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Editorial

Executive summaries

Scale, scope and complexity: assessing banking business models

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For those of us who have been studying the evolution of banking over the years, and specifically witnessed the creation of today's global banking giants, it has been a puzzle as to why these institutions end up having the business models that they do, and whether the benefits of such diverse enterprises flow solely to the management, as some have suggested, or whether shareholders also benefit from such complexities. In this paper, we try to answer these questions by trying to determine whether the complexity of a bank's business model is related to its returns. Our approach allows for the possibility that bank returns may be retained in part by mobile and powerful bankers and that the amount of rent extraction may vary across different lines of business. Using data on U.S. bank holding companies over the years 2003-12, we find strong evidence that the scope of a bank's business is an important determinant of bank returns and that, all else equal, diversification favors bank shareholders relative to bankers. Our statistical results support the hypothesis that banks that achieve effective diversification across lines of business also achieve higher returns. In search of this diversification a bank may enter a more sophisticated line of business, and the bankers needed to do this successfully may command premium compensation. But the organizational complexity needed to achieve a competitive advantage in several wholesale banking businesses simultaneously favors shareholders because it serves to moderate bankers' rent extraction. These forces help us understand the evolution of the business models of some of the largest banks in the last 10 years.

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Scale, scope and complexity: assessing banking business models[1]

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Abstract

In this paper we study how the complexity of a bank's business model is related to its returns. Our approach allows for the possibility that bank returns may be retained in part by mobile and powerful bankers and that the amount of rent extraction may vary across different lines of business. Using data on U.S. bank holding companies over the years 2003–12, we find strong evidence that the scope of a bank's business is an important determinant of bank returns and that, all else equal, wide scope favors bank shareholders relative to bankers. Establishing a presence across a wide range of wholesale banking activities requires a complex organization that would be difficult to replicate elsewhere and in this way serves to moderate bankers' compensation demands. We use our statistical results to shed light on the evolution of the business models of some of the largest U.S. banks over the last 10 years.

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1. Introduction

The banking crisis emanating from the U.S. in 2007–08 and continuing in the sovereign debt crisis in Europe has given rise to an enormous public reaction against past actions of banks and bankers. Following large taxpayer support for the banking sector, banks have come under enormous pressure to break with the past. The drivers of change are coming from many directions. Heightened capital requirements have encouraged deleveraging and asset disposals. Basel III and other detailed changes in prudential regulation have created strong incentives to rebalance the bank's mix of businesses with the retreat from securitization being one of the most visible examples. Compensation practices have been subjected to challenges from directors, shareholders and policymakers. Banks have been actively shifting away from cash bonuses to increased reliance on both long-deferred compensation and straight salary. In apparent reaction, there have been numerous, high-profile departures of senior bankers into hedge funds or other ventures. Efforts to force changes in banking structure are being backed by major legislation following the Volker Rule in the U.S., the U.K.'s Vickers Commission, and the E.U.'s Liikanen report. Aggressive criminal and civil litigation has challenged many business practices. And more recently, especially in the U.S., proposals for breaking up banks through anti-competitive statutes are gaining momentum. As it struggles to keep up, senior bank management is being forced to deeply reconsider its desired banking model.

All these actions are reflections of an enormous public debate, now underway, about the appropriate role of banking in society. In effect, many are asking: why do we need big banks? So far, there have been very few clear and convincing reasons put forward. This void has revealed what has for some time been a concern of regulators, which we can describe as the "big bank puzzle."[2] During the last 25 years, there has been a clear trend toward banking consolidation that has created much larger and more complex banks. Nevertheless, most of the previous research done on banking efficiency has failed to

[2] This puzzle was summarized by Alan Greenspan (2010) as "For years the Federal Reserve was concerned about the ever-growing size of our largest financial institutions. Federal Reserve research had been unable to find economies of scale in banking beyond a modest size."

uncover any evidence of economies of scale or scope in banking that might account for this increased concentration in banking.[3] In the absence of convincing evidence of the greater efficiency of the largest banks, many have found an alternative explanation of the banks' quest for large size that seems to ring true — too big to fail (TBTF).

For some, this explanation seems to fall short of really accounting for the transformation of banking in the last 25 years. Without diminishing the importance of finding appropriate regulatory treatment of large complex banking organizations, it seems hard to accept that the massive consolidation of local banks into dominant regionals and then later into super-regionals was driven solely by a possible funding advantage of being TBTF.[4] According to FDIC statistics, between 2001 and 2012 there were 14 banking failures of banks with total assets of above U.S.$5 billion, which placed them in the top 10% of all banks by size. So, there is still an open question of what were the advantages being sought that created these large banks that never came close to being so large or so complex that the prospect of their failure following an idiosyncratic loss would have posed a systemic risk that justified a public rescue operation.

This question has prompted a small number of researchers to try to have a fresh look at the data to see whether recent data tell a different story than in the past or whether older methodologies were to blame for failing to reveal efficiency benefits of size that were always present. In his review of past literature, De Young (2010) concludes that the traditional static efficiency approach is incapable of capturing the advantages of large organizations that seems to be implied by the observed equilibrium distribution of

[3] The top 10 bank holding companies in the U.S. held 35% of total banking assets in 1990. In 2009 this concentration ratio had risen to 75%. Much of the M&A activity that has taken place in this period has been justified by top management as a search for competitiveness through productivity gains. This seems to be contradicted by early bank efficiency studies, which [as summarized by Berger et al. (1993)] found banks reach minimum efficient scale (i.e., the low point on their cost curves) at U.S.$300 million (i.e., at the 6'th percentile of the distribution of U.S. banks in 1993).

[4] The funding advantage of TBTF is controversial. Acharya et al. (2013) find that banks they characterize as TBTF benefit from a funding advantage about 28 bps per year. However, Araten and Taylor (2012) find that the very largest banks tend to have higher funding costs because of the relatively higher reliance on relatively more expensive forms of external finance. Krozner (2013) discusses these and other findings and emphasizes that the problem of differentiating a TBTF advantage from liquidity, risk or other explanations poses important problems of identification that are still unsolved.

bank sizes. In particular, small and large banks tend to offer very different ranges of services with the latter dominating wholesale banking services. Wheelock and Wilson (2012) use the static cost function framework employed by earlier banking efficiency studies. However, working with more recent data and introducing an important change in the functional form for the empirical specification, they find evidence of stronger economies of scale than in previous studies. Hughes and Mester (2013) allow for managerial risk preferences and use more recent data. Under the assumption that leverage is adjusted optimally in the face of banks' cost of capital, they find significant scale economies.

In our own earlier work on U.S. bank holding companies covering 1990 to 2009, we make a fundamental departure from the static efficiency framework by allowing for the possibility that efficiency gains associated with large scale might be captured in part by mobile bankers. In this rent extraction framework, we find very strong and robust evidence of economies of scale reflected in banking returns [Anderson and Jõeveer (2013)]. We further found that the advantages of size largely operate through three drivers of efficiency — funding efficiency, presence in wholesale banking and leverage. That is, size itself does not produce efficiency gains. Rather, the modes of managing their businesses and kinds of businesses that they can pursue seem to be the advantages available to large banks.

Many wholesale banking activities (custody, market-making in global markets, investment banking) are dominated by a small number of players. The fact that the same banks are often dominant across a wide range of very different activities suggest they may reap synergy gains. That is, there may be significant economies of scope in banking. However, the search for synergies in combining different business lines leads to more complex organizations and significant challenges for management. So the presence or not of scope economies is far from obvious, and the diversity of business models in banking suggests that there is no clear consensus among bankers as to whether the pursuit synergy gains through complexity is worthwhile.[5] Certainly, a number of innovations in the financial

[5] Indeed the conversion of Sandy Weil, the father of Citigroup, to the view that smaller, simpler banking may be better shows that a single banker may be of two minds on the question.

industry have widened the services provided by the banks; yet, the traditional banking business, which relies on collecting deposits and allocating loans to SMEs, is still a major source of income for most of the banks in the U.S..

There is surprisingly little previous research on economies of scope in banking, and the evidence of significant scope economies is limited.[6] Allen and Rai (1996) study banking efficiency in 15 countries during the period 1988–92. They split the sample into "separated" and "universal" banking countries. Separated banks are found to be relatively more X-inefficient and have higher risk exposure. Cavallo and Rossi (2001) study European banks during the period 1992–97. They find scope economies exist, but only for the largest banks. Vander Vennet (2002) finds that financial conglomerates and universal banks are more cost efficient than specialized banks when both traditional and nontraditional banking activities (non-interest income related) are taken into account. Baele et al (2007) use Tobin's Q adjusted for a frontier estimate of X-inefficiency as a proxy for franchise value and find this is an increasing function of noninterest income share in sample of large European banks between 1989 and 2004. They interpret this as supporting the hypothesis that diversification of income sources is value creating.

In this paper, we explore the hypothesis that there are economies of scope in wholesale banking. We estimate the determinants of returns to bank shareholders, of rents accruing to bankers and of the two combined. In addition, we develop a measure of banking scope based on detailed line of business data available from the U.S. regulatory filings. When combined with controls for scale, funding efficiency, presence in wholesale banking markets and leverage, we find that there is strong and robust evidence of economies of scope and that these efficiency gains accrue particularly to bank shareholders. One possible explanation for these results is that the interdependence between business lines in large global banks serves to counterbalance the bargaining power of bankers in any single business line. We use these results to shed light on the evolution of the business models of some of the largest U.S. banks between 2003 and 2012.

