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**Working Paper**

## To Separate or not to Separate Investment from Commercial Banking? An Empirical Analysis of Attention Distortion under Multiple Tasks

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An Empirical Analysis of Attention Distortion under Multiple Tasks

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# To Separate or not to Separate Investment from Commercial Banking?

## An Empirical Analysis of Attention Distortion under Multiple Tasks\*

In the wake of the 2008/2009 financial crisis, a number of policy reports (Vickers, Liikanen, Volcker) proposed to separate investment banking from commercial banking to increase financial stability. This paper empirically examines one theoretical justification for these proposals, namely attention distortion under multiple tasks as in Holmstrom and Milgrom (1991). Universal banks can be viewed as combining two different tasks (investment banking and commercial banking) in the same organization. We estimate pay-performance sensitivities for different segments within universal banks and for pure investment and commercial banks. We show that the pay-performance sensitivity is higher in investment banking than in commercial banking, no matter whether it is organized as part of a universal bank or in a separate institution. Next, the paper shows that relative pay-performance sensitivities of investment and commercial banking are negatively related to the quality of the loan portfolio in universal banks. Depending on the specification, we obtain a reduction in problem loans when investment banking is removed from commercial banks of up to 12 percent. We interpret the evidence to imply that the higher pay-performance sensitivity in investment banking directs the attention of managers away from commercial banking within universal banks, consistent with Holmstrom and Milgrom (1991). Separation of investment banking and commercial banking may indeed be associated with a reduction in risk in commercial banking.

*Keywords: multiple tasks, universal bank, bank holding company, incentive pay, loan performance*

*JEL Classification: G21; G24; G29*

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# 1 Introduction

Since the recent global financial crisis, trading and investment banking activities of commercial banks are deemed to be an important source of financial instability. A number of policy reports proposed to separate the two activities from one another. For example, the “Volcker Rule” prohibits proprietary trading of commercial banks in the U.S and was enacted as part of the Dodd-Frank Act of 2010. Similar proposals were made in the UK (“Vickers report”) and the EU “Liikanen Report”. While the details of the proposals differ, they view investment banking or trading within commercial banks as a greater risk to financial stability than if these activities are separated. The main argument for separation in these reports relates to the subsidy to deposits arising from deposit insurance: As depositors have no incentive to react to higher risk-taking by the bank by either withdrawing deposits or demanding higher interest rates, this may result in a cross-subsidy of risky investment banking and trading through the deposit insurance system (see for example Hakenes and Schnabel, 2014).

While this argument is plausible and may indeed be at work, in this paper we propose an alternative theoretical mechanism of why a separation of investment banking and commercial banking may be advisable from a financial stability perspective. We propose attention distortion in a multi-tasking environment as in Holmstrom and Milgrom (1991) as a justification for the separation of investment banking from commercial banking. Holmstrom and Milgrom (1991) show that if agents are confronted with multiple tasks, incentive pay allocates risks, motivates hard work and also directs the allocation of the agent’s attention among various duties. When compensation is more sensitive to performance in one task under multi-tasking, attention may be disproportionately directed towards this task and away from the other task. We hypothesize that this problem may be relevant in the case of universal banks. When banks have several tasks, such as universal banks, and these tasks differ in their pay-performance sensitivity, bank managers may rationally “neglect” the task that is less performance sensitive. In that case, the performance of one task with less performance-sensitive compensation might suffer relative to the task with more performance-sensitive compensation. Applying this model to our

setting, we first estimate whether there are differences in the pay-performance sensitivity between commercial and investment banking and if so, if they result in a corresponding under-performance of the less pay-performance sensitive business area within the bank.

We apply this theoretical analysis to data for U.S. bank holding companies (BHCs). As BHCs in many cases consist of subsidiaries with different business models, U.S. BHCs provide us with cross-sectional variation of business models. Hence, we exploit the structure of BHCs as multi-tasking agents and the business segments as multiple tasks. Hence, in our setting a bank “business segment” corresponds to a “task” in Holmstrom and Milgrom (1991).

We proceed in two steps in our empirical analysis. First, we estimate pay-performance sensitivities for pure commercial banks, for pure investment banks and for the investment bank and commercial bank segments within universal banks, respectively. For this purpose, we construct a unique hand-collected dataset for the compensation structures at the segment level (investment banking segment and commercial banking segment) of U.S. BHCs and match it with the corresponding financial statements. We find that on average the performance-pay of the investment banking segment is more sensitive to short-term performance than that of the commercial banking segment within universal banks. On average, the pay-performance sensitivity of investment banking is about one and a half times as high as in commercial banking. We conjecture that the reason for this finding is that the performance of the investment banking segment is more easily observable in the short run. At the same time we do not find a statistically significant difference between the pay-performance sensitivity of investment banking within universal banks and the pay-performance sensitivity of pure investment banks. Similarly, there is no statistical difference between the pay-performance sensitivity of pure commercial banks and commercial banking segments within universal banks. Overall, as one may have expected, investment banking is more performance sensitive in its compensation structure.

The higher pay-performance sensitivity of investment banking raises the possibility that investment banking receives more attention compared to commercial banking within universal banks, consistent with the predictions of Holmstrom and Milgrom (1991). This

could ultimately result in commercial bank lending portfolios that are riskier and perform worse. Hence, in a second step we test whether the performance of the loan portfolio is worse in universal banks as a function of the differences in the pay-performance sensitivities within the bank. This would be the case, if the incentive pay structure guides the allocation of effort and attention within banks in line with the model of Holmstrom and Milgrom (1991).

We find that even though there is no significant difference in the pay-performance sensitivity for commercial banking in the different types of banks (universal and specialized commercial banks), the performance of the loan portfolio of universal banks is worse when compensation is more sensitive to the investment banking segment than to the commercial banking segment. This difference in performance is an increasing function of the difference in the pay-performance sensitivities between investment and commercial banking within universal banks. This is in line with the predictions of Holmstrom and Milgrom (1991): Managers tend to devote more attention and effort to the task that more immediately rewards performance and neglect to devote adequate attention and effort to the other task. It turns out that the economic magnitude of the effect strongly depends on whether or not we control for the "risk culture" of banks, i.e. whether pay-performance sensitivity is above the median for both investment and commercial banking, respectively. Ultimately, our empirical analysis suggests that separating the investment banking activities from an average universal bank would reduce loan loss provisions by about 12 percent.

Our findings hence support a separation of investment and commercial banking. Under the current compensation structure with a higher weight on short-term performance it may be preferable to separate commercial banking and investment banking, in order to prevent that the incentives provided by performance-based pay direct the attention and effort of managers too much in the direction of investment banking, neglecting commercial banking. However, rules on the compensation of managers that limit performance-based pay (as recently proposed in the EU, see EBA, 2015) may also mitigate the effect. Ultimately, the correct policy response may depend on the relative restructuring and social costs arising from separating tasks in universal banks, relative to those incurred by inter-

fering with the performance structure within banks. In addition, this study implies that the risk of universal banks is not necessarily associated with investment banking activities per se, but rather with the relative dynamics of incentive pay within banks.

The remainder of this paper is organized as follows. Section 2 provides an overview of the theoretical background of Holmstrom and Milgrom (1991) and the related literature. Section 3 builds up our hypotheses and introduces main identification strategies. In Section 4, we present data and descriptive statistics. In Section 5, we propose our empirical model. Sections 6 and 7 illustrate the results of the analyses and robustness tests respectively. Finally, Section 8 concludes and suggests policy implications.

## 2 Related Literature

To the best of our knowledge, this is the first paper that aims to empirically investigate the relationship between incentive pay and risk-taking within the framework of a multi-tasking problem in universal banks. However, we build on a large literature in labor economics and finance, examining pay for performance and outcomes, as well as a literature that compares universal banking with specialized banks.

First, there are a large number of theoretical studies examining universal banks relative to specialized banking. Many point to inefficiencies that may arise in universal banks or conglomerates (e.g., Rajan et al., 2000; Boot and Ratnovski, 2013; Hakenes and Schnabel, 2014) and argue that separation of investment banking and commercial banking may enhance the stability of banking sector (Hakenes and Schnabel, 2014). Two main arguments are being put forward in favor of the separation of investment banking and commercial banking:<sup>1</sup> First, Hakenes and Schnabel (2014) show that combining trading with commercial banking in a Diamond-Dybvig (1983) model either results in more bank runs when there is no deposit insurance or in an increase in moral hazard in the presence of deposit insurance. A separation may therefore increase financial stability, although

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<sup>1</sup>In this paper we use “investment banking” and “trading” interchangeably. While a number of the recent proposals for separation are strictly focused on trading activities, others are broader and include activities that one would commonly refer to as investment banking. In our empirical analysis, we are unable to distinguish between trading in a narrow sense and investment banking.



these benefits have to be weighted against the costs of breaking up banks and against a potential reduction in credit volume.

Second, Boot and Ratnovski (2013) emphasize the differences between what they refer to as “traditional” banking and trading, somewhat along the lines of this paper. They argue that due to the different characteristics of the two activities, which will be discussed in more detail below, universal banks may under-invest in relationships, undermining the quality of the traditional banking business. The evidence presented in this paper, while emphasizing a somewhat different mechanism, is consistent with this idea. From a corporate governance perspective in a theoretical model for universal banks, Choi (2004) shows that the underwriting business of universal banks is associated with a lower probability of success. This is not because of an inefficiency or lower skill, but because of a lower monitoring incentive in the commercial banking segments in universal banks.

Our study is also related to the relationship between bank diversification and bank risk. This literature analyzes income sources in order to capture bank diversification. Given that there are traditional income sources of banks such as interest income from loans and nontraditional sources such as non-interest income from fees, commissions, and trading revenues, this literature adopts non-interest income as a proxy for bank diversification and analyzes whether the diversification reduces or increases individual bank risk (e.g., Stiroh, 2004; Demirgüç-Kunt and Huizinga, 2010; Köhler, 2014) or systemic risk (e.g., Brunnermeier et al., 2012). In this literature, diversification benefits from non-interest income are found to be small, except for the retail-oriented banks (Köhler, 2014), where adding a “little bit” of investment banking to a functioning retail bank does provide some diversification benefits.

Further, our paper contributes to the growing literature on the incentive-based pay and firm behavior and bank risk-taking. The seminal paper in this literature, Jensen and Murphy (1990) are the first to estimate pay-performance sensitivities for CEOs in a sample of non-financial U.S. firms. The approach taken in this paper largely follows their approach in estimating the pay-performance sensitivity of specialized banks and the different segments within universal banks. In the banking literature, DeYoung et al.

(2013) empirically show that CEO pay-performance sensitivity is positively correlated with bank risk-taking. Acharya et al. (2014) distinguish non-CEO pay from CEO pay and find that non-CEO pay sensitivity before the financial crisis affects bank risk-taking significantly and yields an increase in the realization of risks during the crisis. There is also a literature that has focused on loan officer incentives. For example, Agarwal and Wang (2009) show that volume-based incentives are related to a deteriorating quality of the loan portfolio in commercial banks. Most closely related to our paper, Behr et al. (2014) investigate the implications of an incentive-based loan officer compensation structure considering that loan officers face a multi-tasking problem (originating loans, screening loan applicants and monitoring outstanding loans). The results show, somewhat in line with this paper, that loan officers allocate their effort to tasks that are most rewarded under the incentive contract and neglect others that are not. Overall, they show that incentive-based contracts may result in distortions in loan officer behavior and ultimately undesirable outcomes for the bank.

Fields and Fraser (1999) compare CEO incentive-based compensation in U.S. universal banks and specialized banks in the setting of the gradual deregulation process of the 1990s. They find that commercial banks that add investment banking activities tend to adopt more incentive-based compensation schemes. However, they find that investment banking within a universal bank remains less incentive-based than in a specialized investment bank. The current paper adds to their findings in two dimensions: One, in a more recent sample, we do not find that investment banking within universal banking is less incentivized compared to investment banking in a specialized investment bank. Second, we link the differences in incentive-based pay between commercial banking and investment banking to risk-taking in the commercial loan portfolio.<sup>2</sup>

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<sup>2</sup>There is also a literature on managerial agency costs (Bourjade and Schindele, 2011) and agency costs in universal banks (Ross, 2007).

### 3 Empirical Set-up and Identification

Our study is based on the theoretical prediction of Holmstrom and Milgrom (1991). They show that

*“When there are multiple tasks, incentive pay serves not only to allocate risks and to motivate hard work, it also serves to direct the allocation of the agent’s attention among their various duties.”<sup>3</sup>*

In our context, the incentive pay in universal banks would allocate attention among the different bank business segments, which may yield an unintended deterioration in the business segment where less attention and effort is directed to. In order to apply this theoretical analysis to our empirical analysis, we make several assumptions. First, the analysis in Holmstrom and Milgrom (1991) refers to one agent that is faced with two tasks. In our setting, the “agent” would be the senior management of the bank, whose compensation depends upon the overall profitability. If compensation depends more strongly on one business segment within the bank, senior management would rationally direct more attention towards this segment. The Holmstrom and Milgrom (1991) model lends itself also to a complementary interpretation from the perspective of internal labor markets: If the pay-performance sensitivity is higher in one segment than the other, this segment may attract those employees that are more productive. Again, this could result in a deterioration of performance in the business segment where pay is less dependent on performance. In this paper we make no attempt at distinguishing the two stories.

