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Do Loan Officers' Incentives Lead to Lax Lending Standards?
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ABSTRACT

We study a controlled corporate experiment in which loan officers' compensation structure was altered from fixed salary to volume-based pay. The incentives increased aggressiveness of origination: higher origination rates (+31%), larger loan sizes (+15%), and higher default rates (+28%). Under the incentive system, loan officers have greater influence on loan approval decisions; however, their recommendations do not convey more information. Poor loan performance is caused by lax approval and aggressive loan terms, and is more likely to occur among end-of-month originations, male loan officers, and tenured loan officers. About 10% of the loans under the incentive system are likely to have negative net present value.

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1. Introduction

The recent financial crisis has led to much debate about incentive provisions at financial institutions (e.g., Bebchuck and Spamann 2009; Fahlenbrach and Stulz 2011). While the causes of the mortgage meltdown are complex, many would argue that perverse economic incentives are an important contributing factor. For example, Professor Alan Blinder of Princeton University writes, "Despite the vast outpouring of commentary and outrage over the financial crisis, one of its most fundamental causes has received surprisingly little attention. I refer to the perverse incentives built into the compensation plans of many financial firms, incentives that encourage excessive risk-taking with OPM—Other People's Money."[1] Indeed, many banks in recent years gave out incentive packages to encourage loan underwriting. While such financial incentives are designed to promote greater employee efforts, anecdotal evidence suggests that they also encourage loan officers to make more loans to unqualified borrowers.[2] Moreover, the incentive compensation may have affected loan officers' efforts as well as their role in the decision making process—both of which are typically unobservable to economists.

In this paper, we explore the effects of 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 difference-in-differences study design, we are able to make causal statements about the effects of commission-based compensation on the lending process. Our data provide a unique opportunity to examine the influence of loan officers on the approval decision and assess the amount of soft information that they contribute to this process.

The experiment that we analyze was designed by the Bank to examine 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

[1] Alan Blinder, "Crazy compensation and the crisis," *Wall Street Journal*, May 28, 2009. Another example is Gretchen Morgenson's "Was there a loan it didn't like?" *New York Times*, November 1, 2008.

[2] Supporting the notion that loan officer incentives distort their behavior, the Consumer Financial Protection Bureau proposed in mid-2012 to restrict the degree to which loan officers' compensation depends on loan origination volume, e.g., by allowing commissions to be paid only to retirement accounts. See http://files.consumerfinance.gov/f/201208_cfpb_tila_mlo_compensation_proposed_rule.pdf.

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. Although 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 compensation. 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 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, the year 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.

As expected, the introduction of variable compensation led to an increase in the aggressiveness of loan approval. We document that treated loan officers are 31% more likely to approve loans. Also, approved loans in the treated group are 14.9% larger and their leverage (loan-to-value ratio) is higher by 2.4 percentage points. The fact that loan amounts increase dramatically with only a modest increase in leverage suggests that borrowers posted more collateral than they proposed in the original application. 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 reveals that variable compensation had deeper effects on the

origination process. We document that while the ex ante quality of loans increased, their ex post performance worsened. Specifically, 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—improved by 30% of a standard deviation. In addition, the average external credit quality (measured by a third-party rating agency) increased by 10% of a standard deviation. However, the default rate of loans originated by the treated loan officers increased dramatically. We show that this pattern is consistent with manipulation of soft information by loan officers that led to the adverse selection of poor quality borrowers (see Section 4.2).

We find additional evidence showing that the compensation change led loan officers to push to approve loans as if they had positive soft information about the borrowers. Under the bonus-based compensation system, the weight given to the loan officers' internal risk rating in the approval decision doubled. Similarly, loan officers' opinions have greater weight in providing aggressive loan terms (i.e., size, leverage), irrespective of observable fundamentals. This behavior could be justified if loan officers provided additional valuable information in the origination process, but we find no evidence consistent with this assertion. Whereas loan officers' discretion under the treatment is highly correlated with the approval decision, it has no incremental power in explaining loan performance. This means that bonus-compensated loan officers appear to be adding soft information to the origination process, but they are simply adding noise.