[6] For a description of the estimation of scope economies used in traditional static efficiency studies and a review of past literature, see Hughes and Mester (2010).

2. Understanding complexity in banking

We start from the observation that the emergence of very large banks has also been a move toward more complex banks.[7] In big banks, as in other large, complex organizations, an important challenge is how to mobilize a large workforce with specialized skills in a coordinated fashion. Human capital development and information technology are central to this task. Wholesale banking, in particular, is an example of a knowledge-based industry. This has been described as "the new enterprise" by Rajan and Zingales (2000). They argue that, "But perhaps the most significant change has been to human capital. Recent changes in the nature of organizations, the extent and requirements of markets, and the availability of financing have made specialized human capital much more important, and also much more mobile. But human capital is inalienable, and power over it has to be obtained through mechanisms other than ownership."

The observation that human capital is a crucial input into the provision of banking services is at the heart of our approach. What is described as the inalienability of human capital means that if a worker develops particular skills or knowledge in one firm, these attributes tend to adhere to them. If they choose to move to another firm or setup on their own, there are limits to the ability of their old firm to retain the key skills and knowledge they embodied.

There are abundant examples of this in banking. When a corporate finance specialist moves to another firm, clients from previous M&A deals may decide to look to the banker rather than their previous bank when they consider their next deal. Following several good years a team of traders in a specialized niche security may be lured away by a rival bank with offers of guaranteed bonuses and other attractions. One reason that this feature of human capital is important in understanding how banks achieve efficiency and grow is that the bank with a competitive edge may be able to gain a powerful position in some of its lines of business, and in this way produce some extra-normal returns or rents. But mobile,

[7] This is not to suggest that banks that have pursued a strong growth strategy have actively sought complexity. Complexity of the bank's business model may be the result of trying to achieve synergy gains across a range of banking products, which may not be complex in themselves.

and therefore powerful, employees may be able to extract some of these benefits in the form of superior bonuses, perquisites or other forms of compensation.

This "rent extraction" hypothesis has long been part of the labor economics literature [see, for example, Van Reenan (1996)], but it is absent from the static efficiency methodology that has been adopted by virtually all past studies of banking efficiency. In our view this is key to resolving the "big bank puzzle." ***Figure 1*** illustrates this reasoning. We suppose a bank's business will generate returns for both investors and for bankers. Following the principal/agent paradigm [see, for example, DeMarzo and Fishman (2007)], an efficient bank is one that maximizes the return to investors for a given amount of return for bankers. The figure depicts hypothetical efficiency frontiers for two classes of banks characterized as "large" and "small." To compare the efficiency of these classes of banks we need to look at the distance between one frontier and the other. For example, we could measure the distance from the origin along a ray for each class and then take the ratio of the outer frontier to the inner frontier. In ***Figure 1*** large banks are 25% more efficient than small banks by that measure.

From ***Figure 1*** it is also clear that omitting returns to bankers from an analysis of returns to scale can lead to erroneous conclusions. For example, suppose that most observations for "small banks" are clustered close to the point "S," and at the same time observations for "big banks" are clustered near the large bank frontier at the point "B." Then, a regression of shareholders' returns on size would find a negative relationship; whereas, the analysis combining shareholders' and bankers' returns reveals increasing returns to scale.

This framework can be implemented using a model of the form,
total return = f(return to investors, return to bankers)

Return to investors is measured by return on book equity (ROE), because equity holders have ownership rights and have ultimate say in setting compensation policy.[8]

[8] We have also explored alternative specifications, including return on assets (ROA) and risk adjusted returns on equity using stock price volatility. The results were robust to these modifications.

We define bankers' return as the rate of excess compensation over a "competitive" rate of compensation. First we calculate bankers' excess compensation as the maximum of zero or total employee compensation minus the competitive wage bill. The competitive wage bill is total employee head-count times a competitive wage rate calculated as the average total compensation per employee based on banks with less than U.S.$1 billion in total assets and at least 50 employees. The resulting excess compensation measure is then scaled by dividing by total book equity in order to make this comparable to investors' return. We label this as the bankers' return (mxlrrentseq). Note that this measure covers compensation of all employees. There is an advantage to this measure, as compared with using only top manager compensation (e.g., as reported in Execucomp), because often top compensation is paid to senior investment bankers or top traders who do not figure among the top executives of the bank.[9]

Returns to investors and returns to bankers are combined to give a total return trentseq using the equation.

$$\text{trentseq} = [(1 + r_i)^2 + (1 + r_b)^2]^{0.5}$$

This functional form gives rise to downward sloping, concave frontiers as in ***Figure 1***.

We estimate return relations of the form,

$$\text{return}_{k,t} = \alpha_t + \beta X_{k,t} + \varepsilon_{k,t} \qquad (1)$$

where return is a measure of bank returns (either investors', bankers' or total return), X is a vector of explanatory variables, k is the index of the bank, t is the fiscal year, and ε is an i.i.d. error term. Explanatory variables included are as follows: as a measure of scale we use total assets (at) and also allow for a nonlinearity effective at very large size with a

[9] We have done a variety of robustness checks including alternative specifications of the competitive wage rate and using compensation per employee rather than excess compensation and found qualitative very similar results.

dummy for 10th decile of total assets (at10). We include net interest margin (nim), which proxies for relative funding efficiency. We also interact nim and at10. Presence in wholesale banking activities is captured by noninterest income share to total income (niish) and niish interacted with at10. Capital ratio (ilev) is included to control for risk-taking. And macro and business cycle factors are controlled for by year dummies.

As we have already noted, our central concern is whether the creation of more complex banking structures has produced any net efficiency gains, that is, are there positive economies of scope in banking. Banks increase their scope for a variety of reasons. Combining securities market activities of a broker/dealer with a commercial bank with a rich deposit base may bestow a funding advantage by reducing the need for volatile wholesale funding markets. Large corporate clients may find it efficient to consolidate their diverse banking needs in a single large bank. Reciprocally, banks working with clients on a variety of products may have an information advantage that improves their monitoring efficiency or gives them a richer set of tools to mitigate counterparty risk. Of course, expanding a bank's operations into new products or new geographies may come with significant cost that can outweigh the benefits.[10]

In addition to these possible considerations in a bank's decision to expand its scope, our rent extraction perspective suggests an additional benefit for a bank to embrace a wide scope, namely, that banks with wide scope may find that they can better resist compensation demands of bankers in certain business lines. Indeed in our earlier work we did find that, to a significant degree, the higher returns associated with the biggest banks accrue disproportionately to bankers rather than to bank shareholders. Furthermore, we find that the degree to which bankers are able to retain the benefits of size for themselves is

[10] This has been the theme of the branch of the corporate finance literature that has estimated the "conglomerate discount," i.e., the possibility that the value of an integrated firm may be less than sum of the values of its parts. This methodology has recently been applied to the financial sector by Schmid and Walter (2014). Using a sample of financial firms including banks, insurance companies and other financial firms and employing several alternative definitions of diversification, they find a significant diversification discount in most years. However, the size of the discount was smaller than in previous studies and also became insignificant in the recent financial crisis.

dependent upon the mix of businesses that the bank pursues, that is, on the bank's business model. Some banks may seek advantage through funding efficiency achieved through a rich, cost-effective branch network. Others may seek critical mass in trading and sales through wholesale funding and leverage. These choices have important implications for the bargaining power of bankers. In particular, we found that pursuit of dominance in wholesale markets, even if it means reliance on relatively expensive wholesale finance, tends to be very beneficial to bankers, if not to bank shareholders.

In banking, top managers and active shareholders are well aware of the kind of power that experienced bankers can acquire. As pointed out by Rajan and Zingales, investors need to find the means of asserting themselves in the face of powerful employees who otherwise may have the upper hand in bargaining. A bargaining chip that may tip the balance in the bank investors' favor may take the form of a specific resource in the bank that the employees may not be able to find upon moving to a rival. Examples might be access to a system or payments technology or perhaps a funding source, that cannot be easily found in other competitive banks. Complex systems that have been used to link different lines of business in a large wholesale bank are prime examples of these difficult-to-replicate resources.

The conclusion from this discussion is that by broadening the scope of its operations a bank can generate efficiency gains, but, in addition, it can increase the share of gains that accrue to shareholders. In order to test this hypothesis, we look to information about banks' lines of business in order to construct a measure of scope and use this measure as an additional determinant in our model (1). Our scope measure is based upon data from U.S. bank holding companies (BHC) collected through their Fed regulatory filings FRY9–C. These data have two advantages for our purposes. First, economies of scope may be generated through the combination of diverse businesses that may be housed in different legal entities. However, they should be reflected in return data for the consolidated group. In the U.S., consolidation is done at the BHC level. Second, the Fed regulatory filings is the richest source of information on diverse business lines that is collected on a standardized basis.

