Do Loan Officers' Incentives Lead to Lax Lending Standards?

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Abstract

To better understand the role that loan officers' incentives played 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 document that incentives increased origination rates (+31%), loan sizes (+15%), and the likelihood of default (+28%). These effects are partly driven by moral hazard: treated loan officers use their discretion more in the approval decision; however, their risk assessment is not informative about the likelihood of default. The default rate in the treated group is materially higher for loans approved based on loan officers' discretion and for loans with aggressive loan terms (unrelated to observable fundamentals). We show that factors related to the profitability of origination for loan officers increase the likelihood of origination and of default, and the marginal loans that were originated had a negative net present value.

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

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1. Introduction

A growing literature finds evidence linking the creation of the real estate bubble in the early 2000s to intermediaries' misaligned incentives (e.g., Keys et al. 2010; Ben-David 2011, 2012; Berndt, Hollifield, and Sandas 2010; Agarwal, Ben-David, and Yao 2012). During the lending process, loan officers may approve too many risky loans if their incentives are misaligned with those of the lender and in the presence of information asymmetry (Udell 1989; Berger and Udell 2002; Inderst 2008; Heider and Inderst 2012). This process creates an agency problem because the lending decision depends on information collected by the loan officer that the lender can neither observe nor verify (Agarwal and Hauswald 2011).[1]

The relevance of the agency problem has increased in recent years, given the claims[2] that lending was too aggressive in the period leading up to the subprime crisis. And while the problem can be mitigated by realigning incentives (e.g., by giving loan officers an equity stake in the transaction, see Sufi 2007), in practice, such a realignment has not taken place. Even now, compensation for most loan officers continues to be a combination of a fixed salary and a bonus tied to originated volume (Bureau of Labor Statistics 2012). Our paper offers a unique perspective on the incentives of loans officers in a major U.S. bank at the eve of the global financial crisis.

In this paper, we explore the effects of the widely used volume-based compensation on the origination process of loans. Our analysis is based on a controlled experiment conducted by one of the largest U.S. commercial banks ("the Bank"). This experiment provides novel and direct evidence about the effects of changing the loan officers' incentive structure—from fixed salary to incentive pay. Using a diff-in-diff design of the study, we are able to make causal statements about the effects of commission-based compensation on the lending process. Moving from fixed to variable compensation led loan officers to pursue aggressive lending practices on both the extensive margins (more loans approved) and intensive margins (more aggressive terms for approved loans). While these effects could be viewed as consistent with the Bank's objective and with the incentives provided to the loan officers, further analysis of the determinants of the

[1] Note that the information problem also exists when loans are sourced by mortgage brokers and then sold to lenders, as often happens in the residential market.
[2] See, e.g., Gretchen Morgenson's "Was there a loan it didn't like?" *New York Times*, November 1, 2008.

approval decision and borrower default reveals that the incentive pay scheme induced loan officers to exhibit moral hazard behavior.

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 about half of the small business loan officers in the Bank's New England division. This experiment took place in 2005. The assignment of loan officers to their groups was determined by the legacy human resources computer system to which they belonged. Loan officers could not switch between systems. While loan officers' assignments were not randomized, the choice 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 diff-in-diff research design 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 the loan officer groups are comparable. Our analysis shows that the pool of applications for the treated and control groups[3] are statistically indistinguishable in all of their loan characteristics (e.g., loan size, personal collateral, business collateral, requested loan-to-value (LTV), business credit score, and personal credit score). Furthermore, we show that there is no statistically significant difference in the decisions made by loan officers in the two groups in 2004, before the experiment began. These facts bolster the likelihood that the effects we detect in 2005 are caused by a change in the loan officers' behavior that occurs in response to the change in compensation structure, not to differences in the quality of the pools of applications or the manner in which loan officers make decisions.

The first-order effect of variable compensation is an increase in the aggressiveness of loan approval. We document that treated loan officers are more likely to approve loans by about

[3] We have one loan officer-month treatment group and one loan officer-month control group, which is made up of three subgroups. The treatment group is composed of loan officers treated in 2005, in 2005. The control group comprises: i) loan officers who were not treated in 2004 nor in 2005, in 2004, ii) loan officers who were not treated in 2004 nor in 2005, in 2005, and iii) loan officers who were treated in 2005, in 2004. See Section 3 for further details.

31%. Also, approved loans in the treated group are larger by 14.9%, and their leverage (loan-to-value ratio) is higher by 2.4 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. We also show that the Bank became more efficient and competitive: time-to-decision was shortened by half, and the withdrawal rate of loan offers declined by more than a third. Not surprisingly, we find that the 12-month default probability increased by 1.2 percentage points (a 27.9% increase).

While aggressive lending could be consistent with the Bank's business-expansion objectives, a further analysis of the origination process shows that loan officers exploited the compensation system in an attempt to increase their own benefit. We document that there is a dissonance in the quality of the approved loans. On one hand, the average loan quality, as measured based on either soft or hard information, is *higher* in the treated group. Specifically, the internal risk score—determined by loan officers—improves by about 30% of a standard deviation. In addition, the average external credit quality (measured by a third-party rating agency) increases by about 10% of a standard deviation. On the other hand, the default rate of loans originated by the treated loan officers increased dramatically. These results resonate with Berg, Puri, and Rocholl (2012), who uncover evidence consistent with loan officers manipulating hard information in order to get applications approved, and with Rajan, Seru, and Vig (2010), who show that lenders who sell loans into securitized pools focus on credit parameters that determine approval into the pool while ignoring other credit-relevant parameters.

We find that the incentive-pay regime caused loan officers to increase their involvement in the approval decision and determination of loan terms in ways that indicate moral hazard. With the bonus-based compensation, loan officers' internal risk rating doubled its weight in the approval decision. Similarly, loan terms in the treated group were determined based on loan officers' discretion that is orthogonal to observable fundamentals. Also, we document that the average internal risk rating improved in the treated group, especially for loans with a medium-range probability of origination, i.e., loans for which loan officers' input matters the most. In addition, we show that the likelihood of approval increases for factors that are correlated with the benefit to the the loan officer and are unrelated to the fundamental characteristics of the loans. We report that the probability of loan approval is higher for the treatment group in the second half of the month (when the marginal bonus is higher), for older loan officers (who have fewer

career concerns), and for male loan officers (who are potentially driven by gender-based competition). There are no comparable effects in the control group.

Another piece of evidence for moral hazard comes from analyzing the determinants of borrower default. We show that the high default is concentrated in loans that would not have been originated in the absence of commission-based compensation. This effect accounts for about 40% of the increase in the probability of default. Also, we find a concentration of high borrower default in loans that were originated by commission-compensated loan officers and that have an excessive dollar amount. Together, these effects account for about 66% of the increase in the probability of default. Despite the fact that the discretion of loan officers in the treated group has greater weight in the approval decision, we document that their risk assessment does not contain any additional information about the probability to default. Additionally, the same non-fundamental factors discussed previously also affect the probability of borrower default. The probability of default is higher for loans in the treated group that were originated at the end of the month—consistent with the results of Tzioumis and Gee (2012) for the residential mortgage market. In addition, loans that were originated by male loan officers and by older loan officers are more likely to default. The latter result resembles the finding of Garmaise (2012) that senior loan officers are more likely to allow borrower misrepresentation.

Finally, we conduct an analysis of the net present value (NPV) of originated loans. Because the default is relatively low during the studied period, loans originated by loan officers in the treated group do not appear to have a negative NPV, *on average*. When we examine the distribution of *ex ante* default likelihood, we find that under the incentive-based compensation, there are many more loans that have an ex ante high default probability. However, the interest rates on these loans do not differ materially from the interest rates on loans with low-default probability. We show that under reasonable recovery assumptions, these loans with high default probability have negative NPV—i.e., they destroy shareholder value. Hence, incentive-based compensation leads to lending standards that are too lax.

In sum, our evidence shows that the incentive pay for loan officers has three important unintended consequences. First, commission-paid loan officers approve loans that they would not have in the absence of the incentives. Although the loans in the treated group have better observable credit characteristics relative to those in the control groups, their ex post performance

is worse than that of loans in the control groups. Second, the incentive pay scheme induced loan officers to approve larger loan sizes than they would have without the incentives. These large loans put borrowers in greater risk of default. Third, the bonus system led loan officers to approve a greater number of loans than they would have in the absence of such a system. We show that loans that were approved based on non-fundamental factors (e.g., they occurred at the end of the month and were approved by male and older loan officers) are more likely to default. Overall, our results suggest that commission-based compensation led loan officers to approve too many loans (the excess often being riskier ones) and, therefore, could have had an important role in the deterioration of underwriting standards during the credit boom in the early 2000s and the subsequent wave of delinquencies.

Our study relates to several veins of the literature. In the context of bank lending, Cole, Kanz, and Klapper (2011) use a pure experimental setting implemented on a group of loan officers at a commercial bank in India. They compare the loan approval pattern and effort by loan officers as responses to different incentive schemes. Consistent with our results, they note that loans are more likely to be approved when an origination bonus is granted to loan officers; however, they neither examine loan performance nor 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 such mortgages are of worse quality. Berg, Puri, and Rocholl (2012) examine a dataset developed from loan decisions made based exclusively on hard information. They discover evidence consistent with loan officers manipulating hard information so that loans pass the approval threshold. Shi (2012) documents that loans made in states with higher licensing requirements for brokers are of better credit quality. Hertzberg, Liberti, and Paravisini (2010) document that the rotation of loan officers within a bank causes them to provide more accurate reports.[4] Keys et al. (2010) show that the securitization process led to the lax screening of borrowers. Finally, Fisman, Paravisini, and Vig (2012) study the role of cultural proximity, religious beliefs and shared codes in the loan officer's decision to originate a loan. They find higher loan origination rate if the loan officer and the borrower are from the same cultural and religious background. Arguing that this improves credit allocation efficiency.

[4] Paravisini and Schoar (2012) find that a reduction in monitoring costs in a bank (via the advent of information technology) increases loan officer productivity. Also see Liberti, Seru, and Vig (2012).

Our results indicate the loan officers exploited the compensation system in order to increase their earnings at the expense of the Bank. These conclusions are consistent with the predictions of Udell (1989), Berger and Udell (2002), Inderst (2008), and Heider and Inderst (2012). More broadly, the experiment we analyze is an example of how compensation for short-run performance can lead to an increase in the risk exposure of banks (Bebchuck and Spamann 2009; Acharya et al. 2010).

More generally, many studies examine the incentive provision for individuals in organizations.[5] 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 serves to induce 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 that 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 activities that are directly rewarded and away from uncompensated ones. On the empirical front, several studies examine the effects of incentives on performance. Lazear (2000) studies the performance of auto windshield workers and documents the incentive and worker selection effects of piece-rate contracts, and finds that piece-rate incentives increased productivity and that more productive workers selected into the piece-rate compensation system. Paarsch and Shearer (2000) find similar evidence, using data on Canadian tree planters.

Our paper proceeds as follows. We describe the experiment in Section 2, while we provide information about the available data and discuss the empirical identification in Section 3. In Section 4, we study the origination patterns of loans, and in Section 5, we analyze the performance of originated loans. In Section 6, we discuss whether the observed patterns are consistent with the Bank's objectives. Finally, in Section 7, we offer some concluding remarks.

[5] See Prendergast (1999) for an extensive survey.

