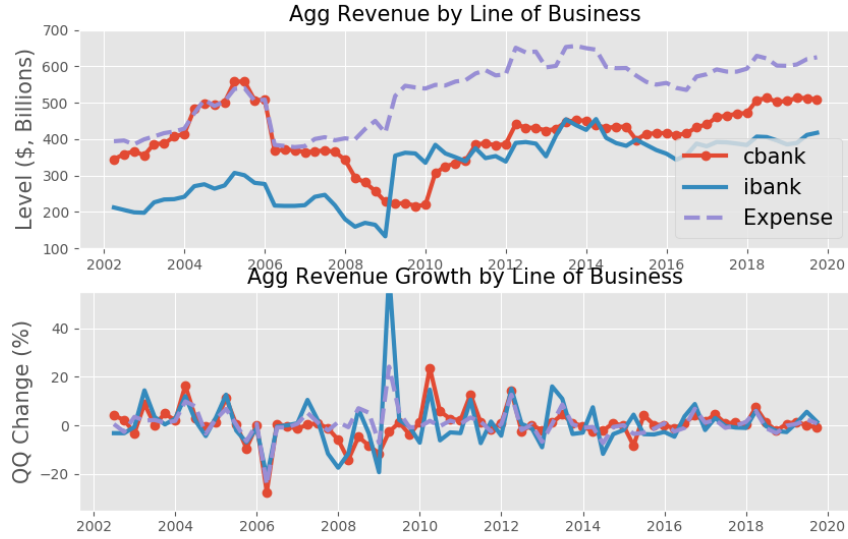
Figure 1: Aggregate U.S. Bank Revenues and Expenses

In Figure 2, I break apart the total expense categories into the subsets of labor, fixed assets and other. While labor remains (weakly) the dominant expense category, it is closely followed by *other* expenditures, which include fees for such activities as consulting, advertising, legal and information technology. Over the sample period, expenses on fixed assets have remained relatively stable and small when compared to the other categories, accounting for less than 10% of total expense.
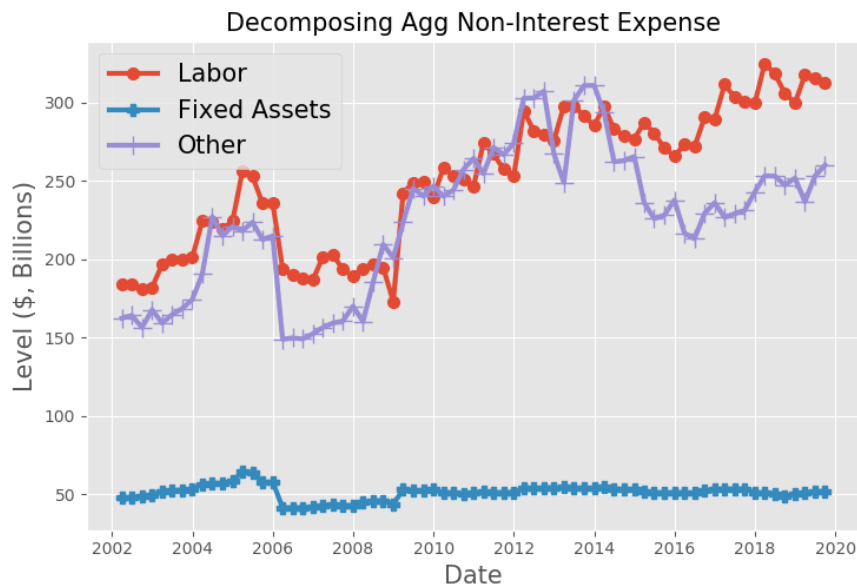


Figure 2: Aggregate U.S. Bank Expenses

# 4 Empirical Method

The main issue with using net income as the measure of bank profitability is that bank expenses are reported as aggregates at the bank-level and are not allocated across business lines. To addres this, I employ a simple empirical method which utilizes variation in the FR Y-9C panel data to infer how expenses are distributed across commercial and investment bank business lines. In particular, assume $Y_{it}^j$ is the $j^{th}$ expense category for bank $i$ at time $t$ of which there are $J$ different expense categories. Further, specify three different sets of covariates: a vector $\mathbf{X_{it}^C}$ of covariates which are specific to commercial bank activity, a vector $\mathbf{X_{it}^I}$ of covariates which are specific to investment bank activity and a vector $\mathbf{X_{it}}$ which are not specific to either business line. Then, estimate the regression equation

$$Y_{it}^j \sim \mathbf{X_{it}^C}\boldsymbol{\beta_j^C} + \mathbf{X_{it}^I}\boldsymbol{\beta_j^I} + \mathbf{X_{it}}\boldsymbol{\beta_j} + \epsilon_{it} \tag{1}$$