The specific measure of banking scope that we employ is based on income statement information. Here, we are able to identify five lines of business: commercial banking, global markets, investment banking, private banking and fund management. From the FRY9–c data we map income into these lines of business as follows. Commercial banking includes the interest income from loans and leases as well as other non-interest income. Global markets includes the income from the trading activities and interest and dividends from securities. Investment banking includes income from investment banking activities, fees from brokerage, income from insurance and reinsurance, venture capital income and net securitization income. Private banking includes income from fiduciary activities and fund management includes net servicing fees. From these we define a concentration index, cindx, calculated as the income shares squared and summed across lines of business. That is for bank k in year t,

$$\text{cindx}_{k,t} = \Sigma_i \left(\frac{\text{inc}_{k,t,i}}{\Sigma_j \text{inc}_{k,t,j}} \right)^2 \qquad (2)$$

where $\text{inc}_{k,t,j}$ is bank k's income from business line i in year t. This index has value between 0.2 and 1. The higher index value means that the bank income streams are more concentrated. For example, if all income comes from commercial banking activities the index will have value 1 and if the income is equally split between commercial banking and investment banking activities the index will have value 0.5. The bank with lower index value follows a more diversified business model. The cindx is our preferred measure of scope because in our view the five lines of business fit reasonably well with the way most large-scale bank categorize their businesses.

3. Statistical results

Our dataset covers U.S. bank holding companies regulated by the Federal Reserve over the years 2003 to 2012. The data start in 2003 because in that year there were important modifications in the FRY9–C report on lines of business that allow us to construct our scope index. This is a large dataset covering most of the largest deposit taking institutions in the U.S. It excludes small banks that fall below the reporting limit, thrift institutions that until 2011 were regulated by the Office of Thrift Supervision, foreign banks, and investment banks that were not organized as bank holding companies until 2008

(e.g., Goldman Sachs and Morgan Stanley). There are a number of missing observations among small banks. We include in the sample only banks within the top five size deciles. After cleaning the data for missing observations and outliers, there are 6763 observations in the sample, or an average of 676 banks per year.

In ***Table 1***, we report summary statistics. Mean return to investors is 5.5% and to bankers 2.2%. As shown in Anderson and Jõeveer (2013), both variables are much higher for larger banks. Mean value of the scope indices cindx is 0.719. This suggests that most banks are not very diversified in their business activity. Inspection of the data confirms that most banks included are heavily concentrated in commercial banking. The size distribution of banks is heavily skewed, as reflected in the mean of total assets of U.S.$16.9 billion compared to a median of U.S.$1.1 billion.

Table 2 reports the simple correlation coefficients among the variables in the sample. The correlations among the explanatory variables are not very high, suggesting that they capture different aspects of bank characteristics.

The results of the estimation of our model (1) are reported in ***Tables 3*** and ***4***.
The regressions of niseq and trentseq are estimated by OLS. The mxlrrentseq model is estimated by Tobit regression. T-ratios reported are based on clustered standard errors.
Table 3 combines measures of the scale (at and at10) with cindx, our measure of scope. In columns 1–3 of that table we see evidence of positive economies of scale in the absence of other controls. Bank size enters positively and is significant in returns to investors, returns to bankers and total returns, and the top size decile is positive and significant in the bankers return and total return regressions.

When the diversification across business lines is included (cindx) the pattern changes markedly. In the investor return regression (***column 4***) the cindx is negative and highly significant; whereas, the scale measures are now insignificant. The cindx enters negatively and is signific ant in the return to bankers (***column 5***) and total returns (***column 6***) regression as well; however, the scale indicators remain positive and significant there. The magnitude of the coefficient on cindx is larger in the investor return regression than in the bankers' return regression. So overall, the results are in line with the hypothesis that increased scope will be particularly beneficial to shareholders.

These results are reinforced when additional controls are included in the analysis as in *Table 4*. In *column 4* of that table the coefficient of cindx is negative and highly significant; whereas, in *column 5* it is negative but insignificant. The economic magnitude of the predicted effect of a change in scope is roughly 10 times greater for shareholders than for bankers. For example, an increase of scope of 10 percentage points (say from cindx=0.60 to cindx=0.50) is predicted to increase investor returns by 1.14%; whereas, banker returns are predicted to rise 0.17%.

The results related to other explanatory variables nim, niish and ilev are rather insensitive to the inclusion of the scope index cindx, suggesting that they are capturing different determinants of bank business models. We find that funding efficiency (nim) is positively related to investors' return but negatively related to bankers' return, while the interaction of this term with at10 has a statistically significant positive effect on all bank return measures. Non-interest income share to total income (niish) turns out to have a positive statistically significant coefficient while its interaction with 10th decile dummy has low predictive power. The capital ratio enters with positive sign in investors' return and with negative sign into bankers' return estimations (though the latter is not statistically significant). Hence, the high capitalization of the bank is beneficial to the investors while there is no effect on bankers. The inclusion of those additional estimates causes size and at10 to lose statistical significance but cindx remains highly significant for investors and total return estimations. Consequently, even though the additional explanatory variables are able to explain the scale effect, they are unable to capture the scope effect. Hence, the diversification of the bank income streams is an important factor for banks' returns.

To summarize our main results, we have found that the scope of business activities is an important determinant of the returns to bank shareholders. Measuring scope as the degree of diversity of income derived from five lines of banking business (commercial banking, global markets, investment banking, private banking and fund management), we find evidence of positive economies of scope in the determination of returns to shareholders. The sensitivity of shareholder returns to increased scope is approximately 10 times the

sensitivity of bankers' returns. This result supports the hypothesis presented in ***Section 2*** that scope favors shareholders because it enables them to retain a larger share of returns relative to the rents conceded to powerful employees. The scope effect is robust to including other determinants of banking returns, namely, funding efficiency, share of non-interest income and leverage. Scope plus these variables largely account for apparent economies of scale in shareholder returns.

4. Bank business models

The statistical results in ***Section 3*** suggest that diversifying activities away from traditional commercial banking into other banking business lines has had a large impact on returns in banking. It can increase the total return in banking, but, sometimes just as important, it can affect the way increased value is allocated between shareholders and bankers. The characteristics that have been identified as drivers of this are scope, funding efficiency, presence in wholesale markets, leverage and, to a lesser extent, scale. Of course, in reality banks cannot easily change these drivers of value one at a time, independently of one another. Instead, major changes in a bank's strategy may affect some or all of them. For example, penetration into wholesale banking may be accomplished through a major acquisition, which will also affect value by increasing its scope and scale. The same acquisition may alter a bank's funding strategy by increasing its reliance on wholesale funding, which results in a reduction of its net interest margin. Furthermore, such major changes in a bank's strategy can have important consequences for the bank's compensation practices. This can affect the way total value created by a bank's strategy is shared out between bankers and shareholders.

In this section, we use our statistical model to study the way that some of the largest U.S. banks have modified their business models in the last 10 years and how this has impacted both their efficiency and the allocation of returns to shareholders and investors. For this purpose, we use the total bank return regression reported in ***Table 4 column 6***.

It should be recognized that by confining ourselves to only the very large banks we are focusing on banks that are already rather different from most small- and medium-sized banks that remain very much based on a traditional commercial banking model. This is reflected in ***Figure 2***, which plots the estimated efficiency frontier for banks grouped within

each of the top 5 size deciles. In this calculation, for each group we evaluate the total return model at the mean value of all the explanatory values used in the regression model. As can be seen from the figure, the largest banks (those among the top size decile) typically achieve an estimated efficiency well beyond that achieved by the smaller banks.

As noted already, these biggest banks include some that have diversified their business lines most. In ***Figure 3***, we have plotted representative efficiency frontiers for the banks group into quintiles based on their scope (as measured by cindx). Again, these frontiers are derived from the estimated equation from ***Table 4 column 6***, evaluated using the group mean values of the explanatory variables. The figure shows that the banks that have the widest scope in the their business lines (i.e., in the first quintile grouped by cindx) also achieve the highest estimated frontier efficiency.

Over the last 10 years, changes in banks' business models necessarily reflect how banks have been affected by the major crisis commencing in 2007 and by the large changes in regulation and business practices that have followed this. This experience has been different for the largest banks, as compared to their smaller counterparts. This is illustrated in ***Figure 4***, where in the top half we have plotted the median return to shareholders and to bankers by year for all banks in our sample (i.e., the top five size deciles of the U.S. bank holding companies reporting to the Federal Reserve). In the bottom half of this figure we report the median returns to shareholders and bankers only for the top size decile banks. The shareholders' return pattern is similar for the full sample and the large bank sample. During the crisis, shareholder returns fell from high levels by a factor of 80% and have been slowly recovering thereafter. However, the story is different for bankers' returns. The median of the full sample bankers' returns were completely wiped out by the crisis and have only slightly returned to positive in 2011. In contrast, for the largest 10% of banks, the decline of banker returns in the crisis was more moderate, a factor of about 50%, and they recovered steadily from 2009 to 2011.

We now turn to the issue of how over the last 10 years some of the largest U.S. banks have changed their business models, as characterized by our statistical models, and what this has meant for their efficiency. In ***Figure 5*** we report evolution of our measure of scope based on diversity of income across business lines, cindx.