This study adopts the same two-step identification strategy as in Acharya et al. (2014): First, we estimate pay-performance sensitivity for each bank and each business segment (investment banking and commercial banking). Second, we estimate its effect on measures of the loan portfolio of the bank. Our intuition builds upon the description of investment banking versus commercial banking in Boot and Ratnovski (2013). They characterize commercial banking as relationship-based and long-term oriented and investment banking

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<sup>3</sup>Holmstrom and Milgrom (1991, p.25)

as transactions-based, scalable and short-term.<sup>4</sup> Ultimately, short-term performance in commercial banking is more difficult to measure than in investment banking and may be associated with a lower pay-performance sensitivity and receive less attention from managers within a universal bank based on the line of arguments in Holmstrom and Milgrom (1991). Put differently, within a bank holding company, compensation may be allocated for each task based on performance at the segment level. The only observable measure of performance is segment total revenue, which is defined as the sum of net interest income and non-interest income earned in the segment. This measure is easily and quantitatively observable in the short-run. It might reasonably measure the performance of investment banking. However, it may not adequately measure the quality of commercial banking. For this commercial banking, therefore, Holmstrom and Milgrom (1991) would argue that a fixed wage (or at least a contract with a relatively low pay-performance sensitivity) is the optimal contract.<sup>5</sup>

Based on these theoretical considerations, we aim to examine three interrelated hypotheses:

*H1. The pay-performance sensitivities of universal banks and specialized banks are not significantly different from each other with regard to the same business segment (commercial banking or investment banking).*

*H2. Within universal banks, the pay-performance sensitivity is higher for the investment banking segment than for the commercial banking segment.*

*H3. The quality of the loan portfolio of universal banks is a decreasing function of the difference in pay-performance sensitivities between the investment banking and the commercial banking segment within universal banks.*

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<sup>4</sup>While not strictly correct we use the term “investment banking” in place of trading and “commercial banking” in the place of “traditional banking” throughout this paper. For more discussion on this issue see the definition of the different types of banks and business segments within universal banks below.

<sup>5</sup>“It may be optimal to provide no quantity incentives when quality is poorly measured.” Holmstrom and Milgrom (1991, p.28)

Hypothesis 1 is important, in order to delineate the attention distortion effect from a pure incentive effect as in Behr et al. (2015), Cole et al. (2015), and Agarwal and Ben-David (2013), who show that high powered incentives for loan officers based on loan volume reduce the incentive of loan officers to monitor loans and ultimately result in a deteriorating loan portfolio. To see this, suppose we found that the pay-performance sensitivity of commercial banking within universal banks was higher than the pay-performance sensitivity in specialized commercial banks. Suppose further that we also found support for hypothesis 3: the quality of the loan portfolio was worse in universal banks. In this case we could not distinguish between a pure incentive story of the loan officer literature and the attention distortion story that we have in mind. The worse quality of the loan portfolio may in that case simply be due to the stronger incentives of loan officers to extend loans regardless of their quality and not due to the attention distortion arising from the *relative* pay-performance sensitivity between investment banking and commercial banking within universal banks.

Hypothesis 2 takes us to the main story of the paper: If pay-performance sensitivity is higher for investment banking than for commercial banking within universal banks, management may rationally devote its attention more towards investment banking. The underlying theoretical foundation for this hypothesis is directly based upon the theoretical considerations in Holmstrom and Milgrom (1991) outlined above.

Hypotheses 3 builds upon hypotheses 1 and 2. Given that we find support for hypotheses 1 and 2, we examine whether the attention distortion induced by the different pay-performance sensitivities within universal banks result in a deterioration of the loan portfolio.

## 4 Data and Descriptive Statistics

### 4.1 Dataset and variable definitions

We construct a unique dataset by combining data from two main sources. Our primary data source is the U.S. bank holding company (BHC) data of Consolidated Financial Statements (FR Y-9C). While we can estimate the pay-performance sensitivity for specialized investment and commercial banks using this standard data source, the data do not provide us with the necessary information to estimate pay-performance sensitivities for different business segments within universal banks. Hence, we augment the BHC data with hand-collected segment compensation and revenue data obtained from annual reports of individual BHC in SEC filings Form 10-K from EDGAR. SFAS No.131 “Disclosures About Segments of an Enterprise and Related Information” requires that a public business enterprise report financial and descriptive information about its reportable operating segments. Operating segments are components of an enterprise about which separate financial information is available that is evaluated regularly by the chief operating decision maker in deciding how to allocate resources and in assessing performance. Generally, financial information is required to be reported on the basis that it is used internally for evaluating segment performance and deciding how to allocate resources to segments (see <http://www.fasb.org/summary/stsum131.shtml>). Therefore, the sample consists of listed BHCs and excludes non-listed BHCs. All variables are annual values at the end of the 4th quarter by using 10-K for the segment report available annually.

We use a similar hand collection procedure as in Ellul and Yerranmilli (2013). First, for the first step estimation, we estimate the model for the pre-crisis period 1997-2006 only, because during and after the crisis the compensation structure has been subject to significant changes due to regulatory intervention and changing market conditions. For the second step to examine loan performance, we extend our sample period to 2007-2009, but also estimate the model separately for the pre-crisis period only. To collect the sample information, we start with all bank holding companies with book assets of more than

USD 10 billion as of 2014.<sup>6</sup> This selection process yields the 70 largest U.S. bank holding companies as of 2014. We then drop those bank holding companies which do not have sufficient observations during the period of 1997-2006 (19 banks), and also those bank holding companies that combine and separate their segments across different types of segments more than twice within the sample period (2 banks). We end up with 49 bank holding companies that account for 84% of the total BHC's assets in the U.S. with 612 bank-year observations for the period of 1997-2009.

### ***Business segment and bank categorization***

Categorizing segments properly is a challenging task, because the categorization of segments may change over time and may vary across banks. For example, some banks indicate in their 10-K report that their segment categorization may not be always comparable to other financial institutions. Therefore, in order to achieve a comparable classification of business segments, we have to manually look at the main features of each segment, such as their activities, asset compositions, and the source of income. That is, regardless of change in organization, we track and categorize those segments which have large trading assets (or non-loan assets) or trading revenue (or non-interest income) as investment banking (IB) segments. When the trading assets or revenues are not observable at the segment level, we refer to the descriptive segment business report to categorize business segments, which then refers to a somewhat larger definition of investment banking, including capital market activities, financial advisory, or investment management services. Similarly, we categorize those business segments with interest income as the main source of income or loans as main asset portfolio as commercial banking (CB) segments.

To summarize, we categorize business segments as commercial banking and investment banking following the rule based on the nature of activities (traditional banking vs. investment banking), share of asset types (loan vs. non-loan), or share of income sources

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<sup>6</sup>We concede that there is survivorship bias in the sample. We considered starting with selecting banks as of 1997. However, the SEC 10-K reports for those banks that appear in 1997 and disappear later are not available in EDGAR. Also those banks that merged after 1997 have to be combined in order to use consolidated information in the FR Y-9C and SEC 10-K, which is prohibitively difficult given our focus on segment compensation and revenue.

(net interest income vs. non-interest income including trading revenue, investment or brokerage fees) as depicted in Table 1. Specialized commercial and investment banks are then those banks that consist of only one segment, respectively.<sup>7</sup> Using this procedure we obtain a sample of 27 universal banks (each with an investment banking and a commercial banking segment), 5 investment banks, and 17 commercial banks. A list of the classified banks included in the respective samples is given in Table 5 in Section 6, along with the baseline results.

Table 1: Segment categorization

Rule	IB Segment	CB Segment
Activity	Investment related services	Lending, deposit taking, payment services
Asset	$Loan\ share(= \frac{Loan}{Segment\ Assets}) \leq 50\%$	$Loan\ share > 50\%$
Income	$IB\ revenue(= \frac{Non-interest\ income}{Segment\ Revenue}) \geq 50\%$	$IB\ revenue < 50\%$

### ***Segment compensation ( $\Delta COMPENSATION$ )***

For the estimation of bank level pay-performance sensitivities we need a measure of changes in segment level compensation. However, banks generally do not report compensation at the segment level in their annual reports or Consolidated Financial Statements for BHCs (FR Y-9C). Hence, we use changes in ‘non-interest expenses’ reported in the SEC filings Form 10-K as a proxy for changes in segment level compensation expenditures. In general, non-interest expenses include, aside from the expenses for personnel (compensation) that we are interested in, expenses for occupancy of buildings, equipment, marketing, professional fees, amortization of intangibles, data processing, telecommunications, and other smaller items. Nevertheless, non-interest expenses at the business segment level may be a good proxy for segment compensation, if all items aside from compensation do not vary much over time and do not vary with performance. Hence, before we proceed further, we check the correlation between non-interest expenses and expenditures for personnel at the bank level. We illustrate the findings in Figures 1-3 in

<sup>7</sup>Even though there are some investment services, some banks do not report these segments. Instead, they put them in an “other” category. Generally this happens, when these segments have a small weight or they are the residual of general corporate business affairs. In that case, we do not count the “other” segment for our categorization.



Appendix A. The figures show that the largest share and almost all of the variation of non-interest expense of BHCs can be attributed to expenses for personnel. As we will ultimately use the first differences of compensation in the regressions, the share matters less for us than the correlation. We find that BHC's FR Y-9C show a correlation of 0.98 between non-interest expense and expenses for compensation at the aggregate bank level. While we obviously cannot observe this correlation at the segment level, in the following we assume that the correlation at the segment level would be of similar magnitude, making changes in non-interest expenses a good proxy for changes in compensation.

While the average correlation between non-interest expenditures and compensation expenditures is encouraging for our approach, we were concerned that there might idiosyncratic costs, such as restructuring costs or M&A costs included in non-interest expense, adding substantial noise to our measure. Ultimately that could result in spurious results for some banks. However, while at the bank level idiosyncratic costs are included in the bank level non-interest expenses (as shown in the Figure 4), this is not the case at the segment level.<sup>8</sup>

When using changes in segment level non-interest expenses as a proxy for changes in segment level compensation, we are faced with a further problem: While we have a decent proxy for total compensation at the segment level, we do not have information about the average number of employees at the segment level. Hence, unfortunately, instead of using average compensations per individual employee in the segment, we have to resort to using the aggregate compensation at the segment level, which may be driven by changes in the number of employees at the segment level in addition to changes in compensation per employee. This shortcoming of the data should be taken as a caveat when interpreting the results below. In order to check the extent to which our estimated pay-performance sensitivities are robust to changes in employment levels, we take average salary per employee for pure investment and pure commercial banks, where we have the data, re-estimate pay-

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<sup>8</sup>Idiosyncratic costs, such as restructuring costs or M&A costs, are reported in 'other' segments or 'corporate' segments in practice. Moreover, although the goodwill impairments are reported by entity level as well as reporting unit, which is equivalent to operating segments (FSAB, 1997, 2001), in our hand collecting procedure, we exclude the goodwill impairments from the segment level non-interest expenses to minimize the noise to our measure.

performance sensitivities, and compare the results to those of our baseline results. Table 9 in Appendix B shows that the differences in estimated pay-performance sensitivities are small and are unlikely to drive our results below.

### ***Segment performance ( $\Delta REVENUE$ )***

As the central explanatory variable in the baseline step 1 regression to obtain segment level pay-performance sensitivity, we use the first difference of segment total revenue hand-collected from the banks' 10-K filings. Unlike Jensen and Murphy (1990) and Fields and Fraser (1999) we are unable to use a market based performance measure, as this is not available at the business segment level. An alternative performance measure for commercial banking would be to use total interest income as in Acharya et al. (2014) and then correspondingly use non-interest revenue as the performance measure for investment banking. However, using the segment level data, there is a closer correspondence between the segment total revenue and segment compensation, as some interest income may accrue in investment banking and some non-interest income in commercial banking. We nevertheless report results using this simpler approach in the robustness section below.