Then, given the set of regression estimates $(\hat{\boldsymbol{\beta}}_j^C, \hat{\boldsymbol{\beta}}_j^I, \hat{\boldsymbol{\beta}}_j)$, I can infer commercial- and investment-specific expense via

$$\begin{aligned}
\hat{Y}_{it}^{j,C} &= \mathbf{X_{it}^C}\hat{\boldsymbol{\beta}}_j^C + \frac{\mathbf{X_{it}}\hat{\boldsymbol{\beta}}_j + e_{it}}{2} \\
\hat{Y}_{it}^{j,I} &= \mathbf{X_{it}^I}\hat{\boldsymbol{\beta}}_j^I + \frac{\mathbf{X_{it}}\hat{\boldsymbol{\beta}}_j + e_{it}}{2}
\end{aligned} \tag{2}$$

for each expense category $j = 1, 2, ..., J$, where the residual which is not specific to a business line $(\mathbf{X_{it}}\hat{\boldsymbol{\beta}}_j + e_{it})$ is evenly split across the categories such that the identity $\hat{Y}_{it}^{j,C} + \hat{Y}_{it}^{j,I} = Y_{it}^j$ holds for each expense category observation. Then, given business line revenues $(R_{it}^C, R_{it}^I)$, net income $(NI_{it}^C, NI_{it}^I)$ can be inferred via

$$\begin{aligned}
\hat{NI}_{it}^C &= R_{it}^C - \left[\hat{Y}_{it}^{1,C} + \hat{Y}_{it}^{2,C} + ... + \hat{Y}_{it}^{J,C}\right] \\
\hat{NI}_{it}^I &= R_{it}^I - \left[\hat{Y}_{it}^{1,I} + \hat{Y}_{it}^{2,I} + ... + \hat{Y}_{it}^{J,I}\right]
\end{aligned} \tag{3}$$

In the current model framework, $J = 3$ with expense categories for labor, fixed assets and *other*. For business line covariates I chose line-specific revenues as a flow measure and line-specific liabilities as a stock measure to help predict expenses (i.e. $\mathbf{X}^C = \{$ cbank revenue, cbank liabilities $\}$ and $\mathbf{X}^I = \{$ ibank revenue, ibank liabilities $\}$). All objets were deflated with 2012 USD and reported units are in thousands USD. Table 1 reports the regression results.

## TABLE 1
### EXPENSE REGRESSION OUTPUT

|  | $(Y^1)$ Labor | $(Y^2)$ Premises, fixed assets | $(Y^3)$ Other |
|---|---|---|---|
| Intercept | 3,048*** | 2,218*** | 10,690*** |
|  | (1,223) | (376) | (2,653) |
| cbank revenue | 0.14*** | 0.03*** | 0.26*** |
|  | (0.002) | (0.001) | (0.003) |
| ibank revenue | 0.12*** | 0.01** | 0.54*** |
|  | (0.001) | (0.000) | (0.002) |
| cbank liabilities | 0.01*** | 0.002** | -0.03*** |
|  | (0.000) | (0.000) | (0.000) |
| ibank liabilities | 0.01*** | 0.0002** | -0.01*** |
|  | (0.000) | (0.000) | (0.000) |
| Time FE | ✓ | ✓ | ✓ |
| Time Periods | 71 | 71 | 71 |
| Entities | 3000 | 3000 | 3000 |
| $R^2$ | 0.96 | 0.90 | 0.80 |

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Each expense category regression is highly significant and effective in capturing a large amount of the expense variation, as proxied by the R-squared measures. I focus on the labor and *other* expense categories as these are the largest components of total bank expenditures. Specifically, each $1,000 increase commercial bank revenues corresponds to a $140 increase in labor expense and a $26 dollar increase in other expenses. This provides some empirical evidence that changes in commercial bank revenues are associated with larger relative changes in labor expense. Further, each $1,000 increase in investment bank revenue corresponds to a $12 increase in labor expense and a $54 increase in other expenses. This also provides some empirical evidence that changes in investment bank revenues are associated with larger relative changes in *other* expenses, compared to the cost of in-bank labor.

