

Do Loan Officers' Incentives Lead to Lax Lending Standards?

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April 2012

Abstract

To understand better the role of loan officers' incentives in the origins of the financial crisis, we study a controlled field experiment conducted by a large bank. In the experiment, the incentive structure of a subset of small business loan officers was altered from fixed salary to volume-based pay. We use a diff-in-diff design to show that while the characteristics of loan applications did not change, incentive-paid loan officers book 19% loans with dollar amounts larger by 19%. We show that treated loan officers use their discretion more in the booking decision. Although loans booked by incentive-paid loan officers have better observable credit quality, they are 28% more likely to default. The increase in default is concentrated in loans that wouldn't have been booked in the absence of commission-based compensation, and in loans with excessive dollar amount. Our results support the idea that the explosion in mortgage volume during the housing bubble and the deterioration of underwriting standards can be partly attributed to the incentives of loan officers.

Keywords: loan officers, default, housing bubble, financial crisis

JEL Classification: G01, G21

* We are grateful to Evgeny Lyandres, Rich Rosen, René Stulz, and Greg Udell for helpful comments. We wish to thank audience members at AEA 2009 annual meeting, FIRS 2009 Prague conference, Federal Reserve Bank of Chicago, Summer Research Conference at the Indian School of Business, and University of Illinois-Chicago for comments. The views in this paper are those of the authors and may not reflect those of the Federal Reserve System, nor of the Federal Reserve Bank of Chicago.

1. Introduction

A growing literature finds evidence linking the creation of the real-estate bubble in the early 2000s to misaligned incentives of intermediaries (e.g., Keys, Mukherjee, Seru, and Vig 2010, Ben-David 2011, 2012, Berndt, Hollifield, and Sandas 2010, Agarwal, Ben-David, and Yao 2012). In the lending process, loan officers may overbook risky loans if their incentives are misaligned with those of lenders and there is information asymmetry (Udell 1989, Berger and Udell 2002, Inderst 2008). The agency problem in the lending process is created because the lending decision is made by the loan officer while the capital is provided by the lender, and because the lending decision depends on information that is neither observable nor verifiable by the lender.¹ Although the problem can be mitigated by aligning incentives (e.g., by loan officers having an equity stake in the transaction, see Sufi 2007), in practice, compensation of most loan officers is a combination of fixed salary and a bonus tied to originated volume (Bureau of Labor Statistics, 2010). While the agency problem in the lending process has been known for decades, it is hard to measure its economic impact in isolation from other institutional effects. Furthermore, it is important to understand the role of incentives to loan officers is especially relevant given the claims² that lending was too aggressive during the period leading to the subprime crisis.

In this paper, we present novel and *direct* evidence showing that a change in the incentive structure of loan officers—from fixed salary to incentive pay—causes loans officers to approve more loans and at greater amounts, leading to a significant decline in the performance of loans. Our findings are based on a controlled experiment conducted by one of the largest U.S. commercial banks (“the Bank”). Thanks to the diff-in-diff design of the study, we are able to

¹ Note that the information problem exists also when loans are sourced by mortgage brokers and then sold to lenders, as often happens in the residential market.

² See, for example, Morgenson, Gretchen, “Was there a loan it didn’t like?” *New York Times*, November 1, 2008.

make causal statements about the effects of commission-based compensation on the lending process.

The corporate experiment that we analyze was designed by the Bank with the intention of examining the influence of variable compensation on loan origination output. For many years, the compensation of small business loan officers was based on a fixed salary. With the credit expansion of the early 2000s the Bank's management decided in 2004 to explore the effects of compensation based on originated volume for half of the small business loan officers in the New England division of the bank. The experiment took place in 2005. The assignment of loan officers to groups was determined by the legacy human resources computer system they belonged to. Loan officers could not switch between the systems. While loan officers' assignment was not randomized, it was unrelated to their performance or prospects. Our dataset contains loan details for more than 30,000 small business loan applications processed by more than 130 loan officers during the 24-month window around the change in incentives. Our research design is diff-in-diff; hence allows us to detect the effects of incentive compensation by exploiting within-loan officer variation.

We begin the empirical analysis by reaffirming the conjecture that loan officer groups are comparable. Our analysis shows that the pool of applications for the treated and control groups are statistically indistinguishable in all loan characteristics (e.g., loan size, personal collateral, business collateral, requested LTV, business credit score, and personal credit score). Furthermore, we show that there is no difference in the decisions made by loan officers in the two groups in 2004, before the experiment began. These facts give us comfort that the effects that we detect in 2005 are caused due to a change in behavior of loan officers in response to the

change in compensation structure and not due to differences in the quality of the pools of applications or in the manner in which loan officers make decisions.

The effects of variable compensation on the pool of booked loans are stark. We find that loan officers with commission-based compensation book more loans and approve larger loan sizes. Loans are about 7 percentage points more likely to be accepted by treated loan officers than by control loan officers (an increase of 19.4% in relative terms). Also, approved loans in the treated group are of larger amounts (by 19.0%) and of higher leverage (by 2.1 percentage points). The fact that loan sizes increase dramatically with only a modest increase in leverage suggests that borrowers posted more collateral than initially planned. The average external credit quality (measured by a third-party rating agency) as well as the internal risk rating of loans booked by treated loan officers improved significantly.

We also find that the weight of loan officers' input in the booking decision is higher under the incentive pay regime. Specifically, one standard deviation improvement in the loan officers' internal risk rating score is associated with a higher likelihood of booking of 9.4% for the control group, and with a higher likelihood of booking of 17.8% for the treatment group. We show that incentive-paid loan officers improved the internal risk rating especially for loans with medium-range probability of booking—loans for which loan officers' input matters the most.

Despite the increase in the apparent quality of loans, we find that loan performance deteriorated significantly. Specifically, we document that 12-month default probability increased by 1.2 percentage points for loans booked by the treated group (an increase of 27.9% in relative terms).

We argue that loan officers' incentives can reconcile the dissonance between the apparent improvement in loan quality and the increased default rate in the treated group. We show that

two factors explain most of the increase in default rate in the incentive pay group. First, we show that the high default is concentrated in loans that that would not have been booked in the absence of commission-based compensation. This effect accounts for about 40% of the increase in the likelihood of default. Consistent with the predictions of Udell (1989), Berger and Udell (2002), and Inderst (2008), these findings indicate that treated loan officers use their discretion to accept poor quality loans and inflate their internal credit score. Second, we find also a concentration of high borrower default in loans that were booked by commission-compensated loan officers and have with excessive dollar amount.

In sum, our evidence shows that incentive pay for loan officers has three important ramifications. First, commission-paid loan officers originate loans that they wouldn't have originated in the absence of the incentives. Although these loans have better observable credit characteristics, their true credit quality is poor. Second, loan officers with incentive pay approve large loan sizes than they would not have approved in the absence of the incentives. These large loans put borrowers in a greater risk of default. Overall, our results suggest that commission-based compensation to loan officers is likely to have had an important role in the deterioration of underwriting standards during the credit boom in the early 2000s and subsequent wave of delinquencies.

Our study relates to several streams of the literature. In the context of bank lending, Cole, Kanz, and Klapper (2010) use a pure experimental setting implemented on a group of loan officers from a commercial bank in India. They compare loan acceptance pattern and effort by loan officers as a response to different incentive schemes. Consistent with our results, they find that loans are more likely to be accepted when origination bonus is granted to loan officers; however, they do not examine loan performance and neither do they tie the effects to the

information problem in lending. Tzioumis and Gee (2012) find that loan officers respond to nonlinear incentives. They show that mortgages are more likely to be approved at the end of the month, and that these mortgages are of worse quality.

More broadly, several studies link misaligned incentives of intermediaries lead to transactions that otherwise would not have taken place. Keys, Mukherjee, Seru, and Vig (2010) show that the securitization process led to lax screening of borrowers. Ben-David (2011, 2012) finds that real-estate agents and mortgage brokers induce borrowers to artificially inflate transaction prices in order to gain access to larger mortgages, and to overpay for housing as well as to borrow at high leverage. Agarwal, Ben-David, and Yao (2012) examine the role of appraisals in overappraising homes during the real-estate bubble. Berndt, Hollifield, and Sandas (2010) document that there is a negative relation between quality of loans originated by mortgage brokers and the fees they earn.