Although they were all very large by 2003, there was considerable diversity of business models across the eight selected banks, as can be seen by the degree of scope. In that year, the bank with the widest scope (lowest cindx) by a considerable margin was JP Morgan Chase, followed by State Street and Citigroup. All three were very prominent in a wide range of wholesale banking services. JP Morgan and Citi had grown through mergers and major acquisitions to become global universal banks. State Street differed from these two by not possessing a very large retail banking activity and by being best known as a global custodian bank. Nevertheless, it had diversified its earnings across distinct business lines. At the opposite end of the scope spectrum were the super-regional banks: Wells Fargo, U.S. Bank and Fifth Third Bank. All 3 had grown over the preceding 15 years through an active process of acquisitions of smaller commercial banks in order to create dense regional networks. In 2003, they were still heavily focused on commercial banking. Bank of America and Wachovia occupied somewhat intermediate positions. They were super-regional banks that had developed clear strengths in areas outside traditional retail and commercial banking.

In the years that followed, these banks went through a number of very significant changes and some of these are clearly visible in the evolution of the scope measure in ***Figure 5***. In particular, there is a rather clear downward trend in the cindx of Wells Fargo, reflecting a diversification away from commercial banking and an increase in the scope of income sources. An important step in this process was the acquisition of Wachovia in 2008, which diversified it geographically but also increased its presence in fund management and private banking. In contrast, the other super-regionals, U.S. Bank and Fifth Third, have stayed firmly committed to the commercial banking model and over time have even become somewhat less diversified in their income sources by lines of business (although they are both very highly diversified geographically).

Turning to the banks with the widest scope in 2003, JP Morgan Chase underwent major changes first through the merger with Bank One in 2004, which dramatically increased its retail network and geographic footprint, and then later through further acquisitions, notably Bear Stearns and Washington Mutual in 2008. These changes have coincided with a perceptible decline in the bank's scope as reflected in an upward trend in cindx. This suggests that the bank has somewhat reinforced the role of commercial banking while still

maintaining a large presence in wholesale market activities. Over the last 10 years, Citi has also seen a decline in scope, as indicated by the evolution of cindx. This has taken place largely since the onset of the crisis and is a reflection of underperformance linked to its difficulties in the mortgage market and more recently certain asset disposals as it has concentrated business lines considered to part of its long-term core. In contrast, State Street has not undergone any comparable transformation and has maintained its presence across a wide range of wholesale banking markets. This is reflected in a very stable cindx, which meant that by this measure it had the broadest scope in 2012. Finally, over this period Bank of America has diversified its business through the acquisition of Merrill Lynch, and this has resulted in a noticeable decline in cindx.

Figure 6 plots the predicted efficiency frontiers in 2003 for the selected banks. This is based on the total return estimates in ***Table 4 column 6*** evaluated at the observed values of the explanatory variable for each bank. The frontiers predicted for the three banks with the widest scope, JP Morgan Chase, Citi and State Street, are virtually identical and are to the northeast of all the other banks. The predicted return frontiers for Bank of America, Wachovia and U.S. Bank are very close to each other. Comparing these two sets of banks, we see that the wide-scope banks are more efficient than the banks heavily concentrated in commercial banking by about 4 percentage points (i.e., total returns of 25% versus 21% of book equity). Wells Fargo occupied a position intermediate between the other super-regionals and the wholesale/global banks. Its predicted efficiency is higher than the other banks heavily concentrated on commercial banking, largely because it achieved a relatively high funding e fficiency (as measured by net interest margin). The relatively low predicted efficiency of Fifth Third is largely accounted for by its relatively low net interest margin.

Also in ***Figure 6***, the diamonds plot the realized returns to shareholders and bankers for the selected banks in 2003. The banks with highest banker returns were JP Morgan Chase and State Street followed by Wachovia, Citi and Bank of America. These were the banks with the widest scope at that time. In contrast, the super-regional commercial banks, Wells Fargo, Fifth Third and U.S. Bank had the lowest returns to bankers. This suggests that the compensation practices differ substantially between complex, highly diversified banks and the banks heavily concentrated in traditional commercial banking. The difference in banker payout rates for JP Morgan Chase and State Street on the one hand and Citi on the other

might be explained by the relatively high shares of income earned in investment banking and private banking by the first two versus Citi where global markets was particularly dominant.

Figures 7, 8 and *9* depict the predicted efficiency frontiers of the selected banks in 2006, 2009 and 2012 respectively. Through these we can trace the effect on predicted bank returns of the various changes these banks made to their business models. Comparing *Figure 6* and *Figure 7* we note that in 2006, JP Morgan Chase was the bank that attained the highest predicted efficiency. This reflected in part the merger with Bank One, which significantly increased its retail network and appears to have contributed to an improvement in its net interest margin. Also, there is a noticeable decrease in JP Morgan Chase realized bankers' return. This also may be attributable to the merger with Bank One, as the latter had much lower bankers' return before the merger.

The predicted total returns for the selected banks in 2009 are seen in *Figure 8*. They reflect the effects of the crisis and are lower overall. JP Morgan Chase is sometimes depicted as one of the winners in the crisis. However, based on our predicted efficiency, its seems to have suffered in relative terms. JP Morgan Chase now lags State Street and Wells Fargo by about 2 percentage points of total return. The crisis was also harsh for Citi, which in this year had the lowest predicted efficiency of all the banks included in this comparison. In each case, the downturn in securities depressed the non-interest income share of earnings, which outweighed the positive effects of some improvement in the net interest margin.

As seen in *Figure 9*, by 2012 the changes in the characteristics of the banks resulted in distinct differences in their predicted total returns. Here, State Street is predicted to exceed the total returns of JP Morgan Chase and Wells Fargo by about 4 percentage points (20% versus 16%). These three were followed by Bank of America (14.5%), U.S. Bank (14%), Fifth Third (13%) and Citi (10%). The low relative efficiency predicted for Citi was due largely to the very low share of non-interest income, as its global markets and investment banking businesses continued to struggle. In contrast, Wells Fargo in 2012 had a non-interest income share of nearly 50%, not far short of that of JP Morgan Chase. Thus, its transformation from a super-regional commercial bank into something resembling a

global bank, at least in terms of its presence in wholesale banking markets if not necessarily in its geographic footprint, seemed to be confirmed. The figure also shows that Bank of America's realized return fell far short of its predicted performance. This suggests it was still struggling with the impact of some of the acquisitions (e.g., Countrywide).

5. Conclusions

In this paper, we have examined the evidence of economies of scope in banking in a large sample of U.S. bank holding companies. Our approach allows for the possibility that a bank may achieve market power in some business lines and that some of the rents created by this advantageous position may be extracted by bankers rather than shareholders. By achieving scope in diversifying across business lines a bank may generate pure efficiency gains, but this can also enhance the ability of shareholders to retain a greater fraction of rents that the bank produces. Our statistical results support thehypothesis that banks that achieve effective diversification across lines of business also achieve higher returns. In search of this diversification a bank may enter a more sophisticated line of business, and the bankers needed to do this successfully may command premium compensation. But the organizational complexity needed to achieve a competitive advantage in several wholesale banking businesses simultaneously favors shareholders because it serves to moderate bankers' rent extraction. These forces help us understand the evolution of the business models of some of the largest banks in the last 10 years.