2 The Loan Approval Process and the Compensation Experiment

2.1 The Loan Approval Process

To better understand the impact of loan officer compensation on the loan approval process, one needs to understand the process of approval itself. The Bank's branches offer retail services, and each branch has a small number of (often one) commercial loan officers. The application process begins when a client (usually a small business owner) asks a loan officer about a potential business loan. In most cases, the loan officer encourages the client to submit an application for review. On the application, the client states the requested amount, the collateral offered (either business- or self-owned collateral), and the loan's purpose. The client also 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, who relies on both hard and soft information. First, the loan officer verifies the information provided by the borrower and gathers additional data to assess the borrower's creditworthiness and probability of repayment (e.g., the borrower's and business's credit rating with an external credit agency). Second, the loan officer conducts an in-depth interview with the client to understand the business needs of the client applying for the loan, as well as potential risks and prospects of the client's firm. Based on this information, the loan officer computes an internal risk rating measure, which summarizes the loan officer's opinion[6] of the potential borrower and ultimately determines the collateral requirements. The credit score system is uniform across branches and is used by the computer system to provide guidelines for the terms of the loan. The loan officer transcribes the relevant information into electronic form, and matches it with credit reports before inputting it into the Bank's proprietary credit-scoring model. In the process, the loan officer gathers soft information, that is, information that would be hard for a third party to verify. The whole lending process, including the credit decision, typically takes four hours to a day from the initial loan interview. In some cases, the branch will invite the applicant to follow up on open questions, review discrepancies in information submitted with credit reports, discuss the prospects of the firm, etc. The loan officer can also adjust the firm's internal score should the applicant deserve credit in

[6] The Bank's lending process resembles that described in Petersen (2004), Berger et al. (2005), and Agarwal and Hauswald (2010). There is a limited attempt at the Bank to code soft information, thereby transforming it into hard information.

the officer's opinion despite failing to meet certain credit-score requirements. These subjective score revisions represent the soft-information component of the Bank's internal credit assessment (see Agarwal and Hauswald 2011). Each loan officer enjoys a considerable amount of autonomy in the assessment, approval, and pricing of loans, but has to justify any deviation from bank-wide practices. As a consequence, credit decisions ultimately reside with the branches because local managers can alter credit scores on the basis of a set of subjective criteria, which the internal score reflects. Similarly, they can alter loan terms (including pricing), tailoring them to the specific circumstances of the application. However, branch managers' career prospects and remuneration depend on the success of their credit decisions, and local overrides are closely monitored by the Bank's overall risk-management staff.

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 based on the information gathered. They also sketch the terms of the loan according to the Bank's lending guidelines and restrictions. Upon approval, the loan officer prepares an offer letter to the client with the details of the loan. Unlike residential loans, for 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 (also see Agarwal and Hauswald 2011).

Once an offer letter is received by the client, he may approve the terms, negotiate them, or withdraw the application. In 2004, about 43% of loan applications made to the Bank were approved; the rest were rejected. Of the 43% approved loans, 12% were withdrawn by borrowers. All originated small business loans were kept on the Bank's balance sheet; none were sold or securitized.

During the life of the loan, monitoring is done automatically through tracking the debt service schedule. On the anniversary of the loan's origination, the borrower meets with the loan officer to discuss the firm's prospects. Whenever an issue arises, such as delinquency, the loan's file is handled by the loan officer.

2.2 The Compensation Scheme Experiment

Loan officers' compensation usually takes the form of a combination of a fixed payment salary and a commission tied to the volume of originated loans (Bureau of Labor Statistics, 2012). Neither of these compensation schemes is tied to loan repayment, failure, or, more broadly, the eventual profitability of the loans. Volume-based compensation contracts may distort loan officers' incentives and encourage them to approve any loan, regardless of its quality.[7] An alternative contract that would provide aligned incentives could link compensation to loan profitability and *ex post* performance. Nevertheless, such a contract also imposes greater risk on loan officers, including risks beyond their control (e.g., a market crash), potentially leading to higher wages that compensate for the higher risk borne 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 its small business loan officers from a fixed salary to a commission-based compensation system.[8] 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 bonus is calculated every month. The bank intended to implement the commission-based scheme for the entire portfolio of loan officers, but it intended to do so in stages in order to evaluate the effects of the new system.

The bonus system works as follows. The loan officers are given a performance measurement system. The performance metric is based on three components: origination dollar (50% weight), the volume of loans (25% weight), and the application decision time (25% weight). Loan officers gain points on large loans, origination volume, and quick decision turnaround. Loan officers were also provided a matrix that translated their performance score into the monetary award. Table 1 describes the translation. For instance, if they achieved 80% of

[7] The desire to originate any loan is offset by the longer-term career concerns of loan officers and the Bank's loan approval guidelines (based on hard information).

[8] During the sample period, this lender ranked among the top five commercial banks and savings institutions, according to the Federal Deposit Insurance Corporation. All loan applications fall under the definition of small- and medium-sized enterprise lending in the Basel I Accord so that the total obligation of the applying firm is less than $1 million and its sales are below $10 million.

their previous year's monthly individual performance, they would not receive any bonus pay. But if they exceeded 80%, 100%, and 120% of the goal, then they would receive a monthly bonus of $333, $540, and $790 and $10.50, $12.50, and $14.50 for each additional percentage point in improvement, respectively. According to the compensation scheme, the marginal loan originated within a month earns a higher bonus amount for the loan officer.[9] The scheme was announced around the middle of 2004.

In the first stage, beginning in 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. Because of previous acquisitions of other banks over the years, the Bank maintained two legacy databases that contained the loan officers' administrative data. Other branches, which were connected to another human resources database, maintained the pre-existing compensation scheme.

The assignment of the acquired banks' loan officers to each of the databases was quasi-randomized in the sense that the assignment was unrelated to past performance or the prospects of the 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 3, Panels B through D for an analysis of the 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, because of the poor results of the pilot program of 2005, the Bank's management decided to roll back the compensation structure to a fixed salary for all loan officers, as in the pre-2005 period.

3 Data and Identification

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-years that were compensated with a fixed salary are

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

defined as the control group. This includes loan officer-years with compensation that did not change (Group A) between 2004 and 2005, as well as loan officer-months in 2004 from the group whose pay was altered in 2005 (Group B). The treatment group consists of loan officer-years in Group B in 2005—that is, loan officer-years with pay in 2005 that was based on the volume originated.

3.1 Empirical Identification

The advantage of the empirical setting in this study is that the change in compensation structure took place only for one group of loan officers, while the other group continued to be compensated at a fixed salary. The fact that the two compensation schemes were active during the same period allows us to identify the effect of compensation with a diff-in-diff identification method. In this method, one uses time fixed effects to control for any temporal systematic shocks and agent fixed effects to control for agent average effects. Then, the interaction between the treatment time (the 2005 dummy in our case) and the treatment group dummy (loan officers with incentive pay) captures the direct effect of the treatment (called the "commission-based compensation" dummy in our analysis). For the effect of the 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. The first is the possibility that the assignment to treatment and control groups was not random. Perhaps the group that was assigned to the treatment was different in some ways relative to the untreated group. Our conversations with the team responsible for the program's implementation confirmed that the only active consideration in choosing the group to be treated was the ease with which the new scheme could be implemented in the computer system. Furthermore, we perform three analyses to test this issue (described in more detail in Section 2.6). In Table 3, Panel B, we test whether the applications from the treated group are different relative to the control group. We find no significant difference between the groups. Further in Table 3, we test whether the loan applications (Panel C) and originated loans (Panel D) were materially different between Groups A and B in 2004, the pre-experiment period. The results show no significant difference between the loan applications and originated loans of the treated and control groups. The second issue is the concern that the modification in the compensation

structure is confounded with additional changes to the lending process. Specifically, one might worry that the change in compensation may be tied to a change in the underwriting model: e.g., instead of the Bank holding the loans on its balance sheet, it may decide to start securitizing them. Such action might encourage loan officers to relax their underwriting standards (see Keys et al. 2010). To make sure this possibility was nullified, we discussed it in depth with the managers of the program and were assured that there were no additional structural changes in the lending process that occurred in parallel with the compensation program's implementation.

Another channel for confounding effects relates to loan officers' expectations. 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 originated loans. Hence, the observed changes in loan officers' behavior may not be a direct response to the change in their compensation structure, but rather a response to implicit instructions from management, communicated through the change in compensation.

Although the management gave no explicit instruction to alter the risk criteria, we recognize that it is possible that loan officers might have interpreted the compensation change as an implicit instruction to change the risk criteria. Such an interpretation could explain the approval of lower-quality loans by loan officers; however, it cannot explain most of the evidence indicating moral hazard behavior.

To summarize, our conclusion is that the diff-in-diff identification strategy is appropriate for studying 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.

3.2 Summary Statistics

We begin our analysis by examining the summary statistics. Because of 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 it into a two-by-two matrix: 2004 versus 2005 and Group A versus 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 loan officers from Group B in 2004.

The summary statistics are provided separately for loan applications and originated loans. In Table 2, Panel A, we present summary statistics for loan applications (the variables featured in Table 2 and others are explained in Appendix A). 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, with an average business Experian credit score of about 198 (out of a range of 100 to 250), and a personal Experian credit score around 728 (out of a range of 400 to 800). The average of the internal risk rating (determined by loan officers) is about 5.9 (in a range of 1 to 10, with a higher internal risk rating reflecting higher risk).

The summary statistics in Table 2, Panel B, reveal sharp differences between the control and treatment groups for the originated loans. First, while the approval rate is about 44%–51% for the control group, it is 59% for the treatment group. Second, the originated loan amount is higher by about 20% for the treatment group relative to the control. Third, the leverage of the loans originated by treated loan officers (i.e., originated LTV) is significantly higher than that of the loans originated by the control group: 77% versus 74%. Fourth, while the borrowers' average credit score is higher for the treated group, the default rate—measured as 90+ days past due within 12 months—is materially higher for the treatment groups (5.2 percentage points versus 4.2 percentage points). In the following subsections, we investigate these patterns in a diff-in-diff setting.

Table 2, Panel C presents summary statistics at the loan officer-month level for the data used in the regressions that use aggregate data (Table 3, Panel A and Table 4).

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

The diff-in-diff framework requires that the treated and control groups be statistically similar in all characteristics except the one being manipulated. In this section, we verify that the characteristics of the loan applications received by Groups A and B are statistically indistinguishable and that in the pre-treatment period (2004), the decisions of loan officers in

both groups are similar. Such evidence would bolster the likelihood that the groups are comparable, and thus that the outcomes of the approval process in the treatment group (e.g., a higher default rate in the treated group) are attributable to the change in compensation scheme.

We perform several tests. The first test compares the volume of applications submitted to the control loan officers and the treated loan officers. In Table 3, Panel A, we count the monthly number of applications and also 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 calendar month fixed effects. The results show that the application volume for the treatment group is statistically indistinguishable from the application volume for the control group. The point estimate of the dollar-volume in the treated group is higher by 1.3% (Column (2)) and the point estimate of the number of applications is higher by 0.7% (Column (4)).

The next analysis—whose results are displayed in Table 3, Panel B—tests for whether specific characteristics of loan applications are statistically different between the control and treatment groups. As in all regressions, we control for loan officer fixed effects, as well as for fixed effects for industry and calendar month. The characteristics that we explore are as follows: the logged amount requested, requested loan-to-value, personal collateral dummy, external (Experian) business credit score, external (Experian) personal credit score, and internal risk rating. The panel shows that all loan application characteristics are statistically indistinguishable between the two groups.

We also conduct tests that compare the characteristics of the loan applications and originated loans of the control and treatment groups in 2004—prior to the initiation of the incentive program. The results of the test, presented in Panel C of Table 3, show that for the control group and the to-be-treated group, the requested loan size, requested LTV, personal collateral indicator, Experian business credit score, Experian personal credit score, internal risk rating, time spent on applications, and the withdrawal rate of approved applications are statistically indistinguishable between the two groups. Panel D of Table 3 displays the results of a similar test for originated loans, instead of applications, in 2004. It shows that the difference between requested and approved logged loan sizes, the difference between requested and

approved LTV, interest rate,[10] Experian business credit score, Experian personal credit score, and internal risk rating are similar across groups.

Overall, the results in this section suggest that there are no material differences between the treated group and the control group. This result bolsters the likelihood that the difference between the characteristics of originated loans and their performance can be attributed to the change in the compensation scheme.

4 Effects of Incentive Pay on the Origination Process

In this section, we explore the effects of incentive compensation across several features: the likelihood of originating a loan, the characteristics of the loans originated by treated loan officers, and these loans' financial terms. Finally, we investigate the effect of incentive pay on the Bank's decision-making process.

4.1 Higher Loan Volume

We explore the effect of incentive pay on the volume of originated loans. In Table 4, we compute the aggregate approved and originated loan volume (Columns (1)–(2) and (5)–(6), respectively), as well as the total number of approved and originated loans at the loan officer-month level (Columns (3)–(4), and (7)–(8), respectively). We regress these amounts on a 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 average dollar amount per loan of approved applications and originated loans increased by 15.0% and 14.5%, respectively (Columns (2) and (6)), and that the number of approved and originated loans increased by a relative factor of 31.3% and 30.5%, respectively (Columns (4) and (8)). These findings are economically significant given that the approval rate in the control group is about 46% (Table 1, Panel A) and origination rate in this group is about 34% (Table 1, Panel B). These results are consistent with the conjecture that variable compensation causes loan officers to approve more loans.