Figure 3 plots the distribution of the expenses categories, over time, for commercial banking activities. One of the key empirical features is that labor expense is the dominant expense category for commercial banks. Further, the labor share has been increasing over time, from 57% in 2002 to 64% in 2020. This is largely explained by a drop in expenses related to the *other* category.
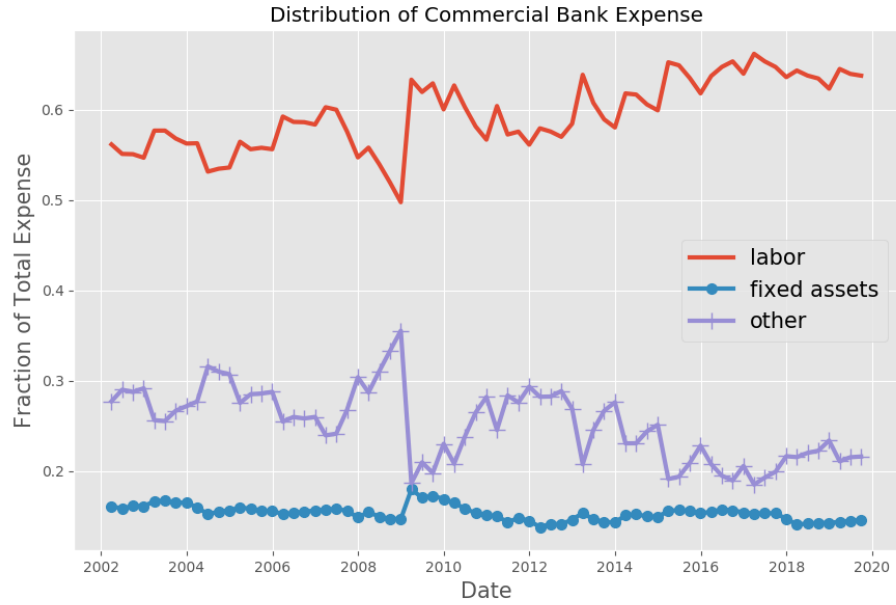
Figure 3: Distribution of Commercial Bank Expense

Figure 4 is a similar plot for how expense is distributed across investment bank activities, over time. Here it is evident that *other* expenditures are the dominant expense category for investment banks, making up roughly 70% of total expenditures. Further, the expense shares for investment banking have been relatively stable over time, other than a gradual drop in fixed asset expenses.
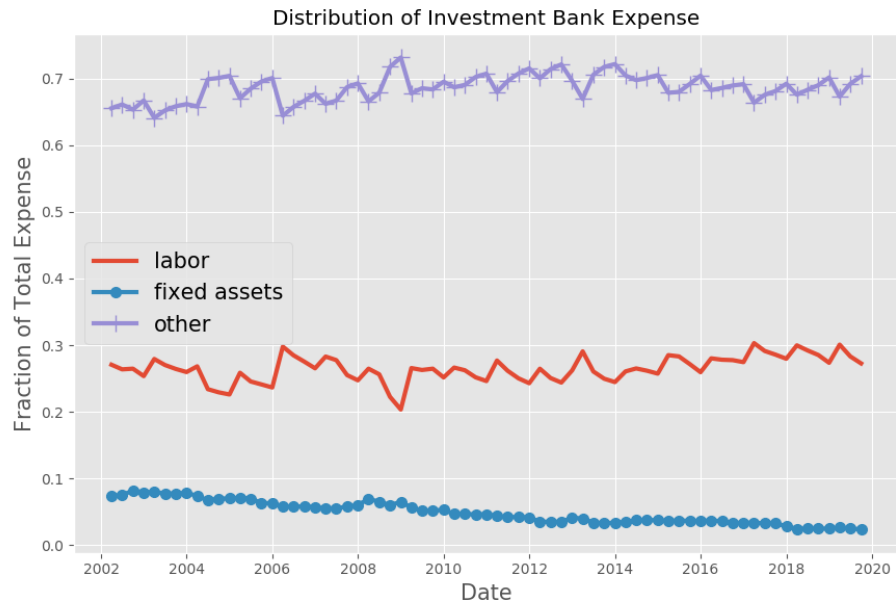