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Appendix

Scale, scope and complexity: assessing banking business models

Figure 1: Mis-specification error from omitting bankers' return

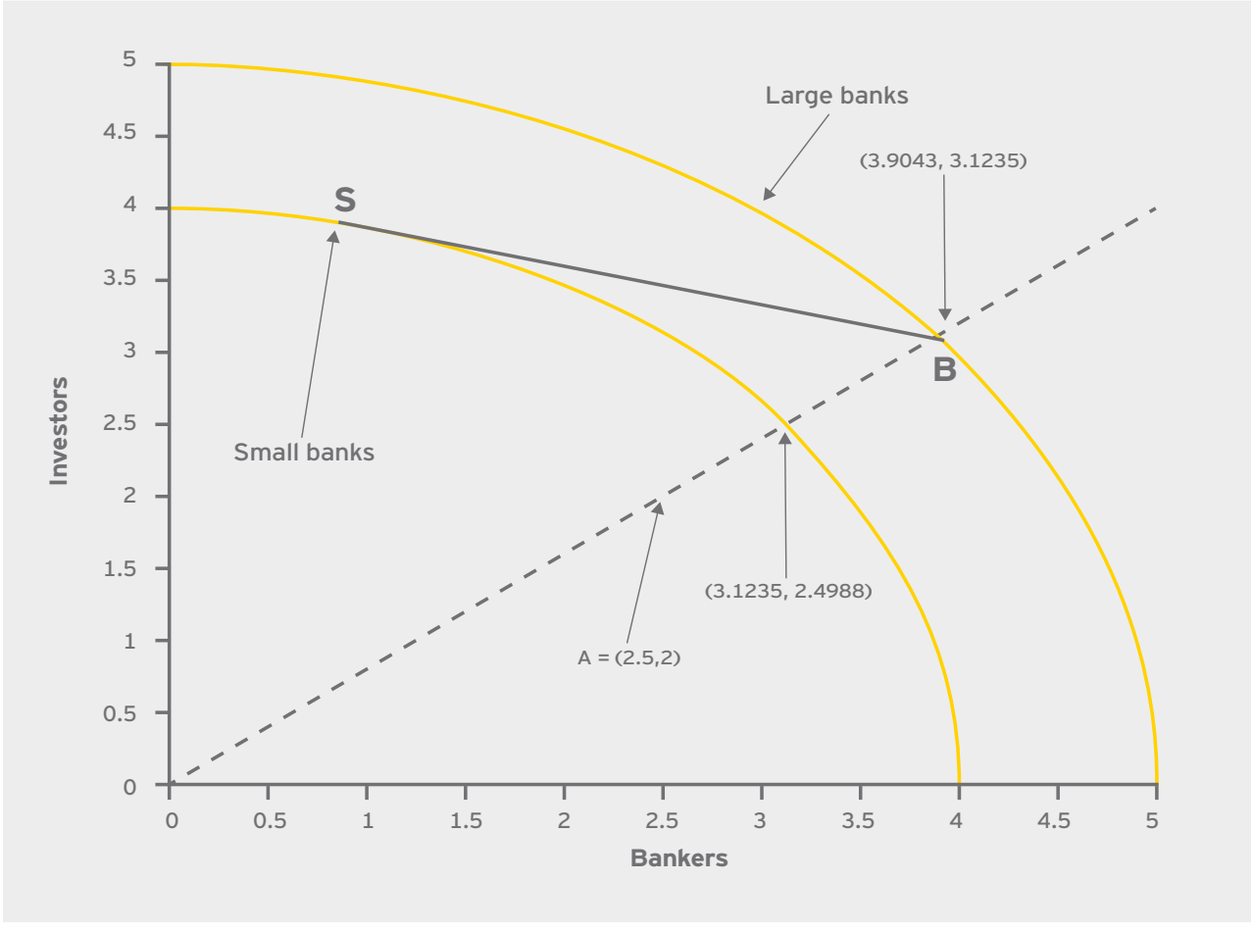

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Table 1: Summary statistics

	Median	Mean	St. dev.
niseq	0.092	0.055	0.219
mxlrrentseq	0.001	0.022	0.044
trentseq	1.490	1.482	0.098
cindx	0.726	0.719	0.135
at	1,152	16,900	132,000
nim	3.295	3.318	1.087
niish	0.218	0.242	0.151
ilev	0.088	0.092	0.042

niseq is return on equity, mxlrrentseq is bankers' rent as a per dollar of equity, trentseq is total rent, cindx is concentration index based on income structure, at is total assets (million dollars), nim is net interest margin (percent), niish is share cent of non-interest income in total revenues and ilev is ratio of book equity to total assets.

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Table 2: Correlations

	niseq	mxlrrentseq	trentseq	cindx	at	nim	niish	ilev
niseq	1.000							
mxlrrentseq	-0.069	1.000	0.044					
trentseq	0.678	0.300	1.000					
cindx	-0.082	-0.166	-0.114	1.000				
at	0.015	0.115	0.046	-0.208	1.000			
nim	0.133	-0.124	0.133	0.248	-0.041	1.000		
niish	0.147	0.374	0.294	-0.284	0.202	-0.118	1.000	
ilev	0.188	0.023	0.137	-0.034	-0.004	0.169	0.253	1.000

niseq is return on equity, mxlrrentseq is bankers' rent as a per dollar of equity, trentseq is total rent, cindx is concentration index based on income structure , at is total assets (million dollars), nim is net interest margin (percent), niish is share cent of non-interest income in total revenues and ilev is ratio of book equity to total assets.

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Table 3: Return regressions: scale and scope

Dependent Variable	niseq	mxlrrentseq	trentseq	niseq	mxlrrentseq	trentseq
at	0.000b (2.40)	0.000[a] (4.25)	0.000[a] (2.87)	0.000 (1.22)	0.000[a] (3.41)	0.000[b] (2.17)
at10	0.001 (0.08)	0.027[a] (4.72)	0.009[c] (1.86)	-0.008 (-0.82)	0.021[a] (3.94)	0.005 (0.95)
cindx				-0.104[a] (-4.00)	-0.057[a] (-3.15)	-0.053[a] (-3.57)
Cons	0.128a (39.74)	0.013[a] (-3.26)	1.524[a] (644.09)	0.201[a] (10.90)	0.031[b] (2.21)	1.562[a] (146.79)
yr dummy	yes	yes	yes	yes	yes	yes
R-sq	0.112		0.168	0.116		0.173
Nobs	6763	6763	6763	6763	6763	6763

The dependent variables are return on equity (niseq), bankers' rent as a percent of equity (mxlrrentseq), and total rent (trentseq). The explanatory variables are total assets (at), a dummy variable if a bank is in the 10th size decile (at10), concentration index based on income structure (cindx), and year dummies. The regressions of niseq and trentseq are estimated by OLS. The mxlrrentseq model is estimated by Tobit regression. T-ratios based on clustered standard errors are reported in parentheses. a, b and c indicates significant at the 1%, 5% and 10% levels respectively.

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Table 4: Return regressions: scale, scope plus additional controls

Dependent variable	niseq	mxlrrentseq	trentseq	niseq	mxlrrentseq	trentseq
at	0.000 (1.37)	0.000[b] (2.57)	0.000 (0.28)	0.000 (0.25)	0.000[b] (1.98)	-0.000 (-0.61)
at10	-0.086c (-1.65)	-0.039[c] (-1.92)	-0.045[b] (-2.56)	-0.096[c] (-1.80)	-0.040[b] (-1.99)	-0.049[a] (-2.72)
nim	0.018a (2.62)	-0.007[b] (-2.24)	0.012[a] (5.50)	0.021[a] (2.80)	-0.006[c] (-1.92)	0.013[a] (5.34)
nimat10	0.022c (1.82)	0.010[c] (1.84)	0.009[b] (2.28)	0.022[c] (1.80)	0.010[c] (1.83)	0.009[b] (2.26)
niish	0.189a (4.63)	0.106[a] (3.14)	0.185[a] (7.62)	0.169[a] (4.05)	0.103[a] (2.92)	0.178[a] (6.93)
niishat10	-0.016 (-0.23)	0.064 (1.64)	0.031 (0.94)	-0.007 (-0.10)	0.065[c] (1.65)	0.034 (1.03)
ilev	0.761a (3.60)	-0.060 (-1.09)	0.103[c] (1.91)	0.756[a] (3.90)	-0.060 (-1.08)	0.101[c] (1.93)
cindx				-0.114[a] (-3.74)	-0.017 (-0.91)	-0.041[a] (-2.67)
cons	-0.048 (-1.57)	-0.005 (-0.50)	1.429[a] (162.87)	0.026 (0.74)	0.007 (0.37)	1.456[a] (109.94)
yr dummy	yes	yes	yes	yes	yes	yes
R-sq	0.167		0.268	0.172		0.270
Nobs	6763	6763	6763	6763	6763	6763

The dependent variables are return on equity (niseq), bankers' rent as a percent of equity (mxlrrentseq), and total rent (trentseq). The explanatory variables are total assets (at), a dummy variable if a bank is in the 10th size decile (at10), net interest margin (nim), nim interacted with at10 (nimat10), percent of non-interest income in total revenues (niish), niish interacted with at10 (niishat10), ratio of book equity to total assets (ilev), concentration index based on income structure (cindx) and year dummies. The regressions of niseq and trentseq are estimated by OLS. The mxlrrentseq model is estimated by Tobit regression. T-ratios are reported in parentheses. a, b and c indicates significant at the 1%, 5% and 10% levels, respectively.

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Figure 2: Efficiency frontiers across size deciles in 2006