Also, many studies examine the incentive provision to individuals in organizations.³ In the context of compensation contracts, the provision of incentives usually takes the form of pay-for-performance, or piece-rate contracts (Lazear and Rosen 1981, Stiglitz 1981, Holmström 1999, Green and Stokey 1983). While piece-rate payment has the effects of inducing appropriate effort levels and mitigate moral hazard problems (Lazear 1986), it may give rise to dysfunctional behavioral responses, where agents emphasize only those aspects of performance which are rewarded (Baker 1992). Following Holmström and Milgrom (1991) and Baker (1992), this incentive problem has become known as multi-tasking, where agents allocate effort toward those activities that are directly rewarded and away from uncompensated ones. On the empirical front, several studies examine the effects of incentives on performance. Lazear (1986) studies the

³ See Prendergast (1999) for an extensive survey.

performance of auto windshield workers and documents the incentive and worker selection effects of piece-rate contracts. Paarsch and Shearer (2000) find similar evidence using data on Canadian tree planters.

The paper proceeds as following. Section 2 describes the experiment. Section 3 studies the origination patterns of loans. Section 4 analyzes the drivers of loan performance. Section 5 offers some concluding remarks.

2 Corporate Experiment

2.1 A Bank Experimenting with Compensation Schemes

Loan officer compensation usually takes form as a combination of fixed payment salary and commission tied to the volume of booked loans (Bureau of Labor Statistics, 2010). Neither of these compensation schemes is tied to loan repayment, failure, or more broadly—the eventual profitability of these loans. Volume-based compensation contracts may distort loan officers’ incentives and encourage them to approve any loan, regardless of its quality.⁴ An alternative contract that would provide aligned incentives could link compensation to loan profitability and *ex post* performance. Nevertheless, such contract also imposes greater risk on loan officers, including risks beyond their control (e.g., market crash), potentially leading to higher wages compensating for the higher risk born by loan officers. Baker (2002) argues that the trade-off between risk and distortion in this case is made in favor of lower risk and higher distortion.

In 2004, the management of the New England division of a large U.S. commercial bank decided to explore the possibility of altering the compensation scheme of small business loan

⁴ The desire to originate any loan is offset by career concerns of loan officers and loan acceptance guidelines of the bank (based on hard information).

officers from fixed salary to commission-based compensation system. Under the proposed program, loan officers would receive a lower fixed salary (80% of their original salary), and a bonus that increases with the originated volume. The bank intended to implement the commission-based scheme for the entire portfolio of loan officers, but eventually implemented the scheme in stages, in order to evaluate the effects of the new system.

In the first stage, starting January 2005, the new scheme was to be put into action in a subset of branches that administered their human resources issues through one of the legacy databases. Due to earlier acquisitions of other banks over years, the bank maintained two legacy databases that contain the loan officers' administrative data. Other branches, which were connected to another human resources database, maintained their old compensation scheme.

The assignment of the acquired banks' loan officers to each of the databases was quasi-randomized in the sense that the assignment is unrelated to past performance or prospects of loans or loan officers. Hence, the portfolio of loan applications received by the two groups of loan officers have identical underwriting standards, geographical focus, portfolio management practices, and loss outcomes prior to the modification in the compensation structure (see Table 2, Panels B through D for analysis of application characteristics across the groups). Loan officers were not allowed to switch between the two systems.

The complete implementation of the commission-based scheme was supposed to take place in 2006, however, due to the poor results of the pilot of 2005, the management of the bank decided to roll back compensation structure to fixed salary for the all loan officers, as in the pre-2005 period.

2.2 Loan Approval Process

To understand better the impact of loan officer compensation on the loan approval process, one needs to understand the process of approval itself. The branches of the bank offer retail services, and in each branch there a small number of commercial loan officers. The application process begins when a client, most of whom are small business owners, inquires with a loan officer about a potential loan for his business. In most cases, the loan officer encourages the client to submit an application for a review. On the application, the client states the requested amount, the collateral offered (either business- or self-owned collateral), and the purpose of the loan. In addition, the client submits supporting information such as financial and tax information and provides a list of assets owned.

The application is then processed by the loan officer. The loan officer verifies the information provided by the borrower and gathers additional information to assess the credit worthiness of the borrowers and the probability of repayment (e.g., the borrower's and business' credit rating with an external credit agency). Also, the loan officer conducts an in-depth interview with the client to understand the business needs of the loan as well as potential risks and prospects. Based on this information, the loan officer computes an internal risk rating measure, which summarizes the loan officer's view⁵ of the potential borrower and ultimately determines the collateral requirements. The credit score system is uniform across branches and used by the computer system to provide guidelines for the terms of the loan.

The decision about the loan is made at the branch level. The loan officer and the branch manager decide whether to approve or reject the loan upon the information gathered. They also sketch the terms of the loan are sketched based on the lending guidelines and restrictions of the

⁵ The lending process in the bank resembles the lending process described in Petersen (2004), where soft information is transformed to hard information, by coding it.

bank. Upon approval the loan officer prepares an offer letter to the client with the details of the loan. Unlike residential loans in which the lender approves or rejects the requested amount, commercial loans can be approved with an amount smaller than the amount requested. Although branches are autonomous in their lending decisions, these decisions are subject to scrutiny at the bank level, hence, deviations from bank-wide practices need to be justified by the loan officer's subjective assessment of the quality of the credit and collateral.

Once offer letter is received by the client he may accept the terms, negotiate them, or withdraw the application. In 2004, about 31% of applications were eventually booked, 12% of applications were withdrawn, and the rest were rejected. All booked loans of small businesses were kept on the bank's balance sheet; none were securitized.

During the life of the loan, monitoring is done automatically through the tracking the debt service schedule. On the anniversary of the loan, the borrower meets with the loan officer and discusses the firm's prospected with the loan officer. Whenever an issue arises, such as delinquency, the file is handled by the loan officer. For a more detailed description of the process, see Agarwal and Hauswald (2010).

2.3 Description of the Data

The dataset used in the study is an extract of the proprietary database used by the bank. The dataset includes information about all applications submitted to the New England division of the bank in 2004 and 2005. Loan officer-months that were compensated with fixed salary are defined as the control group. This includes loan officers whose compensation did not change (Group A) between 2004 and 2005, as well as loan officer-months in 2004 from the group whose

pay was altered later in 2005 (Group B). The treatment group consists of loan officer-months in Group B in 2005, who were paid based on volume originated.

2.4 Empirical Identification

The advantage of the empirical setting in this study is that the change in compensation structure took place only in one group of loan officers, while the other group was continued to be compensated in a fixed salary as before. The fact that the two compensation schemes were active during the same period allows us to identify the effect of compensation using a diff-in-diff identification method. In this method, one uses time fixed effects—to control for any temporal systematic shocks—and for agent fixed effects—to control for agents' average effect. Then, the interaction between the treatment time (2005 dummy in our case) and treatment group dummy (loan officers with incentive pay) captures the direct effect of the treatment (called “commission-based compensation” dummy in our analysis).

For the effect of change in compensation to be properly identified based on the diff-in-diff method, we need to ensure that there are no confounding factors in the research design. In the current study, we are concerned with two issues. First, there is a possibility that the assignment to treatment and control was not random. Perhaps the group that was assigned to the treatment was different on some dimensions relative to the untreated group. Our conversations with the team responsible for the implementation of the program confirmed that the only consideration that was at play in choosing the group to be treated was the ease of implementation of the new scheme in the computer system. Furthermore, we perform three analyses to test this issue (described in more detail in Section 2.6). In Table 2, Panel B, we test whether applications are different from the treated group relative to the control groups. We find that there is no

significant difference between the groups. Further in the Table 2 we test whether loan applications (Panel C) and booked loans (Panel D) were materially different between Groups A and B in 2004, during the pre-experiment period 2004. The results show that there is no significant difference between the applications and booked loans of the treated and control groups.

Second, there is a concern that the modification in the compensation structure is confounded with additional changes in the lending process. Specifically, one might worry that the change in compensation may be tied to a change in the underwriting model: for example, instead of the bank holding the loans on its balance sheet, the bank may decide to start securitizing them. Such action might encourage loan officers to relax their underwriting standards (see Keys, Mukherjee, Seru, and Vig 2010). To nullify this possibility, we performed a depth interview with the managers of the programs, and were assured that there were no additional structural changes in the lending process in parallel with the implementation of the compensation program.

Another channel for confounding effects relates to expectations by loan officers. That is, a change in compensation could be interpreted by loan officers as an implicit instruction from management to increase the volume and size of booked loans. Hence, the observed changes in the behavior of loan officers may not be a direct response to the change in their compensation structure, but rather a response to the implicit instructions by management, communicated through the change in compensation.