We find additional evidence suggesting that bonus compensation led loan officers to push loans above the approval hurdle. In particular, 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' opinion would matter the most. This is consistent with loan officers "pushing" borderline borrowers beyond the approval threshold. Similar evidence is documented by Berg, Puri, and Rocholl (2012), who uncover data patterns consistent with loan officers manipulating hard information in order to get applications approved, and by Brown, Schaller, Westerfeld, and Heusler (2012), who find that loan officers often use their discretion and override their banks' credit rating systems even though these rating changes are not informative about future loan performance.

Our analysis shows that the likelihood of approval increases for factors that are correlated with benefits to the loan officer and are unrelated to the fundamental characteristics of the loans. We show that the probability of loan approval is higher among the treatment group in the second half of the month (when the marginal bonus is higher), among older loan officers (who have fewer career concerns), and among male loan officers (complementing the gender effects for loan officers documented by Beck, Behr, and Guettler 2013). 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 defaulting loans are concentrated in the subset of loans that would not have been originated in the absence of commission-based compensation. This effect accounts for 40% of the increase in the probability of default. We also find a concentration of high borrower default among loans that were originated by commission-compensated loan officers and that have an excessive dollar amount. Together, these effects account for 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 assessments do not contain any additional information about the probability of default. Additionally, the same nonfundamental 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 (2013) 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 likelihoods, we find that the likelihood of default is materially higher for loans originated under the incentive-based compensation system. However, the interest rates on these loans do not differ substantially from those of loans with a low default probability. We show that under reasonable assumptions about the loan recovery rate and other fees that are charged, 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 system leads to an increase in the loan volume generated by the Bank but at the cost of substantial deterioration in the information quality that is generated in the origination process. We conclude that in regard to the 20% bonus considered in this study, it is difficult to determine that the cost overshadows the benefits.

Our study relates to several veins of the literature. In the context of bank lending, our paper is complementary to Cole, Kanz, and Klapper (2011), who study similar issues in different environments. Whereas we study changes in the compensation scheme in a corporate environment in the United States, they make use of a pure experimental setting implemented with a group of loan officers at a commercial bank in India. They compare the loan approval pattern of real loans and effort by loan officers in response to different incentive schemes. Consistent with our results, they note that loans are more likely to be approved when an origination bonus is given to loan officers. In addition, they find that incentives increase the likelihood of accepting loans that are of poorer quality. Tzioumis and Gee (2013) 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 poorer quality. Berg, Puri, and Rocholl (2012) examine a data set 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) find that the rotation of loan officers within a bank causes them to provide more accurate reports.[3] Keys, Mukherjee, Seru, and Vig (2010) show that the securitization process leads to the lax screening of borrowers. Rajan, Seru, and Vig (2010) show that default prediction models failed during the credit boom, due to overweighting hard information. 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 a 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.

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

Our results indicate that the loan officers exploited the compensation system 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). They argue that during the lending process, loan officers may approve too many risky loans if their incentives are misaligned with those of their employer (the lender) in the presence of information asymmetry. An agency problem arises when the lending decision depends on information collected by the loan officer that the lender can neither observe nor verify. Although the problem can theoretically 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 often does not occur. 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; Acharya et al. 2013).[4]

More generally, many studies examine organizations' employee incentive structures.[5] In the context of compensation contracts, incentives usually take 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 can give rise to dysfunctional behavioral responses, whereby 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 multitasking, defined as agents allocating 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) looks at the performance of auto windshield workers and documents the incentive and worker selection effects of piece-rate contracts. He finds that piece-rate incentives increase productivity and that more productive workers select into the piece-rate compensation system. Paarsch and Shearer (2000) find similar evidence using data on Canadian tree planters.

[4] A growing literature finds evidence linking the creation of the real estate bubble in the early 2000s to financial intermediaries' misaligned incentives (e.g., Keys et al. 2010; Ben-David 2011, 2012; Berndt, Hollifield, and Sandas 2010; Agarwal, Ben-David, and Yao 2012).
[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 loan officers. (Most have only one.) The loan application process begins when a client—typically a small business owner—inquires about a potential business loan. During our sample period, the Bank offered a standard product: a five-year amortizing adjustable rate mortgage. The loans were kept on the books of the Bank and were not sold or securitized. 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),[6] and the purpose of the loan. 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, appraisal of the collateral). 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 business. Based on this information, the loan officer determines an internal risk rating measure, which summarizes the loan officer's opinion of the potential borrower.[7] 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 gathers both hard and soft information about the borrower and collateral. Then, the loan officer inputs the relevant information into the computer and matches it with credit reports before inputting it into the Bank's proprietary credit-scoring model. 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

[6] Collateralized assets are typically accounts receivable (measured at their face value) or personal homes (measured using an automatic valuation model (AVM)). Loan officers have little control over these valuations.