[10] All loans are adjustable-rate loans. This should not be a concern, since all regressions include month fixed effects.

4.2 Credit Quality of Approved Loans

Given that the volume of originated loans increased in the treatment group, we test whether the loan terms are materially different. We first examine whether the credit quality of approved loans in the treatment group materially differs from the credit quality of approved loans in the control group. Columns (1) and (2) of Table 5, Panel A present regressions of Experian business and personal credit scores on the commission-based compensation indicator and controls. The regressions show that the credit quality of approved loans, based on external sources, is significantly higher in the treated group. The economic magnitude of the increase in the treatment group is approximately 10% of one standard deviation.

4.3 Loan Terms

Next, we explore the difference in loan size between the control and treatment groups. Table 2 and Figure 1 show that the average originated loan size increases in the treatment group by 18.9% (from $253,219 to $301,004).

We examine three loan attributes: dollar size, leverage, and interest rate. In Table 5, Panel A, Column (3), we regress the log difference between the approved 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, relative to the requested loan amount, treated loan officers approve loans that are larger by 14.9%. Similarly, Column (4) shows that relative to the requested LTV, loans originated by treated loan officers have an LTV higher by 2.4 percentage points. The fact that loan size increased dramatically while LTV only moderately increased means that borrowers increased the collateral that they pledged for the loan following the negotiation with the loan officer. In addition, we find a small increase in the interest rate; Column (5) presents evidence that interest rates charged to loans originated by treated loan officers are higher by 0.02%.

We also document that bonus-based compensation enhanced the loan officers' productivity and improved the competitiveness of the Bank. Under incentive pay, the time from application to decision was shortened by over half a month (Column (6)). Also, the probability

an approved loan's being withdrawn declined by 5.0% in the treated group. This is a significant drop, given that the withdrawal rate was about 13% in the control group.

We are interested in understanding the drivers of the changes in the parameters of approved loans. In particular, are these changes due to the change in composition of the approved loans (and could therefore be explained by loan application fundamentals), or are the changes due to loan officers' discretion affected by the new 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 (namely, logged requested amount, personal collateral indicator, LTV, LTV-squared, Experian business credit score, and Experian personal credit score) and fixed effects (specifically, loan officer fixed effects, industry fixed effects, and calendar month fixed effects). The regression is provided in Appendix B. We use these regressions to compute the predicted value of the internal risk rating as well as the regression residual for the entire sample (including the treated group). The predicted value reflects the compilation of observable characteristics into the internal risk rating in the absence of incentive compensation. The residual reflects the independent judgment of loan officers, potentially based on unobservable borrower and loan characteristics.

Table 5, Panel B explores whether the changes in approved loans' characteristics in the treated group are driven by observable loan fundamentals or by loan officers' discretion. The results show that all three changes in loan parameters are related to loan officers' discretion (captured by the residual of the internal risk rating score)—and less so to observable fundamentals. The direction of the effects is as expected. The interaction between the treatment indicator and the residual of the internal risk rating in Column (1) shows that treated loan officers approve loans that are larger relative to the requested amounts for borrowers with a smaller residual on the internal risk rating (i.e., those of better quality as judged by the loan officer, based on unobservable characteristics). A similar result appears for approved leverage relative to the requested leverage (Column (2)). Also, borrowers with lower unobservable credit quality (a higher internal risk rating residual) pay a higher interest rate (Column (3)).

Overall, the results in Table 5 indicate that following the change in compensation, approved loans are larger in size with higher leverage, although there is no difference in the

external risk measures of the approved loans in the treated group versus the control group. Thus, these results show that the decision to increase the leverage of borrowers is driven by loan officers' discretion. In the latter part of the analysis, we will use default statistics to test whether loan officers' discretion during the treatment period was justified.

4.4 Decision-Making at the Bank

We next explore how incentive pay affected the way in which loan officers perform their role in the lending process. At this stage, we restrict ourselves to descriptive analysis, leaving the interpretation to Section 5.

4.4.1 Loan Officers' Input into the Loan Approval Process

Traditionally, loan officers' duties require them to collect information on potential borrowers, evaluate it, and process the loan. As mentioned earlier, loan officers' input into 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 approval decision. In particular, we test whether loan officers' professional opinions have a greater weight on the originating decision during the treatment period.

In Table 6, Panel A, we use the sample of all loan applications, and regress an indicator of whether an application was approved. We control for loan characteristics and for loan officer, industry, and calendar month fixed effects. The results in Columns (1) and (2) show that the likelihood of approving a loan following the modification in compensation is higher by 5.5 to 6.3 percentage points, which reflects a relative increase of about 11% in the likelihood of approving loans.

In Figure 2, we provide a graphical time-series of the approval rates. In this figure, we plot the residuals from the approval regression—a regression of the approval indicator on fundamental determinants: the personal collateral dummy, the Experian business and personal credit scores, LTV, LTV-squared, and the interest rate, as well as the loan officer, industry, and

calendar month fixed effects. The regression is provided in Appendix B, Column (1). The sample used in the regression includes only the control sample. Figure 1 shows that treated loan officers dramatically and consistently increased their approval rates once they started receiving the incentive pay.

To explore loan officers' input into the decision to approve, we decompose the internal risk rating to a predicted component and a residual, as we did in Section 4.3. The regression uses a sample based on observations from the control group only and is provided in Appendix B, Column (3). 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 that is orthogonal to observable characteristics; i.e., it reflects his judgment and discretion with respect to a particular loan, beyond the observable loan characteristics. The monthly time-series of the residuals of the internal risk rating variable is in Figure 3. The figure shows that in the control group, residuals are concentrated around zero. In the treatment group, however, the average residual is negative in all months indicating that loan officers' reported a lower perceived risk in approved loans.

To examine the effect of loan officers' input into the loan approval decision, we rerun the base regression, this time controlling for the loan officers' residual from the internal risk rating regression (Table 6, Panel A, Column (3)). The regression shows that the effect of the treatment on approval reduces to 3.0%. The coefficient on the internal risk rating is statistically different from zero and has a value of -0.0918. This means that, on average, a one standard deviation decrease in the internal risk rating (1.51) is associated with an increase in the probability of approval of 13.9 percentage points, i.e., a 42.1% relative increase in the probability of approval.[11] Hence, in general, loan officers' judgment is an important input into the approval decision.

A related question is whether loan officers' impact on the originating decision is higher in the treatment group than in the control group. This will provide evidence that loan officers use their discretion more in the origination process when they are compensated based on originated volume. In Column (4) of Table 6, Panel A, we interact the residual of the internal risk rating with the commission-based compensation indicator. The regressions show that the coefficient is

[11] The probability of origination in the control group is approximately 33%; 13.9% / 33% = 42.1%.

negative and statistically significant, meaning that loan officers' input into the approval decision is greater during the treatment period. The economic effect is large. While in the control group a downward shift of one standard deviation in the internal risk rating is associated with an increase of 9.3 percentage points in the likelihood of approval,[12] the effect is 17.1 percentage points in the treatment group,[13] i.e., an 83% increase.

In parallel with the increase in weight that loan officers put on their own input for the approval decisions, the importance of the external credit scores declines. Table 6, Panel A, Column (5) shows that the interactions between the treatment dummy and the external scores have negative coefficients, meaning that the sensitivity of the loan approval decision to external scores is lower in the treatment group than in the control group.

Hence, our results show that commission-based compensation leads to a higher probability of loan approval. Furthermore, we find that the approval decision places significantly more weight on the opinion of loan officers, as reflected in the strong association with the residual from the internal risk rating regression.

4.4.2 Loan Officers' Internal Risk Rating

Given that the input of loan officers is more substantial when compensation is dependent on the volume originated, we are interested in exploring which loans receive better internal risk ratings and the loans on which officers spend their time. First, we examine the average effect of incentive pay on loans' internal risk ratings. In Table 6, Panel B, Columns (1) and (3), we present base regressions in which the internal risk rating is regressed on the treatment indicator for the entire sample of applications and for the sample of approved loans, respectively; we find that, on average, treated loan officers provide a lower internal risk rating (reflecting better quality).

Second, we investigate which loans receive the "improved" internal risk rating. In particular, we are interested in studying this issue with respect to the *ex ante* likelihood of approval. We again use the two-stage analysis. In the first stage, we regress an approval indicator on fundamental variables. This regression is provided in Appendix B, Column (1). We then split

[12] 0.0615 * 1.51 = 9.3%.
[13] (0.0615 + 0.0515) * 1.51 = 17.1%.

the predicted value of approval into five 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 a lower risk rating score to loans that are in the middle range of *ex ante* approval probability. These are the marginal loans for which loan officers' opinions arguably had the most impact. We note that there is no such effect for loans in the control group.

We also explore the time that treated loan officers spend on applications with respect to their *ex ante* probability of approval. In Table 6, Panel B, Columns (5)–(8), we present evidence that treated loan officers spend less time on loans that have a very low or very high *ex ante* probability of approval, but relatively more time on loans with a medium likelihood of approval.

These results can be interpreted in two non-mutually exclusive ways. If the input of treated loan officers into the origination process contains more information about credit, then these results may indicate that loan officers truly put effort into investigating marginal loans and that some decide that the client's credit is better than what the observables indicate. The other view is more skeptical of the loan officers' motivation. If loan officers' behavior is driven by moral hazard, then they spend marginally more time on borderline applications and make a special effort to push them above the threshold. This behavior would be consistent with Berg, Puri, and Rocholl (2012), who find that loan officers engage in the manipulation of hard information (e.g., income and credit scores) to make borrowers eligible.

At this stage of the analysis, we cannot reject either interpretation. In the following sections, however, we will find that the loan officers' discretionary component is uninformative about the *ex post* performance of loans. This lends merit to the view skeptical of the motivation behind loan officers' exertion of more effort.

4.4.3 Non-Fundamental Factors Affecting the Origination Decision

An important question is whether loan officers act in concert with the Bank's objectives or whether they exploit the compensation scheme to generate higher income for themselves. We explore this issue by testing whether non-fundamental factors affect the loan approval decision. We examine three non-fundamental factors that could affect the approval decision: time of the

month, the loan officer's tenure, and the loan officer's gender. We chose these variables as they are unrelated to borrower quality while reflecting the differential effects of approving a loan for the loan officer.

First, we compare loans made during the first half of the month with those from the second half. Since the incentive scheme provides an increasing marginal reward for loans originated later in the month, loan officers may be more eager to approve loans toward month end. Tzioumis and Gee (2012) find that the origination volume of residential mortgages is higher toward the end of the month, and show that these loans' quality is lower. In Table 6, Panel A, we regress the loan approval indicator on a treatment indicator interacted with an indicator for whether the loan was originated in the second half of the month. The results (Column (6)) show that loans in the treatment group are more likely to be originated in the second half of the month than they are in the first half—by 2.9%. This effect is economically meaningful, as the base approval rate in the control group is about 46% (Table 2, Panel A). There is no comparable effect for the control group.

Second, we examine the effects of loan officer age. Older loan officers may have fewer career concerns and may therefore be willing to take greater risks and game the system. In Table 6, Panel A, Column (7), we find that while above-median-aged loan officers in the control group do not originate more loans than their peers, above-median-aged loan officers in the treatment group approve more loans by 3.1%. (Results, unreported, are similar for loan officers with above-median tenure.)[14]

Third, we examine the gender of loan officers. Male loan officers may exhibit stronger competitive behavior (Gneezy, Niederle, and Rustichini 2003; Gneezy and Rustichini 2004) and may therefore be more willing to aggressively approve loans when they are compensated based on success. We test this hypothesis in Column (8). Indeed, we find that male loan officers in the treatment group are 3.0% more likely to originate loans when they have bonus compensation. There is no similar effect for the control group.

[14] One might suspect that loan officer age is correlated with salary and that this correlation generates the results. The rationale is that highly salaried loan officers are incentivized to generate relatively more loans (since the bonus is quoted in nominal dollars). In fact, we find that the correlation between salary and age is virtually zero. Hence, this mechanism does not explain our results.