While it is hard to separate the effects of the compensation scheme from the implicit expectations it creates, there are several facts that make it hard to believe that the change in behavior is created by loan officers' interpretation of management's intentions. The first fact is

that while the internal risk score improved following the change in compensation, default rate increased by 27.9%. This pattern cannot be explained by loan officers catering to an implicit higher demand for originations. The second fact is that the new commission-based compensation system was public knowledge across the bank. Hence, we would anticipate that an interpretation of the pilot program as management attempting to boost originated volume, would be common to treated and control groups. The third fact is that the increase in default rate is not compensated by higher interest rates charged to these loans; hence, it is unlikely that the bank has changed its assessment of risk differentially for treated and control groups. Finally, the commission-based compensation program was considered a failure and scrapped at the end of 2005. The bank's management was not satisfied with the increased in default rate and decided to roll back the compensation scheme to a flat structure. Thus, the management revealed its intentions *ex post* as being disappointed by the decline in the quality of the loan book.

To summarize, our conclusion is that the diff-in-diff identification strategy is appropriate to study the effects of compensation structure on the behavior of loan officers. Our identification is particularly strong as we control for loan officer fixed effects, meaning that the effects we identify are within-loan officer effects.

2.5 Summary Statistics

We begin our analysis with examining the summary statistics. Due to the large effects and the diff-in-diff research design, many of the effects reported in the paper can be observed directly through the summary statistics. For the purpose of describing the data, we split the data according to 2×2 matrix: 2004 vs. 2005, and Group A vs. Group B. The treatment group

includes loan officers from Group B in 2005. The control group consists of loan officers from Group A in 2004 and 2005, as well as of loan officers from Group B in 2004.

The summary statistics are provided for applications and for booked loans separately. In Table 1, Panel A, we present summary statistics for loan applications. Requested loans are about \$450,000. About 26% of the applications are proposed to be supported by personal collateral. In terms of credit quality, applicants are on average of high quality. The average business Experian score is about 198 (out of a range of 100 to 250), and the personal Experian credit score is around 728 (out of a range of 400 to 800).

The summary statistics in Table 1, Panel B, reveal a sharp difference between the control and treatment groups for the booked loans. First, while the acceptance rate is about 31%-36% for the control groups, it is 47% for the treatment group. Second, the approved loan amount is higher by about 20% for the treatment group relative to the control. Third, the approved leverage of loans booked by treated loan officers is significantly higher than that booked by the control group: 77% vs. 74%. Fourth, while the average credit score of borrowers is higher for the treated group (business score: 196 (treatment) vs. 185 (control), and personal score: 726 (treatment) vs. 718 (control)). Finally, default rate—measured as 90+ days past due within 12 months—is materially higher for the treatment groups (5.2% vs. 4.2%).

Next, we turn to diff-in-diff tests to measure the magnitude of the effects in a controlled fashion.

2.6 Verifying the Validity of the Diff-in-Diff Assumptions

The diff-in-diff framework requires that the treated and control groups will be statistically similar in all dimensions except for the dimension that is manipulated. In this section we verify that the characteristics of applications received by Groups A and B are statistically indistinguishable, and that in the pre-treatment period (2004) loan officers' decisions are similar. Such evidence would provide comfort that the groups are comparable, and thus the outcomes of the approval process in the treatment group (e.g., higher default rate in the treated group) can be attributed to the change in the compensation scheme.

We perform several tests. The first test compares the volume of applications that is submitted to control loan officers and to treated loan officers. In Table 2, Panel A, we count the monthly number of applications, as well as aggregate the dollar volume of these applications for each loan officer. Then, we log these figures and regress them on loan officer fixed effects as well as on month fixed effects. The results show that the point estimate of the dollar-volume in the treated group is higher by 5% (Column (2)) and the point estimate of the number of applications is higher by 3% (Column (4)), however, they are statistically not indistinguishable from zero. The increase in loan application, albeit the little statistical significance, is not entirely unexpected as compensation-incentivized loan officers may try harder to turn loan inquiries into formal applications.

The next analysis, in Table 2, Panel B, tests for whether specific loan characteristics are statistically different between the control and treatment groups. As in all regressions, we control for loan officer fixed effects, as well for fixed effects for industry and calendar month. The characteristics that we explore are: logged amount requested, requested loan-to-value, personal

collateral dummy, external (Experian) business, personal credit score, and internal risk rating. The panel shows that all loan characteristics are statistically indistinguishable between groups.

We also conduct tests that compare the characteristics of applications and booked loans of the control and treatment groups in 2004—prior to the initiation of the incentive program. Panel C tests the similarity of application characteristics across groups. The results show that the requested loan size, requested LTV, personal collateral indicator, Experian business score, Experian personal score, internal risk rating are the statistically indistinguishable between the control group and the treatment-to-be group. Panel D performs a similar test for booked loans, instead of applications, in 2004. It shows that the difference between requested and approved loans size and LTV, interest rate,⁶ credit scores, and internal risk ratings are similar across groups.

Overall, the results in this section suggest that there are no material difference between the treated group and the control groups. This result provides comfort about that the difference between the characteristics of booked loans and their performance can be attributed to the change in the compensation scheme.

3 Effects of Incentive Pay

In this section we explore the effects of incentive compensation on several dimensions. First, we examine the effect on the likelihood of booking a loan. Second, we explore the credit quality of loans booked by treated loan officers and their financial terms. Third, we investigate the effect of incentive pay on the decision making process in the bank.

⁶ All loans are adjustable rate loans. This should not be a concern as all regressions include month fixed effects.

3.1 Higher Loan Volume

We explore the effect of incentive pay on the volume of booked loans. In Table 3, we compute the aggregate booked volume, as well as the total number of booked loans at the loan officer-month level. We regress these amounts on commission-based compensation dummy, in addition to loan officer and calendar month fixed effects. The regressions show that following the change in the compensation scheme, the dollar volume increased by about 5.0% (Column (2)), and the number of booked loans increased by about 9.6% (Column (4)). These results are consistent with the conjecture that variable compensation causes loan officers to accept more loans.

3.2 Credit Quality of Booked Loans

Next, we examine whether the credit quality of loans booked by treated loan officers materially differs from the credit quality of loans in the control group. Table 4, Column (1) and (2), present regressions of Experian business and personal credit scores on commission-based compensation indicator and controls. The regressions show that the credit quality, based on external sources, of booked loans increases significantly in the treated group.

3.3 Loan Terms

Given that the volume of booked loans increased in the treatment group, we turn to testing whether loan terms are materially different. Table 1 and Figure 2 show that the average loan size increased by 18.9% (from \$253,219 to \$301,004).

We examine three loan attributes: dollar size, leverage, and interest rate. In Table 4, Column (3), we regress the log difference between the booked amount and the requested amount, on the commission-based compensation dummy in addition to loan characteristics and fixed effects, as before. The regression shows that loan booked by treated loan officers are at higher amounts by 14.1%. Similarly, the LTV of booked loans increased by 2.4% (Column (6)). Interest rates charged to loans booked by treated loan officers are higher by 0.02%. The fact that loan size increased dramatically, while LTV increased only moderately means that borrowers increased the collateral that they pledge in the loan following the negotiation with the loan officer.

The differences in loan size and leverage between the control and the treatment imply that loans booked by treated loan officers. We are interested to understand the drivers of the changes in the parameters of booked loans. In particular, are these changes due to the change in composition of booked loans, or are these changes due to loan officers' independent judgment, fostered by the incentive compensation? We explore this issue in a two-stage process. In the first stage, we isolate the control sample (comprised of the 2004 sample and the control sample of 2005) and run a regression of the internal risk rating on loan characteristics: logged requested amount, personal collateral indicator, LTV, LTV-squared, Experian business score, and Experian personal score. The regression is provided in Appendix B. We use these regressions to calculate the predicted value of the internal risk rating as well as the regression residual. The predicted value reflects the compilation of observable characteristics into the internal risk rating in absence of incentive compensation. The residual reflects the independent judgment of loan officers, potentially based on unobservable borrower and loan characteristics.

Table 4, Columns (4), (6) and (8), explores whether the changes in booked loans' characteristics are driven by observable loan fundamentals or by loan officers' discretion. The results show that the all three changes in loan parameters are related to loan officers' discretion, and none are related to observable fundamentals. The direction of the effects is expected. Specifically, the interaction between the treatment indicator and the residual of the internal risk rating in Column (4) shows that treated loan officers approve loans that are larger relative to the requested amounts for borrowers with higher credit quality. A similar result appears for booked leverage relative to the requested leverage (Column (6)). Also, borrowers at lower unobservable credit quality (higher internal risk rating residual) pay higher interest rate (Column (8)).