Figure 4: Distribution of Investment Bank Expense

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Lastly, Figure 5 plots net income, distributed across the business lines. It's clear that commercial bank net income was the predominant source of bank profitability in the beginning of the sample, accounting for roughly 70% of net income. However that share has decline over time and now (as of 2020) commercial bank activity accounts for only 55% of bank profitability. Of equal interest is how the profit shares have changed over time and, in particular, with respect to the period of time surrounding the financial crisis of 2007 and ensuing recession. From the figure it appears that while both sources of net income were severely affected by the financial crisis, investment bank net income recovered to a relatively higher level and the profit shares have remained relatively constant since then.
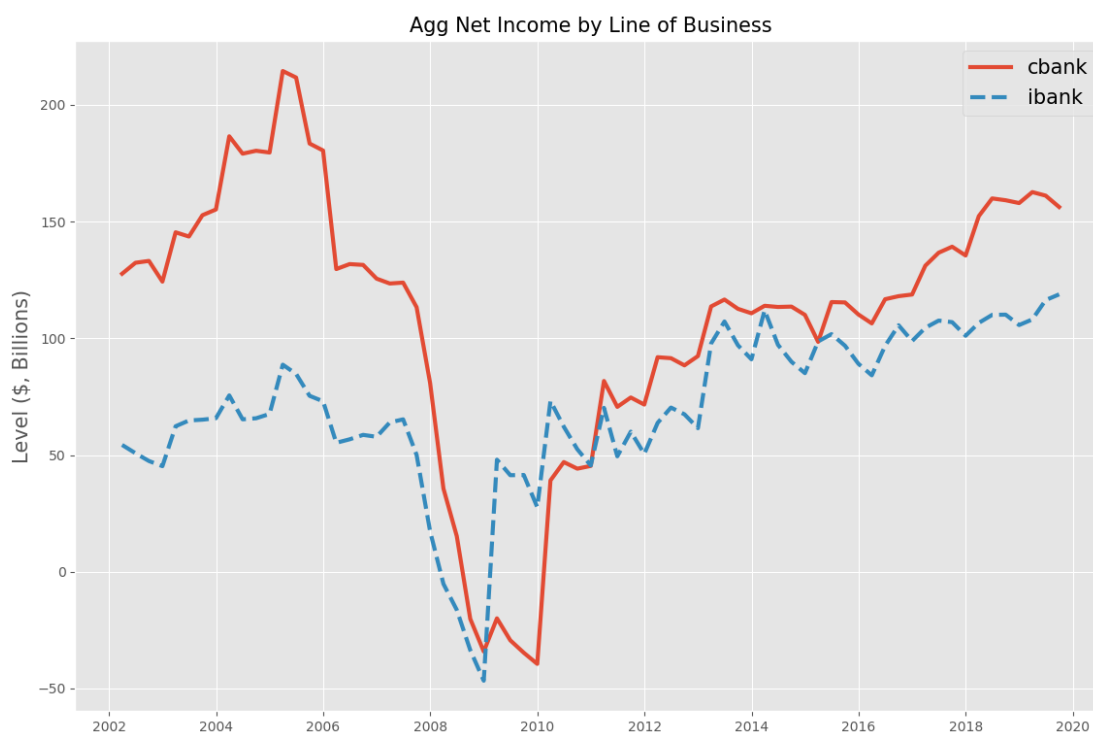


Figure 5: Bank Net Income by Line of Business

# 5    Measures of Correlation

In this section, I consider multiple measures of correlation to capture both the (i) aggregate, cyclical properties of business line profitability as well as (ii) bank-level measures of the pairwise correlation between commercial and investment bank net income. Specifically, for the bank-level measures, I consider a cross-sectional measure and an intra-bank measure as was done by Stiroh [2004].

**Aggregate, Cyclical Measures.** Using deflated U.S. GDP as a measure of aggregate production, I compute correlations based upon the cyclical components of GDP and aggregate bank net income (NI), investment bank net income (Ibank NI) as well as commercial bank net income (Cbank NI). Table 2 provides the net income correlation matrix. I find that while commercial bank net income is positively correlated with the business cycle (0.44), investment bank net income is weakly negative (-0.09). This has a dampening effect on the business cycle correlation for total net income. In this sense, investment bank profits have some diversification benefits in that they perform well during economic downturns.[15] Despite this, looking at pairwise correlations between ibank and cbank net income, there exists a strong positive correlation (0.66) casting some doubt on the diversification benefits, in the long run.