In sum, our findings suggest that non-fundamental factors have an important effect on the probability that loans would be originated. Specifically, we provide evidence that the structure of the compensation scheme (a reset of the volume count at the beginning of the month) and the differential response of loan officers to the bonus scheme (age, gender) affect the probability of origination in the anticipated direction. Hence, these results support the conjecture that loan officers exploit the incentive system to enhance their income.

5 Loan Performance

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 approved by the treated loan officers. In this section, we explore the *ex post* performance of loans, conditioning on loan officer treatment.

5.1 Measuring Loan Performance

Our tests of loan performance are based on an analysis of loan defaults. We measure the default event as a delinquency of 90 days or more. within one year of the originating the loans. The raw default rate in the control group is 4.2 percentage points in 2004–05, while in 2005 it as high as 5.2 percentage points in the treated group (Table 2, Panel B). To verify that the difference is statistically significant, we regress a default indicator on the commission-based compensation dummy in addition to the loan officer, industry, and calendar month fixed effects. At this point we are interested in measuring the difference in default rates without controlling for borrower and loan characteristics. The results in Table 7, 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, compared with the base default rate of 4.3% for the control group in 2005). In Columns (3) and (4), we also control for the interest rate charged to the loans. This control should capture the *ex ante* risk as the Bank perceives it. 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 the default rate is not priced in the originated loans.

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

5.2 Why Do Loans in the Treated Group Default More Often?

Next, we investigate the factors that lead to the increase in defaults among loans originated by treated loan officers. There are three potential and related channels that could explain the increase in defaults. First, it is possible that loans officers used their discretion to originate bad loans. This channel suggests that loan officers approve loans that in the absence of incentive pay, they would not have been approved. Second, loans in the treated group were larger than those in the control group. It is plausible that the increase in loan size and leverage increased the borrowers' risk of default. Third, the incentives could lead loan officers to spend too little time on applications, neglecting important information.

We test these channels in Table 8, Panel A; Column (1) provides the base regression. In this column, a 12-month default indicator is regressed on the loan characteristics: a personal collateral dummy, the Experian business and personal credit scores, LTV, LTV-squared, and the interest rate, in addition to the loan officer, industry, and calendar month fixed effects. The coefficient on the commission-based compensation indicator suggests that the default rate in the treatment group is higher by 0.85%.

We check the relation between the high default rate in the treatment group and the originating process. In Columns (2) and (3) of Table 8, Panel A, we control with the residuals from the internal risk rating regressions and the approval regression, respectively. The residual from the internal risk regression conveys the loan officers' view of a loan beyond the observable fundamentals. Column (2) shows that loans that have a higher internal risk rating (i.e., loans to applicants identified by loan officers as having worse credit profiles) have a higher likelihood of default. The residual from the approval regression reflects the degree to which a loan was originated beyond what its fundamentals would predict. Column (3) indicates that loans with an approval decision that is less dependent on fundamentals are more likely to default. Importantly, by including the controls in Columns (2) and (3), the coefficient of the commission-based

compensation is cut by nearly half—from 0.85% to 0.44% and 0.51%, respectively, in the regressions.

The second explanation for the high default rate—that the higher-than-usual leverage and loan size caused the increase in default—is tested in Columns (4) and (5). We compute the residual from a leverage regression, as well as the residual from a loan size regression (both regressions are in Appendix B). We then include these residuals as controls in the base regression. In Column (4), we control for residuals from the leverage regression; the regression shows that after controlling for the residual, the effect of the commission-based compensation declines from 0.85% (Column (1)) to 0.46%. The result is similar for the residual from the loan size regression (Column (5)); when this variable is included in the regression, the magnitude of the commission-based coefficient declines to 0.56%.

The third possibility, that loan officers neglect information, is tested in Column (6). We use the same technique of controlling for the residual from a time-spent regression (see Appendix B). The results show the opposite: the loans that loan officers spent more time on are more likely to default. This could be explained if the time spent on applications is correlated with the complexity of the case. But another possibility is that the time spent on an application indicates that the loan officer made a special effort to push to approve the loan beyond the threshold. In Column (7), we include all variables in the regression and find that they all remain statistically significant. When all these variables are included, the magnitude of the treatment dummy decreases to a statistically insignificant 0.23%, suggesting that these variables explain 73% of the increase in default.

To explore further the impact that treated loan officers have on the origination process and consequent default, we repeat the specifications from Table 8, Panel A; this time we interact the treatment dummy with the residuals. The results are presented in Table 8, Panel B. Column (1) shows that the internal risk rating does have additional explanatory power of the likelihood of default during the treatment period. This is an important finding as we previously found that the internal risk rating has a greater role in the approval decision (Section 4.4.1); however, the current result shows that there is no additional information in the loan officers' risk assessment. Columns (2)–(4) show that the sensitivity of default of loans originated by treated loan officers is higher to residuals from the approval regression, LTV regression, and loan size regression. These

results are consistent with the idea that aggressive approval and aggressive loan terms, which are not based on application observables, lead to higher default rate. The magnitude of the effect is approximately double the sensitivity of the control group. Also, the more time the loan officer spent on the application, the higher the likelihood of default is (Column (5)). When all variables are considered together (Column (6)), it appears that aggressive lending (i.e., lending decisions not based on application observables) on both the extensive and intensive margins leads to a higher likelihood of default.

In summary, the results show that the high borrower default rate during the treatment period can be explained by two of the three channels examined. First, loan officers with variable compensation originated loans that they would not have in the absence of incentive compensation. Second, the treated loan officers approved loans that were too large in size and higher than usual in leverage such that borrowers were pushed into default. However, a third possible channel—that loan officers neglected loan application information—turned out not to be an explanatory factor in high borrower default. Rather, our results show the opposite: The loans that loan officers spent more time on are more likely to default.

5.3 Non-Fundamental Factors Are Correlated with Default Probabilities

The previous results show that incentive pay improved the productivity of loan officers while simultaneously increasing the likelihood of borrower default. It is plausible that the incentives led loan officers to descend the "quality ladder" and choose worse borrowers, which are nevertheless profitable to the Bank. While we cannot reject this hypothesis given the data's short time series, we can test whether non-fundamental factors are correlated with loan default. To do so, we use an approach similar to the one from in Section 4.4.3, where we examined the approval decision with respect to the decision's timing (first versus second half of the month), as well as the loan officer's age and gender.

In Table 8, Panel C, we regress the default indicator on an interaction of the treatment indicator and a second-half-of-the-month indicator. The results in Column (1) show that loans originated in the second half of the month in the treatment group have a higher probability of default by 0.29 percentage points. This magnitude is economically significant given that the

default rate in the treatment group is 5.2 percentage points. There is no analogous effect for the control group.

We also examine the effects of the loan officers' age on the probability of default. Column (2) present results that loans originated by treated loan officers of above-median age are 0.54 percentage points more likely to default. Again, there is no comparable effect in the control group.

Finally, we examine the effect of a loan officer's gender on loan performance. The results in Column (3) show that loans originated by male loan officers in the treatment group are 0.35 percentage points more likely to default within one year. The control group shows no similar results.

To conclude this section, our findings show that the quality of originated loans declined with the implementation of bonus-based compensation, and that approval and default are both tightly related to loan officers' discretion rather than to fundamentals. We further presented evidence that the non-fundamental factors that are related to loan officers' compensation but unrelated to the quality of loans affect the likelihood of both approval and default. Hence, although we cannot reject the hypothesis that incentive pay improved the Bank's profitability, we demonstrate that implementing bonus-based compensation caused loan officers to approve too many loans.

6 Loan Officers' Salaries

Our final set of empirical tests relates to the salaries that the treated loan officers receive. In particular, we would like to verify that loan officers with a propensity to originate low-quality loans are compensated with larger salaries.

We obtain loan officer-month total compensation data for both the control and treatment groups. Our base analysis regresses the logged salary figure on a commission-based compensation indicator and calendar month fixed effects. We find that the loan officers in the treatment group are compensated by 8.2% higher salaries than the loan officers in the control group (Table 9, Column (1)).

Then, we explore whether age, tenure, and gender significantly enhance loan officers' salary in the treatment group. In Column (2) of Table 9, we interact an above-median indicator with the treatment indicator. The result shows that above-median-aged treated loan officers earn 3.9% higher salaries than below-median-aged treated loan officers. This result is consistent with the idea that above-median-aged loan officers have fewer career concerns, enabling them to originate more low-quality loans. A similar specification in Column (3) shows that above-median-tenured treated loan officers earn 2.5% higher salaries than their below-median-tenured counterparts. Further, Column (4) shows that above-median-aged and above-median-tenured treated loan officers are non-overlapping groups—once both enter the regression, both conserve their economic magnitude.

In Column (5), we test the effect of loan officers' gender on their salaries. We find that while there is no gender effect for the control group, male treated loan officers receive compensation that is higher by 3.6% than female treated loan officers.

Overall, the salary results are consistent with the notion that loan officers adversely lowered the lending standards in order to earn larger salaries.

7 Do Loan Officers Approve Too Many Loans?

In the previous sections we have shown that bonus-based compensation led loan officers to approve more loans that resulted in higher rate of default. Furthermore, we show that approvals and defaults are both correlated with factors that are unrelated to quality of the borrower but rather to the benefit of the loan origination to the loan officer. While these results reflect moral hazard among treated loan officers, they do not necessary mean that loan officers originated bad loans for the Bank, i.e., that have negative net present value.

In order to test whether loans have negative NPV, we need to compare the default probabilities and the interest charged on these loans in the treatment and control groups. We perform two analyses: (1) exploring that the *average* loan has a negative NPV, and (2) exploring that the *marginal* loan has a negative NPV.

7.1 NPV of the Average Loan

We assess whether the average loan has a negative NPV based on the following calculation. We assume that that recovery rate of defaulted small business loans is in the range of 30% to 50%. From the experiment's results, we note that the default rate increased from 4.2 percentage points to 5.2 percentage points and the interest rate, 9.6%, practically did not change (see the summary statistics on interest rates in Table 2, Panel B).

Given this information we can compute the cost of capital required to make these loans profitable. In the control group, lending is profitable if the cost of capital is lower than 6.7% (recovery is 30%) to 7.5% (recovery is 50%). In the treatment group, lending would be profitable if the cost of capital is lower than 6.0% to 7.0%. Overall, the difference between the control and treatment groups is not large; without further information about the cost of capital of the Bank (which we do not readily have), it is hard to determine whether loans originated by the treated group were bad on average.

There is one caveat to this calculation: It implicitly assumes that the 2004–2005 default rates as the modal default rates. In retrospect, this was a relatively prosperous period with low default rates. To perform this calculation correctly we need to use the long-term default rate of the borrower population, which is not available to us. Under more severe economic conditions, it is plausible that the loans in the treatment group would have negative NPV on average.

7.2 NPV of the Marginal Loan

Another way to approach the problem is to calculate the NPV of the marginal loan. It is possible that treated loan officers did not originate bad loans *on average*, yet some loans *on the margin* could have been identified as being bad. Such evidence would mean that the incentive-based compensation pushed loan officers to approve too many loans.

To compute whether the marginal loans have negative NPV, we need to find the marginal loans. We do so by generating a distribution of the ex ante probabilities of default for the treatment and the control samples of loans. We use the 2004 control sample to estimate a default model. Specifically, we regress (logit) a default indicator on logged originated amount, personal collateral indicator, Experian business and personal credit scores, originated LTV, originated LTV-squared, and interest rate.

We use the coefficients from the estimation regressions to predict the probability of default in 2005. Then, we plot a histogram for both the control and treatment samples (Figure 4). The histogram shows that the ex ante probabilities of default for the control group range between zero and 15%. In contrast, the treatment group has over 10% of loans with higher default probabilities (of 15% to 30%). Hence, the marginal loans are those in the 25%-30% default probability bucket.