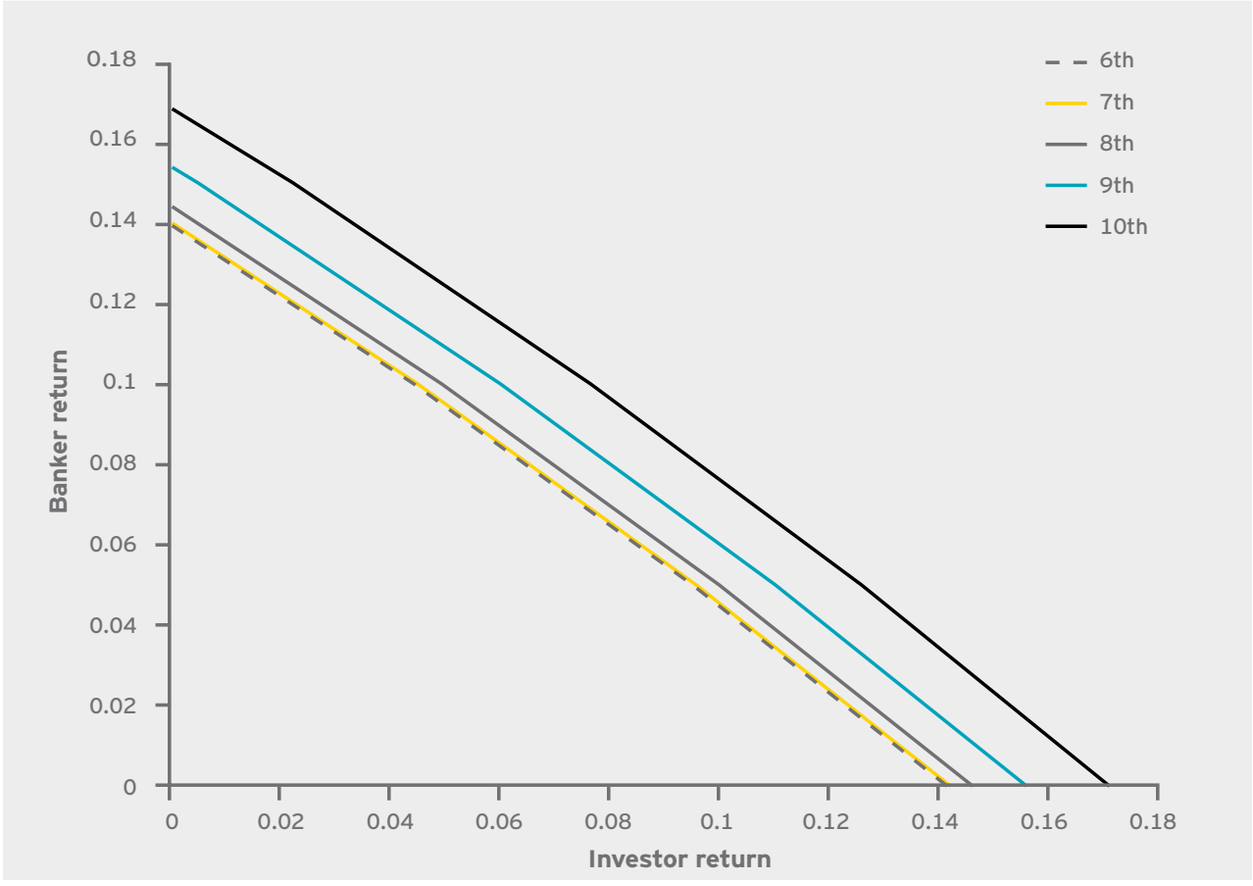

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Figure 3: Efficiency frontiers across scope quintiles in 2006

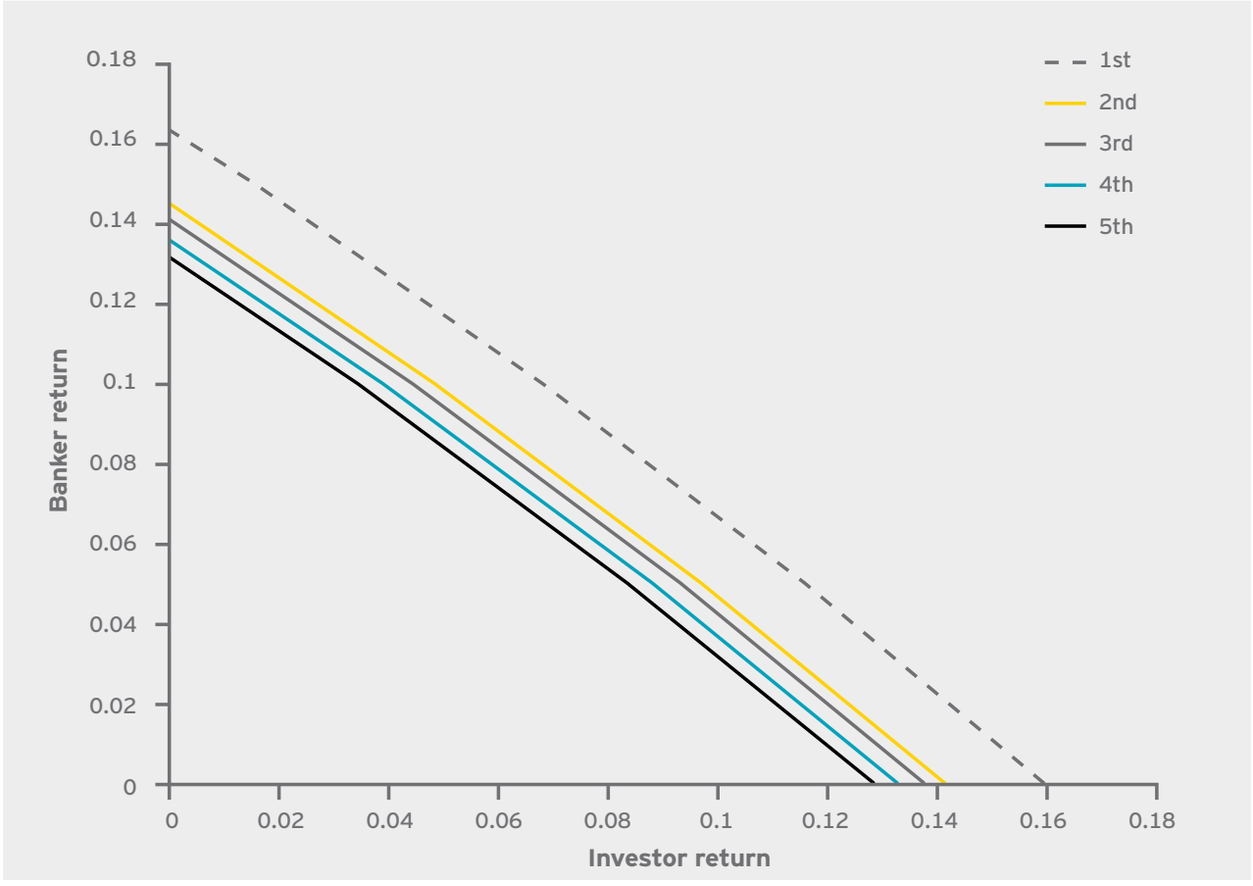

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Figure 4: Banking returns since 2003

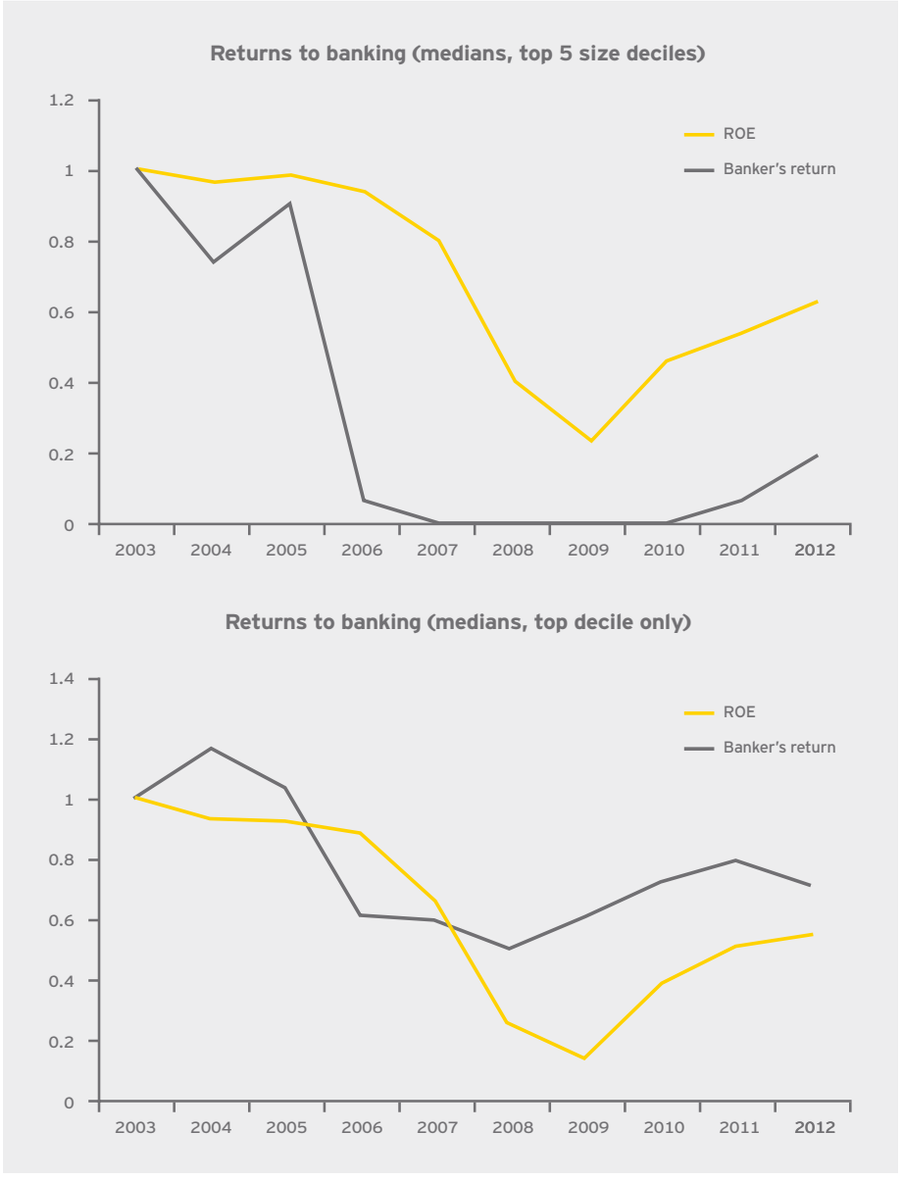

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Figure 5: Cindx over years for selected banks