TABLE 2
NET INCOME CORRELATION MATRIX

|  | GDP | NI | Ibank NI | Cbank NI |
|---|---|---|---|---|
| GDP | 1 | – | – | – |
| NI | 0.26 | 1 | – | – |
| Ibank NI | -0.09 | 0.86 | 1 | – |
| Cbank NI | 0.44 | 0.95 | 0.66 | 1 |

NOTE: All data items are of quarterly frequency and the cyclical component of the hp-filter with $\lambda$=1600. The sample period is from 2002:Q1 to 2019:Q4.

To understand the added insight of using net income as the measure of profitability, Table 3 provides the same correlation matrix but just for bank revenues by business line. Three main differences arise. First, total revenue correlations with the business cycle are essentially acyclical (-0.05). Second, investment bank revenue seems even more counter-cyclical relative to using net income (with a correlation of -0.46). Third, the pairwise correlation between investment and commercial bank revenues remains positive but smaller (0.40) when compared to the net income pairwise correlations. Thus, the revenue correlation matrix overstates the diversification benefit of

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[15]For example, investment bank trading desks perform well during periods of market turbulence and high volatility.

investment bank activities in terms of both its cyclical properties, as well as its pairwise correlation with commercial bank activity.

TABLE 3
REVENUE CORRELATION MATRIX

|  | GDP | Rev | Ibank Rev | Cbank Rev |
|---|---|---|---|---|
| GDP | 1 | – | – | – |
| Rev | -0.05 | 1 | – | – |
| Ibank Rev | -0.46 | 0.80 | 1 | – |
| Cbank Rev | 0.30 | 0.87 | 0.40 | 1 |

NOTE: All data items are of quarterly frequency and the cyclical component of the hp-filter with $\lambda$=1600. The sample period is from 2002:Q1 to 2019:Q4.

Table 4 also provides the expense correlation matrix. It shows that commercial bank expenses are relatively acyclical (0.05) while investment bank expenses are counter-cyclical (-.64). If a significant fraction of commercial bank expense is towards labor and labor contracts are slow to adjust to the business cycle, it provides some insight as to why there is little variation in commercial bank expense. Separate than the commercial bank, investment bank activity is dominated by external consulting fees, data processing and information technology. The negative correlation suggests that during economic downturns, these services and expenses rise.

TABLE 4
EXPENSE CORRELATION MATRIX

|  | GDP | Exp | Ibank Exp | Cbank Exp |
|---|---|---|---|---|
| GDP | 1 | – | – | – |
| Exp | -0.37 | 1 | – | – |
| Ibank Exp | -0.64 | 0.86 | 1 | – |
| Cbank Exp | 0.05 | 0.82 | 0.41 | 1 |

NOTE: All data items are of quarterly frequency and the cyclical component of the hp-filter with $\lambda$=1600. The sample period is from 2002:Q1 to 2019:Q4.

**Cross-Section Correlation.** In this section, I consider the pairwise correlation of investment bank net income and commercial bank net income, in the cross section; that is, for each time period, I compute the correlation of net income. For each period, given there are $N$ banks, I

compute

$$\begin{aligned}
\rho_t = \ & Corr(NI_t^I, NI_t^C) \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad (4)\\
= \ & \frac{\sum_{i=1}^{N}\left[(NI_{i,t}^I - \bar{NI}_t^I)(NI_{i,t}^C - \bar{NI}_t^C)\right]}{\left[\sum_{i=1}^{N}(NI_{i,t}^I - \bar{NI}_t^I)^2\right]^{1/2}\left[\sum_{i=1}^{N}(NI_{i,t}^C - \bar{NI}_t^C)^2\right]^{1/2}}
\end{aligned}$$