[7] 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.

to follow up on open questions, review discrepancies in information submitted with credit reports, discuss the prospects of the business, and so forth. The loan officer can also adjust the firm's internal score should the applicant deserve credit in 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 branch 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.

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 for 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 that requested or subject to additional collateral. Though branches are autonomous in their lending decisions, they are subject to the lending guidelines 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). The credit committee at the bank is composed of the branch manager and the loan officer(s). The branch managers' career prospects and remuneration are not tied to the compensation of loan officers but rather depend on the success of their credit decisions; local overrides are closely monitored by the Bank's risk-management staff.

Once an offer letter is received by the client, the client may accept the loan, negotiate the terms, or withdraw the application. In 2004, 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 prospects of the business. Whenever an issue such as delinquency arises, the loan's file is handled by the loan officer.

2.2 The Variable Compensation Experiment

Loan officers' compensation is usually 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 packages 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.[8] An alternative contract with aligned incentives could link compensation to loan profitability and ex post performance. Such a contract, however, would also impose greater risk on loan officers, including risks beyond their control (e.g., a market crash) and thus might require higher wages to compensate for this higher risk. 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.[9] The Bank was motivated to do so by competitive pressure from other lenders (consistent with the "bonus culture" model of Bénabou and Tirole (2013)). Other lenders in the area had introduced performance-based compensation, and the management thought that introducing such a payment structure would improve the profitability of the unit. Under the proposed program, loan officers would receive a lower fixed salary (80% of their original salary) and a bonus that increased with the originated volume. The bonus is calculated every month. The Bank intended to implement

[8] 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).

[9] 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.

the commission-based scheme for the entire portfolio of loan officers in stages to allow for evaluation of the effects of the new system.

The bonus system worked as follows. The loan officers were given a performance measurement system. The performance metric was based on three components: originated dollar amount (50% weight), number of loans (25% weight), and the application decision time (25% weight). Loan officers gained points on large loans, high origination volume, and quick decision turnaround. This three-prong compensation structure forced the loan officer to generate loan volume efficiently and put more focus on larger loans. Loan officers were also provided a matrix that translated their performance score into the monetary award. Table 1 presents the translation. For instance, if the loan officers achieved 80% of their previous year's monthly individual performance, they would not receive any bonus pay. But if they exceeded 80%, 100%, or 120% of the goal, then they would receive a monthly bonus of $333, $540, or $790 and $10.35, $12.50, or $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.[10] The scheme was announced around June 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 Bank's legacy databases. The allocation of branches to treatment and control groups was based on their previous affiliations. Specifically, the Bank had evolved as a product of several mergers and acquisitions, the most recent of which took place in mid-2001. Since then the Bank maintained two legacy computer systems that were used in administering human resource and compensation information. The incentive pilot, therefore, was implemented in one computer system (of the acquiring bank) and applied to all loan officers who were connected to that system, and the rest of the loan officers continued with their old compensation structure. We call the group of branches that did not change their compensation structure Group A, and the group that experienced the compensation modification – Group B.

The assignment of the acquired banks' loan officers to each of the databases was quasi-random in the sense that the assignment was unrelated to past performance or the prospects of loans or loan officers. Hence, the portfolio of loan applications received by the two groups of

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

loan officers have identical underwriting standards, geographical focus, portfolio management practices, and loss outcomes prior to the modification of 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.

In such an experiment, there is a possibility that loan officers behave strategically. For example, loan officers could approve bad loans so that management would retract the bonus-based compensation scheme. While this is a theoretical possibility, we doubt that our results stem from such behavior. First, treated loan officers were located in different branches across different localities, and therefore are not likely to have colluded. Second, from informal conversations with loan officers and management, we got the impression that loan officers were enthusiastic about the new bonus scheme, because it moved them closer to the compensation scheme that was prevalent in many of the competing banks.