## **4.2 Descriptive statistics**

Table 2 provides the definitions and data sources for each variable in detail and Table 3 presents summary statistics. The average bank owns assets amounting to USD 135 billion, holds 9.1 percent equity, 5.2 percent liquid assets, and 64 percent deposits (in relation to its total assets). The average loan loss provision is USD 1.1 billion. Charge-offs show moments to the loan loss provision. Loan loss provision over total assets, charge-offs over total assets, non-performing loans to total assets show a highly skewed distribution. Non-interest expense, proxy for segment compensation, of average IB segment (USD 3 billion) is higher than that of average CB segment (USD 2 billion). The segment revenues for IB and CB segments are similar to each other (USD 4.6 billion and USD 4.5 billion, respectively). Among the 49 sample banks, 18 banks are larger than USD 100 billion, 5 banks are USD 50 billion-100 billion, and 26 banks are USD 10 billion-50 billion based

on the total assets as of 2014. However, some banks might be much smaller than USD 10 billion in 1997, if they have grown largely over time.

Table 4 shows the means and the differences in means for the samples of universal banks and specialized banks by each segment. With regard to the level of segment revenue and segment non-interest expense which proxies segment compensation, there is significant difference between universal banks and specialized banks. The mean of the first difference of non-interest expense shows a significant difference between universal banks and specialized banks for IB segments as well as for CB segments. However, the first difference of segment revenue only exhibit a significant difference in CB segments.

## 5 Empirical Model

### 5.1 First step: Estimation of segment pay-performance sensitivity

As mentioned earlier, in the first step, we estimate pay-performance sensitivity by task segments ( $\hat{\beta}_{IB}, \hat{\beta}_{CB}$ ) for each bank holding company  $i$ . As our baseline model, we employ a first-difference specification of level variables following Jensen and Murphy (1990) and Fields and Fraser (1999). We do not follow Acharya et al. (2014) here, who use a log-difference specification, because in the log-difference specification we lose observations for banks incurring losses in a period. The baseline model for the estimation of the bank specific pay-performance sensitivities is shown in equation (1) below:

$$\Delta COMPENSATION_{k,t} = \alpha + \beta_k \Delta REVENUE_{k,t} + \varepsilon_{k,t} \quad (1)$$

where  $\Delta X_{k,t}$  indicates first-difference of level for each variable  $X$ , for segment  $k \in \{IBsegment, CBsegment\}$  and year  $t$ . We run this equation separately for each segment of the sample banks with four or more observations as in Jensen and Murphy (1990). Following the literature, we do not use any other control variables in these specifications. In the robustness section, we add lagged revenue in order to account for possible timing differences between reported compensation and revenue and find that the results are robust.

Aside from obtaining the necessary pay-performance sensitivities used in the second step, the results will also inform us about potential differences in pay-performance sensitivity between the respective segments of universal banks and the same activity in specialized banks. This is important, because only if they are the same we exclude that incentive pay per se is driving our results and not the *differences* in incentive pay between investment banking and commercial banking within a universal bank.

## 5.2 Second step: The effect of relative pay-performance sensitivity on portfolio quality

In this second step, we use the estimates of pay-performance sensitivity ( $\hat{\beta}_{i,k}$ ) for bank  $i$  and task segment  $k$  from the first step as an explanatory variable to analyze its effect on loan performance. As our main dependent variable, we use the natural logarithm of the ratio of loan loss provision to total assets ( $\ln(\frac{LLP}{Asset})$ ).<sup>9</sup> The logarithm of the ratio is employed to address the skewness of its distribution (Foos et al., 2010). Hence, we estimate the following model:

$$Y_{i,t} = \alpha + \delta \hat{\beta}ratio_i + \phi BC_t + \rho IS_{i,t} + X'_{i,t} \lambda + \mu_{i,t} \quad (2)$$

where  $\hat{\beta}ratio_i = \frac{\hat{\beta}_{i,IB}}{\hat{\beta}_{i,CB}}$ .  $\hat{\beta}_{i,k}$  indicates the estimates of pay-performance sensitivity of segment  $k \in \{IBsegment, CBsegment\}$  in bank  $i$ . Thus the explanatory variable  $\hat{\beta}ratio_i$  is the ratio of the investment banking pay-performance sensitivity relative to commercial banking pay-performance sensitivity within universal banks. The higher the ratio, the more incentives there are to devote attention and effort to investment banking within a universal bank.  $Y_{i,t}$  is the log of the ratio of loan loss provision ( $\ln(\frac{LLP}{Asset})$ ). In some specifications we include a number of bank controls  $X_{i,t}$  that may be related to the performance of loans, including *Size*, which is measured by the natural logarithm of total assets. Large banks may have more capacity to take riskier portfolios. *Capital ratio* is total equity divided by total assets. Regarding capital ratio, there are contradicting

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<sup>9</sup>For robustness we adopt alternative measures of loan performance, such as loan charge-offs and non-performing loans in Section 7.

arguments. Well-capitalized banks are considered to be more risk-averse by Flannery (1989), Gennote and Pyle (1991), and Dewatripont and Tirole (1994). However, Kim and Santomero (1988), Rochet (1992), and Hellmann et al. (2000) show well-capitalized banks are less risk-averse. *Liquidity ratio* is the cash and equivalent liquid assets divided by total assets. Banks hold liquidity in order to avoid fire sales when they are hit by a funding shock. *Deposit ratio* controls for the funding structure of banks. It is defined as the total deposits divided by total assets.

We also control in some specifications for business cycle effects by including  $BC_t$  which is annual real GDP growth ( $\Delta GDP$ ). As Greenawalt and Sinkey (1988) and Laeven and Majnoni (2003), we control for income smoothing (*IS*) by earnings before taxes and loan loss provision over total assets ( $\frac{Earnings}{Assets}$ ). Further, it may be important to control for the overall "risk culture" within the bank. Banks that are overall more prone to risk taking may have higher pay-performance sensitivities in both segments. Hence, in some specifications below we control for this by including the pay-performance sensitivity within the commercial banking segment as a further control variable. We also estimate specifications, in which we include a dummy if both the investment banking and the commercial banking pay-performance sensitivities simultaneously are above the sample median.

The model serves to test hypothesis 3: when in the investment banking pay-performance sensitivity is higher than in commercial banking within universal banks, attention might be reallocated away from commercial banking and the quality of the loan portfolio may deteriorate, due to insufficient screening and monitoring activities. Therefore, we predict the coefficient  $\delta$  to be significantly positive. In the robustness section, we replace loan loss provisions with alternative measures of loan portfolio performance, such as loan charge-offs and non-performing loans. The results are robust to these changes.

## 6 Baseline Results

This section presents and discusses the baseline results. We begin with the first step: the pay-performance sensitivity estimation for the respective segments within universal

banks and for specialized investment and commercial banks.

## 6.1 First step: pay-performance sensitivity

Table 5 presents the list of bank holding companies in the sample and the estimates of pay-performance sensitivity by segments for universal banks and for specialized banks respectively. The estimates were obtained by estimating equation (1) for each bank and segment. At the bottom of the table, we report summary statistics for the estimated segment pay-performance sensitivity in universal banks, investment banks, and commercial banks.

Consider the sample averages first, which are reported at the bottom of the three panels of the table. We find that the investment banking pay-performance sensitivity is higher than in commercial banking, whether investment banking is organized as part of a universal bank or in a specialized institution. Within universal banks (Panel A), we find a mean of 0.564 for investment banking (median: 0.566) and a mean of 0.360 (median: 0.393) for commercial banking. We find that the difference is significant at the 5 percent level. For specialized banks (Panels B and C), we find an average pay-performance sensitivity of 0.443 (median: 0.478) for investment banks and of 0.367 (median: 0.392) for commercial banks. We also checked whether the investment banking pay-performance sensitivity is different if organized within a universal bank or in a specialized institution and we find that the difference is not significantly different from zero. We find the same for commercial banking.

Simple t-tests still do not preclude that the pay-performance sensitivities were drawn from different distributions. In order to address this concern, we use a Kolmogorov-Smirnov test. We test the null that the samples are drawn from the same distribution. First we compare the same segment in universal and specialized banks. For both investment banking and commercial banking, we obtain large p-values and we cannot reject the null hypothesis that the estimates are drawn from the same distribution and there is no significant difference between universal banks and specialized banks in the distribution of segment pay-performance sensitivity. Further, we also analyze whether the

pay-performance sensitivity is higher for the investment banking than for the commercial banking segment within universal banks. The Kolmogorov-Smirnov test yields p-values of zero, which implies that the estimates for investment banking and commercial banking within universal banks are not drawn from the same distribution.

For robustness, we also report in Table 5 the mean values for statistically significant coefficients at the 10% significance level and the results of t-tests for difference between the two segments only when both coefficients are significant within the same bank. Similarly, we report the mean values of the significant coefficients in the specialized banks and t-test results between bank types. We find the baseline results above remain consistent. The pay-performance sensitivities of universal banks are not significantly different from those of specialized banks. Within universal banks, the IB segment shows higher pay-performance sensitivity than CB segment.

It may be useful at this point to compare our estimated pay-performance sensitivities to those in the literature. Acharya et al. (2014) report only summary statistics for cash compensation and stock compensation for non-CEO compensation elasticity. Their results show that the mean of cash compensation elasticity is around 0.98 and that of stock compensation is around 0.52, quite a bit higher than our results. Fields and Fraser (1999) are methodologically closest to our approach. They adopt the level changes in the CEO salary and bonus regressed upon the level changes in net income. Our results for both the commercial banking segment in universal banks (0.36) and their results for transitional banks (0.35) are pretty close to each other, as are their estimates for traditional banks (0.30 versus 0.37). Our study updates the change in compensation in commercial banks competing with universal banks. Also, while their results for investment banks are much higher than transitional banks, in our study we do not find this as the IB segments in universal banks are incentivized as much as specialized investment banks.

The results in this section support Hypotheses 1 and 2: One, we find that pay-performance sensitivity in investment banking is higher than in commercial banking, both across specialized banks and within universal banks. At the same time, we find no difference in pay-performance sensitivity for the same activity (investment banking,

commercial banking) whether the activity is organized in a specialized bank or a universal bank. We use these results in the next section to estimate the effect of the differences of pay-performance sensitivity within universal banks on the quality of the loan portfolio of universal banks.

## 6.2 Second step: loan performance

In the second step, we analyze our main hypothesis ( $H3$ ). We examine whether the differences in pay-performance sensitivity between investment banking and commercial banking within universal banks result in worse loan portfolios at universal banks. We would interpret this finding as evidence in favor of an attention distortion in line with the theoretical model of Holmstrom and Milgrom (1991). Based on Holmstrom and Milgrom (1991), we expect loan screening and monitoring to be worse in universal banks when pay-performance sensitivity is higher for investment banking than commercial banking. Under multiple tasks, when compensation is more sensitive to short-term performance in one of the tasks, managers rationally devote more attention to the task that is more closely related to short-term performance and away from the task that is not.

Table 6 shows the results of estimating equation (2). Our main coefficient of interest is  $\delta$ , which measures the effect of the relative pay-performance sensitivity within universal banks on the quality of the loan portfolio. In column (1) without bank controls, we find a positive and significant (at the 1 percent level) coefficient, which is in line with Hypothesis 3 and the predictions of the Holmstrom and Milgrom (1991) model. Adding bank controls and time effects in column (2) does not change this result. The bank controls largely come out as expected. The coefficient of *Size* is positive and significant. This implies large banks are associated with large loan loss provisions, as expected. The effect of *Capital ratio* on loan performance is ambiguous reflecting the contradicting arguments in the literature. *Liquidity ratio* and *Deposit ratio* are negatively associated with loan performance but insignificant.

Columns (3) in Table 6 report the effects on loan performance with control variables for the business cycle and income smoothing, in addition to bank controls. The coefficient



for  $BC$  ( $\Delta GDP$ ) is negative, which implies when there is an economic boom, there are fewer loan losses, in line with expectations. The coefficient for  $IS$  ( $\frac{Earnings}{Asset}$ ) is positive but insignificant. The positive sign is in line with the income smoothing hypothesis, which implies banks smooth income by increasing loan loss provision when earnings are increasing. The coefficients for  $\hat{\beta}ratio$  remain positive and significant in column (3). This result are robust to including the crisis period in columns (4), (5), and (6) in Table 6.

This results are in line with hypothesis 3: If pay in investment banking is more performance-sensitive pay than in commercial banking within universal banks, the loan performance worsens. This might be due to the attention distortion away from commercial banking. The attention devoted to screening and monitoring loans may be influenced by the compensation structure within universal banks. Within the bank, more attention may be devoted to investment banking, rather than commercial banking, because the salaries of bank employees respond much more strongly to success in investment banking than to commercial banking.