This metric allows me to capture differences across banks' business lines, controlling for common shocks, as well as the time-varying property of the correlation. Figure 6 plots equation $\rho_t$ for net income as well as its revenue counterpart. For net income, and similar to the aggregate correlation matrix, commercial and investment bank net income are positively correlated ($\approx 0.8$) at the beginning and end of the sample period. From 2006 to 2010 though, the correlation declined (with significant fluctuation) until reaching negative levels in 2009Q4, before climbing back to beginning-of-period levels from 2010 to 2020. This feature validates earlier results that investment bank net income is counter-cyclical while it shares a positive pairwise correlation with commercial bank net income, in the long run. The revenue correlation measure displays similar properties, albeit with less volatility and movement than the net income correlation measure.
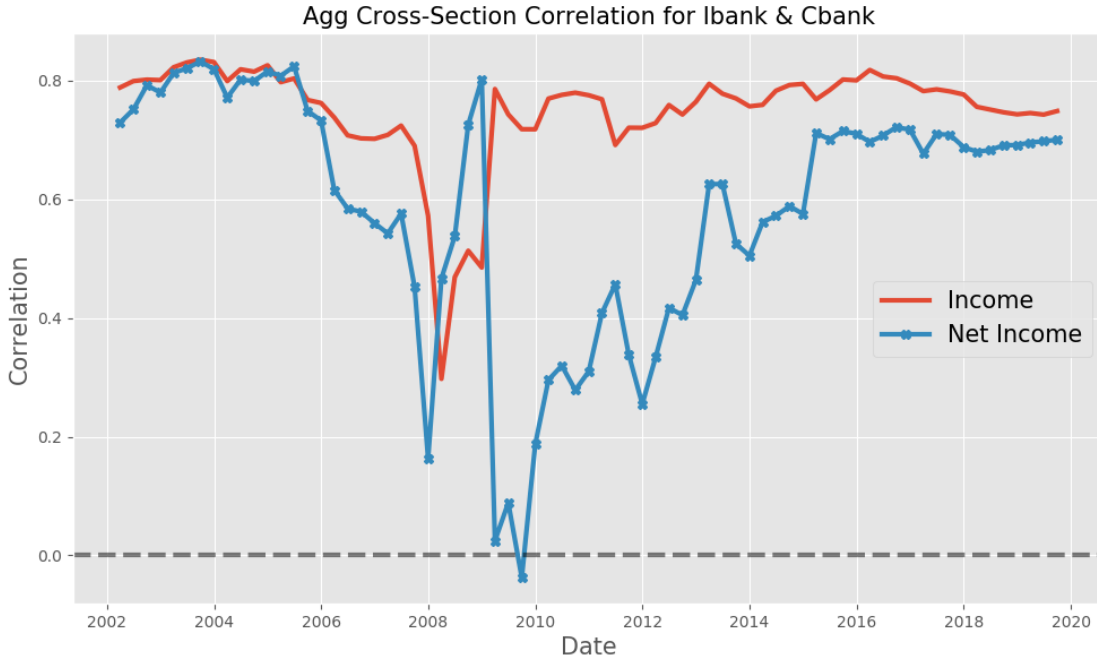


Figure 6: Cross-Sectional Correlations

**Intra-Bank Correlation.** I consider a second bank-level correlation measure which computes the correlation of ibank and cbank net income within a particular bank, over time. This allows for a better investigation into bank heterogeneity and differences in operations. In particular, I compute

$$
\begin{aligned}
\rho_i =\ & Corr(NI_i^I, NI_i^C) \\
=\ & \frac{\sum_{t=1}^{T_i} \left[(NI_{i,t}^I - \bar{NI}_i^I)(NI_{i,t}^C - \bar{NI}_i^C)\right]}{\left[\sum_{t=1}^{T_i}(NI_{i,t}^I - \bar{NI}_i^I)^2\right]^{1/2} \left[\sum_{t=1}^{T_i}(NI_{i,t}^C - \bar{NI}_i^C)^2\right]^{1/2}}
\end{aligned}
\tag{5}
$$