The complete implementation of the commission-based scheme was supposed to take place in 2006; however, the program was discontinued prematurely. The risk management division was monitoring this pilot on a monthly basis. At the beginning of 2006, the division advised the management that default rates were higher than expected and therefore recommended abolishing the incentive program. 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 data available to us contain all of the loan 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 defined as the control group. This includes loan officer-years with compensation that did not change between 2004 and 2005 (Group A), 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. Unfortunately, we do not have access to loan applications made following the pilot in 2006.

3.1 Empirical Identification

The advantage of the empirical setting in this study is that the change in the compensation structure applied to only 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 using a diff-in-diff approach. In this method, one uses time fixed effects to control for any temporal systematic shocks and loan officer fixed effects to control for loan officer average effects.[11] Then, the interaction between the treatment time (the 2005 dummy in our case) and the treatment group dummy (the group of loan officers who received incentive pay in 2005) 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 loan applications from the treated group are different relative to the control group. We find no significant difference between the groups. In Table 3, we also test whether the loan applications (Panel C) and approved 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 approved loans of the treated and control groups. The second concern is that the modification in the compensation structure is confounded with additional changes to the lending process. Specifically, the change in compensation could 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

[11] Given that we have loan officer fixed effects and that borrowers are typically from the county where the branch is located, we do not include additional geographical fixed effects.

sure that this possibility is 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 might 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 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, we conclude 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 because 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 consists of 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 for loan applications and originated loans are presented separately. In Table 2, Panel A, we show summary statistics for loan applications (the variables featured in Table 2 and others are explained in Appendix A). Requested loans are approximately

$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 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 5.9 (in a range of 1 to 10, with a higher internal risk rating reflecting higher risk).

The summary statistics in Table 2, Panels A and B, reveal sharp differences between the control and treatment groups in regard to originated loans. First, the approval rate is 44%–51% for the control group but is 59% for the treatment group (Panel A). Second, the originated loan amount is higher by 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 75%. Fourth, even though 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 items 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 in the pretreatment period (2004) and that 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. First, we compare 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 time fixed effects (24-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.[12] The point estimate of the dollar-volume in the treated group is 1.3% higher (Column (2)), and the point estimate of the number of applications is 0.7% higher (Column (4)).

The next analysis tests for whether specific characteristics of loan applications are statistically different between the control and treatment groups. As in all regressions, we control for fixed effects for industry and month. The application 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. Table 3, Panel B, shows that all loan application characteristics are statistically indistinguishable between the two groups. We intentionally omit loan officer fixed effects from the regressions; when added, the variables of interest remain statistically insignificant.

We also conduct tests that compare the characteristics of 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 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 the subset of approved 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,[13] 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

[12] The results are similar when loan officer fixed effects are added.

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

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 the terms of these loans. 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 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 14.9% 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 results are consistent with the conjecture that variable compensation causes loan officers to approve more loans.

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 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 (compare coefficients to standard deviations of credit scores in Table 2, Panel B).

At first, this result seems counterintuitive: loan officers are incentivized to accept more loans with relatively little emphasis on quality, but the outcome is that the external credit quality measures improve. However, we believe that the pattern can be explained by adverse selection of borrowers to the bank.[14]

Consider the following example based on two borrowers. One borrower has a high external credit score and is of high quality based on soft information ("good borrower"). The second borrower also has a high external credit score but is of poor quality, according to soft information ("bad borrower"). In the control group, neither borrower is likely to become a client of the bank. The bank will approve the good borrower, but the borrower is likely to go to another bank because many banks compete for his or her business. Using the same data set as we do, Agarwal and Hauswald (2010) find supporting evidence that good borrowers are likely to withdraw their approved applications. A similar outcome is achieved for the bad borrower, because the bank is likely to reject him or her. In the treatment group, however, the outcome is different. Again, the good borrower is approved but is likely to turn the bank down. In contrast to the control group, the treatment group is likely to approve the bad borrower. Since this borrower has fewer alternative sources of financing in the market, he or she is likely to accept the loan offer. Thus, in the treatment group, the bank ends up lending to a borrower with a high external credit score but with poor overall credit quality.