Overall, the results in Table 4 indicate that following the change in compensation approved loans are larger in size and with higher leverage, although there is no difference in external risk measures of the booked loans in the treated groups versus the control. We show that the decision to increase the leverage of borrowers is driven by loan officers' discretion.

3.4 Decision Making at the Bank

We next explore the way in which incentive pay affected the way in which loan officers perform their role in the lending process. At this stage, we restrict the analysis to descriptive analysis, leaving the interpretation to Section 4.

3.4.1 Loan Officers' Input in the Loan Approval Process

Traditionally, loan officers' job requires them to collect information on potential borrowers, evaluate it, and process the loan. As mentioned earlier, loan officers' input to the

process is summarized in a single number: the internal risk rating. This figure reflects the perceived risk of the borrower in the eyes of the loan officer. This credit score relies on observable risk characteristics as well as on the loan officer's judgment. To evaluate the way in which incentive compensation modified the loan approval process, we analyze the determinants of the booking decision. In particular, we test whether loan officers' professional opinion has a greater weight on the booking decision during the treatment.

In Table 5, Panel A, we use the sample of all loan applications, and regress an indicator for whether an application was accepted. We control for loan characteristics and for loan officer, industry, and calendar month fixed effects. The results in Column (1) and (2) show that the likelihood of accepting a loan following the modification in compensation is higher by about 7 percentage points, which reflects a relative increase of about 19.5% in the likelihood of booking loans.

In Figure 1 we provide graphical time-series of the booking rates. In this figure we plot the residuals from the booking regressions. The booking regressions are regressions of booking indicator on fundamental determinants: personal collateral dummy, Experian business and personal scores, LTV, LTV-squared, and interest rate, in addition to loan officer, industry, and month fixed effects. The regressions are provided in Appendix B. Figure 1 shows that treated loan officers increased dramatically and consistently their booking rates once they started receiving the incentive pay.

To explore the input of loan officers to the booking decision, we decompose the internal risk rating, to a predicted component and to a residual. The regression uses a sample based on observations from the control groups only, and is provided in Appendix B. The predicted component from this regression reflects the internal risk rating based on observable

characteristics. The residual from the regression reflects the input of the loan officer into the process, i.e., reflects his judgment and discretion with respect to the particular loan.

To examine the effect of loan officers' input on the loan booking decision, we rerun the base regression, this time controlling for loan officers' residual from the internal risk rating regression. The regression shows that the effect of the treatment on booking reduces to 3.9%. The coefficient on the internal risk rating is -0.0935. This means that, on average, one standard deviation decrease in the internal risk rating ($=-1.51$) is associated with an increase in the probability of 14.1%.

A related question is whether loan officers' impact on the booking decision is higher in the treatment group than in the control. This will be evidence that loan officers use their discretion more in the booking process when they are compensated based on originated volume. In Column (4) we interact the residual of the internal risk rating with the commission-based compensation indicator. The regressions show that the coefficient is negative and statistically significant, meaning that loan officers' input into the booking decision is greater during the treatment period. The economic effect is large. While in the control group a shift of one standard deviation in the internal risk rating is associated with an increase of 9.4% in the likelihood of booking, the effect is 17.8% in the treatment group.

Hence, our results show that the likelihood of booking loans increased by 7 percentage points (19.5% relative increase) in the treated group. Furthermore, the weight of loan officers' input into the lending process is higher when loan officers' are compensated with commission-based pay.

3.4.2 Loan Officers' Internal Risk Rating

Given that the input of loan officers is greater when compensation is dependent on volume booked, we are interested to explore which loans are those that loan officers provide more informative opinions. First, we examine the average effect of incentive pay on assigned internal risk rating. In Table 5, Panel B, Columns (2) and (4) we regress the internal risk rating on the commission-based compensation indicator for the entire sample of applications and for the sample of booked loans, respectively. The coefficient on the incentive pay dummy ranges from -0.053 to -0.065 indicating that loan officers provide lower internal risk ratings (i.e., showing lower risk) when their compensation is tied to originated volume.

Second, we use a two-stage analysis to examine the internal risk rating with respect to the *ex ante* probability of booking. In the first stage we regress a booking indicator on fundamental variables. This regression is provided in Appendix B. We then split the predicted value of booking into five equally spaced probability buckets and create indicators for each bucket. Then, we regress the internal risk rating variable on interactions of the *ex ante* probability indicators with the incentive pay indicator. The results show that treated loan officers assign lower risk rating score to loans that are in the middle range of *ex ante* probability. These are the marginal loans where loan officers' opinion is arguably most impactful.

Hence, the results show that treated loan officers assign lower internal risk ratings to mid-range loans, i.e., loans that have marginal probability of acceptance.

4 Loan Officers Exploiting the Incentive System?

The results so far present evidence that the weight of loans officers' input into the lending process increases following the introduction of incentive pay. As a consequence more loans are

being booked by treated loan officers. Incentives based on volume originated might have a downside as well, i.e., providing incentives to loan officers to overbook loans. While loan officers' pay is tied to booked volume, their compensation is not directly related to the quality of booked loans.⁷ Thus, there is a possibility that loan officers exploit their sensitive decision making position to overbook loans.

4.1 Increase in Default Rate

To provide an account on the performance of booked loans we measure the default event as 90 day delinquency within one year of the booking the loans. Raw default rate in the control groups is 4.2%, while it as high as 5.2% in the treated group in 2005 (Table 1, Panel B). To verify that the difference is statistically significant, we regress a default indicator on the commission-based compensation dummy in addition to loan officer, industry, and calendar month fixed effects. At this point we are interested to measure the difference in default rates without controlling for borrower and loan characteristics. The results in Table 5, Columns (1) and (2), show that the default rate of the treated group is higher by 1.2 percentage points (a 27.9% relative increase, comparing with the base rate default rate of 4.3% of the control group in 2005). In Columns (3) and (4) we control also for the interest rate charged to the loans. This control should capture the *ex ante* risk as perceived by the bank. The regressions reveal that the coefficient on the commission-based compensation dummy remains virtually unchanged with this additional control. This result suggests that the increase in default rate is not priced in the booked loans.

⁷ Although there are no official ramifications for origination of poor quality loans, in the long run, loan officers who originate bad loans consistently may suffer career consequences.

To summarize, the default rate is higher for the treated group following the implementation of the commission-based compensation scheme by 27.9% relative to the base rate default rate. It appears that this extended risk is not sufficiently compensated for by higher interest rates.

4.2 Why Does Default Rate Increase?

Next, we investigate the factors that lead to the increase in default. There are two potential, and related, channels that could explain the increase in default. First, it is possible that loans officers used their discretion to book bad loans. This channel suggests that loan officers accept loans that in the absence of incentive pay wouldn't have been accepted. Second, loans in the treated group were materially larger than those in the control group. It is plausible that the increase in loan size and in leverage increased borrowers' risk of default.

We test these channels in Table 7. Column (1) provides the base regression. In this column a 12-month default indicator is regressed on the loan characteristics: personal collateral dummy, Experian business and personal scores, LTV, LTV-squared, and interest rate, in addition to loan officer, industry, and month fixed effects. The coefficient on the commission-based compensation indicator suggests that default rate in the treatment group is higher by 0.9%.

We check the relation between the high default rate in the treatment group and the booking process. In Columns (2) and (3) of Table 7, we control with the residual from the internal risk rating regressions and from the booking regression, respectively. The residual from the internal risk regression conveys loan officers' view about the loan beyond the observable fundamentals. The residual from booking regression reflects the degree to which a loan was booked beyond what its fundamentals would predict. Column (2) shows that loans that have

higher internal risk rating (i.e., identified by loan officers as worst credit) have a higher likelihood of default. Column (3) indicates that loans that their booking decision is less dependent on fundamentals are more likely to default. Importantly, by including these controls, the coefficient of the commission-based compensation is cut by nearly a half—from 0.9% to 0.5% in each of the regressions.