We want make sure that the effect is indeed due to the difference in pay-performance sensitivity between investment and commercial banking and not due to a higher propensity of the bank to take risk overall, which in turn affects pay-performance sensitivities. Hence, we estimate a model in which we include  $RC_i$ , which equals one if  $\hat{\beta}_{i,IB}$  and  $\hat{\beta}_{i,CB}$  are larger than median of each segment pay-performance sensitivity in universal banks, and zero otherwise. We include both the dummy by itself and also interact it with the variable of interest,  $\hat{\beta}ratio$  as in the following equation:

$$Y_{i,t} = \alpha + \delta_1 \hat{\beta}ratio_i + \delta_2 \hat{\beta}ratio_i \cdot RC_i + \gamma RC_i + \phi BC_t + \rho IS_{i,t} + X'_{i,t} \lambda + \mu_{i,t} \quad (3)$$

Table 7 shows the results. During the pre-crisis period (columns (1)-(3)), those banks with high risk culture exhibit a stronger attention distortion effect than those banks with low risk culture. The difference is significant at least at the five percent level. We do not find this effect once we include the crisis period.

Alternatively, we include the pay-performance sensitivity for commercial banking separately in the regressions as an additional control variable. That would more cleanly

differentiate the effects coming from a greater pay-performance sensitivity in commercial banking (which we are not interested in) and the relative pay-performance sensitivity between IB and CB, which we are. We use the following regression:

$$Y_{i,t} = \alpha + \delta \hat{\beta} ratio_i + \gamma \hat{\beta}_{CB,i} + \phi BC_t + \rho IS_{i,t} + X'_{i,t} \lambda + \mu_{i,t} \quad (4)$$

Table 8 reports the results. We find that the magnitude of the effect of the relative pay-performance sensitivity becomes much larger than the baseline in Table 6, especially in the pre-crisis period.

The economic magnitude of the coefficients differs significantly across specifications. The economic magnitude of the effect in the baseline is small. Removing investment banking from the average universal bank would reduce loan loss provisions by about 1 percent. Including the crisis period reduces the coefficients in columns (5) and (6). This implies that during the crisis banks become more risk averse and the attention distortion effect becomes smaller. However, in the following extension we find a larger effects when we control for bank's risk culture and high pay-performance sensitivity of commercial banking segment.

Overall, in this section we uncover three main results. First, we find a significantly positive relationship between the ratio of pay-performance sensitivity of investment banking and commercial banking and the quality of the loan portfolio. This relationship is robust to including a number of different sets of control variables. Second, the effect for average universal banks is small, but in the case of banks that rely more on incentive based pay overall (both for investment banking and commercial banking), i.e. that exhibit what we label a "high risk culture", removing investment banking from universal banks may substantially reduce risk taking. For those banks, our estimates for the reduction in loan loss provisions would be about a 12 percent reduction.

## 7 Robustness

### *Timing of changes in compensation*

Jensen and Murphy (1990) point out that the timing of performance payments may not be perfectly synchronous with performance. For example, compensation decisions may be made before performance data is available for the current fiscal year. They find that the changes in compensation are related to lagged performance as well as current performance measures. In a similar vein, Fields and Fraser (1999) estimate pay-performance sensitivity for both contemporaneous and lagged performance measures. They propose that the sum of both estimates for contemporaneous and lagged performance may describe the relationship between compensation and performance better than the estimates for contemporaneous pay-performance sensitivity alone, which may be depending on the firm's policy.

In order to address this question, we estimate the following regression separately for each segment:

$$\Delta COMPENSATION_{k,t} = \alpha + \beta_{1,k} \Delta REVENUE_{k,t} + \beta_{2,k} \Delta REVENUE_{k,t-1} + \varepsilon_{k,t} \quad (5)$$

where  $k \in \{IBsegment, CBsegment\}$  and  $t$  year.

Table 10 in Appendix B shows the estimation results for  $\hat{\beta}_1$ ,  $\hat{\beta}_2$ , and  $\hat{\beta}'$ , which is the sum of  $\hat{\beta}_1$  and  $\hat{\beta}_2$  for the investment banking and commercial banking segments.  $\hat{\beta}_1$  measures segment pay-performance sensitivity in the same year.  $\hat{\beta}_2$  measures segment pay-performance sensitivity relative to performance lagged by one year. The results suggest that adding lagged revenue does not significantly improve the estimation. In only very few cases we find a significant coefficient for lagged revenue. Applying the t-test for mean values for each bank type and segment shown in the Table 10 at the bottom of each panel, we find the same result as in the baseline, which implies that there is no significant difference in the pay-performance sensitivity between universal banks and specialized banks. This is confirmed by the Kolmogorov-Smirnov test. We also re-estimated the second stage regressions (not reported) and found consistent results.

### *Alternative measure of segment revenue*

A simple alternative way to measure business segment revenue is to simply use interest income as the revenue for commercial banking and non-interest revenue for investment banking. While we would argue that our measure more accurately reflects the activities in the respective segments, it is interesting to see whether the results are robust to this change. The estimation results of universal banks in Table 11 in the Appendix B show largely consistent results for commercial banking and for specialized investment banks. However, the estimated pay-performance sensitivity for the investment banking segment within universal banks comes out significantly higher than in the baseline. With these results for the pay-performance sensitivity, we rerun the baseline regressions for the second step and find consistent results (not reported).

### *Alternative measures for loan performance*

Following Laeven and Majnoni (2003), we take loan loss provision at time  $t$  divided by total assets at time  $t - 1$  as dependent variable to avoid potential endogeneity between flow variable and stock variable. The results in Table 12 do not make much change in the baseline results.

Even though we address the business cycle and the income smoothing in the baseline model, there might still be concern regarding the validity of the loan loss provision as the dependent variable for loan performance measure. The loan loss provision is not a realized measure of loan performance, but rather a forward looking expectation of loan losses based on managerial prediction. Hence, as an alternative we adopt the loan charge-offs and non-performing loans as our measure of loan performance. Loan charge-offs are defined as the natural logarithm of the charge-offs ( $ChO$ ) over total assets ( $\ln(\frac{ChO}{Asset})$ ). Non-performing loans are defined as the natural logarithm of the non-performing loans ( $NPL$ ) over total assets ( $\ln(\frac{NPL}{Asset})$ ). Tables 13 and 14 in the Appendix B show the results for 2nd step with the loan charge-offs and non performing loans as dependent variables.<sup>10</sup> The coefficients for  $\hat{\beta}ratio$  continue to be positive and significant.

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<sup>10</sup>We drop the income smoothing control for the alternative dependent variable as the income smoothing hypothesis applies only to loan loss provision.

### *Generated regressors*

In the second step we use generated regressors estimated from the first step, which may affect the standard errors in the second step. In theory, in order to deal with the adjustment of the standard errors of generated regressors, one would use bootstrapping by running both stages together in each bootstrap sample. Alternatively, we can adopt Murphy-Topel approach (Murphy and Topel, 1985; Hardin, 2002). However, to our setting both approaches are not suitable, as we do not have a nested model as in Hardin (2002), where predicted dependent variables or residuals are used as regressors for the second stage regression. We obtain two estimates from two separate regressions for IB and CB segments for each bank  $i$  in the first step and then use the ratio of the regressors in the second stage.

Alternatively, we can calculate a theoretical standard error based on a pooled OLS in the first stage with bootstrapping. From the distribution of  $\hat{\beta}$  in the first stage, we obtain the standard error for  $\hat{\beta}_{ratio}$  by assuming that  $\hat{\beta}_{IB}$  and  $\hat{\beta}_{CB}$  are uncorrelated, an assumption that, however, clearly is violated in our sample. Nevertheless, as long as the assumption holds, we might adjust the standard error in the second stage regression with theoretical standard error. However, the variance and expected values of reciprocal in the ratio of two estimates cannot be linearly calculated. Instead, if we take  $\Delta\hat{\beta} = \hat{\beta}_{IB} - \hat{\beta}_{CB}$  as an alternative explanatory variable with a linear combination form, it is more applicable to get the theoretical standard error with the assumption of independence or no correlation. From the first stage of pooled OLS using this alternative variable, we can adjust the theoretical standard error by bootstrapping, which still yields significant coefficients for  $\Delta\hat{\beta}$  in the second stage.

## 8 Conclusion

In this study, we analyze one particular theoretical foundation for the claim that combining investment banking with commercial banking within universal banks may be detrimental for financial stability. We argue that attention distortion away from commercial

banking induced by differences in pay-performance sensitivities within universal banks may result in a deterioration of the quality of loan portfolios in universal banks. The argument is motivated by the model of Holmstrom and Milgrom (1991). They show that if agents are confronted with multiple tasks, incentive pay allocates risks, motivates hard work and also directs the allocation of the agent's attention among various duties. Hence, we hypothesize that the loan performance is worse within universal banks when performance pay is more sensitive to the investment banking segment than to the commercial banking segment. As more attention is allocated to investment banking segment, the traditional business of commercial banking segment might perform worse.

We implement an empirical analysis using data on U.S. bank holding companies. We hand-collect a unique dataset for the compensation structure at the segment level and match this information with the Consolidated Financial Statements (FR Y-9C). As a first step, we investigate whether the incentive pay structure at the segment level differs across bank types, but not across activity types across institutions. Investment banking is associated with a higher pay-performance sensitivity than commercial banking whether it is organized as part of a universal bank or in a specialized institution. Further, we do not find a significant difference in pay-performance sensitivity between commercial banking within a universal bank and commercial banking within a specialized institution. We find these results to be robust across a wide variety of specifications.

As a second step, we test whether the differences between commercial banking and investment banking within universal banks in the pay-performance sensitivity affects the quality of the loan portfolio in universal banks. The results show that, when two different tasks are combined within an institution, the performance of commercial banking becomes relatively worse. This is consistent with the theory of Holmstrom and Milgrom (1991): in a setting with multiple tasks, attention is directed disproportionately to the task where the reward in the short term is highest and away from the task where compensation is less sensitive to performance. It is important to emphasize that we are able to clearly delineate the effect from the case, where the incentives of loan officers are distorted by volume-based incentive contracts as in Cole et al. (2015) and Behr et al. (2014).

The results suggest that removing investment banking from universal banks would significantly improve the quality of loan portfolios of these banks. In our preferred specification, where control for the risk culture of the bank, the improvement comes to about 12 percent. Hence, the results do support the recent proposals to separate investment banking from commercial banking (Volcker rule, Vickers report, Liikanen report), but the underlying mechanism at work is different from the previous literature. They also suggest that stricter rules on incentive based pay may serve the same purpose without incurring the potentially large re-organization costs associated with separating universal banks into an investment and a commercial bank.

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Table 2: Variable Definitions and Sources

This table describes variable definitions and data sources.

Variable	Definition	Source
<i>Panel A: 1st Step</i>		
<i>Dependent Variable</i>		
$\Delta COMPENSATION$	First difference of segment non-interest expense. Proxy for segment compensation	SEC Filing Form 10-K
<i>Explanatory Variable</i>		
$\Delta REVENUE$	First difference of segment revenue (= net interest income + non-interest revenue)	SEC Filing Form 10-K
<i>Panel B: 2nd Step</i>		
<i>Dependent Variable</i>		
$\ln(\frac{LLP}{Asset})$	Natural logarithm of the ratio of provision for loan and lease losses (BHCK4230) to total assets	FR Y9-C, Fed Chicago
$\ln(\frac{ChO}{Asset})$	Natural logarithm of the ratio of charge-offs on allowances for loan and lease losses (BHCK4635) to total assets	FR Y9-C, Fed Chicago
$\ln(\frac{NPL}{Asset})$	Natural logarithm of the ratio of non-performing loans of past due 90 days or more (BHCK5525) to total assets	FR Y9-C, Fed Chicago
<i>Explanatory Variables</i>		
$\hat{\beta}_{IB}$	Regression coefficients for investment banking segment pay-performance sensitivity	1st Step
$\hat{\beta}_{CB}$	Regression coefficients for commercial banking segment pay-performance sensitivity	1st Step
<i>Control Variables</i>		
Bank specific characteristics		
<i>Size</i>	Natural logarithms of total assets (BHCK2170)	FR Y9-C, Fed Chicago
<i>Capital Ratio</i>	Total equity (BHCK3210) divided by total assets	FR Y9-C, Fed Chicago
<i>Earnings Ratio</i>	Net income before taxes and loan loss provision (BHCK4301+BHCK4230) divided by total assets	FR Y9-C, Fed Chicago
<i>Liquidity Ratio</i>	Cash and Balances at other depository institutions (BHCK0081+BHCK0395+BHCK0397) divided by total assets	FR Y9-C, Fed Chicago
<i>Deposit Ratio</i>	Total deposits (BHDM6631+BHDM6636) divided by total assets	FR Y9-C, Fed Chicago

Table 3: Summary Statistics

This table presents summary statistics, reporting variable names, means, medians, standard deviations, and the number of observations for which data is available in our sample from 1997 to 2009. All variables are based on annual bank data. The sources are: SEC Filings Form 10-K from EDGAR and FR Y9-C from Fed Chicago.