4.3 Loan Terms

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

[14] Evidence for a similar mechanism is presented in Gropp, Gruendl, and Guettler (2012). They find that risky borrowers with positive soft information are more likely to be financed by relationship banks and risky borrowers with negative soft information are more likely to be financed by transaction banks. Rajan, Seru, and Vig (2010) show that default prediction models failed during the credit boom, because they overweighted hard information relative to soft information. Also, Hauswald and Marquez (2006) present a related model of information acquisition under bank competition.

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 14.6%. Column (4) shows that under the incentive compensation treatment, borrowers are more likely to pledge business collateral (as opposed to personal collateral), relative to the control group. Similarly, Column (5) shows that relative to the requested LTV, loans originated by treated loan officers have an LTV that is 2.4 percentage points higher. The fact that loan size increases dramatically but LTV only moderately increases means that borrowers increased the collateral that they pledged for the loan following the negotiation with the loan officer. In addition, interest rates charged to loans originated by treated loan officers are 0.02 percentage points higher (Column (6)).

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 (7)). Also, the probability an approved loan's being withdrawn declined by 5.0 percentage points in the treated group (Column (8)). This is a significant drop, given that the withdrawal rate was about 13 percentage points 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 (made up 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, requested LTV, requested LTV-squared, Experian business credit score, and Experian personal credit score) and fixed effects (specifically, loan officer, industry, and 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). Because the coefficients are estimated on the control group only but the residuals are calculated for the entire sample, the residuals have a non-zero mean. 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.

In Figure 2, we plot the average residuals of the internal risk ratings over time for the two groups. The chart shows that the mean residuals for the control group hovers around zero for all time periods. In contract, the residuals for the treatment group become negative once the compensation pilot began in January 2005.

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 (proxied by the residuals of the internal risk ratings). 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. Controlling for observed loan characteristics, better opinion of loan officers in the treatment group (i.e., negative internal risk rating residual) translates to larger approved loan amounts relative to the requested amounts (Column (1)), higher approved leverage relative to the requested leverage (Column (2)), lower interest rates (Column (3)), shorter time spent on applications (Column (4)), and a lower likelihood that the application is withdrawn (statistically insignificant; Column (5)).

Overall, the results in Table 5 indicate that following the change in compensation, approved loans appear to have higher credit quality based on external credit measures. Controlling for the internal and external quality measure, these loans are for larger amounts and have higher leverage 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 (Section 5.2), we use default statistics to test whether loan officers' discretion during the treatment period was justified.

4.4 The Decision-Making Process at the Bank

Our data provide a unique opportunity to examine the lending process. We next explore how incentive pay affected the way in which loan officers performed their role in the lending process. We first present a descriptive analysis and then interpret these results in Section 5.

4.4.1 Loan Officers' Input into the Loan Approval Process

Traditionally, loan officers' duties include collecting information on potential borrowers, evaluating it, and processing loans. 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.[15]

In Table 6, Panel A, we use the sample of all loan applications and regress an indicator of whether an application was approved on a commission-based compensation dummy interacted with borrower and loan characteristics as well as loan officer characteristics. We control for loan characteristics and for loan officer, industry, and 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 5.3 to 6.1 percentage points; the coefficient in Column (2) represents a relative increase of 13% in the likelihood of approving loans.

In Figure 3, we provide a graphical time-series of the residuals from the approval regression.[16] The regression uses only the control sample, but the residuals are calculated for the entire sample and therefore do not have a mean of zero. The figure shows that treated loan

[15] Agarwal and Hauswald (2011) find that loan officers receive more authority when they produce more soft information. Brown, Westerfeld, Schaller, and Heusler (2012) find that loan officers often smooth credit shocks that affect their clients.

[16] The approval regression is a regression of the approval indicator on fundamental determinants: the logged requested amount, the personal collateral dummy, the Experian business and personal credit scores, requested LTV, and requested LTV-squared, as well as the loan officer, industry, and month fixed effects. The regression is provided in Appendix B, Column (1).