One may wonder about the extent to which loan booking that is unrelated on economic fundamentals is more severe in the treatment group than in the control group. To provide an account on this issue, we interact the residual from the internal risk rating and the residual of the the booking regression with the commission-based compensation in Columns (7) and (8), respectively. The regressions show that the importance (measured as the slope) of both residuals on default is about double in the treatment group relative to the control. For example, the slope of the internal risk rating is 0.0884 in the control and 0.1746 ($=0.0884 + 0.0872$) in the treatment. Similarly for the residual from the booking regression: the effect is 0.0531 in the control and 0.115 ($=0.0619 + 0.0531$) in the treatment group. Hence, our results show that the overbooking of loans is twice as severe in when incentive pay is in force.

The second explanation for the high default rate—that the higher-than-usual loan size and leverage of borrowers caused the increase in default—is tested in Columns (5) and (6). We compute the residual from a leverage regression, as well as the residual from a loan size regression (both regressions are in Appendix B). Then, we include these residuals as controls in the regression. In Column (5), we control for residuals from the leverage regression. The regression shows that once controlling for the residual, the effect of the commission-based compensation declines from 0.9% (Column (1)) to 0.5%. The result is similar for the residual

from the loan size regression. When this variable is included in the regression, the magnitude of the commission-based coefficient declines to 0.6%.

To understand whether the effect of leverage and loan size is different in the treated group relative to the control, we interact the residuals with the treatment dummy (Columns (9) and (10)). The regressions show that the effect of both variables on borrower is about double in the treatment group.

In Column (7), we include all four control variables: the residual from the internal risk rating regressions, the residual from the booking regression, the residual from the leverage regression, and the residual from the loan size regression. When all these variables are included the magnitude of the treatment dummy decreased to a statistically insignificant 0.32%, suggesting that these variables explain most of the increase in default.

In summary, the results show that the high borrower default rate during the treatment period can be explain by both channels. First, loan officers with variable compensation booked loans that would not have been booked in the absence of incentive compensation. Second, treated loan officers approved too-large loans that pushed borrowers into default.

5 Conclusion

In this paper we present direct evidence that commission-based compensation causes loan officers to overbook risky loans. This result is particularly contributing to our understanding the role of incentives in brewing the real-estate bubble in the early 2000s. Our results show that compensation scheme of loan officers led to lax lending standards in two dimensions. First, loans that otherwise would have been accepted, are booked when loan officers are subject to incentive

pay. Second, loan officers with variable compensation approve large loan sizes and encourage borrowers to put more collateral. Eventually, these large loans drive borrowers into default.

The paper presents novel and direct evidence about the effects of loan officer compensation on characteristics of accepted loans about their unobserved quality. The results show loans that are accepted under the variable compensation regime led to higher volume of booked loans at higher leverage. Although these loans have apparent high credit quality, they default more often.

Our results support the view that intermediaries had an important role in propagating the real-estate bubble in the early 2000's, partly because their incentives are misaligned. It is important to note that the compensation scheme examined here is not different from the scheme was common during the bubble years with most lenders (see, Bureau of Labor Statistics 2010, and Berndt, Hollifield, and Sandas 2010).

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Appendix A: Variable Definition

Variable	Description
<i>Requested amount</i>	The dollar amount requested by the loan applicant.
<i>Booked amount</i>	The dollar amount that was booked by the bank.
<i>Personal collateral</i>	An indicator variable to whether the loan applicant proposes to collateralize a personal asset (=1); otherwise, the loan applicant proposes to collateralize a business asset (=0).
<i>Loan-to-value (LTV)</i>	Computed as the loan amount divided by value of the collateral, multiplied by 100.
<i>Experian business score</i>	Applicant's business credit score, as reported by Experian. Score ranges from 100 to 250. High score means higher credit quality.
<i>Experian personal score</i>	Applicant's personal credit score, as reported by Experian. Score ranges from 400 to 850. High score means higher credit quality.
<i>Internal risk rating</i>	Applicant's risk rating as computed by the loan officer. Score ranges from 1 to 5. Unlike Experian scores, low internal risk rating reflects higher credit quality.
<i>Withdrawn</i>	An indicator to whether a loan application was withdrawn before or after a decision was made by the bank.
<i>Commission-based compensation</i>	An indicator to whether: 1) the loan application was handled by a loan officer is part of Group B (treated with commission-based compensation in 2005), and 2) the year of loan application is 2005.
<i>Interest rate</i>	The interest rate paid on the loan.
<i>Default within 12 months</i>	An indicator to whether the loan became delinquent (60 days past due or more) within 12 months since booking.
<i>Loan booked</i>	An indicator to whether a loan application was booked by the bank.
<i>Residual from loan booking regression</i>	Residual from a regression of the loan booked variable on loan characteristics (See Appendix B).
<i>Residual from internal risk rating regression</i>	Residual from a regression of the internal risk rating variable on loan characteristics (See Appendix B).
<i>Residual from LTV regression</i>	Residual from a regression of the LTV variable on loan characteristics (See Appendix B).
<i>Residual from log(Booked amount) regression</i>	Residual from a regression the log(Booked amount) variable on loan characteristics (See Appendix B).

Appendix B: Booking and Internal Risk Rating Regressions (First Stage Regressions)

The table presents analysis of outcomes of the lending process on determinants. The sample contains only applications (Colum (1)) and booked loans (Columns (2) to (4)) from the control group: Group A in 2004 and 2005, and Group B in 2004. All regressions are OLS regressions. Variables are defined in Appendix A. Standard errors are clustered at the loan officer level. Standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Sample:	<u>Loan booked (0/1)</u>	<u>Internal risk rating</u>	<u>LTV</u>	<u>log(Booked loan amount)</u>
	Control only	Control only	Control only	Control only
	(1)	(2)	(3)	(4)
log(Requested amount)	-0.0424** (0.0184)	0.0267** (0.0131)	0.0230 (0.0161)	-0.0154* (0.0089)
Personal collateral	0.0439*** (0.0106)	-0.1143*** (0.0298)	-0.0325*** (0.0061)	0.0603** (0.0250)
LTV	-0.0402*** (0.0100)	0.0338*** (0.0051)		
LTV ²	-0.1225*** (0.0420)	0.1074*** (0.0154)		
Experian business score	0.0732*** (0.0249)	-0.0068*** (0.0010)	-0.0055*** (0.0004)	0.0029*** (0.0007)
Experian personal score	0.0587*** (0.0136)	-0.0069*** (0.0012)	-0.0038*** (0.0009)	0.0088*** (0.0002)
LTV (Requested)			-0.4681*** (0.0707)	-0.6103*** (0.2192)
LTV ² (Requested)			-0.6024*** (0.0725)	0.5119*** (0.1076)
Loan officer fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes
Observations	22,480	22,480	22,480	22,480
Adj. R ²	0.18	0.24	0.14	0.09

Table 1. Summary Statistics

The table presents summary statistics for the data used in the study. Panel A presents summary statistics for loan applications. Panel B presents summary statistics for the booked loans. Panel C presents summary statistics for data aggregated at the loan officer-month level. Variables are defined in Appendix A.

Panel A: Loan Applications

	2004				2005			
	Group A (Control)		Group B (Control)		Group A (Control)		Group B (Treatment)	
	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev
# Applications	6,920		7,996		7,564		7,788	
Amount	\$455,240	\$336,805	\$426,480	\$378,698	\$454,141	\$369,635	\$444,137	\$381,829
Personal collateral (0/1)	0.255	0.436	0.261	0.439	0.280	0.449	0.239	0.427
LTV	61.28	43.00	65.30	44.03	65.16	46.87	63.05	43.48
Experian business score	200.86	72.23	195.88	75.87	195.99	75.27	200.36	68.47
Experian personal score	731.85	70.31	725.41	68.06	725.91	74.39	728.06	76.72
Internal risk rating	5.82	1.73	5.81	1.54	5.94	1.31	5.96	1.47
Withdrawn (0/1)	0.132	0.338	0.118	0.322	0.150	0.357	0.119	0.324