Next, we explore whether interest rates of the loans originated by the treated group compensate for the higher probability of default. Figure 5 presents the average interest rate charged loans within each bucket for both control and treatment samples. The chart clearly shows that interest rates barely vary with the probability of default for either sample. To compensate for the high default rate of 25%-30%, the credit spread should be at least 12%-21%. The figure shows that the interest rate charged for loans in both groups in the 25%-30% default probability bucket is about 10.5%, on average, only slightly higher than the interest charged for the group in the 0%-5% default probability bucket. Hence, these loans with high default probability have negative NPV.

Based on these two exercises, we conclude that the marginal loans that treated loan officers originated had negative NPV.

8 Conclusion

In this paper, we present direct evidence that commission-based compensation causes loan officers to approve too many risky loans. This result provides a unique contribution to our understanding of the role that incentives played in helping to create the real estate bubble in the early 2000s. Our evidence shows that the commission-based compensation scheme of loan officers led to lower underwriting standards in three ways. First, when loan officers are subject to incentive pay, loans are approved that would otherwise not have been. Second, loan officers with variable compensation (relative to those without) approve loans of larger sizes and encourage borrowers to put up more collateral (as indicated by modest increases in leverage). Eventually, these larger loans with higher collateral drive borrowers into default. Third, loans were more likely to be approved when they benefit loan officers more (e.g., at the end of the month, when the marginal bonus is higher).

An important question is whether providing incentives to drive up loan volume was a profitable proposition for the Bank, despite the moral hazard behavior exhibited by treated loan officers. In an analysis of the NPV of the marginal loans, we find that while virtually all loans in the control group had predicted default rates of up to 15%, some loans in the treatment group had predicted default rates of up to 30%. We show that the interest rates charged on loans in the treatment group did not compensate for the increase in risk of default. Hence, the marginal loans in the treatment group have negative NPV.

In sum, our results support the view that intermediaries had an important role in propagating the real estate bubble in the early 2000s, partly because their incentives were misaligned with the objectives of the lenders. In the experiment, the commission provided to loan officers was of 20% of their original salary. Our results indicate that the effects of these incentives were large, even to a degree that led loan officers to approve too many loans. In the residential real-estate lending industry, incentives are even steeper: commission contracts are often of 100% commission (see, Bureau of Labor Statistics 2012; Berndt, Hollifield, and Sandas 2010). It is therefore plausible that incentives in the residential market led to even greater distortions in loan origination than what is documented in this study. Nevertheless, it is also important to note that our results do not preclude the possibility that lenders can increase their profitability by properly calibrating the incentives of loan officers.

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Appendix A: Variable Definitions

Variable	Description
Requested amount	The dollar amount requested by the loan applicant.
Originated amount	The dollar amount that was originated by the Bank.
Personal collateral	An indicator variable as to whether the loan applicant proposes to collateralize a personal asset (=1); otherwise, the loan applicant proposes to collateralize a business asset (=0).
Loan-to-value (LTV)	Computed as the loan amount divided by the value of the collateral.
Experian business score	Applicant's business credit score, as reported by Experian. Scores range from 100 to 250. A higher score means higher credit quality.
Experian personal score	Applicant's personal credit score, as reported by Experian. Scores range from 400 to 850. A higher score means higher credit quality.
Time spent	Time interval between application submission and decision. Measured in months.
Internal risk rating	Applicant's risk rating as computed by the loan officer. Scores range from 1 to 10. Unlike Experian scores, a low internal risk rating reflects higher credit quality.
Withdrawn	An indicator of whether a loan application was withdrawn before or after a decision was made by the Bank.
Commission-based compensation	An indicator of whether: 1) the loan application was handled by a loan officer who is part of Group B (treated with commission-based compensation in 2005), and 2) the year of the loan application is 2005.
Interest rate	The interest rate paid on the loan.
Default within 12 months	An indicator of whether the loan became delinquent (90 days or more past due) within 12 months since originating.
Loan originated	An indicator of whether a loan application was originated by the Bank.
Residual from loan originating regression	Residual from a regression of the loan originated variable on loan characteristics (see Appendix B).
Residual from internal risk rating regression	Residual from a regression of the internal risk rating variable on loan characteristics (see Appendix B).
Residual from LTV regression	Residual from a regression of the LTV variable on loan characteristics (see Appendix B).
Residual from log(Originated amount) regression	Residual from a regression of the log(originated amount) variable on loan characteristics (see Appendix B).

Appendix B: First Stage Regressions

The table presents an analysis of outcomes of the lending process on determinants. The sample contains only applications (Column (1)) and originated loans (Columns (2)–(4)) from the control group: Group A in 2004 and 2005, and Group B in 2004. All regressions are ordinary least squares (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:	Applications (Control only)			Accepted loans (Control only)	
Dependent variable:	Loan accepted (0/1)	Time spent	Internal risk rating	LTV	log(Loan amount)
	(1)	(2)	(3)	(4)	(5)
log(Requested amount)	-0.3007**	0.1423***	0.0264*	0.0256	-0.0164
	(0.0700)	(0.0395)	(0.0147)	(0.0224)	(0.0122)
Personal collateral (0/1)	0.0215***	-0.0491***	-0.1497***	-0.0395***	0.0818**
	(0.0077)	(0.0139)	(0.0391)	(0.0070)	(0.0344)
Experian business score	-0.1397***	-0.1191***	-0.0091***	-0.0063***	0.0032***
	(0.0481)	(0.0242)	(0.0011)	(0.0004)	(0.0008)
Experian personal score	-0.1295***	-0.1772***	-0.0084***	-0.0052***	0.0093***
	(0.0391)	(0.0507)	(0.0012)	(0.0012)	(0.0003)
LTV (Requested)	0.0471***	0.0401***	0.0444***	-0.6075***	-0.8142***
	(0.0139)	(0.0150)	(0.0068)	(0.0838)	(0.2224)
LTV^2 (Requested)	-0.0796***	0.0836**	0.1346***	-0.7031***	0.6948***
	(0.0162)	(0.0328)	(0.0202)	(0.0774)	(0.1485)
Loan officer fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	22,480	22,480	22,480	10,470	10,470
Adj. R^2	0.17	0.15	0.26	0.14	0.10

Table 1. Incentive Plan

The table presents details about the incentive plan.

Total Score	Incentive award per month
Less than 80% of goal (last year's performance)	No award
80% of goal	$ 333 + $10.5 per percentage point above 80% of goal
100% of goal	$ 540 + $12.5 per percentage point above 100% of goal
120% of goal	$ 790 + $14.5 per percentage point above 120% of goal

Table 2. 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 originated 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	
Requested 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
Requested LTV (%)	61.283	43.001	65.301	44.029	65.161	46.873	63.049	43.483
Experian business score (100-250)	200.863	72.228	195.884	75.868	195.988	75.273	200.359	68.471
Experian personal score (400-850)	731.847	70.305	725.405	68.063	725.908	74.394	728.057	76.723
Internal risk rating (1-10)	5.819	1.734	5.813	1.537	5.940	1.313	5.958	1.470
Time spent (months)	1.380	0.850	1.350	0.700	1.320	0.750	1.060	0.530
Accepted (0/1)	0.449	0.497	0.436	0.496	0.512	0.500	0.592	0.491
Withdrawn (0/1)	0.132	0.338	0.118	0.322	0.150	0.357	0.119	0.324

Panel B: Originated Loans

	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
# Originated loans	2,192		2,548		2,744		3,680	
% Loans originated	30.55	46.10	32.19	46.75	35.74	49.92	46.56	47.59
Requested amount ($)	$302,074	$305,891	$302,966	$301,933	$303,082	$306,939	$302,224	$317,073
Originated amount ($)	$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 (originated) (0/1)	0.270	0.409	0.280	0.403	0.300	0.420	0.250	0.404
Requested LTV (%)	79.060	20.930	78.440	19.280	79.030	17.040	78.520	18.400
Originated LTV (%)	72.986	31.477	76.237	30.899	74.901	33.105	77.033	26.049
Experian business score (100-250)	184.870	68.946	186.115	78.924	185.500	93.091	196.095	87.015
Experian personal score (400-850)	716.692	87.439	718.897	88.580	719.537	98.245	725.765	66.510
Time spent (months)	1.270	0.880	1.282	0.858	1.275	0.799	1.020	0.540
Internal risk rating (1-10)	5.230	1.840	5.380	1.520	5.440	1.300	4.930	1.530
Interest rate (%)	9.910	5.020	9.850	4.890	9.580	4.880	9.650	4.930
# 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(Originated amount)-log(Requested amount)	-0.129	-0.039	-0.146	-0.117	-0.077	-0.075	0.014	0.104
Originated LTV-Requested LTV	-0.060	0.104	-0.022	0.116	-0.041	0.158	0.007	0.080
Residual from origination regression	0.008	0.034	0.008	0.033	0.008	0.032	0.065	0.033
Residual from internal risk rating regression	0.010	0.039	0.009	0.040	0.009	0.042	-0.092	0.040
Residual from leverage regression	0.003	0.034	0.003	0.033	0.004	0.032	0.007	0.032
Residual from loan size regression	0.004	0.038	0.003	0.040	0.004	0.042	0.071	0.039
Residual from time spent regression	0.003	0.029	-0.005	0.033	0.005	0.040	-0.139	0.059

Table 2. Summary Statistics (Cont.)

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	
log(Application avg amount ($k))	5.582	5.336	5.382	5.352	5.587	5.349	5.399	5.534
log(Approved avg amount ($k))	5.293	5.562	5.296	5.485	5.290	5.433	5.525	5.661
log(Originated avg amount ($k))	5.281	5.394	5.299	5.307	5.294	5.374	5.551	5.446
log(# Applications)	3.794	1.885	3.795	1.884	3.799	1.865	3.812	1.842
log(# Approved loans)	3.378	1.858	3.399	1.878	3.381	1.840	3.705	1.819
log(# Originated loans)	3.373	1.861	3.396	1.861	3.391	1.834	3.816	1.840
Salary ($)	$43,292	$32,941	$43,023	$32,114	$43,139	$32,327	$47,305	$32,672
log(Salary ($))	4.567	4.555	4.583	4.544	4.608	4.601	4.660	4.521
Age (years)	43.050	12.076	43.500	12.201	42.900	12.094	43.100	12.044
Tenure (years)	3.050	2.560	3.140	2.599	3.040	2.570	3.080	2.556
Male (%)	62.90		68.04		64.50		66.93	

Table 3. Analysis of Loan Application Volume and Characteristics

The table presents an analysis of the loan application volume and characteristics. Panel A uses a sample at the loan officer-month level and explores 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 the characteristics of loan applications 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 Group B (to be treated in 2005) are different in the pre-treatment period (2004). Panel D tests whether originated loans made by Group A (control) and Group B (to be treated in 2005) are different in the pre-treatment period (2004). All regressions are ordinary least squares (OLS) regressions. Variables are defined in Appendix A. In Panel A, standard errors are clustered at the month level. In Panels B through 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

Dependent variable:	Applications (monthly)			
Denoted in:	log(Avg Amount ($))		log(# applications)	
	(1)	(2)	(3)	(4)
Commission-based compensation (0/1)	0.0195	0.0125	0.0009	0.0072
	(0.0259)	(0.0298)	(0.0138)	(0.0253)
Loan officer fixed effects	Yes	Yes	Yes	Yes
Month fixed effects	No	Yes	No	Yes
Observations	3,192	3,192	3,192	3,192
Adj. R^2	0.17	0.23	0.16	0.22

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

Dependent variable:	log(Requested amount)	Requested LTV	Personal collateral	Experian business score	Experian personal score	Internal risk rating
	(1)	(2)	(3)	(4)	(5)	(6)
Commission-based compensation (0/1)	0.0166	0.0262	0.0143	7.2032	4.0303	0.0447
	(0.0654)	(0.1854)	(0.0572)	(6.0220)	(5.1130)	(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 3. Analysis of Loan Application Characteristics (Cont.)