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. Of course, the residual may contain soft information that is observable to the loan officer but not to the econometrician; however, this component should be eliminated in the diff-in-diff procedure. Figure 2 shows the monthly time-series of the residuals of the internal risk rating variable. 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 for approved loans.

To examine the effect of loan officers' input into the loan approval decision, we interact the commission-based compensation with the residual of the internal risk rating (Table 6, Panel A, Column (3)). This test determines whether loan officers' opinions receive higher weight in approval decisions when compensation depends on originated volume. The regressions show that the coefficient of the interaction is negative and statistically significant, meaning that loan officers' input into the approval decision is greater during the treatment period. Furthermore, the magnitude of the coefficient of the interaction is almost the same as the coefficient of the main effect of the internal risk rating residual, suggesting that the weight of loan officers' opinions in the treatment group is almost double that of the weight in the control group.

To gauge the economic significance of the effect, consider the main effect of 0.06. A one standard deviation decrease in the internal risk rating (1.51, from Table 2, Panel A) is associated with an increase in the probability of approval of 9.1 percentage points in the control group. In

contrast, in the treatment group, a one standard deviation decrease in the internal risk rating is associated with a 16.6 percentage point increase in the likelihood of approval.[17]

In parallel with the increase in weight that loan officers put on their own input for the approval decisions, the importance of external credit scores declines. Table 6, Panel A, Column (3) shows that the interactions between the treatment dummy and 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—controlling for external credit scores—the approval decision for the treated group 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.

4.4.1.1 Internal Risk Rating and Marginal Loans

Given that the input of loan officers is more substantial when compensation is dependent on the volume originated, we want to examine which loans receive better internal risk ratings and the loans on which loan officers spend their time. In particular, it is interesting to explore whether the internal risk rating and time spent vary under the compensation treatment with the ex ante likelihood of approval. First, we examine the average effect of incentive pay on loans' internal risk ratings. In Table 6, Panel B, Column (1), we present the base regression in which the internal risk rating is regressed on the treatment indicator for the entire sample of applications. We find that, on average, treated loan officers provide a lower internal risk rating (reflecting better quality).

Second, we investigate which loans receive the enhanced internal risk rating. In particular, we are interested in studying this issue with respect to the ex ante likelihood of approval. We again use a 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 the predicted value of approval into five probability buckets and create indicators for each

[17] $(0.05 + 0.06) \times 1.51 = 16.6$.

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 the ex ante approval probability. These are marginal loans for which loan officers' opinions arguably had the most impact. We find 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 (3) and (4), 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 nonmutually exclusive ways. If the input of treated loan officers into the origination process contains more information about credit quality, then these results may indicate that loan officers truly exert effort into investigating marginal loans and that some decide that the client's credit quality is better than what the observables indicate. The other view is more skeptical of the loan officers' motivations. 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 in line with Berg, Puri, and Rocholl (2012), who find that loan officers manipulate 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.

4.4.2 Nonfundamental Factors Affecting the Approval Decision

We return to exploring the determinants of the approval decisions. 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 examine this issue by testing whether nonfundamental factors affect the loan approval decision. We examine three

nonfundamental factors that could affect the approval decision: time in the month, the loan officer's tenure, and the loan officer's gender. We chose these variables because they are unrelated to borrower quality while reflecting the differential effects of approving a loan for the loan officer.[18]

First, we compare loans made during the first half of the month with those from the second half. Because 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's end. Tzioumis and Gee (2013) find that the origination volume of residential mortgages is higher toward the end of the month, and they show that the quality of these loans 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 (5)) show that loans in the treatment group are 2.7 % more likely to be originated in the second half of the month than in the first half. 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 (see main effect).

Second, we examine the effects of loan officer tenure. More experienced officers may have fewer career concerns and may therefore be willing to take greater risks and game the system. During the compensation pilot, above-median-tenured loan officers are more likely to approve more loans than their peers by 3.0 percentage points.[19] Conversely, the main effect of the above-tenure indicator in Table 6, Panel A, Column (6) shows that above-median-tenured loan officers in the control control do not approve more loans than their peers.