Panel B: Booked Loan

	2004				2005			
	Group A (Control)		Group B (Control)		Group A (Control)		Group B (Treatment)	
	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev
# Booked loans	2,192		2,548		2,744		3,680	
% Loans booked	30.55	46.10	32.19	46.75	35.74	49.92	46.56	47.59
Amount (requested)	\$302,074	\$305,891	\$302,966	\$301,933	\$303,082	\$306,939	\$302,224	\$317,073
Amount (booked)	\$224,614	\$279,361	\$216,048	\$229,403	\$253,219	\$257,801	\$301,004	\$299,013
Personal collateral (requested) (0/1)	0.206	0.473	0.199	0.382	0.191	0.379	0.198	0.401
Personal collateral (booked) (0/1)	0.270	0.409	0.280	0.403	0.300	0.420	0.250	0.404
LTV (requested) (%)	79.06	20.93	78.44	19.28	79.03	17.04	78.52	18.4
LTV (booked) (%)	72.99	31.48	76.24	30.90	74.90	33.10	77.03	26.05
Experian business score	184.87	68.95	186.11	78.92	185.50	93.09	196.09	87.01
Experian personal score	716.69	87.44	718.90	88.58	719.54	98.25	725.77	66.51
Internal risk rating	5.23	1.84	5.38	1.52	5.44	1.30	4.93	1.53
Interest rate (%)	9.91	5.02	9.85	4.89	9.58	4.88	9.65	4.93
# Defaults	91		107		119		192	
Defaulted within 12 months (0/1)	0.042	0.199	0.042	0.201	0.043	0.204	0.052	0.222
log(Booked loan (\$))-log(Requested loan (\$))	-0.13	-0.04	-0.15	-0.12	-0.08	-0.07	0.01	0.10
Booked LTV-Requested LTV	-5.98	10.43	-2.17	11.57	-4.08	15.76	0.70	8.03
Residual from booking regression	0.01	0.03	0.01	0.03	0.01	0.03	0.06	0.03
Residual from internal risk rating regression	0.01	0.04	0.01	0.04	0.01	0.04	-0.09	0.04
Residual from leverage regression	0.00	0.03	0.00	0.03	0.00	0.03	0.01	0.03
Residual from loan size regression	0.00	0.04	0.00	0.04	0.00	0.04	0.07	0.04

Panel C: Loan Officer-Month Data

	2004				2005			
	Group A (Control)		Group B (Control)		Group A (Control)		Group B (Treatment)	
	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev
N(loan officer-month) = 6,312								
# loan officers	68		65		65		65	
Applications: log(Volume (\$))	5.58	5.34	5.38	5.35	5.59	5.35	5.40	5.53
Booked loans: log(Volume (\$))	5.16	5.35	5.09	5.31	5.32	5.34	5.42	5.39
Applications: log(# booked loans)	3.79		3.80		3.80		3.81	
Booked loans: log(# booked loans)	3.27		3.31		3.37		3.52	

Table 2. Analysis of Loan Application Volume and Characteristics

The table presents analysis of loan application volume and characteristics. Panel A uses a sample at the loan officer-month level and explore whether the dollar volume and the number of applications are different for applications made to loan officers who receive commission-based compensation. Panel B tests whether characteristics of loan applications for loan officers are different for applications made to loan officers who receive commission-based compensation. Panel C tests whether loan applications received by Group A (control) and by Group B (to be treated in 2005) are different in the pre-treatment period (2004). Panel D tests whether booked loan made by Group A (control) and by Group B (to be treated in 2005) are different in the pre-treatment period (2004). All regressions are OLS regressions. Variables are defined in Appendix A. In Panel A standard errors are clustered at the month level. In Panels B to D standard errors are clustered at the loan officer level. Standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Loan Application Volume in Treated and Control Groups

	Applications (monthly)			
	log(Volume (\$))		log(# applications)	
	(1)	(2)	(3)	(4)
Commission-based compensation	0.0724 (0.0802)	0.0502 (0.0693)	0.0392 (0.0392)	0.0293 (0.0408)
Loan officer fixed effects	Yes	Yes	Yes	Yes
Month fixed effects	No	Yes	No	Yes
Observations	6,312	6,312	6,312	6,312
Adj. R ²	0.17	0.23	0.16	0.22

Panel B: Characteristics of Loan Applications in Treated and Control Groups

	log(Amount requested)	Requested LTV	Personal collateral	Experian business score	Experian personal score	Internal risk rating
	(1)	(2)	(3)	(4)	(5)	(6)
Commission-based compensation	0.0166 (0.0654)	0.0262 (0.1854)	0.0143 (0.0572)	7.2032 (6.0220)	4.0303 (5.1130)	0.0447 (0.1389)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Loan officer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	30,268	30,268	30,268	30,268	30,268	30,268
Adj. R ²	0.16	0.14	0.18	0.13	0.12	0.17

Table 2. Analysis of Loan Application Characteristics (Cont.)

Panel C: Loan Applications in Groups A and B in 2004

	<u>log(Requested amount)</u>	<u>Requested LTV</u>	<u>Personal collateral</u>	<u>Experian business score</u>	<u>Experian personal score</u>	<u>Internal risk rating</u>	<u>Time spent</u>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Group B (to be treated in 2005)	-0.0366 (0.0523)	-0.0415 (0.1282)	0.0014 (0.0143)	-3.2124 (3.4288)	-4.2615 (5.6591)	0.0038 (0.0069)	0.0013 (0.0498)
log(Requested amount)			0.0367*** (0.0109)	-0.0136 (0.0107)	-0.0064 (0.0146)	0.0040 (0.0190)	0.0073 (0.0272)
Personal collateral	0.0471 (0.0466)	0.0227 (0.0766)	-0.0275 (0.0265)	0.0332 (0.0225)	0.0220 (0.0281)	-0.0070 (0.0411)	-0.0091 (0.0555)
LTV			0.0187*** (0.0061)	0.0384 (0.0379)	0.0007** (0.0003)	0.0020 (0.0080)	0.0025 (0.0100)
LTV ²			0.0385*** (0.0053)	-0.0441*** (0.0218)	-0.0038*** (0.0011)	0.0040 (0.0400)	0.0051 (0.0574)
Experian business score	0.0284*** (0.0081)	0.0478*** (0.0080)	-0.0664*** (0.0149)		0.0316*** (0.0082)	-0.0070*** (0.0026)	-0.0046 (0.0035)
Experian personal score	0.0382 (0.0587)	0.0586*** (0.0182)	-0.0198 (0.0342)	0.0291 (0.0170)		-0.0347*** (0.0041)	-0.0461*** (0.0045)
Internal risk rating	-0.0717*** (0.0041)	-0.0421*** (0.0042)	0.0321*** (0.0035)	-0.0036*** (0.0005)	-0.0127 (0.0153)		
Loan officer fixed effects	No	No	No	No	No	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,916	14,916	14,916	14,916	14,916	14,916	14,916
Adj. R ²	0.05	0.07	0.19	0.11	0.10	0.74	0.20

Panel D: Booked Loans in Groups A and B in 2004

	<u>log(Booked loan (\$))</u>	<u>Booked LTV</u>		<u>Experian business score</u>	<u>Experian personal score</u>	<u>Internal risk rating</u>
	<u>-log(Requested loan (\$))</u>	<u>-Requested LTV</u>	<u>Interest rate</u>	(4)	(5)	(6)
	(1)	(2)	(3)			
Group B (to be treated in 2005)	-0.0212 (0.0514)	-0.0397 (0.0616)	0.0012 (0.0161)	1.0709 (2.2490)	1.6481 (2.4789)	0.0034 (0.0089)
log(Requested amount)			0.0352*** (0.0102)	-0.0106 (0.0098)	-0.0062 (0.0118)	0.0035 (0.0155)
Personal collateral	0.0546 (0.0467)	0.0435 (0.0658)	-0.0230 (0.0216)	0.0329 (0.0215)	0.0188 (0.0190)	-0.0060 (0.0382)
LTV			0.0163*** (0.0054)	0.0329 (0.0355)	0.0006** (0.0002)	0.0018 (0.0075)
LTV ²			0.0376*** (0.0051)	-0.0360*** (0.0225)	-0.0042*** (0.0010)	0.0038 (0.0321)
Experian business score	0.0244*** (0.0080)	0.0350*** (0.0081)	-0.0570*** (0.0119)		0.0247*** (0.0075)	-0.0060*** (0.0022)
Experian personal score	0.0415 (0.0871)	0.0369*** (0.0076)	-0.0180 (0.0297)	0.0228 (0.0134)		-0.0330*** (0.0036)
Internal risk rating	-0.0622*** (0.0040)	-0.0522*** (0.0036)	0.0313*** (0.0034)	-0.0037*** (0.0004)	-0.0104 (0.0118)	
Loan officer fixed effects	No	No	No	No	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,740	4,740	4,740	4,740	4,740	4,740
Adj. R ²	0.07	0.11	0.21	0.12	0.10	0.69