where $T_i$ is the the total number of time periods observed for bank $i$.[16] Figure 7 plots the distribution of $\rho_i$ for both net income and revenues and using equation (5) in levels (left panel) as well as growth rates of net income (right panel).[17]
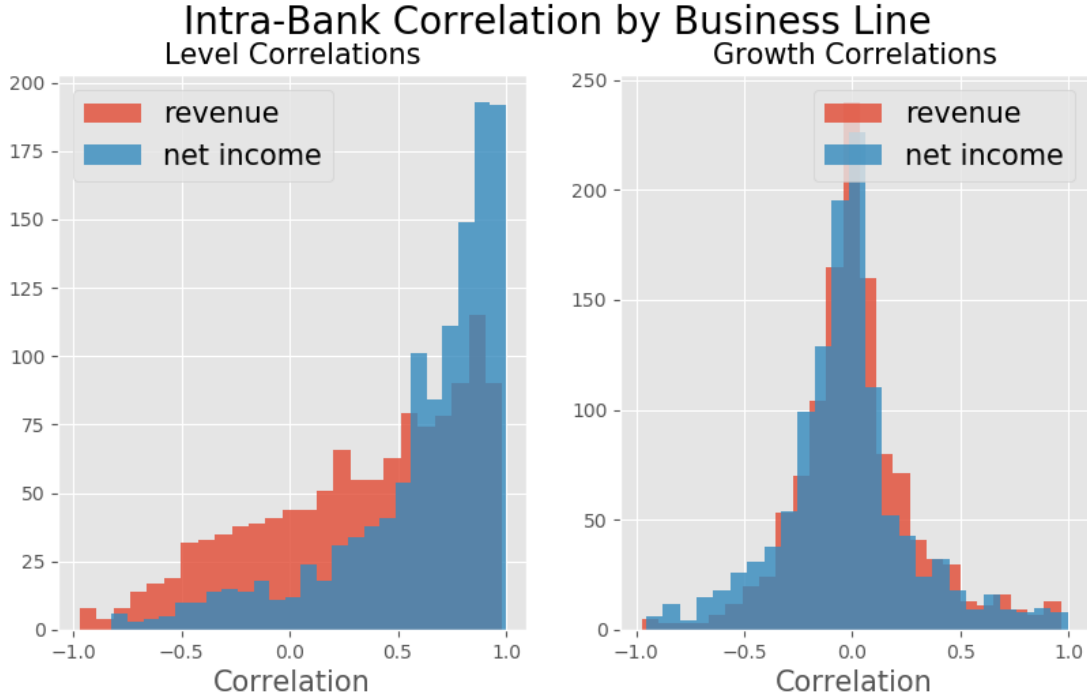


Figure 7: Intra-Bank Correlations

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[16]I restrict the sample to include only banks which have at least 24 periods of observations, meaning at least 6 years.

[17]The distribution of revenue correlations is characterized by a mean of 0.33, median of 0.42 and standard deviation of 0.48. The distribution of net income correlations is characterized by a mean of 0.61, median of 0.73 and standard deviation of 0.38. The distribution of revenue growth correlation is characterized by a mean of 0.02, median of -0.0, standard deviation of 0.28. The distribution of net income growth correlations is characterized by a mean of -0.03, median of -0.03 and standard deviation of 0.31.

An immediate observation from both panels is that there exists significant variation in bank-specific business line correlations. This suggests fixed effects or differences, at the bank-level, with respect to operations and the overall business model. For the level correlations (left panel) there is significant variation but a large mass of banks with highly positive correlations which is further emphasized by the net income measure, relative to the revenue measure. As for growth correlations (right panel), there is also significant variation but the distribution exhibits a symmetric property with a large mass of correlations centered around zero. Figure 9 in the appendix also plots the same distributions for growth correlations, partitioned by bank size, but there is not significant change when conditioning in this way.

# 6    Conclusion

In summary, I investigate how bank profitability covaries across bank business lines. The purpose of this exercise is to provide additional empirical insight to inform upon future policy decisions, as well as banking modeling frameworks. While this topic is one that has previously received much attention, I diverge from the empirical literature in three ways. First, I focus upon bank net income as my key metric for profitability. Second, instead of splitting bank activity by interest and non-interest activity, I create new definitions for commercial and investment bank activity so as to more realistically capture the way bank activity is bundled together, in practice. Third, I use FR Y-9C holding company data to account for the ways in which bank subsidiaries coordinate activities.

I find that, in the aggregate, commercial and investment bank net income are positively correlated, while investment bank net income is weakly counter-cyclical, suggesting possible diversification benefits for the two business lines. When looking at bank-level measures of correlation, I find the same features show up when looking in the cross-section. Further, when I consider intra-bank measures of correlation, I find a significant degree of heterogeneity, suggesting differences in business models of operation at the bank-level. In terms of future research, I believe these results warrant a more granular approach to business lines, further splitting apart commercial and investment bank activities (as defined in this paper). This exercise can shed more light on bank-level differences as well as business cycle features of the various business lines.