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

Dependent variable:	log(Req'd amount)	Req'd LTV (%)	Personal collateral	Experian business score	Experian personal score	Internal risk rating	Time spent	Application withdrawn
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Group B (to be treated in 2005) (0/1)	-0.0366	-0.0415	0.0014	-3.2124	-4.2615	0.0038	0.0013	0.0029
	(0.0523)	(0.1282)	(0.0143)	(3.4288)	(5.6591)	(0.0069)	(0.0498)	(0.0090)
log(Requested amount)			0.0367***	-0.0136	-0.0064	0.0040	0.0073	0.1406**
			(0.0109)	(0.0107)	(0.0146)	(0.0190)	(0.0272)	(0.0585)
Personal collateral (0/1)	0.0471	0.0227	-0.0275	0.0332	0.0220	-0.0070	-0.0091	0.0297*
	(0.0466)	(0.0766)	(0.0265)	(0.0225)	(0.0281)	(0.0411)	(0.0555)	(0.0153)
Requested LTV			0.0187***	0.0384	0.0007**	0.0020	0.0025	0.0714***
			(0.0061)	(0.0379)	(0.0003)	(0.0080)	(0.0100)	(0.0200)
Requested LTV^2			0.0385***	-0.0441**	-0.0038***	0.0040	0.0051	0.0413*
			(0.0053)	(0.0218)	(0.0011)	(0.0400)	(0.0574)	(0.0218)
Experian business score	0.0284***	0.0478***	-0.0664***		0.0316***	-0.0070***	-0.0046	-0.1459***
	(0.0081)	(0.0080)	(0.0149)		(0.0082)	(0.0026)	(0.0035)	(0.0513)
Experian personal score	0.0382	0.0586***	-0.0198	0.0291*		-0.0347***	-0.0461***	-0.0925*
	(0.0587)	(0.0182)	(0.0342)	(0.0170)		(0.0041)	(0.0045)	(0.0484)
Internal risk rating	-0.0717***	-0.0421***	0.0321***	-0.0036***	-0.0127			
	(0.0041)	(0.0042)	(0.0035)	(0.0005)	(0.0153)			
Loan officer fixed effects	No	No	No	No	No	No	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,916	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	0.07

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

Dependent variable:	log(Originated amount) -log(Requested amount)	Originated LTV -Requested LTV (%)	Interest rate	Experian business score	Experian personal score	Internal risk rating
	(1)	(2)	(3)	(4)	(5)	(6)
Group B (to be treated in 2005)	-0.0212	-0.0397	0.0012	1.0709	1.6481	0.0034
	(0.0514)	(0.0616)	(0.0161)	(2.2490)	(2.4789)	(0.0089)
log(Originated amount)			0.0352***	-0.0106	-0.0062	0.0035
			(0.0102)	(0.0098)	(0.0118)	(0.0155)
Personal collateral	0.0546	0.0435	-0.0230	0.0329	0.0188	-0.0060
	(0.0467)	(0.0658)	(0.0216)	(0.0215)	(0.0190)	(0.0382)
Originated LTV			0.0163***	0.0329	0.0006**	0.0018
			(0.0054)	(0.0355)	(0.0002)	(0.0075)
Originated LTV^2			0.0376***	-0.0360***	-0.0042***	0.0038
			(0.0051)	(0.0225)	(0.0010)	(0.0321)
Experian business score	0.0244***	0.0350***	-0.0570***		0.0247***	########
	(0.0080)	(0.0081)	(0.0119)		(0.0075)	(0.0022)
Experian personal score	0.0415	0.0369***	-0.0180	0.0228		########
	(0.0871)	(0.0076)	(0.0297)	(0.0134)		(0.0036)
Internal risk rating	-0.0622***	-0.0522***	0.0313***	-0.0037***	-0.0104	
	(0.0040)	(0.0036)	(0.0034)	(0.0004)	(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 4. Analysis of the Effects of Compensation on Approved and Originated Volume

The table presents an analysis of the effects of commission-based compensation on approved and originated volumes. The table uses data aggregates at the loan officer-month level to test whether the average loan size of approved or originated loans is higher for loan officers who receive commission-based compensation. All regressions are ordinary least squares (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.

Dependent variable:	Approved loans (monthly)				Originated loans (monthly)			
Denoted in:	log(Avg Amount ($))		log(# Accepted loans)		log(Avg Amount ($))		log(# Originated loans)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Commission-based compensation (0/1)	0.1472***	0.1495***	0.2822***	0.3127***	0.1435***	0.1454***	0.2756***	0.3054***
	(0.0477)	(0.0399)	(0.0584)	(0.0513)	(0.0462)	(0.0428)	(0.0463)	(0.0384)
Loan officer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
Observations	3,192	3,192	3,192	3,192	3,192	3,192	3,192	3,192
Adj. R^2	0.13	0.15	0.15	0.17	0.16	0.17	0.19	0.20

Table 5. Analysis of the Effects of Compensation on the Characteristics of Approved Loans

The table presents an analysis of the effects of commission-based compensation on the characteristics of approved loans. The table uses a sample at the approved loan level. All regressions are ordinary least square (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: Characteristics of Approved Loans

Dependent variable:	Experian bus score	Experian pers'l score	log(Accepted amount) -log(Req'd amount)	Accepted LTV -Req'd LTV	Interest rate (%)	Time spent	Application withdrawn (0/1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Commission-based compensation (0/1)	7.482***	10.5239***	0.1488***	0.0241***	0.0199***	-0.5704***	-0.0503**
	(2.3332)	(3.6173)	(0.0531)	(0.0081)	(0.0065)	(0.1023)	(0.0215)
Personal collateral (0/1)	0.0262**	0.0013	0.0357	0.0527	-0.0537*	-0.0370***	0.0287**
	(0.0102)	(0.0113)	(0.0749)	(0.0469)	(0.0290)	(0.0088)	(0.0136)
Originated LTV	-0.0122***	-0.0204***	-0.0190***		0.0183***	0.0249**	0.0762***
	(0.0039)	(0.0039)	(0.0035)		(0.0063)	(0.0097)	(0.0207)
Originated LTV^2	-0.0563***	-0.0388***	-0.0795***		0.0742**	0.0842***	0.0453**
	(0.0194)	(0.0123)	(0.0170)		(0.0347)	(0.0191)	(0.0205)
Experian business score		0.0522***	0.0542***	0.0337**	-0.0852**	-0.0686***	-0.1263**
		(0.0122)	(0.0185)	(0.0163)	(0.0347)	(0.0190)	(0.0505)
Experian personal score	0.0565***		0.0461***	0.0644***	-0.0538	-0.1269***	-0.0814*
	(0.0107)		(0.0156)	(0.0193)	(0.0612)	(0.0392)	(0.0434)
Internal risk rating (predicted)			-0.0212***	-0.0216	0.0400*	0.0164***	0.0140***
			(0.0053)	(0.0138)	(0.0223)	(0.0046)	(0.0037)
Internal risk rating (residual)			-0.0385***	-0.0189	0.0407**	0.0363***	0.0332***
			(0.0049)	(0.0144)	(0.0191)	(0.0040)	(0.0035)
Loan officer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,359	14,359	14,359	14,359	14,359	14,359	14,359
Adj. R^2	0.16	0.18	0.17	0.13	0.24	0.18	0.11

Table 5. Analysis of the Effects of Compensation on the Characteristics of Approved Loans (Cont.)

Panel B: The Impact of Loan Officers' Input on the Characteristics of Approved Loans

Dependent variable:	log(Approved amount) -log(Requested amount)	Approved LTV -Requested LTV (%)	Interest rate (%)	Time spent	Application withdrawn (0/1)	Application withdrawn (0/1)
	(1)	(2)	(3)	(4)	(5)	(6)
Commission-based compensation (0/1)	0.0437	0.0017	0.0040	-0.1559	-0.0503**	-0.0130
	(0.0949)	(0.0107)	(0.0069)	(0.1090)	(0.0215)	(0.0177)
× Internal risk rating (predicted)	-0.0188	-0.0168*	0.0131	0.0695**		0.0203**
	(0.0618)	(0.0095)	(0.0084)	(0.0342)		(0.0100)
× Internal risk rating (residual)	-0.0207**	-0.0190**	0.0293***	0.1333*		0.0110*
	(0.0090)	(0.0092)	(0.0057)	(0.0723)		(0.0075)
Personal collateral (0/1)	0.0553	0.0535	-0.0518*	-0.0383***	0.0287**	0.0280*
	(0.0350)	(0.0338)	(0.0302)	(0.0102)	(0.0136)	(0.0150)
Originated LTV			0.0198***	0.0298***	0.0762***	0.0662***
			(0.0061)	(0.0103)	(0.0207)	(0.0179)
Originated LTV^2			0.0681***	0.0651**	0.0453**	0.0385*
			(0.0254)	(0.0261)	(0.0205)	(0.0217)
Experian business score	0.0279*	0.0394*	-0.0764**	-0.0844***	-0.1263**	-0.1529***
	(0.0157)	(0.0212)	(0.0346)	(0.0208)	(0.0505)	(0.0488)
Experian personal score	0.0603***	0.0705***	-0.0446	-0.1229***	-0.0814*	-0.0822*
	(0.0169)	(0.0215)	(0.0684)	(0.0385)	(0.0434)	(0.0451)
Internal risk rating (predicted)	-0.0168*	-0.0211*	0.0383	0.0199***	0.0140***	0.0159***
	(0.0101)	(0.0131)	(0.0234)	(0.0037)	(0.0037)	(0.0032)
Internal risk rating (residual)	-0.0164	-0.0183	0.0411*	0.0329***	0.0332***	0.0278***
	(0.0105)	(0.0121)	(0.0226)	(0.0042)	(0.0035)	(0.0034)
Loan officer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,359	14,359	14,359	14,359	14,359	14,359
Adj. R^2	0.17	0.13	0.23	0.18	0.11	0.11

Table 6. Decision Making and *Ex Ante* Approval Probability

The table presents evidence that the higher likelihood of approving loans and excessive default are driven by information asymmetry that loan officers possess. The table uses a sample at the approved loan level. Panel A explores the drivers of loan approving. 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 Approving Loans

	Dependent variable: Loan accepted (0/1)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Commission-based compensation (0/1)	0.0554***	0.0632***	0.0300***	0.0317**	0.0135*	0.0175	0.0244	0.0355***	0.0412***
	(0.0206)	(0.0198)	(0.0105)	(0.0124)	(0.0070)	(0.0202)	(0.0168)	(0.0109)	(0.0151)
× Internal risk rating (residual)				-0.0515***	-0.0308***				
				(0.0140)	(0.0091)				
× Experian business score					-0.0101*				
					(0.0054)				
× Experian personal score					-0.0287				
					(0.0183)				
× Second half of the month (0/1)						0.0286**			0.0240*
						(0.0127)			(0.0127)
× Age above median (0/1)							0.0306***		0.0374***
							(0.0087)		(0.0083)
× Male (0/1)								0.0300***	0.0291***
								(0.0101)	(0.0097)
Internal risk rating (residual)			-0.0918***	-0.0615**	-0.0520**				
			(0.0196)	(0.0264)	(0.0208)				
Second half of the month (0/1)						0.0069			0.0071
						(0.0120)			(0.0147)
Age above median (0/1)							0.0024		0.0019
							(0.0168)		(0.0145)
Male (0/1)								0.0012	0.0012
								(0.0102)	(0.0095)
log(Originated amount)		-0.0316**	-0.0240***	-0.0208*	-0.0183*	-0.0297**	-0.0334*	-0.0438**	-0.0330**
		(0.0129)	(0.0087)	(0.0121)	(0.0096)	(0.0126)	(0.0186)	(0.0177)	(0.0158)
Personal collateral (0/1)		0.0329***	0.0235***	0.0187**	0.0155***	0.0371***	0.0545***	0.0386***	0.0367***
		(0.0079)	(0.0058)	(0.0075)	(0.0051)	(0.0110)	(0.0081)	(0.0088)	(0.0076)
Experian business score		0.0625***	0.0483***	0.0325*	0.0302**	0.0563**	0.0603**	0.0630***	0.0751***
		(0.0201)	(0.0159)	(0.0190)	(0.0139)	(0.0255)	(0.0256)	(0.0223)	(0.0211)
Experian personal score		0.0442***	0.0410***	0.0385***	0.0228***	0.0540***	0.0692***	0.0450***	0.0490***
		(0.0116)	(0.0080)	(0.0076)	(0.0053)	(0.0134)	(0.0115)	(0.0100)	(0.0125)
Requested LTV		-0.0168**	-0.0177***	-0.0154***	-0.0134***	-0.0246**	-0.0283**	-0.0238**	-0.0188*
		(0.0081)	(0.0061)	(0.0058)	(0.0043)	(0.0103)	(0.0119)	(0.0110)	(0.0107)
Requested LTV^2		-0.0646*	-0.0446*	-0.0397	-0.0279	-0.0608	-0.0854**	-0.0885**	-0.0847**
		(0.0360)	(0.0239)	(0.0289)	(0.0194)	(0.0407)	(0.0402)	(0.0390)	(0.0408)
Loan officer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,359	14,359	14,359	14,359	14,359	14,359	14,359	14,359	14,359
Adj. R^2	0.12	0.13	0.14	0.14	0.16	0.16	0.15	0.18	0.20

Table 6. Decision Making and *Ex Ante* Approval Probability (Cont.)