Table 3. Analysis of the Effects of Compensation of Booked Volume

The table presents an analysis of the effects of commission-based compensation on booked volume. The table uses data aggregates at the loan officer-month level to test whether volume of booked loans is higher for loan officers who receive commission-based compensation. All regressions are OLS regressions. Variables are defined in Appendix A. Standard errors are clustered at the month level. Standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Booked loans (monthly)			
	log(Volume (\$))		log(# booked loans)	
	(1)	(2)	(3)	(4)
Commission-based compensation	0.0491*** (0.0174)	0.0502*** (0.0139)	0.0818*** (0.0280)	0.0959*** (0.0304)
Loan officer fixed effects	Yes	Yes	Yes	Yes
Month fixed effects	No	Yes	No	Yes
Observations	6,312	6,312	6,312	6,312
Adj. R ²	0.10	0.14	0.10	0.15

Table 4. Analysis of the Effects of Compensation on the Characteristics of Booked Loans

The table presents an analysis of the effects of commission-based on the characteristics of booked loans. The table uses a sample at the booked loan level. All regressions are OLS regressions. Variables are defined in Appendix A. Standard errors are clustered at the loan officer level. Standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Experian bus score	Experian pers'l score	log(Booked loan (\$)) -log(Requested loan (\$))		Booked LTV -Requested LTV		Interest rate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Commission-based compensation	7.3889*** (2.2197)	9.8820*** (3.5434)	0.1412*** (0.0524)	0.0398 (0.0929)	0.0239*** (0.0074)	0.0017 (0.0105)	0.0188*** (0.0061)	0.0038 (0.0066)
× Internal risk rating (predicted)				-0.0181 (0.0595)		-0.0163* (0.0088)		0.0121 (0.0083)
× Internal risk rating (residual)				-0.0190** (0.0088)		-0.0189** (0.0084)		0.0284*** (0.0055)
Personal collateral	0.0240** (0.0096)	0.0012 (0.0105)	0.0349 (0.0686)	0.0527 (0.0328)	0.0522 (0.0436)	0.0519* (0.0310)	-0.0516* (0.0272)	-0.0495* (0.0299)
LTV	-0.0118*** (0.0036)	-0.0198*** (0.0038)	-0.0176*** (0.0035)				0.0181*** (0.0060)	0.0187*** (0.0058)
LTV ²	-0.0546*** (0.0186)	-0.0354*** (0.0115)	-0.0741*** (0.0158)				0.0706** (0.0324)	0.0623** (0.0249)
Experian business score		0.0489*** (0.0113)	0.0502*** (0.0172)	0.0265* (0.0144)	0.0310* (0.0161)	0.0372* (0.0196)	-0.0787** (0.0317)	-0.0748** (0.0332)
Experian personal score	0.0522*** (0.0105)		0.0449*** (0.0146)	0.0551*** (0.0164)	0.0617*** (0.0176)	0.0661*** (0.0214)	-0.0493 (0.0576)	-0.0432 (0.0640)
Internal risk rating (predicted)			-0.0207*** (0.0049)	-0.0155 (0.0101)	-0.0208 (0.0132)	-0.0207* (0.0124)	0.0400** (0.0203)	0.0378 (0.0231)
Internal risk rating (residual)			-0.0366*** (0.0045)	-0.0159 (0.0103)	-0.0184 (0.0135)	-0.0171 (0.0112)	0.0380** (0.0184)	0.0400* (0.0221)
Loan officer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,164	11,164	11,164	11,164	11,164	11,164	11,164	11,164
Adj. R ²	0.16	0.18	0.16	0.16	0.12	0.12	0.23	0.22

Table 5. Decision Making and *Ex Ante* Booking Probability

The table presents evidence that the higher likelihood of booking loans and excessive default are driven by information asymmetry that loan officers possess. The table uses a sample at the booked loan level. Panel A explores the drivers of loan booking. Panel B explores the drivers of loan default. All regressions are OLS regressions. Variables are defined in Appendix A. Standard errors are clustered at the loan officer level. Standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Likelihood of Booking Loans

	Dependent variable: Loan booked (0/1)			
	(1)	(2)	(3)	(4)
Commission-based compensation	0.0707*** (0.0226)	0.0644*** (0.0207)	0.0391*** (0.0145)	0.0321** (0.0135)
× Internal risk rating (residual)				-0.0591*** (0.0149)
Internal risk rating (residual)			-0.0935*** (0.0233)	-0.0620** (0.0266)
log(Requested amount)		-0.0427*** (0.0162)	-0.0287** (0.0123)	-0.0291* (0.0149)
Personal collateral		0.0457*** (0.0096)	0.0274*** (0.0080)	0.0250*** (0.0077)
Experian business score		0.0681*** (0.0264)	0.0556*** (0.0193)	0.0409** (0.0197)
Experian personal score		0.0592*** (0.0123)	0.0449*** (0.0094)	0.0392*** (0.0089)
LTV		-0.0235** (0.0101)	-0.0180*** (0.0065)	-0.0190*** (0.0070)
LTV ²		-0.0848** (0.0372)	-0.0546* (0.0309)	-0.0462 (0.0321)
Loan officer fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes
Observations	30,268	30,268	30,268	30,268
Adj. R ²	0.14	0.14	0.15	0.15

Table 5. Decision Making and *Ex Ante* Booking Probability (Cont.)

Panel B: Likelihood of Booking Loans

Sample:	Dependent variable: Internal risk rating			
	All		Only booked loans	
	(1)	(2)	(3)	(4)
Commission-based compensation	-0.0649*** (0.0204)		-0.0532*** (0.0171)	
× Predicted booking probability 0.0÷0.2		-0.0137 (0.0300)		-0.0112 (0.0261)
× Predicted booking probability 0.2÷0.4		-0.0444 (0.0288)		-0.0407 (0.0275)
× Predicted booking probability 0.4÷0.6		-0.0928*** (0.0284)		-0.0927*** (0.0267)
× Predicted booking probability 0.6÷0.8		-0.0499* (0.0261)		-0.0431* (0.0248)
× Predicted booking probability 0.8÷1.0		-0.0172 (0.0300)		-0.0153 (0.0257)
Predicted booking probability 0.0÷0.2		-0.0135 (0.0285)		-0.0115 (0.0279)
Predicted booking probability 0.2÷0.4		-0.0147 (0.0303)		-0.0128 (0.0293)
Predicted booking probability 0.4÷0.6		-0.0142 (0.0288)		-0.0126 (0.0271)
Predicted booking probability 0.6÷0.8		-0.0144 (0.0289)		-0.0131 (0.0249)
Predicted booking probability 0.8÷1.0		-0.0142 (0.0304)		-0.0119 (0.0292)
log(Requested amount)	0.0423** (0.0169)	0.0408** (0.0166)	0.0362** (0.0152)	0.0399*** (0.0149)
Personal collateral	0.0385*** (0.0121)	0.0363*** (0.0117)	0.0383*** (0.0111)	0.0339*** (0.0097)
LTV	0.0317*** (0.0101)	0.0288*** (0.0098)	0.0291*** (0.0086)	0.0238*** (0.0086)
LTV ²	0.1425*** (0.0394)	0.1358*** (0.0364)	0.1194*** (0.0379)	0.1184*** (0.0342)
Experian business score	-0.0584** (0.0251)	-0.0556** (0.0238)	-0.0515** (0.0235)	-0.0472** (0.0193)
Experian personal score	0.0603*** (0.0119)	0.0571*** (0.0115)	0.0508*** (0.0105)	0.0459*** (0.0097)
Loan officer fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes
Observations	30,268	30,268	11,164	11,164
Adj. R ²	0.68	0.68	0.59	0.57

Table 6. Likelihood of Defaulting

The table presents an analysis of the effect of commission-based on the likelihood of loan default within 12 months. The table uses a sample at the booked loan level. All regressions are OLS regressions. Variables are defined in Appendix A. Standard errors are clustered at the loan officer level. Standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