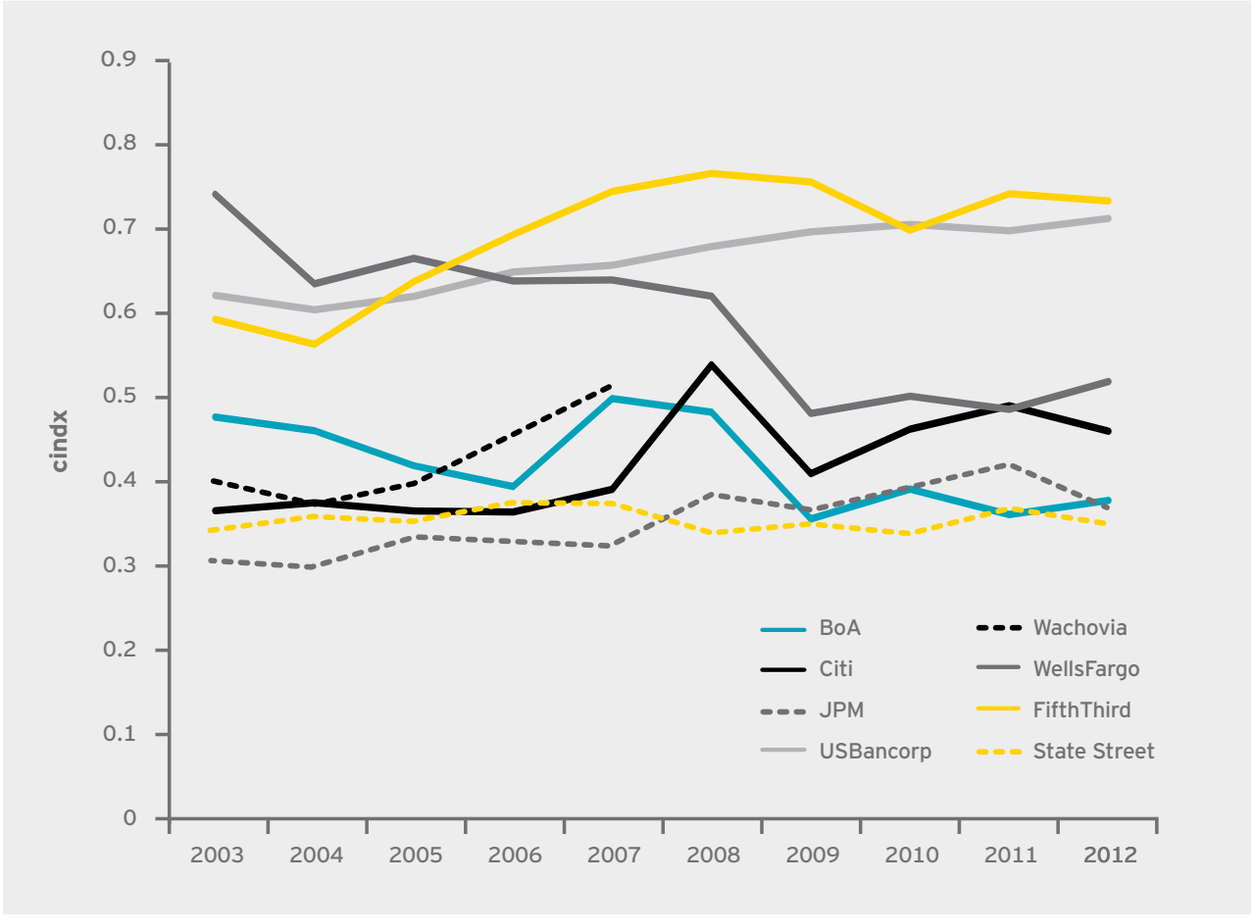

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Figure 6: Efficiency frontiers for selected banks in 2003

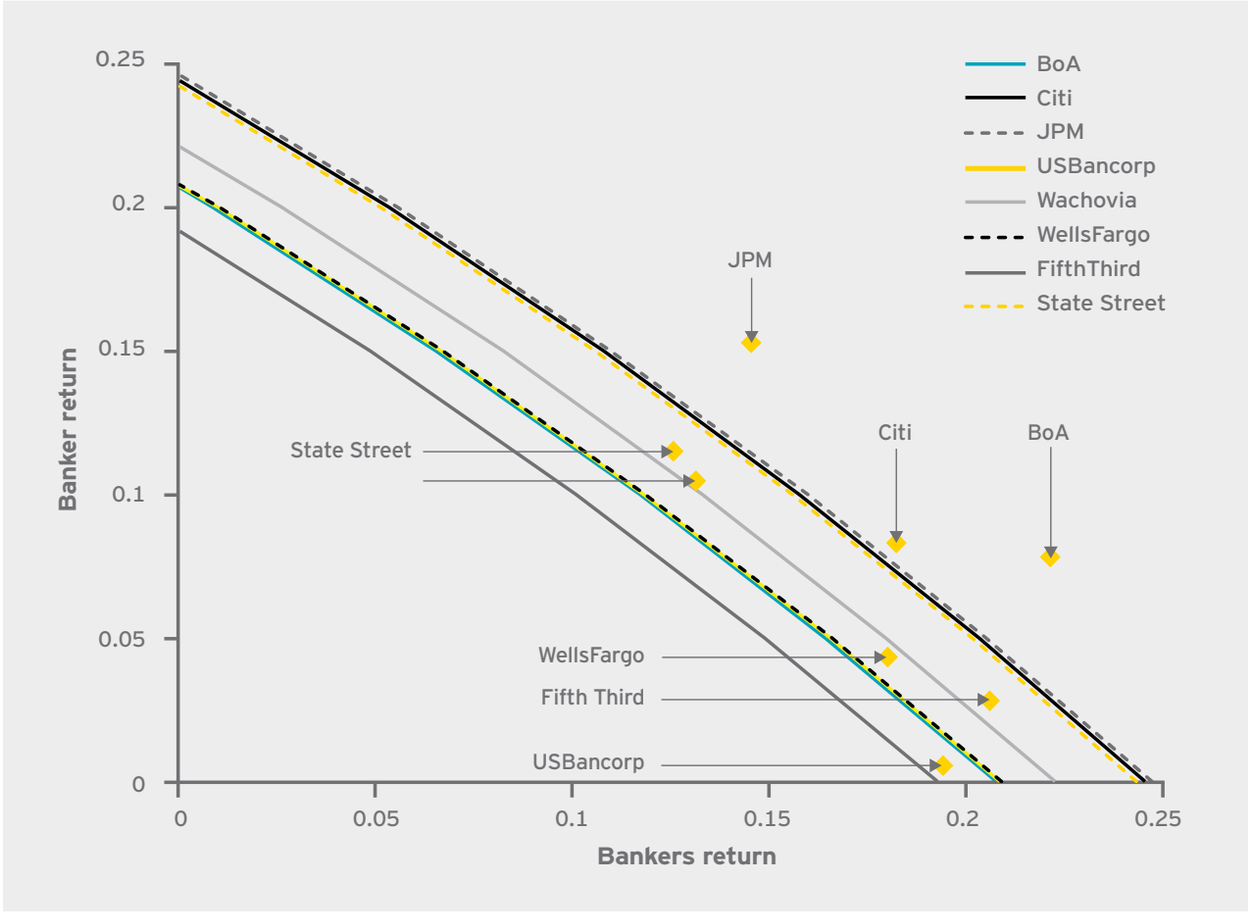

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Figure 7: Efficiency frontiers for selected banks in 2006