Third, we examine the gender of loan officers. Male loan officers have been shown to respond more strongly to incentives (e.g., 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 (7). Indeed, we find that male loan officers in the treatment group are 2.8% more likely to originate loans when they have

[18] We verify that loan officers' tenure and gender are uncorrelated with loan applicants' credit quality (e.g., Experian credit scores).

[19] One might suspect that the result is driven by loan officer salary and not by loan officer tenure. The rationale would be 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 tenure is virtually zero. Hence, this mechanism does not explain our results.

bonus compensation. These results perhaps shed new light on the findings of Beck, Behr, and Guettler (2013) that loans approved by female loan officers perform better.

In sum, our findings suggest that nonfundamental factors have an important effect on the probability that loans will 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 indicate that the weight of loans officers' input into the lending decision 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 with respect to 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 loan origination. The raw default rate in the control group is 4.2 percentage points in 2004–2005, and in the treated group in 2005, it as high as 5.2 percentage points (Table 2, Panel B). To test whether the univariate difference is statistically significant, we regress a default indicator on the commission-based compensation dummy in addition to the loan officer, industry, and month fixed effects. The results in Table 7, Columns (1) and (2) show that the default rate of the treated group is 1.2 percentage points higher (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 rates charged to the loans. This control should capture the ex ante risk as the Bank perceives it. 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 27.9% higher for the treated group following the implementation of the commission-based compensation scheme. The interest rates charged to loans do not appear to capture the default risk.

5.2 The Informational Content of Loan Officers' Opinion

In Section 4.4.1, we documented that the weight of loan officers' opinions in the approval decision nearly doubled under the incentive compensation pilot. This may be aligned with the Bank's intentions to have loan officers more involved in the origination process as long as they exert more effort and provide more soft information to the process. To assess whether the informational content of loan officers' opinions improved with the transition to incentive-based compensation, we test whether the internal risk rating better predicts loan performance following the implementation of the compensation pilot.

The results of this test are provided in Table 8, Panel A, Column (1). we regress the default-within-12-months dummy on the commission-based compensation dummy interacted with the residual from the internal risk rating regression (Appendix B, Column (3)), as well as on the main effect of the residual and controls and fixed effects as usual. The regression shows that the main effect is statistically and economically significant. A one standard deviation increase in the residual of the internal risk rating (0.004, from Table 2, Panel B) is associated with an increase in default rate by 0.34 percentage points, which is high relative to the average level of default of about 4.2% in the control group. Hence, in the control group, the soft and unobservable information that is captured by the residual of the internal risk rating conveys a lot of information about the default prospects of loans.

The coefficient on the interaction between the treated group and the internal risk rating is small and statistically insignificantly different from zero. This indicates that loan officers do not provide more information about the credit quality of borrowers under the variable compensation.

Our results indicate that the opinions of loan officers have greater weight in the loan approval decision but that their opinions do not contain additional information. It seems that loan officers become more involved in the process (e.g., voicing their opinions more loudly or

pounding on their managers' desks) but that they do so at random, without any real value to their advice.

To provide additional evidence about the informational content in loan officers' opinions, we explore the relation between default and time-to-decision. If loan officers exerted more effort in investigating the borrower and the business, then it would follow the time spent on a case in due diligence would be negatively correlated with default. In other words, the more time spent on a loan file, the less likely it would be to default. To test this prediction, we regress the default indicator on an interaction of the commission-based compensation and the residual from the time spent regression (Appendix B, Column (2)), in addition to the main effect, controls, and fixed effects. The coefficient on the main effect in this regression is statistically insignificantly different from zero, indicating that for the control group there is no relation between the likelihood of default and the time spent on the case. The coefficient on the interaction term is positive, meaning that under the treatment, cases that take longer are more likely to default. This result contradicts the "naïve" prediction that loan officers exert more effort and time in digging for better information. To the contrary, more time spent on a loan file is associated with a higher likelihood of failure.

5.3 Why Do Loans in the Treated Group Default More Frequently?

Next, we investigate the factors that lead to the increase in defaults among loans originated by treated loan officers. There are two channels that could explain the increase in defaults. First, treated loan officers (with or without direction from the Bank) lowered the approval hurdle and approved loans that the control group would not have approved (extensive margin). Second, terms of approved loans in the treatment group are more aggressive, which led to higher default rates (intensive margin).