Variable Group and Name	Unit	Mean	Median	SD	N
<i>Panel A: Segment Variables</i>					
<b>IB segment</b>					
Non-interest expense	USD mil.	3,145	432	6,139	385
Revenue	USD mil.	4,602	592	9,293	395
<b>CB segment</b>					
Non-interest expense	USD mil.	2,094	436	4,811	558
Revenue	USD mil.	4,520	829	9,994	561
<i>Panel B: Bank Variables</i>					
Loan loss provision (LLP)	USD mil.	1,099	45	4,177	535
$\frac{LLP}{Asset}$	%	0.48	0.25	0.71	535
Charge-offs (ChO)	USD mil.	1,001	48	3,347	535
$\frac{ChO}{Asset}$	%	0.47	0.29	0.60	535
Non-performing loans (NPL)	USD mil.	553	21	2,789	535
$\frac{NPL}{Asset}$	%	0.19	0.13	0.26	535
$\hat{\beta}_{IB}$	See Table 5				
$\hat{\beta}_{CB}$	See Table 5				
Total Assets	USD mil.	134,885	18,148	341,498	535
Size	logarithm	10.20	9.81	1.69	535
Capital Ratio	%	9.09	8.89	2.05	535
Earnings Ratio	%	2.06	2.05	0.80	535
Liquidity Ratio	%	5.16	3.54	5.87	534
Deposit Ratio	%	63.91	67.36	18.35	535

Table 4: Sample Differences

This table presents variable means and differences in means for the samples of universal banks (UB), investment banks (IB), and commercial banks (CB) by segments in the period of 1997-2009 in our sample. All variables are calculated based on annual bank observations. Unless otherwise stated, the data is reported in percentages. Significance levels are indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

Variable	Unit	IB segment			CB segment		
		IB	UB	Difference (IB-UB)	CB	UB	Difference (CB-UB)
<b>Panel A: Segment Variables</b>							
Non-interest Expense	USD mil.	8,075	2,162	5,913***	517	3,174	-2.657***
Revenue	USD mil.	11,810	3,258	8,552***	1,800	6,442	-4,642***
$\Delta$ Non-interest Expense	USD mil.	725	239	486**	36	320	-284**
$\Delta$ Revenue	USD mil.	1,098	456	642	89	674	-585**
<b>Panel B: Bank variables</b>							
Loan loss provision	USD mil.	48	1,761	-1,713*	187	1,744	-1,557***
$\frac{LLP}{Asset}$	%	0.04	0.55	-0.51***	0.45	0.55	-0.10
Charge-offs	USD mil.	34	1,590	-1,556**	195	1,576	-1,381***
$\frac{ChO}{Asset}$	%	0.04	0.54	-0.50***	0.43	0.54	-0.11*
Non-performing loans	USD mil.	55	916	-860	42	906	-864***
$\frac{NPL}{Asset}$	%	0.04	0.23	-0.19***	0.14	0.23	-0.09***
Total Assets	USD mil.	133,290	207,483	-74,193	16,374	205,548	-189,174***
Size	logarithm	11.33	10.78	0.55*	9.08	10.76	-1.68***
Capital Ratio	%	7.37	8.93	-1.56***	9.68	8.91	0.77***
Earnings Ratio	%	1.52	2.10	-0.58***	2.07	2.10	-0.03
Liquidity Ratio	%	25.01	4.56	20.45***	3.02	4.56	-1.54***
Deposit Ratio	%	25.15	63.22	-38.07***	71.01	63.48	7.53***

Table 5: 1st Step: Pay-Performance Sensitivity Estimates by BHCs

This table describes the list of Bank Holding Companies (BHCs) in the sample and the first step pay-performance sensitivity estimates over the period from 1997 to 2006. The asset size is recorded as of the end of year 2014. Share indicates asset share among total BHCs. Bank types are universal banks, investment banks, and commercial banks.

$$\Delta COMPENSATION_{k,t} = \alpha_k + \beta_k \Delta REVENUE_{k,t} + \varepsilon_{k,t}$$

where  $k \in \{IBsegment, CBsegment\}$ . Significance levels are indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

Bank	IB segment ( $\hat{\beta}_{IB}$ )	CB segment ( $\hat{\beta}_{CB}$ )	Asset (USD bil.)	Share (%)
	(1997-2006)	(1997-2006)		
<b>Panel A: Universal Bank</b>				
JPMorgan Chase & Co.	0.534**	0.393***	2,573	15.5
Bank of America Corporation	0.408***	0.357***	2,107	12.7
Citigroup Inc.	0.424	0.492***	1,843	11.1
Wells Fargo & Company	0.680***	0.585**	1,687	10.1
U.S. Bancorp	0.859***	0.050	403	2.4
PNC Financial Services Group, Inc.	0.733***	0.686***	345	2.1
HSBC North America Holdings Inc.	0.571***	0.607***	290	1.7
Suntrust Bank, Inc.	0.170	0.037	190	1.1
BB&T Corporation	0.777***	-0.059	187	1.1
Fifth Third Bankcorp	0.456***	0.232**	139	0.8
Regions Financial Corporation	0.831***	0.400**	120	0.7
M&T Bank Corporation	-0.029	0.495***	97	0.6
Keycorp	0.620***	0.684***	94	0.6
Comercia Incorporated	0.259**	0.272*	69	0.4
Huntington Bancshares Incorporated	0.448**	0.889***	66	0.4
Zions Bancorporation	0.177	0.321**	57	0.3
SVB Financial Group	0.018	0.411***	39	0.2
First Citizens Bancshares, Inc.	-0.154	0.255	30	0.2
BOK Financial Corporation.	0.716***	0.522**	29	0.2
Cullen/Frost Bankers, Inc.	0.837***	0.484**	28	0.2
Associated Banc-Corp	0.875***	0.426**	27	0.2
First Horizon National Corporations	0.566	0.315	26	0.2
Commerce Bancshares, Inc.	0.253	0.017	24	0.1
Hancock Holding Company	2.372	0.499***	21	0.1
Wintrust Financial Corporation	0.959***	0.312	20	0.1
Valley National Bancorp	0.198**	0.290	19	0.1
Bank of Hawaii Corporation	0.676*	-0.252	15	0.1
Mean (UB)	0.564	0.360		
Median (UB)	0.566	0.393		
SD (UB)	0.470	0.250		
Min (UB)	-0.154	-0.252		
Max (UB)	2.372	0.889		
N (UB)	27	27		
Mean Difference ( $\hat{\beta}_{IB} - \hat{\beta}_{CB}$ )	0.204**			
<b>Significant coefficients (10% level) for both IB and CB segments only</b>				
Mean (UB)	0.613	0.503		
N (UB)	13	13		
Mean Difference ( $\hat{\beta}_{IB} - \hat{\beta}_{CB}$ )	0.110			
$p$ -value for $\hat{\beta}_{IB} - \hat{\beta}_{CB} > 0$	(0.059)			

Continues from the previous page.

Bank	IB segment ( $\hat{\beta}_{IB}$ ) (1997-2006)	CB segment ( $\hat{\beta}_{CB}$ ) (1997-2006)	Asset (USD bil.)	Share (%)
<b>Panel B: Investment Bank</b>				
Goldman Sachs Group, Inc.	0.539***		856	5.1
Morgan Stanley	0.514***		802	4.8
Bank of New York Mellon	0.478*		385	2.3
State Street Corporation	0.213		274	1.6
Northern Trust Corporation	0.474***		110	0.7
Mean (IB)	0.443			
Median (IB)	0.478			
SD (IB)	0.132			
Min (IB)	0.213			
Max (IB)	0.539			
N (IB)	5			
Mean Difference (UB-IB)	0.121			
<b>Significant coefficients (10% level) for IB segment only</b>				
Mean (IB)	0.501			
N (IB)	4			
Mean Difference (UB-IB)	0.112			
<b>Panel C: Commercial Bank</b>				
Capital One Financial Corporation		0.162**	309	1.9
Ally Financial Inc.		0.026	152	0.9
New York Community Bancorp, Inc.		0.040	49	0.3
First Niagara Financial Group, Inc.		0.436***	39	0.2
Popular, Inc.		-0.012	33	0.2
City National Corporation		0.124	33	0.2
East West Bancorp, Inc.		0.390***	29	0.2
Synovus Financial Corp.		0.673***	27	0.2
Firstmerit Corporation		0.430	25	0.1
Prosperity Bancshares, Inc.		0.392***	22	0.1
TCF Financial Corporation		0.285*	19	0.1
Susquehanna Bancshares, Inc.		0.602***	19	0.1
Fulton Financial Corporation		0.756***	17	0.1
Iberiabank Corporation		0.698**	16	0.1
Privatebancorp, Inc.		0.186	16	0.1
Bancorpsouth, Inc.		0.646**	13	0.1
International Bancshares Corporation		0.405*	12	0.1
Mean (CB)		0.367		
Median (CB)		0.392		
SD (CB)		0.250		
Min (CB)		-0.012		
Max (CB)		0.756		
N (CB)		17		
Mean Difference (UB-CB)		-0.007		
<b>Significant coefficients (10% level) for CB segment only</b>				
Mean (CB)		0.495		
N (CB)		11		
Mean Difference (UB-CB)		0.008		



Table 6: 2nd Step: Effects on Loan Performance

This table reports the effects of the pay-performance sensitivity on loan loss provision in universal banks. The pay-performance sensitivity is estimated over pre-crisis period (1997-2006) and the loan loss provision includes pre-crisis and during crisis period.

$$Y_{i,t} = \alpha + \delta \hat{\beta}ratio_i + \phi BC_t + \rho IS_{i,t} + X'_{i,t} \lambda + \mu_{i,t}$$

where  $\hat{\beta}ratio_i = \frac{\hat{\beta}_{i,IB}}{\hat{\beta}_{i,CB}}$ .  $\hat{\beta}_{i,k}$  indicates the estimates of pay-performance sensitivity of segment  $k \in \{IBsegment, CBsegment\}$  in bank  $i$ .  $Y_{i,t}$  is loan loss provision ( $\ln(\frac{LLP}{Asset})$ ) in the pre-crisis period (1997-2006) and pre- and during crisis period (1997-2009).  $BC_t$  indicates business cycle approximated by annual real GDP growth.  $IS_{i,t}$  captures income smoothing by earnings before taxes and loan loss provision over total assets.  $X_{i,t}$  is vector of bank characteristics in pre-crisis period (1997-2006) and pre- and during crisis period (1997-2009). Significance levels are indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ . Robust standard errors are in the parentheses.

$\ln(\frac{LLP}{Asset})$	Pre-crisis (1997-2006)			Pre- and during crisis (1997-2009)		
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\beta}ratio_i$ (1997-2006)	0.026*** (0.008)	0.026*** (0.007)	0.020*** (0.007)	0.016* (0.009)	0.017*** (0.006)	0.016** (0.007)
<i>Size</i>		0.192*** (0.060)	0.169*** (0.061)		0.169*** (0.046)	0.168*** (0.046)
<i>Capital Ratio</i>		-0.694 (3.200)	-4.677 (3.280)		1.907 (2.700)	1.431 (2.686)
<i>Liquidity Ratio</i>		-1.399 (1.954)	-1.418 (1.891)		-1.605 (1.200)	-1.599 (1.187)
<i>Deposit Ratio</i>		-0.365 (0.630)	-0.358 (0.596)		-0.710 (0.495)	-0.697 (0.491)
<i>BC(<math>\Delta</math>GDP)</i>			-0.228*** (0.058)			-0.509*** (0.039)
<i>IS(<math>\frac{Earnings}{Assets}</math>)</i>			27.022 (8.687)			4.546 (7.122)
Constant	-6.097*** (0.070)	163.535*** (40.391)	232.346*** (43.529)	-5.761*** (0.935)	-239.170*** (33.145)	375.232*** (50.412)
Time effects	No	Yes	Yes	No	Yes	Yes
SE	Robust	Robust	Robust	Robust	Robust	Robust
N. Obs	231	231	231	312	312	312
R <sup>2</sup>	0.02	0.35	0.38	0.01	0.57	0.57

Table 7: 2nd Step: Risk Culture Effects on Loan Performance

This table reports the risk culture effects of the pay-performance sensitivity on loan loss provision in universal banks. The pay-performance sensitivity is estimated over pre-crisis period (1997-2006) and the loan loss provision includes pre-crisis and during crisis period.

$$Y_{i,t} = \alpha + \delta_1 \hat{\beta}ratio_i + \delta_2 \hat{\beta}ratio_i \cdot RC_i + \gamma RC_i + \phi BC_t + \rho IS_{i,t} + X'_{i,t} \lambda + \mu_{i,t}$$

where  $\hat{\beta}ratio_i = \frac{\hat{\beta}_{i,IB}}{\hat{\beta}_{i,CB}}$ .  $\hat{\beta}_{i,k}$  indicates the estimates of pay-performance sensitivity of segment  $k \in \{IBsegment, CBsegment\}$  in bank  $i$ .  $Y_{i,t}$  is loan loss provision ( $\ln(\frac{LLP}{Asset})$ ) in the pre-crisis period (1997-2006) and pre- and during crisis period (1997-2009).  $RC_i$  is a dummy variable for risk culture of bank  $i$ , which equals one if  $\hat{\beta}_{i,IB}$  and  $\hat{\beta}_{i,CB}$  are larger than median of each segment pay-performance sensitivity in universal banks, and zero otherwise.  $BC_t$  indicates business cycle approximated by annual real GDP growth.  $IS_{i,t}$  captures income smoothing by earnings before taxes and loan loss provision over total assets.  $X_{i,t}$  is vector of bank characteristics in pre-crisis period (1997-2006) and pre- and during crisis period (1997-2009). Significance levels are indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ . Robust standard errors are in the parentheses.