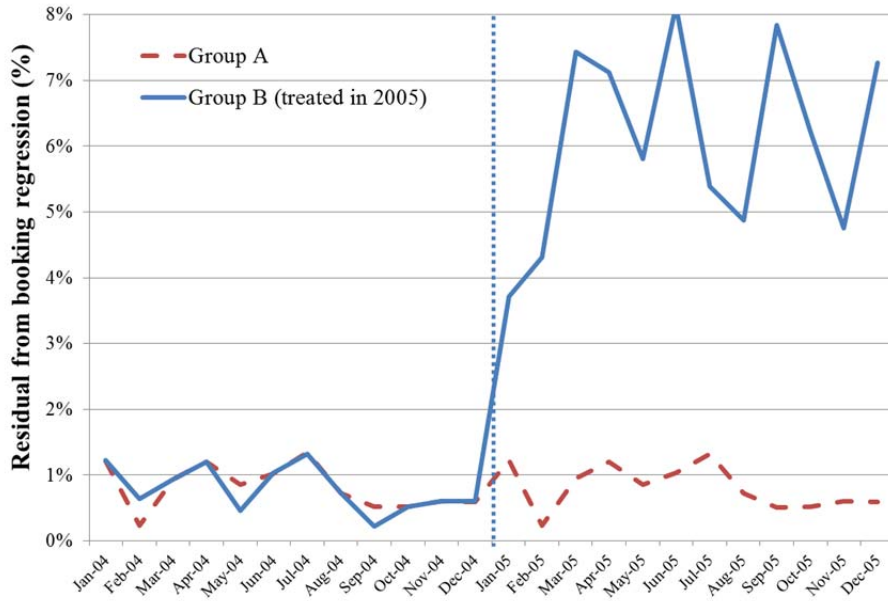
	Defaulted within 12 months (0/1)			
	(1)	(2)	(3)	(4)
Commission-based compensation	0.0122*** (0.0033)	0.0120*** (0.0034)	0.0118*** (0.0036)	0.0114*** (0.0031)
Interest rate			0.0391*** (0.0137)	0.0348*** (0.0140)
Loan officer fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	No	Yes	No	Yes
Month fixed effects	No	Yes	No	Yes
Observations	11,164	11,164	11,164	11,164
Adj. R ²	0.21	0.21	0.23	0.23

Table 7. Loan Officer Compensation and Information Asymmetry

The table presents evidence that the higher likelihood of booking loans and excessive default are driven by information asymmetry that loan officers possess. The table explores the drivers of loan default. All regressions are OLS regressions. Variables are defined in Appendix A. Standard errors are clustered at the loan officer level. Standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

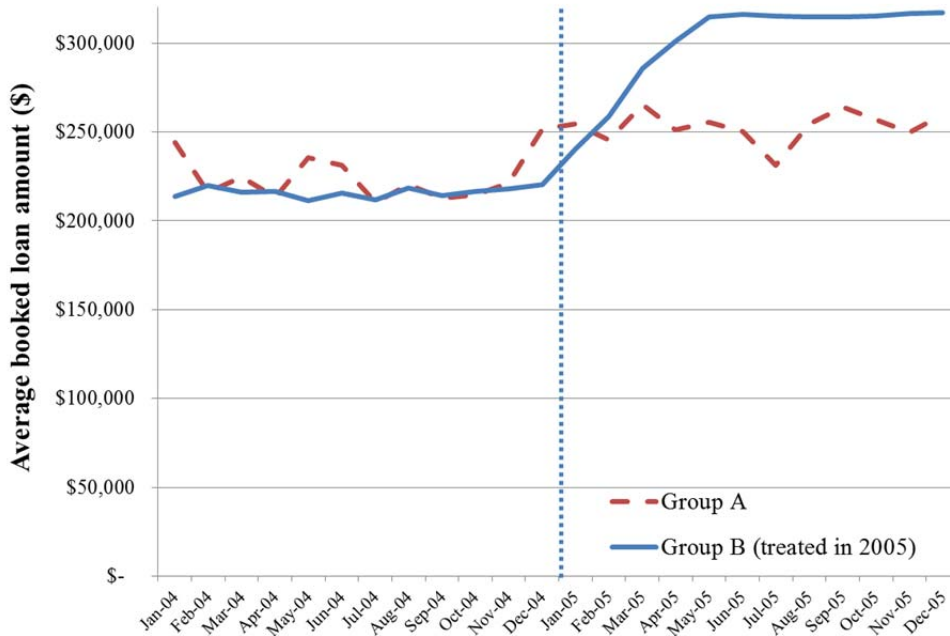
	Dependent variable: Defaulted within 12 months (0/1)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Commission-based compensation	0.0090*** (0.0017)	0.0049*** (0.0018)	0.0052** (0.0025)	0.0050** (0.0022)	0.0059** (0.0024)	0.0032 (0.0027)	0.0020 (0.0027)	0.0026 (0.0019)	0.0064*** (0.0023)	0.0024 (0.0025)	0.0017 (0.0026)
× Internal risk rating (residual)							0.0872*** (0.0136)				0.0812*** (0.0135)
× Loan booked (residual)								0.0619*** (0.0128)			0.0586*** (0.0136)
× LTV (residual)									0.0245 (0.0186)		0.0265 (0.0206)
× log(Booked loan amount) (residual)										0.2043*** (0.0506)	0.1962*** (0.0510)
Internal risk rating (residual)		0.0764*** (0.0209)					0.0759*** (0.0186)	0.0884*** (0.0185)			0.0820*** (0.0192)
Loan booked (residual)			0.0567*** (0.0137)				0.0542*** (0.0139)		0.0531*** (0.0127)		0.0610*** (0.0131)
LTV (residual)				0.0252 (0.0205)			0.0284 (0.0204)			0.0261 (0.0204)	0.0283 (0.0202)
log(Booked loan amount) (residual)					0.1991*** (0.0541)	0.1702*** (0.0523)				0.2008*** (0.0495)	0.1909*** (0.0564)
log(Requested amount)	0.0864*** (0.0256)	0.0946*** (0.0280)	0.0321 (0.0273)	0.1008*** (0.0287)	0.0099 (0.0297)	0.0125 (0.0246)	0.0875*** (0.0246)	0.0306 (0.0246)	0.0867*** (0.0295)	0.0110 (0.0299)	0.0119 (0.0277)
Personal collateral	-0.0490 (0.0374)	-0.0766 (0.0512)	-0.0619 (0.0412)	-0.0530 (0.0391)	-0.0515 (0.0389)	-0.0646 (0.0427)	-0.0692 (0.0477)	-0.0518 (0.0371)	-0.0547 (0.0408)	-0.0685 (0.0466)	-0.0692 (0.0413)
Experian business score	-0.0011 (0.0009)	-0.0015* (0.0008)	-0.0012 (0.0011)	-0.0009 (0.0007)	-0.0012 (0.0011)	-0.0012 (0.0009)	-0.0013 (0.0010)	-0.0010 (0.0008)	-0.0012 (0.0011)	-0.0015* (0.0009)	-0.0015* (0.0009)
Experian personal score	-0.0009 (0.0007)	-0.0008 (0.0008)	-0.0010 (0.0008)	-0.0009 (0.0007)	-0.0011 (0.0010)	-0.0008 (0.0009)	-0.0010 (0.0008)	-0.0010 (0.0006)	-0.0009 (0.0010)	-0.0009 (0.0008)	-0.0008 (0.0007)
LTV	0.0149** (0.0068)	0.0169** (0.0072)	0.0170** (0.0079)	0.0133** (0.0064)	0.0170*** (0.0054)	0.0175** (0.0080)	0.0174** (0.0074)	0.0139** (0.0054)	0.0191*** (0.0054)	0.0167** (0.0073)	0.0177** (0.0083)
LTV ²	0.0394*** (0.0023)	0.0435*** (0.0023)	0.0375*** (0.0026)	0.0307*** (0.0019)	0.0450*** (0.0020)	0.0377*** (0.0021)	0.0417*** (0.0023)	0.0379*** (0.0020)	0.0417*** (0.0021)	0.0402*** (0.0022)	0.0443*** (0.0021)
Interest rate	0.0481*** (0.0147)	0.0554*** (0.0148)	0.0571*** (0.0171)	0.0470*** (0.0146)	0.0570*** (0.0217)	0.0595*** (0.0158)	0.0686*** (0.0166)	0.0450*** (0.0147)	0.0584*** (0.0197)	0.0613*** (0.0179)	0.0605*** (0.0169)
Loan officer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,164	11,164	11,164	11,164	11,164	11,164	11,164	11,164	11,164	11,164	11,164
Adj. R ²	0.21	0.23	0.22	0.22	0.22	0.30	0.26	0.26	0.26	0.29	0.30

Figure 1. Booking Rate (Residual) over Time and across Groups



The chart shows the average residual from the booking regression (see Appendix B). The residuals are averaged within group (Groups A and B) and month.

Figure 2. Average Booked Loan Amount over Time and across Groups



The chart shows the average loan size. Loan sizes are averaged within group (Groups A and B) and month.