Panel B: Internal Risk Rating and Time Spent as a Function of *Ex Ante* Approval Probability

Dependent variable:	Internal risk rating				Time spent (months)			
Sample:	All		Only accepted loans		All		Only accepted loans	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Commission-based compensation (0/1)	-0.0698***		-0.0661***		-0.1333***		-0.0999***	
	(0.0223)		(0.0203)		(0.0432)		(0.0380)	
× Predicted approval probability 0.0÷0.2		-0.0147		-0.0138		-0.1713***		-0.1487***
		(0.0311)		(0.0296)		(0.0380)		(0.0305)
× Predicted approval probability 0.2÷0.4		-0.0471		-0.0440*		-0.1426***		-0.1367***
		(0.0294)		(0.0255)		(0.0378)		(0.0371)
× Predicted approval probability 0.4÷0.6		-0.0948***		-0.0803***		-0.0614*		-0.0474
		(0.0308)		(0.0266)		(0.0349)		(0.0303)
× Predicted approval probability 0.6÷0.8		-0.0521*		-0.0431**		-0.0980***		-0.0746**
		(0.0273)		(0.0202)		(0.0376)		(0.0325)
× Predicted approval probability 0.8÷1.0		-0.0182		-0.0156		-0.1488***		0.1154***
		(0.0324)		(0.0299)		(0.0326)		(0.0234)
Predicted approval probability 0.0÷0.2		-0.0141		-0.0118		0.0314		0.0236
		(0.0294)		(0.0282)		(0.0212)		(0.0162)
Predicted approval probability 0.2÷0.4		-0.0155		-0.0141		0.0140***		0.0108***
		(0.0318)		(0.0258)		(0.0047)		(0.0037)
Predicted approval probability 0.4÷0.6		-0.0144		-0.0121		-0.0035		-0.0030
		(0.0302)		(0.0295)		(0.0123)		-(0.0109)
Predicted approval probability 0.6÷0.8		-0.0144		-0.0123		-0.0182		-0.0143
		(0.0317)		(0.0245)		(0.0284)		-(0.0211)
Predicted approval probability 0.8÷1.0		-0.0156		-0.0111		-0.0382		-0.0282
		(0.0326)		(0.0257)		(0.0410)		-(0.0365)
log(Originated amount)	0.0453**	0.0423**	0.0332**	0.0343*	0.1326***	0.1290***	0.1223***	0.1098***
	(0.0169)	(0.0180)	(0.0149)	(0.0179)	(0.0347)	(0.0363)	(0.0322)	(0.0265)
Personal collateral (0/1)	0.0387***	0.0367***	0.0281***	-0.0303**	-0.0482***	-0.0498***	0.0425***	0.0474***
	(0.0125)	(0.0127)	(0.0114)	(0.0121)	(0.0139)	(0.0125)	(0.0114)	(0.0099)
Requested LTV	0.0329***	0.0312***	0.0321***	0.0246***	0.0368**	0.0322**	0.0332**	0.0229*
	(0.0101)	(0.0099)	(0.0077)	(0.0093)	(0.0148)	(0.0148)	(0.0137)	(0.0128)
Requested LTV^2	0.1494***	0.1418***	0.1207***	0.1265***	0.0803***	0.0807***	0.0623***	0.0801***
	(0.0396)	(0.0375)	(0.0372)	(0.0346)	(0.0298)	(0.0261)	(0.0239)	(0.0206)
Experian business score	-0.0605**	-0.0582**	-0.0480**	-0.0426*	-0.1022***	-0.1148***	0.0738***	-0.1145**
	(0.0260)	(0.0241)	(0.0220)	(0.0222)	(0.0208)	(0.0208)	(0.0153)	(0.0200)
Experian personal score	0.0649***	0.0604***	0.0568***	0.0539***	-0.1513***	-0.1761***	0.1266***	0.1307***
	(0.0126)	(0.0120)	(0.0103)	(0.0102)	(0.0454)	(0.0477)	(0.0420)	(0.0401)
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	30,268	30,268	14,359	14,359	30,268	30,268	14,359	14,359
Adj. R^2	0.68	0.68	0.49	0.48	0.44	0.46	0.36	0.37

Table 7. Likelihood of Defaulting

The table presents an analysis of the effect of commission-based compensation on the likelihood of loan default within 12 months. The table uses a sample at the originated 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.

Dependent variable:	Defaulted within 12 months (0/1)			
	(1)	(2)	(3)	(4)
Commission-based compensation (0/1)	0.0122***	0.0120***	0.0118***	0.0114***
	(0.0033)	(0.0034)	(0.0036)	(0.0031)
Interest rate (%)			0.0391***	0.0348**
			(0.0137)	(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 8. Loan Officer Compensation and Information Asymmetry

The table presents evidence that the higher likelihood of originating loans and excessive defaults are driven by information asymmetry that loan officers possess (Panels A and B), and by non-fundamental factors (Panel C). 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: Explaining the Likelihood of Defaulting

	Dependent variable: Defaulted within 12 months (0/1)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Commission-based compensation (0/1)	0.0085***	0.0044**	0.0051**	0.0046**	0.0056***	0.0051***	0.0023
	(0.0017)	(0.0017)	(0.0024)	(0.0021)	(0.0022)	(0.0017)	(0.0026)
Internal risk rating (residual)		0.0724***					0.0344**
		(0.0184)					(0.0170)
Loan accepted (residual)			0.0560***				0.0336***
			(0.0131)				(0.0112)
Originated LTV (residual)				0.0617***			0.0283*
				(0.0197)			(0.0179)
log(Originated loan amount) (residual)					0.1874***		0.0731*
					(0.0486)		(0.0432)
Time spent (residual)						0.0203*	0.0179*
						(0.0115)	(0.0118)
log(Originated amount)	0.0833***	0.0899***	0.0295	0.0865***	0.0096	0.0077	0.0087
	(0.0242)	(0.0274)	(0.0243)	(0.0266)	(0.0283)	(0.0229)	(0.0232)
Personal collateral (0/1)	-0.0443	-0.0693	-0.0603	-0.0471	-0.0473	-0.0448	-0.0399
	(0.0346)	(0.0459)	(0.0401)	(0.0359)	(0.0357)	(0.0329)	(0.0316)
Experian business score	-0.0010	-0.0014*	-0.0011	-0.0009	-0.0011	-0.0009	-0.0010
	(0.0008)	(0.0008)	(0.0010)	(0.0007)	(0.0010)	(0.0009)	(0.0008)
Experian personal score	-0.0008	-0.0008	-0.0009	-0.0008	-0.0010	-0.0010	-0.0010
	(0.0007)	(0.0007)	(0.0007)	(0.0006)	(0.0009)	(0.0008)	(0.0009)
Originated LTV	0.0139**	0.0146**	0.0162**		0.0152***	0.0122***	0.0144***
	(0.0062)	(0.0067)	(0.0076)		(0.0049)	(0.0047)	(0.0044)
Originated LTV^2	0.0353***	0.0396***	0.0351***		0.0403***	0.0336***	0.0426***
	(0.0023)	(0.0021)	(0.0025)		(0.0018)	(0.0017)	(0.0016)
Interest rate (%)	0.0455***	0.0544***	0.0517***	0.0451***	0.0498**	0.0526***	0.0516***
	(0.0132)	(0.0132)	(0.0148)	(0.0136)	(0.0200)	(0.0200)	(0.0196)
Loan officer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,164	11,164	11,164	11,164	11,164	11,164	11,164
Adj. R^2	0.21	0.23	0.21	0.22	0.22	0.22	0.24

Table 8. Loan Officer Compensation and Information Asymmetry (Cont.)

Panel B: Likelihood of Default – Sensitivity to Residuals

	Dependent variable: Defaulted within 12 months (0/1)					
	(1)	(2)	(3)	(4)	(5)	(6)
Commission-based compensation (0/1)	0.0018	0.0025	0.0063***	0.0024	0.0044**	0.0021
	(0.0025)	(0.0019)	(0.0022)	(0.0024)	(0.0022)	(0.0022)
× Internal risk rating (residual)	0.0075					0.0074
	(0.0120)					(0.0118)
× Loan accepted (residual)		0.0590***				0.0247**
		(0.0127)				(0.0114)
× Originated LTV (residual)			0.0435**			0.0198***
			(0.0180)			(0.0158)
× log(Originated loan amount) (residual)				0.1943***		0.0722
				(0.0496)		(0.0471)
× Time spent (residual)					0.0509***	0.0208
					(0.0165)	(0.0163)
Internal risk rating (residual)	0.0866***					0.0395**
	(0.0170)					(0.0169)
Loan accepted (residual)		0.0508***				0.0301**
		(0.0126)				(0.0124)
Originated LTV (residual)			0.0658***			0.0368**
			(0.0196)			(0.0173)
log(Originated loan amount) (residual)				0.1958***		0.0622*
				(0.0485)		(0.0462)
Time spent (residual)					0.0247*	0.0154*
					(0.0184)	(0.0154)
log(Originated amount)	0.0772***	0.0295	0.0853***	0.0105	0.0094	0.0095
	(0.0229)	(0.0235)	(0.0294)	(0.0286)	(0.0265)	(0.0285)
Personal collateral (0/1)	-0.0635	-0.0510	-0.0533	-0.0658	-0.0567	-0.0632
	(0.0437)	(0.0359)	(0.0405)	(0.0455)	(0.0407)	(0.0421)
Experian business score	-0.0012	-0.0010	-0.0012	-0.0015*	-0.0012*	-0.0013
	(0.0010)	(0.0008)	(0.0011)	(0.0009)	(0.0007)	(0.0008)
Experian personal score	-0.0009	-0.0010	-0.0009	-0.0009	-0.0007	-0.0009
	(0.0007)	(0.0006)	(0.0010)	(0.0007)	(0.0007)	(0.0006)
Originated LTV	0.0157**	0.0136**		0.0162**	0.0133**	0.0148**
	(0.0069)	(0.0053)		(0.0072)	(0.0068)	(0.0068)
Originated LTV^2	0.0395***	0.0361***		0.0390***	0.0361***	0.0349***
	(0.0021)	(0.0019)		(0.0021)	(0.0019)	(0.0019)
Interest rate (%)	0.0646***	0.0439***	0.0583***	0.0589***	0.0555***	0.0516***
	(0.0158)	(0.0147)	(0.0188)	(0.0178)	(0.0175)	(0.0176)
Loan officer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,164	11,164	11,164	11,164	11,164	11,164
Adj. R^2	0.26	0.26	0.26	0.29	0.25	0.31

Table 8. Loan Officer Compensation and Information Asymmetry (Cont.)