$\ln(\frac{LLP}{Asset})$	Pre-crisis (1997-2006)			Pre- and during crisis (1997-2009)		
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\beta}ratio_i$ (1997-2006)	0.031*** (0.008)	0.028*** (0.007)	0.020*** (0.008)	0.015* (0.009)	0.019*** (0.006)	0.017** (0.007)
$\hat{\beta}ratio_i \cdot RC_i$ (1997-2006)	0.172*** (0.064)	0.159** (0.078)	0.220*** (0.071)	0.091 (0.066)	0.068 (0.071)	0.077 (0.072)
$\hat{\beta}ratio_i$ + $\hat{\beta}ratio_i \cdot RC_i$	0.204*** (0.066)	0.187** (0.079)	0.239*** (0.072)	0.106 (0.067)	0.087 (0.072)	0.094 (0.073)
$BC(\Delta GDP)$			-0.233*** (0.059)			-0.507*** (0.039)
$IS(\frac{Earnings}{Assets})$			31.617*** (8.899)			5.152 (7.487)
Constant	-7.253*** (0.939)	156.848*** (41.439)	222.544*** (44.268)	-9.170*** (0.966)	-242.211*** (33.670)	369.471*** (51.347)
Time effects	No	Yes	Yes	No	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
SE	Robust	Robust	Robust	Robust	Robust	Robust
N. Obs	231	231	231	312	312	312
R <sup>2</sup>	0.20	0.38	0.41	0.21	0.58	0.58

Table 8: 2nd Step: Risk Culture Effects by Disentangling  $\hat{\beta}_{CB}$

This table reports the risk culture effects by disentangling the effects of the CB segment pay-performance sensitivity on loan loss provision in universal banks. The pay-performance sensitivity is estimated over pre-crisis period (1997-2006) and the loan loss provision includes pre-crisis and during crisis period.

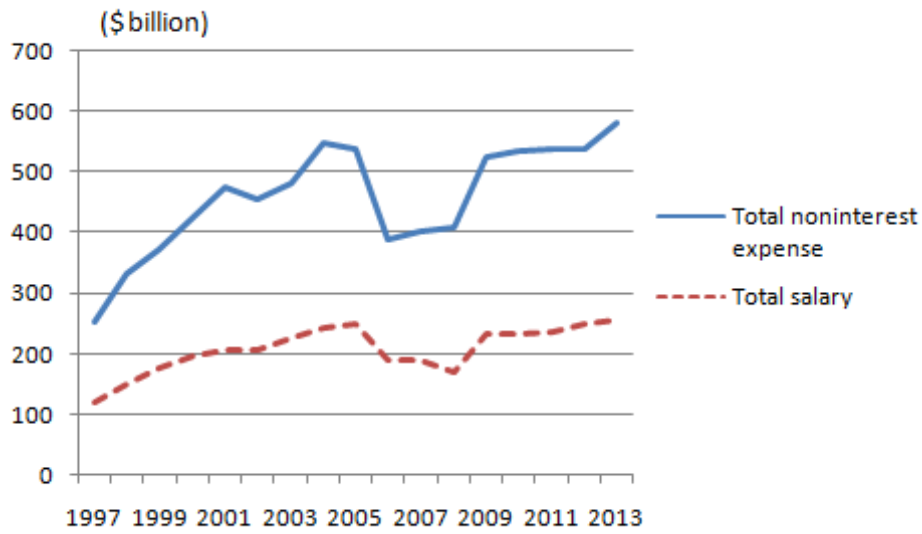
$$Y_{i,t} = \alpha + \delta \hat{\beta}ratio_i + \gamma \hat{\beta}_{CB,i} + \phi BC_t + \rho IS_{i,t} + X'_{i,t} \lambda + \mu_{i,t}$$

where  $\hat{\beta}ratio_i = \frac{\hat{\beta}_{i,IB}}{\hat{\beta}_{i,CB}}$ .  $\hat{\beta}_{i,k}$  indicates the estimates of pay-performance sensitivity of segment  $k \in \{IBsegment, CBsegment\}$  in bank  $i$ .  $Y_{i,t}$  is loan loss provision ( $\ln(\frac{LLP}{Asset})$ ) in the pre-crisis period (1997-2006) and pre- and during crisis period (1997-2009).  $BC_t$  indicates business cycle approximated by annual real GDP growth.  $IS_{i,t}$  captures income smoothing by earnings before taxes and loan loss provision over total assets.  $X_{i,t}$  is vector of bank characteristics in pre-crisis period (1997-2006) and pre- and during crisis period (1997-2009). Significance levels are indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ . Robust standard errors are in the parentheses.

$\ln(\frac{LLP}{Asset})$	Pre-crisis (1997-2006)			Pre- and during crisis (1997-2009)		
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\beta}ratio_i$ (1997-2006)	0.059*** (0.014)	0.052*** (0.013)	0.046*** (0.013)	0.037*** (0.013)	0.042*** (0.010)	0.040*** (0.011)
$\hat{\beta}_{CB,i}$ (1997-2006)	0.920** (0.383)	0.865** (0.364)	0.823** (0.367)	0.711** (0.342)	0.777*** (0.277)	0.791*** (0.279)
$BC(\Delta GDP)$			-0.237*** (0.058)			-0.505*** (0.039)
$IS(\frac{Earnings}{Assets})$			29.859*** (8.869)			6.018 (6.641)
Constant	-7.078*** (0.956)	148.215*** (41.315)	221.876*** (41.649)	-9.141*** (0.935)	-250.105*** (33.484)	357.415*** (51.110)
Time effects	No	Yes	Yes	No	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
SE	Robust	Robust	Robust	Robust	Robust	Robust
N. Obs	231	231	231	312	312	312
R <sup>2</sup>	0.22	0.39	0.41	0.23	0.59	0.60

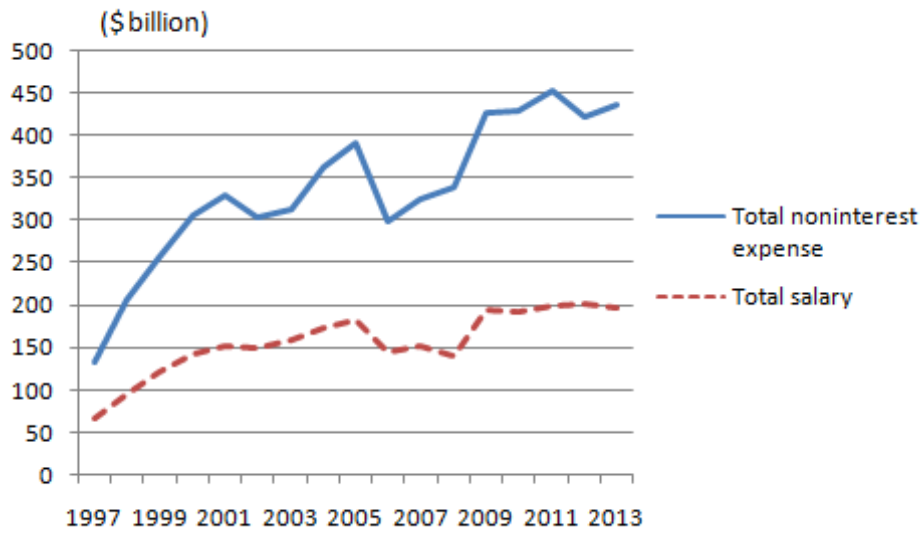
## Appendix A: Overview of BHC Expense Structure

Figure 1: Expense Composition in BHCs



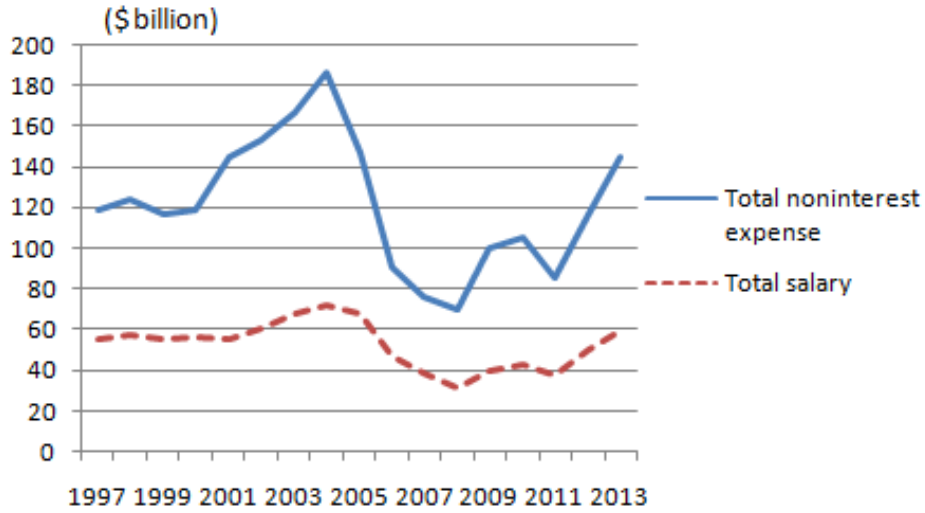
Total BHCs (Correlation = 0.98)

Figure 2: Expense Composition in Large BHCs



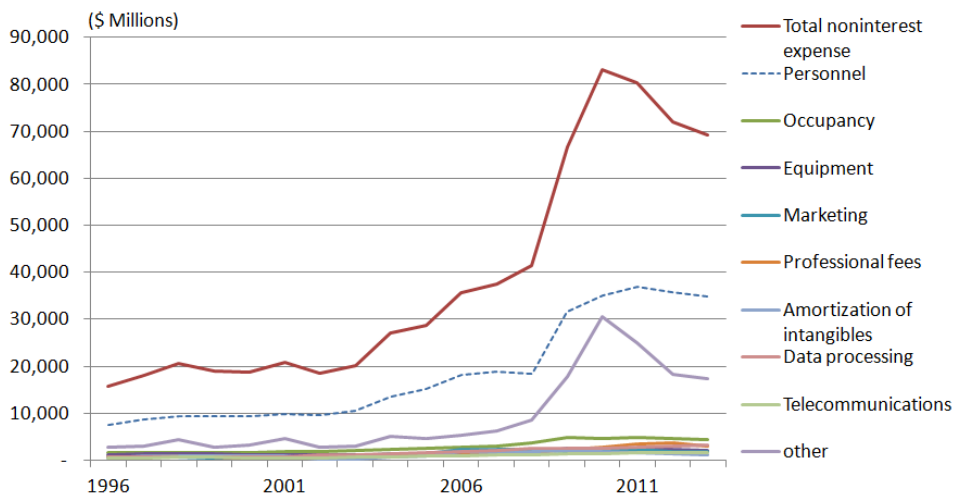
Large BHCs (Correlation = 0.98)

Figure 3: Expense Composition in Small BHCs



Small BHCs (Correlation = 0.94)

Figure 4: Example of BHC Non-interest Expense : Bank of America



\*Jump of other expense around 2010 covers the expense for merger of Merrill Lynch

## Appendix B : Robustness Tests

Table 9: Pay-Performance Sensitivity Estimates by Average Compensation

This table describes robustness of the first step pay-performance sensitivity estimates comparing with average compensation over the period from 1997 to 2006. Bank types are investment banks and commercial banks. Regressions for baseline with total compensation and robustness with average compensation are following:

$$\Delta COMPENSATION_{k,t} = \alpha_k + \beta_{1k} \Delta REVENUE_{k,t} + \varepsilon_{k,t}$$

$$\Delta (COMPENSATION/EMP)_{k,t} = \alpha_k + \beta_{2k} \Delta (REVENUE/EMP)_{k,t} + \varepsilon_{k,t}$$

where  $k \in \{IBsegment, CBsegment\}$  and  $EMP$  is the number of employees. Significance levels are indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