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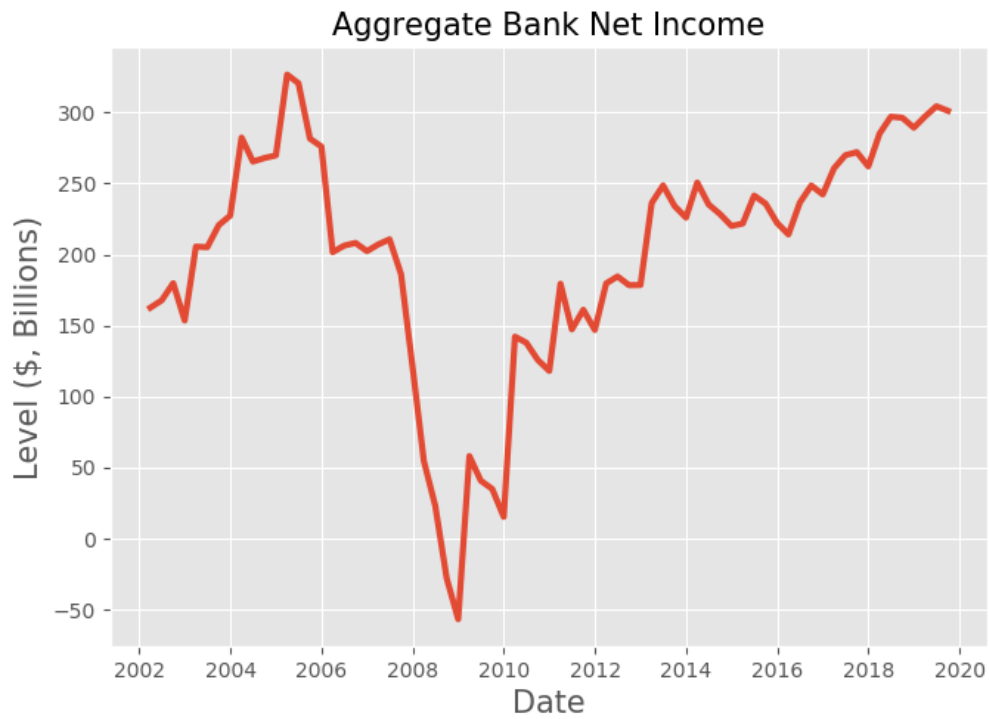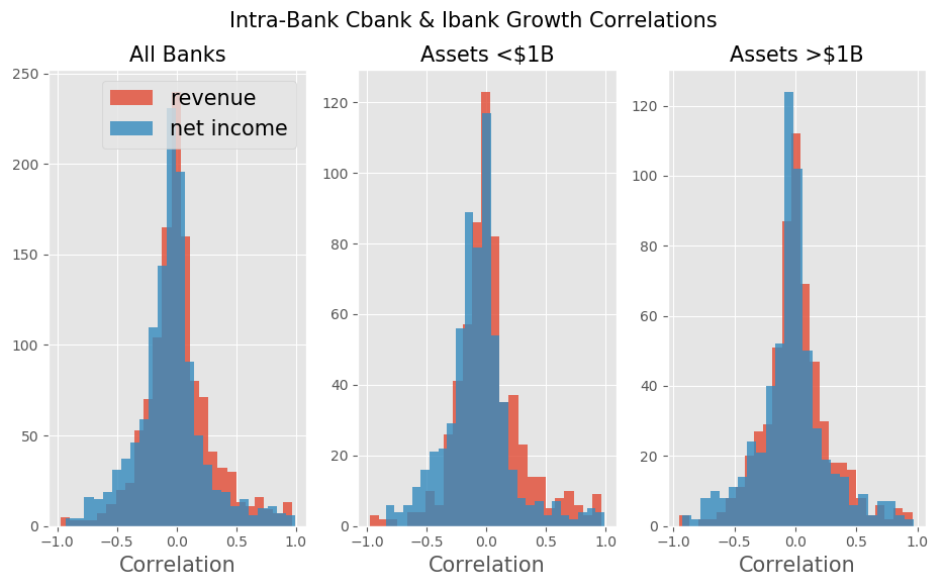
# Appendix

## Other Figures and Tables



Figure 8: Aggregate Bank Net Income



Figure 9: Intra-Bank Correlations by Size