Panel C: Likelihood of Default – Sensitivity to Non-Fundamental Factors

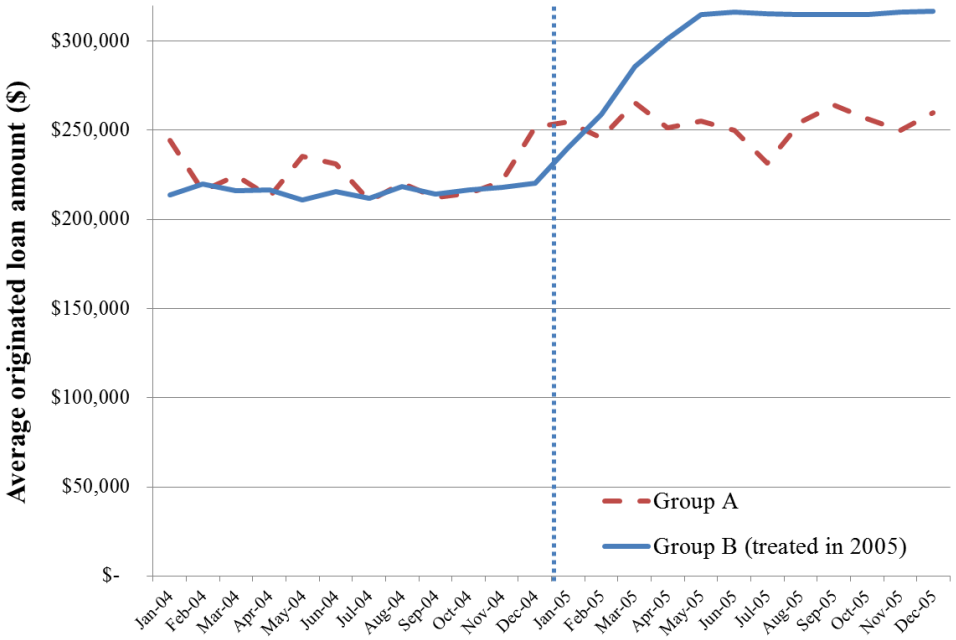
	Dependent variable: Defaulted within 12 months (0/1)			
	(1)	(2)	(3)	(4)
Commission-based compensation (0/1)	0.0020	0.0036***	0.0025	0.0014
	(0.0016)	(0.0014)	(0.0023)	(0.0025)
× Second half of the month (0/1)	0.0029***			0.0030***
	(0.0009)			(0.0009)
× Age above median (0/1)		0.0054***		0.0053***
		(0.0012)		(0.0011)
× Male (0/1)			0.0035***	0.0037***
			(0.0012)	(0.0011)
Second half of the month (0/1)	0.0008			0.0008
	(0.0009)			(0.0010)
Age above median (0/1)		0.0009		0.0010
		(0.0013)		(0.0013)
Male (0/1)			0.0010	0.0009
			(0.0013)	(0.0013)
log(Originated amount)	0.0805***	0.0647***	0.0590***	0.0596***
	(0.0236)	(0.0229)	(0.0192)	(0.0188)
Personal collateral (0/1)	-0.0429	-0.0423	-0.0374	-0.0362
	(0.0270)	(0.0297)	(0.0289)	(0.0298)
Experian business score	-0.0010	-0.0008	-0.0008	-0.0008
	(0.0007)	(0.0008)	(0.0008)	(0.0007)
Experian personal score	-0.0008	-0.0007	-0.0008	-0.0008
	(0.0006)	(0.0006)	(0.0005)	(0.0005)
Originated LTV	0.0112**	0.0114**	0.0123**	0.0128***
	(0.0056)	(0.0052)	(0.0048)	(0.0047)
Originated LTV^2	0.0346***	0.0351***	0.0355***	0.0368***
	(0.0022)	(0.0020)	(0.0021)	(0.0020)
Interest rate (%)	0.0383***	0.0318**	0.0383***	0.0365***
	(0.0096)	(0.0126)	(0.0107)	(0.0112)
Loan officer fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes
Observations	11,164	11,164	11,164	11,164
Adj. R^2	0.21	0.21	0.21	0.21

Table 9. Loan Officers' Salaries

The table explores the determinants of loan officer salaries. All regressions are ordinary least squares (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.

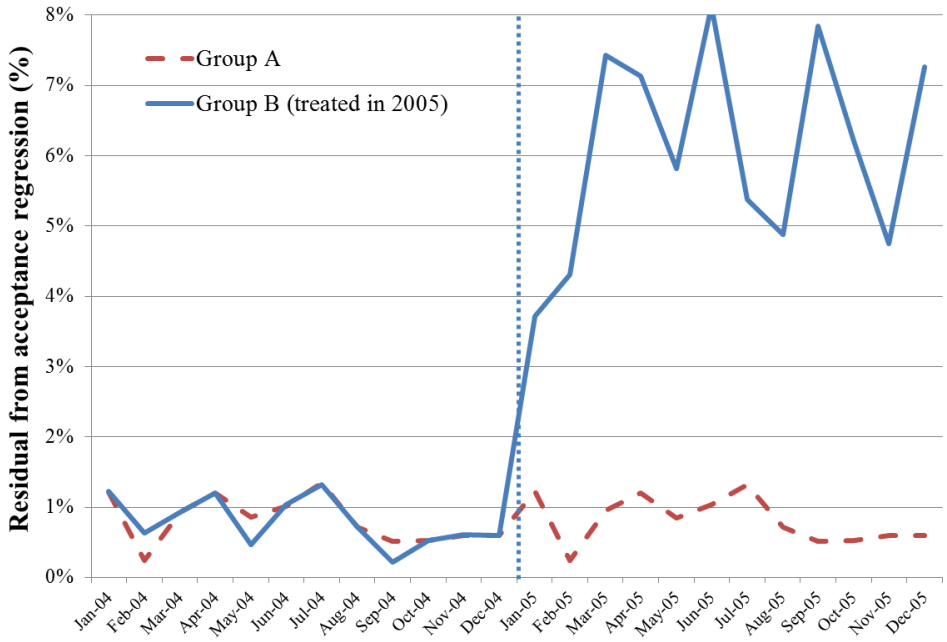
	Dependent variable: log(Salary ($))				
	(1)	(2)	(3)	(4)	(5)
Commission-based compensation (0/1)	0.0822***	0.0487**	0.0753***	0.0164	0.0656***
	(0.0203)	(0.0229)	(0.0138)	(0.0143)	(0.0160)
× Age above median (0/1)		0.0386**		0.0457**	
		(0.0181)		(0.0227)	
× Tenure above median (0/1)			0.0252**	0.0358**	
			(0.0115)	(0.0160)	
× Male (0/1)					0.0361***
					(0.0108)
Age above median (0/1)		0.0136		0.0149	
		(0.0279)		(0.0152)	
Tenure above median (0/1)			0.0059	0.0057	
			(0.0143)	(0.0121)	
Male (0/1)					0.0070
					(0.0116)
Month fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	6,312	6,312	6,312	6,312	6,312
Adj. R^2	0.54	0.58	0.57	0.67	0.69

Figure 1. Average Originated Loan Amount over Time and across Groups



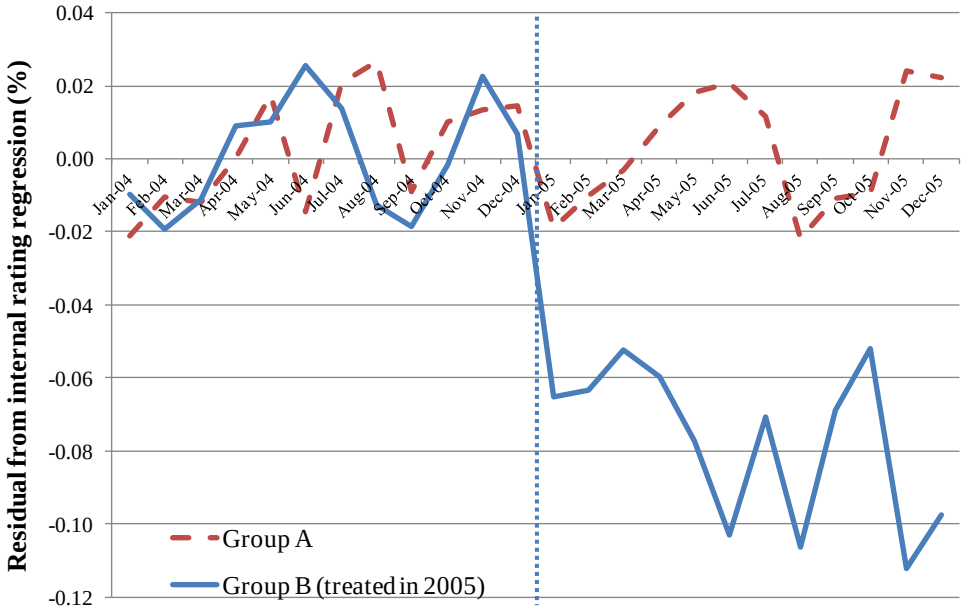
The chart shows the average loan size. Loan sizes are averaged within group (Groups A and B) and month.

Figure 2. Approval Rate (Residual) over Time and across Groups



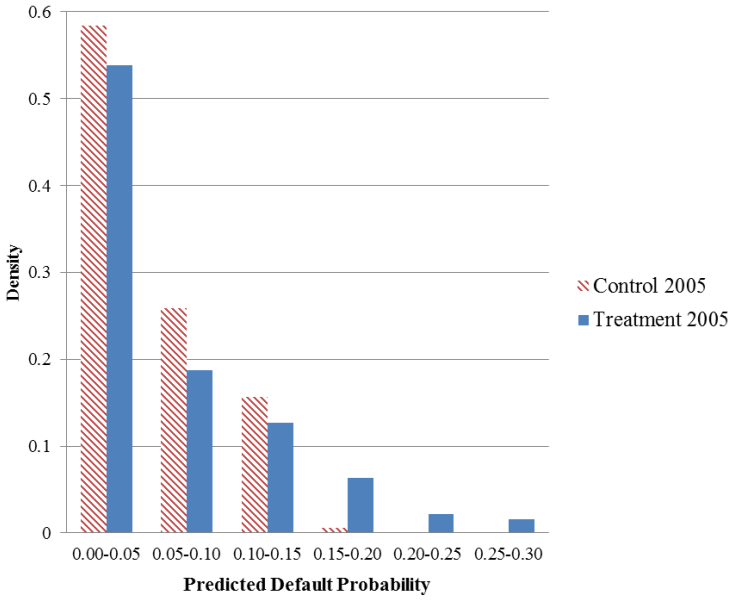
The chart shows the average residual from the approval regression (see Appendix B). The residuals are averaged within group (Groups A and B) and month.

Figure 3. Internal Risk Rating (Residual) over Time and across Groups



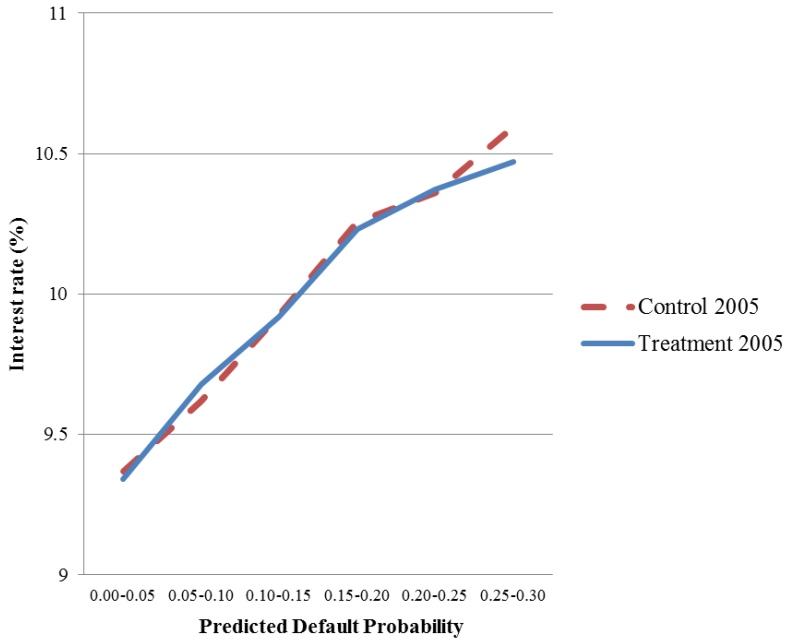
The chart shows the average residual from the internal rating regression (see Appendix B). The residuals are averaged within group (Groups A and B) and month.

Figure 4. Predicted Default Probabilities



The chart shows the predicted probabilities for the control (Group A) and treatment (Group B) groups in 2005. The predicted default probability is computed based on a default regression of a default indicator on logged originated amount, personal collateral indicator, Experian business and personal credit scores, originated LTV, originated LTV-squared, and interest rate.

Figure 5. Predicted Default Probabilities



The plot shows the average interest rate per bucket of predicted probabilities for the control (Group A) and treatment (Group B) groups in 2005. The predicted default probability is computed based on a default regression of a default indicator on logged originated amount, personal collateral indicator, Experian business and personal credit scores, originated LTV, originated LTV-squared, and interest rate.