Bank	Baseline ( $\hat{\beta}_{1k}$ )	Average ( $\hat{\beta}_{2k}$ )	Difference ( $\hat{\beta}_{1k} - \hat{\beta}_{2k}$ )
<b><i>Panel A: Investment Bank</i></b>			
Goldman Sachs Group, Inc.	0.539***	0.648**	-0.109
Morgan Stanley	0.514***	0.511***	0.003
Bank of New York Mellon	0.478*	0.404*	0.074
State Street Corporation	0.213	0.133	0.080
Northern Trust Corporation	0.474***	0.455***	0.019
Mean (IB)	0.443	0.430	
Median (IB)	0.478	0.455	
SD (IB)	0.132	0.189	
Min (IB)	0.213	0.133	
Max (IB)	0.539	0.647	
N (IB)	5	5	
<b><i>Panel B: Commercial Bank</i></b>			
Capital One Financial Corporation	0.162**	0.141*	0.021
Ally Financial Inc.	0.026	0.032	-0.006
New York Community Bancorp, Inc.	0.040	0.119	-0.079
First Niagara Financial Group, Inc.	0.436***	0.379**	0.057
Popular, Inc.	-0.012	-0.008	-0.004
City National Corporation	0.124	0.182	-0.058
East West Bancorp, Inc.	0.390***	0.300	0.090
Synovus Financial Corp.	0.673***	0.742***	-0.069
Firstmerit Corporation	0.430	0.421	0.009
Prosperity Bancshares, Inc.	0.392***	0.723***	-0.331
TCF Financial Corporation	0.285*	0.339**	-0.054
Susquehanna Bancshares, Inc.	0.602***	0.576***	0.026
Fulton Financial Corporation	0.756***	0.785***	-0.029
Iberiabank Corporation	0.698**	0.681**	0.017
Privatebancorp, Inc.	0.186	0.938	-0.752
Bancorpsouth, Inc.	0.646**	0.662**	-0.016
International Bancshares Corporation	0.405*	0.231	0.174
Mean (CB)	0.367	0.426	
Median (CB)	0.392	0.379	
SD (CB)	0.250	0.292	
Min (CB)	-0.012	-0.008	
Max (CB)	0.756	0.938	
N (CB)	17	17	

Table 10: Pay-Performance Sensitivity Estimates for Different Timing by BHCs

This table describes the robustness test for contemporaneous and one year lagged pay-performance sensitivity estimates over the period from 1997 to 2006. Bank types are universal banks, investment banks, and commercial banks.

$$\Delta COMPENSATION_{k,t} = \alpha_k + \beta_{1,k} \Delta REVENUE_{E_{k,t}} + \beta_{2,k} \Delta REVENUE_{E_{k,t-1}} + \varepsilon_{k,t}$$

where  $k \in \{IBsegment, CBsegment\}$  and  $\hat{\beta}' = (\hat{\beta}_1 + \hat{\beta}_2)$ . Significance levels are indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

Bank	IB segment ( $\hat{\beta}_{IB}$ )			CB segment ( $\hat{\beta}_{CB}$ )		
	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}'_{IB}$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}'_{CB}$
<b>Panel A: Universal Bank<sup>1)</sup></b>						
JPMorgan Chase & Co.	0.477*	0.068	0.545*	0.391**	-0.012	0.379**
Bank of America Corporation	0.416***	-0.152	0.264	0.415***	-0.088	0.326***
Citigroup Inc.	0.428	0.040	0.468	0.455**	-0.077	0.379
Wells Fargo & Company	0.729***	-0.345**	0.384	0.762**	0.333	1.094**
U.S. Bancorp	0.875***	-0.110	0.765**	0.051	-0.184	-0.133
PNC Financial Services Group, Inc.	0.707***	0.184	0.891***	0.721***	-0.118	0.603***
HSBC North America Holdings Inc.	0.596***	0.095	0.691*	0.611***	0.032	0.642***
Suntrust Bank, Inc.	0.182*	0.784**	0.966**	-0.238	0.560	0.322
BB&T Corporation	0.614	-0.010	0.605	0.028	-0.346	-0.318
Fifth Third Bankcorp	0.456***	0.037	0.493**	0.225**	-0.090	0.135
Regions Financial Corporation	0.833***	0.017	0.850***	0.377*	0.026	0.402*
M&T Bank Corporation	-0.046	-0.101*	-0.147*	0.568***	0.140	0.709**
Keycorp	0.619***	0.008	0.627***	0.687***	0.015	0.702***
Comercia Incorporated	0.241**	-0.143	0.098	0.414***	-0.319**	0.095
Huntington Bancshares Incorporated	0.377	-0.028	0.349	0.927***	0.059	0.986**
Zions Bancorporation	0.361**	0.268**	0.629**	0.290**	0.235	0.525**
SVB Financial Group	-0.014	-0.030	-0.044	0.425**	-0.027	0.380**
First Citizens Bancshares, Inc.	-0.169	0.297**	0.128	0.318	0.059	0.378
BOK Financial Corporation.	0.721***	0.018	0.739***	0.109	-0.605**	-0.496
Cullen/Frost Bankers, Inc.	0.830**	0.042	0.872**	0.613*	-0.369	0.244
Associated Banc-Corp	0.871***	0.120	0.992***	0.401**	-0.001	0.400
Commerce Bancshares, Inc.	0.171	0.352***	0.523***	0.040	-0.041	-0.001
Hancock Holding Company	1.355	-0.525	0.831	0.546**	-0.017	0.530
Wintrust Financial Corporation	0.969***	0.041	1.010**	0.612**	0.751**	1.363**
Valley National Bancorp	0.213**	-0.109	0.104	0.676**	0.524**	1.200**
Bank of Hawaii Corporation	0.736	0.026	0.762	-0.663	-0.446	-1.109
Mean (UB)	0.521	0.032	0.554	0.375	-0.000	0.375
Median (UB)	0.536	0.022	0.616	0.414	-0.014	0.389
SD (UB)	0.352	0.238	0.329	0.341	0.306	0.527
Min (UB)	-0.169	-0.525	-0.150	-0.663	-0.605	-1.109
Max (UB)	1.355	0.784	1.010	0.927	0.751	1.363
N (UB)	26	26	26	26	26	26
Mean Difference ( $\hat{\beta}_1 - \hat{\beta}_2$ )	0.489***			0.375***		
Mean Difference ( $\hat{\beta}_{IB} - \hat{\beta}_{CB}$ )	0.146	0.032	0.178			
p-value for $\hat{\beta}_{IB} - \hat{\beta}_{CB} > 0$	(0.066)	(0.318)	(0.092)			

1) Estimation of First Horizon National Corporation is not available due to small number of observations.

Continues from the previous page.

Bank	IB segment ( $\hat{\beta}_{IB}$ )			CB segment ( $\hat{\beta}_{CB}$ )		
	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_{IB}$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_{CB}$
<b>Panel B: Investment Bank</b>						
Goldman Sachs Group, Inc.	0.505***	0.019	0.524**			
Morgan Stanley	0.473***	0.152**	0.624***			
Bank of New York Mellon	0.534**	-0.370	0.164			
State Street Corporation	0.211	0.135	0.347			
Northern Trust Corporation	0.478***	-0.011	0.468***			
Mean (IB)	0.440	-0.015	0.425			
Median (IB)	0.478	0.019	0.468			
SD (IB)	0.130	0.211	0.177			
Min (IB)	0.211	-0.370	0.164			
Max (IB)	0.534	0.152	0.624			
N (IB)	5	5	5			
Mean Difference ( $\hat{\beta}_1 - \hat{\beta}_2$ )	0.455**					
Mean Difference ( $UB - IB$ )	0.081	0.047	0.128			
<b>Panel C: Commercial Bank</b>						
Capital One Financial Corporation				0.169*	0.006	0.176
Ally Financial Inc.				0.039	0.038	0.077
New York Community Bancorp, Inc.				0.080	-0.121	-0.041
First Niagara Financial Group, Inc.				0.433***	0.126*	0.559***
Popular, Inc.				-0.014	-0.028	-0.042
City National Corporation				0.072	-0.103	-0.031
East West Bancorp, Inc.				0.030	0.473	0.503***
Synovus Financial Corp.				0.817***	-0.203*	0.615***
Firstmerit Corporation				0.450	-0.215	0.235
Prosperity Bancshares, Inc.				0.650***	-0.362**	0.287***
TCF Financial Corporation				0.160	0.049	0.209
Susquehanna Bancshares, Inc.				0.513***	-0.106	0.407**
Fulton Financial Corporation				0.757***	-0.052	0.704***
Iberiabank Corporation				0.809**	0.279	1.089*
Privatebancorp, Inc.				0.473	0.265	0.738*
Bancorpsouth, Inc.				0.652**	-0.196	0.457
International Bancshares Corporation				0.533*	0.318	0.851
Mean (CB)				0.390	0.010	0.400
Median (CB)				0.450	-0.028	0.407
SD (CB)				0.295	0.222	0.333
Min (CB)				-0.014	-0.362	-0.042
Max (CB)				0.817	0.473	1.089
N (CB)				17	17	17
Mean Difference ( $\hat{\beta}_1 - \hat{\beta}_2$ )				0.380***		
Mean Difference ( $UB - CB$ )				-0.014	-0.010	-0.024



Table 11: Pay-Performance Sensitivity Estimates by Segment Income

This table describes robustness of the first step pay-performance sensitivity estimates comparing with estimates with net interest income for commercial banks and non-interest income for investment banks over the period from 1997 to 2006. Bank types are universal banks, investment banks, and commercial banks. Regressions for baseline with total revenue and robustness by segment income are as following:

$$\Delta COMPENSATION_{k,t} = \alpha + \beta_k \Delta REVENUE_{k,t} + \varepsilon_{k,t}$$

$$\Delta COMPENSATION_{IB,t} = \alpha + \beta_{1,IB} \Delta NONINTEREST_{IB,t} + \varepsilon_t$$

$$\Delta COMPENSATION_{CB,t} = \alpha + \beta_{2,CB} \Delta INTEREST_{CB,t} + \varepsilon_t$$

where  $k \in \{IBsegment, CBsegment\}$ ,  $NONINTEREST$  is non-interest income, and  $INTEREST$  is net interest income. Significance levels are indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

Bank	Baseline Total revenue ( $\hat{\beta}_{IB}$ )	Robustness Non-interest income ( $\hat{\beta}_{1,IB}$ )	Difference ( $\hat{\beta}_{IB} - \hat{\beta}_{1,IB}$ )
<b>Panel A: Universal Bank, IB segment</b>			
JPMorgan Chase & Co.	0.534**	0.556***	-0.022
Bank of America Corporation	0.408***	0.758***	-0.350
Citigroup Inc.	0.424	- <sup>1)</sup>	-
Wells Fargo & Company	0.680***	0.989***	-0.309
U.S. Bancorp	0.859***	0.883***	-0.024
PNC Financial Services Group, Inc.	0.733***	0.832***	-0.099
HSBC North America Holdings Inc.	0.571***	1.158**	-0.587
Suntrust Bank, Inc.	0.170	1.053	-0.883
BB&T Corporation	0.777***	0.978***	-0.201
Fifth Third Bankcorp	0.456***	0.807***	-0.351
Regions Financial Corporation	0.831***	0.901***	-0.070
M&T Bank Corporation	-0.029	0.089	-0.118
Keycorp	0.620***	1.407***	-0.787
Comercia Incorporated	0.259**	0.390***	-0.131
Huntington Bancshares Incorporated	0.448**	0.753***	-0.305
Zions Bancorporation	0.177	0.186	-0.009
SVB Financial Group	0.018	0.025	-0.007
First Citizens Bancshares, Inc.	-0.154	-0.080	-0.074
BOK Financial Corporation.	0.716***	0.786**	-0.070
Cullen/Frost Bankers, Inc.	0.837***	1.187***	-0.350
Associated Banc-Corp	0.875***	0.887***	-0.012
First Horizon National Corporations	0.566	0.634	-0.068
Commerce Bancshares, Inc.	0.253	0.281	-0.028
Hancock Holding Company	2.372	1.199	1.173
Wintrust Financial Corporation	0.959***	1.155***	-0.196
Valley National Bancorp	0.198**	-0.034	0.232
Bank of Hawaii Corporation	0.676*	0.644	0.032
Mean (UB)	0.564	0.709	
Median (UB)	0.566	0.796	
SD (UB)	0.470	0.418	
Min (UB)	-0.154	-0.080	
Max (UB)	2.372	1.407	
N (UB)	27	26	

1) Estimation with segment non-interest income is not available for Citigroup Inc. as segment non-interest income has been separately reported from 2006.