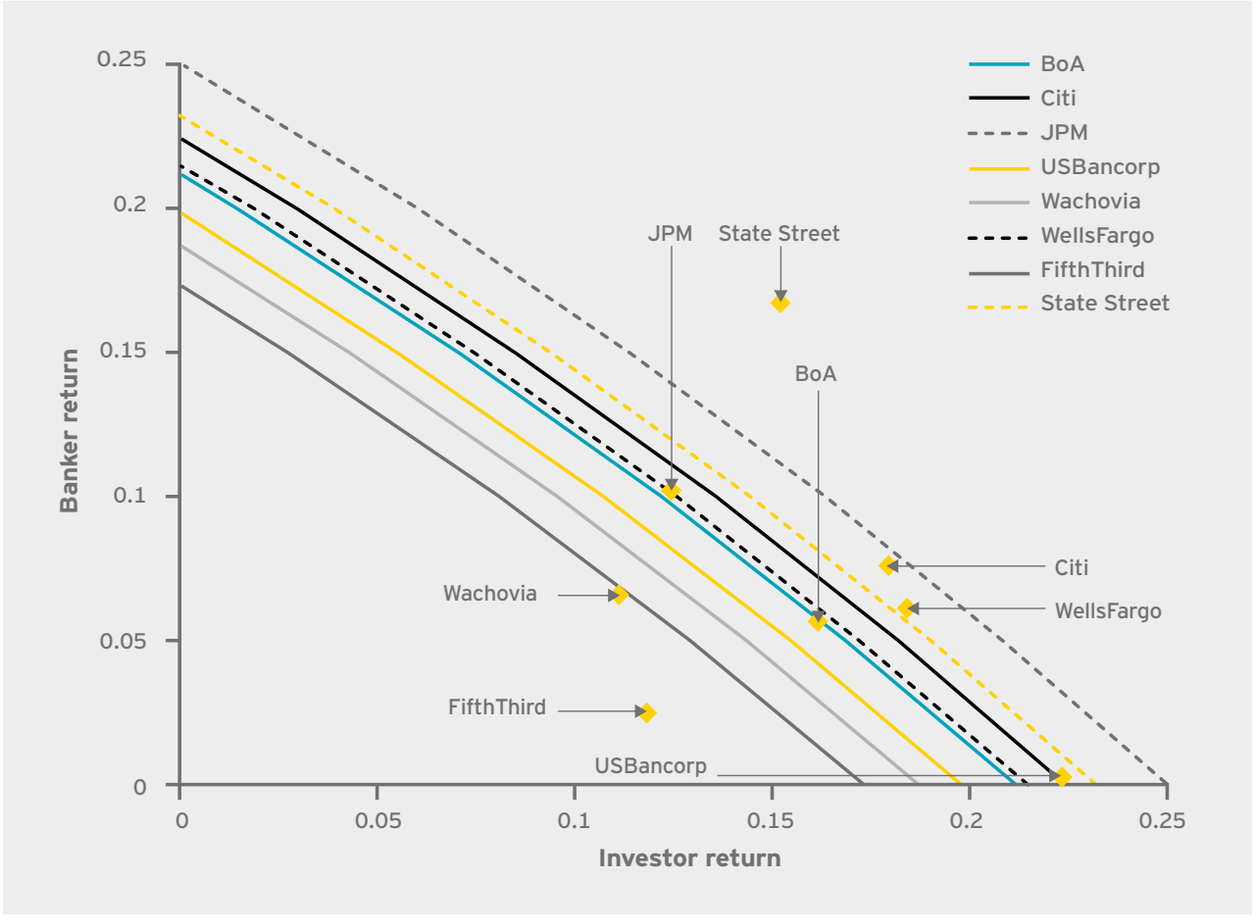

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Figure 8: Efficiency frontiers for selected banks in 2009

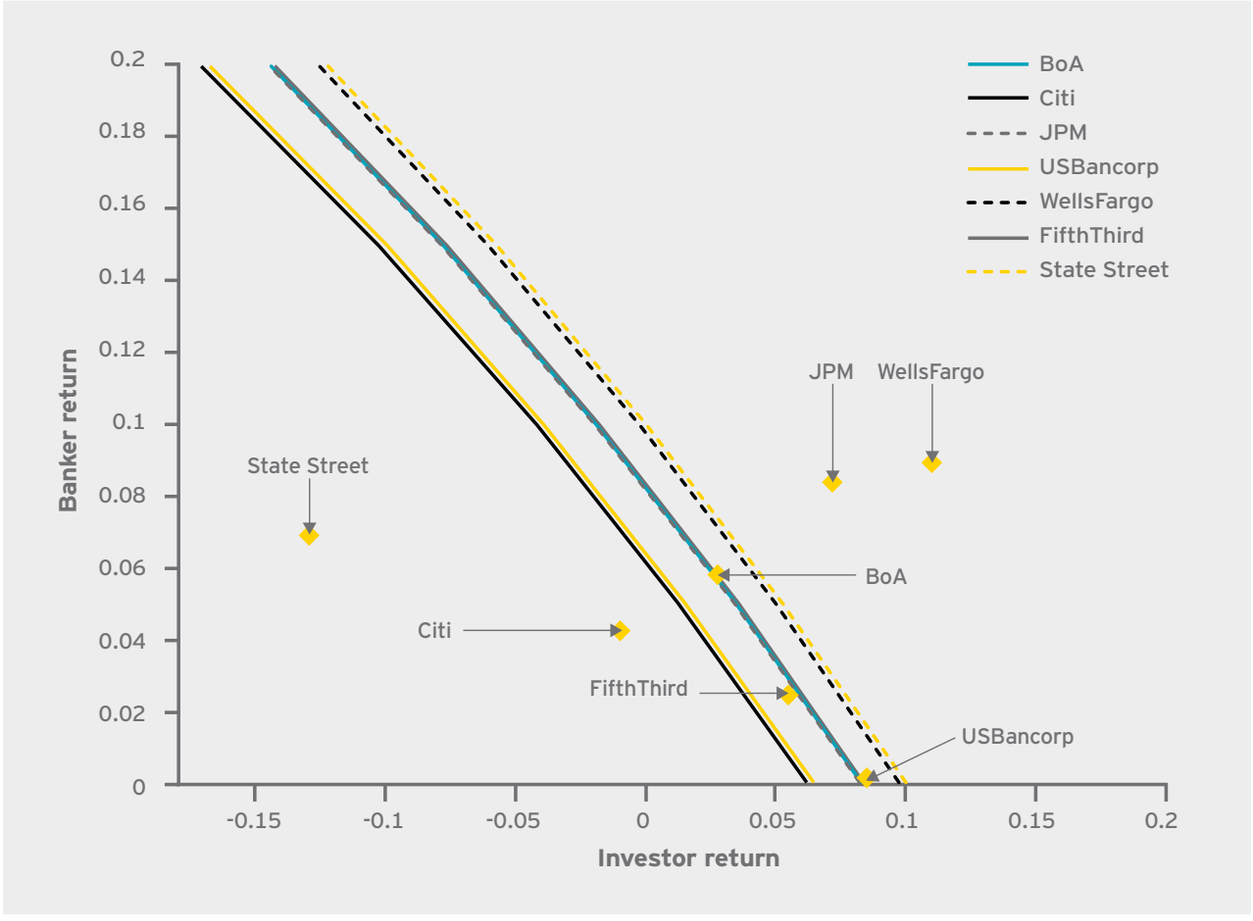

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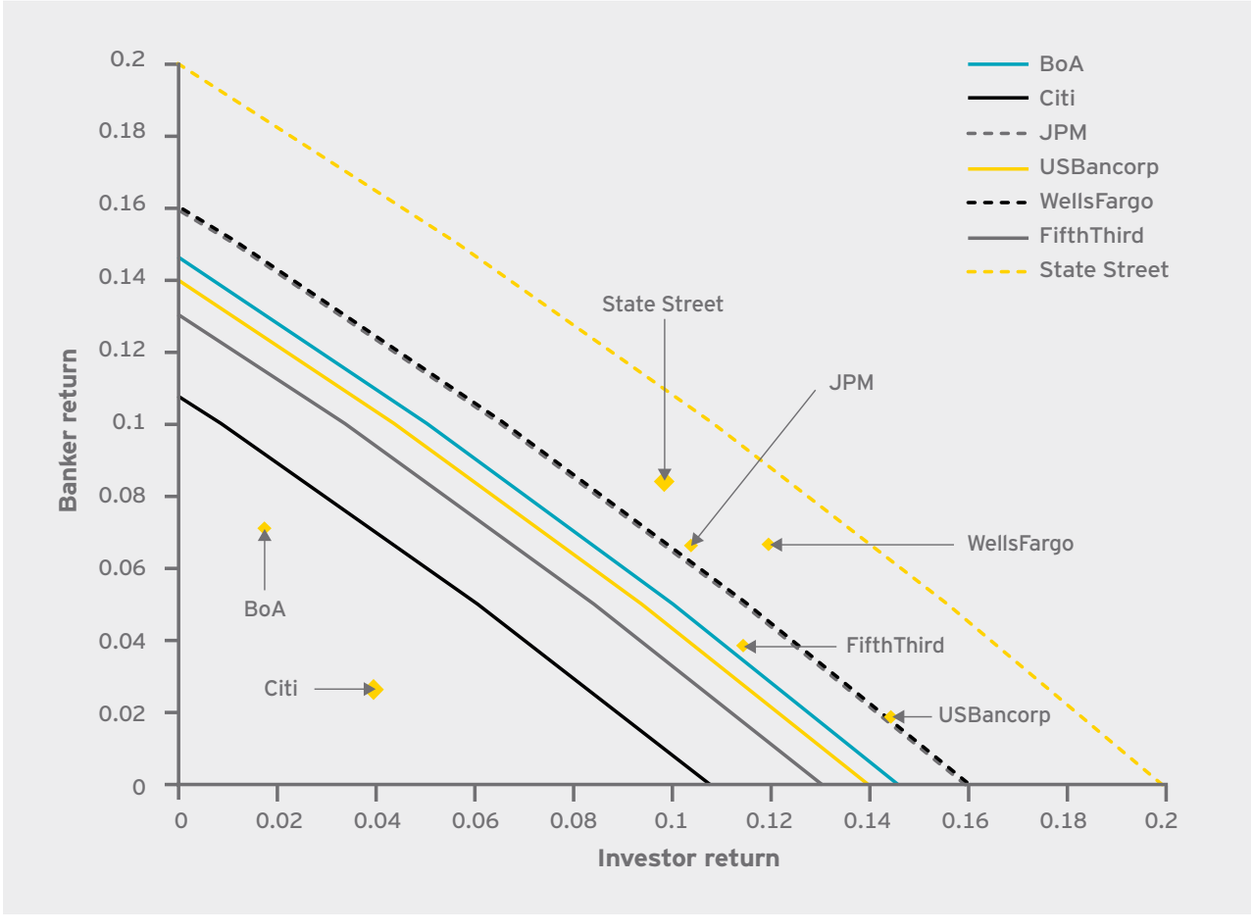
Figure 9: Efficiency frontiers for selected banks in 2012



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