*Continues from the previous page.*

<b>Bank</b>	<b>Baseline</b> Total revenue $(\hat{\beta}_{CB})$	<b>Robustness</b> Net interest income $(\hat{\beta}_{1,CB})$	<b>Difference</b> $(\hat{\beta}_{CB} - \hat{\beta}_{1,CB})$
<b><i>Panel B: Universal Bank, CB segment</i></b>			
JPMorgan Chase & Co.	0.393***	0.524***	-0.131
Bank of America Corporation	0.357***	0.318**	0.039
Citigroup Inc.	0.492***	-2)	-
Wells Fargo & Company	0.585**	0.588	-0.003
U.S. Bancorp	0.050	-0.016	-0.066
PNC Financial Services Group, Inc.	0.686***	1.108**	-0.422
HSBC North America Holdings Inc.	0.607***	0.884***	-0.277
Suntrust Bank, Inc.	0.037	0.053	-0.016
BB&T Corporation	-0.059	-0.131	0.072
Fifth Third Bankcorp	0.232**	0.252**	-0.020
Regions Financial Corporation	0.400**	0.489**	-0.089
M&T Bank Corporation	0.495***	0.718**	-0.223
Keycorp	0.684***	1.034***	-0.350
Comercia Incorporated	0.272*	0.269	0.003
Huntington Bancshares Incorporated	0.889***	-0.441	1.330
Zions Bancorporation	0.321**	0.315*	0.006
SVB Financial Group	0.411***	0.516***	-0.105
First Citizens Bancshares, Inc.	0.255	0.250	0.005
BOK Financial Corporation.	0.522**	0.382	0.140
Cullen/Frost Bankers, Inc.	0.484**	0.279	0.205
Associated Banc-Corp	0.426**	0.488*	-0.062
First Horizon National Corporations	0.315	0.796	-0.481
Commerce Bancshares, Inc.	0.017	-0.032	0.049
Hancock Holding Company	0.499***	0.587***	-0.088
Wintrust Financial Corporation	0.312	0.617*	-0.305
Valley National Bancorp	0.290	-0.094	0.384
Bank of Hawaii Corporation	-0.252	-0.300	0.048
Mean (UB)	0.360	0.364	
Median (UB)	0.393	0.350	
SD (UB)	0.250	0.391	
Min (UB)	-0.252	-0.441	
Max (UB)	0.889	1.108	
N (UB)	27	26	

2) Estimation with segment net interest income is not available for Citigroup Inc. as segment net interest income has been separately reported from 2006.

Continues from the previous page.

<b>Bank</b>	<b>Baseline</b> Total revenue $(\hat{\beta}_{IB})$	<b>Robustness</b> Non-interest income $(\hat{\beta}_{1,IB})$	<b>Difference</b> $(\hat{\beta}_{IB} - \hat{\beta}_{1,IB})$
<b><i>Panel C: Investment Bank</i></b>			
Goldman Sachs Group, Inc.	0.539***	0.530***	0.009
Morgan Stanley	0.514***	0.463***	0.051
Bank of New York Mellon	0.478*	0.792***	0.314
State Street Corporation	0.213	-0.010	0.223
Northern Trust Corporation	0.474***	0.598***	-0.124
Mean (IB)	0.443	0.475	
Median (IB)	0.478	0.530	
SD (CB)	0.132	0.297	
Min (CB)	0.213	-0.010	
Max (CB)	0.539	0.792	
N (IB)	5	5	
	<b>Baseline</b> Total revenue $(\hat{\beta}_{CB})$	<b>Robustness</b> Net interest income $(\hat{\beta}_{1,CB})$	<b>Difference</b> $(\hat{\beta}_{CB} - \hat{\beta}_{1,CB})$
<b><i>Panel D: Commercial Bank</i></b>			
Capital One Financial Corporation	0.162**	0.155	0.007
Ally Financial Inc.	0.026	0.020	0.006
New York Community Bancorp, Inc.	0.040	-0.010	0.050
First Niagara Financial Group, Inc.	0.436***	0.529***	-0.093
Popular, Inc.	-0.012	-0.401	0.389
City National Corporation	0.124	0.075	0.049
East West Bancorp, Inc.	0.390***	0.368***	0.022
Synovus Financial Corp.	0.673***	1.078*	-0.405
Firstmerit Corporation	0.430	0.505	-0.075
Prosperity Bancshares, Inc.	0.392***	0.453***	-0.061
TCF Financial Corporation	0.285*	0.493	-0.208
Susquehanna Bancshares, Inc.	0.602***	0.579**	0.023
Fulton Financial Corporation	0.756***	0.681***	0.075
Iberiabank Corporation	0.698**	1.443***	-0.745
Privatebancorp, Inc.	0.186	0.207	-0.021
Bancorpsouth, Inc.	0.646**	0.785***	-0.139
International Bancshares Corporation	0.405*	0.448	-0.043
Mean (CB)	0.367	0.436	
Median (CB)	0.392	0.453	
SD (CB)	0.250	0.432	
Min (CB)	-0.012	-0.401	
Max (CB)	0.756	1.443	
N (CB)	17	17	

Table 12: Effects on Loan Performance to Lagged Assets

This table reports the effects of pay-performance sensitivity on loan loss provision in universal banks. The pay-performance sensitivity is estimated over pre-crisis period (1997-2006) and the loan loss provision includes pre-crisis and during crisis period.

$$Y_{i,t} = \alpha + \delta \hat{\beta}ratio_i + \phi BC_t + \rho IS_{i,t} + X'_{i,t} \lambda + \mu_{i,t}$$

where  $\hat{\beta}ratio_i = \frac{\hat{\beta}_{i,IB}}{\hat{\beta}_{i,CB}}$ .  $\hat{\beta}_{i,k}$  indicates the estimates of pay-performance sensitivity of segment  $k \in \{IBsegment, CBsegment\}$  in bank  $i$ .  $Y_{i,t}$  is loan loss provision to lagged assets ( $\ln(\frac{LLP_t}{Asset_{t-1}})$ ) in the pre-crisis period (1997-2006) and pre- and during crisis period (1997-2009).  $BC_t$  indicates business cycle approximated by annual real GDP growth.  $IS_{i,t}$  captures income smoothing by earnings before taxes and loan loss provision over total assets.  $X_{i,t}$  is vector of bank characteristics in pre-crisis period (1997-2006) and pre- and during crisis period (1997-2009). Significance levels are indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ . Robust standard errors are in the parentheses.

$\ln(\frac{LLP_t}{Asset_{t-1}})$	Pre-crisis (1997-2006)			Pre- and during crisis (1997-2009)		
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\beta}ratio_i$ (1997-2006)	0.026*** (0.010)	0.026*** (0.008)	0.021** (0.009)	0.016 (0.010)	0.017** (0.006)	0.016** (0.007)
<i>Size</i>		0.245*** (0.066)	0.229*** (0.068)		0.220*** (0.049)	0.220*** (0.049)
<i>Capital Ratio</i>		-2.512 (3.708)	-5.868 (3.899)		0.259 (2.988)	0.020 (2.940)
<i>Liquidity Ratio</i>		-1.361 (2.150)	-1.469 (2.098)		-0.749 (1.362)	-0.751 (1.351)
<i>Deposit Ratio</i>		0.399 (0.686)	0.050 (0.658)		-0.314 (0.515)	-0.308 (0.514)
<i>BC (<math>\Delta GDP</math>)</i>			-0.181*** (0.061)			-0.509*** (0.040)
<i>IS (<math>\frac{Earnings}{Asset}</math>)</i>			21.732** (10.491)			2.237 (7.192)
Constant	-6.006*** (0.079)	231.439*** (49.679)	292.334*** (45.789)	-5.642*** (0.077)	-209.785*** (37.507)	455.485*** (60.175)
Time effects	No	Yes	Yes	No	Yes	Yes
SE	Robust	Robust	Robust	Robust	Robust	Robust
N. Obs	204	204	204	285	285	285
R <sup>2</sup>	0.02	0.38	0.40	0.01	0.58	0.58

Table 13: Effects on Alternative Measures of Loan Performance (Charge-offs)

This table reports the effects of pay-performance sensitivity on loan charge-offs in universal banks. The pay-performance sensitivity is estimated over pre-crisis period (1997-2006) and the loan loss provision includes pre-crisis and during crisis period.

$$Y_{i,t} = \alpha + \delta \hat{\beta}ratio_i + \phi BC_t + X'_{i,t} \lambda + \mu_{i,t}$$

where  $\hat{\beta}ratio_i = \frac{\hat{\beta}_{i,IB}}{\hat{\beta}_{i,CB}}$ .  $\hat{\beta}_{i,k}$  indicates the estimates of pay-performance sensitivity of segment  $k \in \{IBsegment, CBsegment\}$  in bank  $i$ .  $Y_{i,t}$  is loan charge-offs ( $\ln(\frac{ChO}{Asset})$ ) in the pre-crisis period (1997-2006) and pre- and during crisis period (1997-2009).  $BC_t$  indicates business cycle approximated by annual real GDP growth.  $X_{i,t}$  is vector of bank characteristics in pre-crisis period (1997-2006) and pre- and during crisis period (1997-2009). Significance levels are indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ . Robust standard errors are in the parentheses.

$\ln(\frac{ChO}{Asset})$	Pre-crisis (1997-2006)			Pre- and during crisis (1997-2009)		
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\beta}ratio_i$ (1997-2006)	0.020*** (0.007)	0.014** (0.006)	0.014** (0.006)	0.014** (0.007)	0.013** (0.005)	0.013** (0.005)
<i>Size</i>		0.142*** (0.039)	0.137*** (0.040)		0.142*** (0.046)	0.115*** (0.035)
<i>Capital Ratio</i>		9.716*** (2.404)	9.716*** (2.404)		9.179*** (2.159)	9.179*** (2.159)
<i>Liquidity Ratio</i>		3.318** (1.629)	3.318** (1.629)		1.145 (0.946)	1.145 (0.946)
<i>Deposit Ratio</i>		-0.833* (0.449)	-0.833* (0.449)		-1.115*** (0.394)	-1.115*** (0.394)
<i>BC (<math>\Delta GDP</math>)</i>			-0.136*** (0.046)			-0.372*** (0.036)
Constant	-5.796*** (0.051)	139.203*** (32.017)	194.112*** (35.101)	-5.602*** (0.053)	-155.642*** (27.055)	297.797*** (41.463)
Time effects	No	Yes	Yes	No	Yes	Yes
SE	Robust	Robust	Robust	Robust	Robust	Robust
N.Obs	235	235	235	316	316	316
R <sup>2</sup>	0.02	0.43	0.43	0.01	0.56	0.56

Table 14: Effects on Alternative Measures of Loan Performance (Non-performing loans)

This table reports the effects of pay-performance sensitivity on non-performing loans in universal banks. The pay-performance sensitivity is estimated over pre-crisis period (1997-2006) and the loan loss provision includes pre-crisis and during crisis period.

$$Y_{i,t} = \alpha + \delta \hat{\beta}ratio_i + \phi BC_t + X'_{i,t} \lambda + \mu_{i,t}$$

where  $\hat{\beta}ratio_i = \frac{\hat{\beta}_{i,IB}}{\hat{\beta}_{i,CB}}$ .  $\hat{\beta}_{i,k}$  indicates the estimates of pay-performance sensitivity of segment  $k \in \{IBsegment, CBsegment\}$  in bank  $i$ .  $Y_{i,t}$  is non-performing loans ( $\ln(\frac{NPL}{Asset})$ ) in the pre-crisis period (1997-2006) and pre- and during crisis period (1997-2009).  $BC_t$  indicates business cycle approximated by annual real GDP growth.  $X_{i,t}$  is vector of bank characteristics in pre-crisis period (1997-2006) and pre- and during crisis period (1997-2009). Significance levels are indicated by \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ . Robust standard errors are in the parentheses.

$\ln(\frac{NPL}{Asset})$	Pre-crisis (1997-2006)			Pre- and during crisis (1997-2009)		
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\beta}ratio_i$ (1997-2006)	0.022*** (0.008)	0.019** (0.009)	0.019** (0.009)	0.027*** (0.010)	0.021*** (0.008)	0.021*** (0.008)
<i>Size</i>		0.162*** (0.060)	0.162*** (0.060)		0.292*** (0.053)	0.292*** (0.053)
<i>Capital Ratio</i>		2.715 (4.567)	2.715 (4.567)		1.314 (3.337)	1.314 (3.337)
<i>Liquidity Ratio</i>		-6.070** (2.463)	-6.070** (2.463)		-7.935*** (1.547)	-7.935*** (1.547)
<i>Deposit Ratio</i>		-0.015 (0.546)	-0.015 (0.546)		0.762 (0.479)	0.762 (0.479)
<i>BC (<math>\Delta GDP</math>)</i>			-0.069 (0.070)			-0.294*** (0.056)
Constant	-6.760*** (0.068)	126.943** (62.978)	154.960** (62.795)	-6.593*** (0.066)	-85.310* (46.826)	272.680*** (79.126)
Time effects	No	Yes	Yes	No	Yes	Yes
SE	Robust	Robust	Robust	Robust	Robust	Robust
N.Obs	232	232	232	312	312	312
R <sup>2</sup>	0.02	0.19	0.19	0.02	0.40	0.40

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