We test these channels in Table 8, Panel A. We begin with the extensive margin. Column (3) provides a regression of the 12-month default indicator on the commission-based compensation interacted with the loan approval residual (Appendix B, Column (1)) in addition to the main effect, controls, and fixed effects. A high value for the loan approval residual means that a loan was approved not based on observable fundamentals. The main effect of the residual in the regression in Column (3) is positive and statistically significant, showing that loans that

were approved not based on fundamentals are more likely to default in the control group. The magnitude of the coefficient is 0.049, suggesting that an increase of one standard deviation in this variable (0.033) is associated with a 0.16 percentage point higher default rate.[20] In the treatment group, the effect is more than double: a one standard deviation increase in the loan approval residual is associated with a 0.34 percentage point higher default rate.[21]

Next, we turn to the intensive margin. In Columns (4) and (5) we regress the default indicator on interactions of the commission-based compensation interacted with the residuals of the LTV regression (Appendix B, Column (4)), and the residuals of the logged loan amount regression (Appendix B, Column (5)), respectively. High residual values mean that loan terms are abnormally aggressive. The regressions show that the effects of loan term aggressiveness on default are positive in the control group, i.e., more abnormally aggressive loan terms are more likely to default. For the treated group, however, the effects of these variables are more than double. In the control, a one standard deviation increase in abnormal LTV and abnormal logged loan amount are associated with default rates higher by 0.08[22] percentage points and 0.72[23] percentage points, respectively. In the treatment group, the corresponding effects are 0.19[24] percentage points and 1.45[25] percentage points, respectively. The effect of abnormally large loan size on default appears to be economically very important in determining default.

In summary, we find evidence that loans under the incentive compensation program are more likely to default due to high sensitivity to unwarranted loan approval and to aggressive loan terms.

5.4 Nonfundamental 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 weaker borrowers who are nevertheless profitable to the Bank. While we cannot reject this hypothesis given the data's

[20] 0.049 × 0.033 = 0.16.
[21] (0.049 + 0.054) × 0.033 = 0.34.
[22] 0.024 × 0.033 = 0.08.
[23] 0.179 × 0.040 = 0.72.
[24] (0.024 + 0.035) × 0.033 = 0.19.
[25] (0.179 + 0.183) × 0.040 = 1.45.

short time series, we can test whether nonfundamental factors are correlated with loan default. To do so, we use an approach similar to that used in Section 4.4.2, in which we examine the approval decision with respect to the decision's timing (first versus second half of the month) as well as the loan officer's tenure and gender.

In Table 8, Panel B, 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 0.3 percentage point higher probability of default. 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' tenure on the probability of default. Column (2) present results that loans originated by treated loan officers of above-median tenure are 0.2 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 0.4 percentage points more likely to default within one year. The control group shows no similar results.

To conclude, 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 present evidence that the nonfundamental 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 month fixed effects. We find that the loan officers in the treatment group are compensated with 8.2% higher salaries than the loan officers in the control group (Table 9, Column (1)).

Then, we look at whether 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-tenure treated loan officers earn 2.5% higher salaries than below-median-aged treated loan officers. This result is consistent with the idea that above-median-tenured loan officers have fewer career concerns, enabling them to originate more low-quality loans. In Column (3), 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?

The previous sections demonstrate that bonus-based compensation led loan officers to approve more loans that resulted in higher rates of default. Furthermore, we show that approvals and defaults are both correlated with factors that are unrelated to that 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, i.e., those with negative net present value.

More generally, one can think of compensation as a continuum ranging from 100% salary to 100% commission-based. In the case of our experiment, loan officers are paid approximately

80% salary and 20% commission-based compensation. We next ask whether this combination generates many loans with negative NPV.

To test whether loans in the treatment group 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 whether the *average* loan has a negative NPV and (2) exploring whether the *marginal* loan has a negative NPV.

7.1 NPV of the Average Loan

We first explore whether *on average* loans originated by the treated group have negative NPV. To do so, we assume that the 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 for the treated group from 4.2 percentage points to 5.2 percentage points. Conversely, the 9.6% interest rate paid by borrowers in the treated group is virtually the same as that paid by borrowers in the control groups (see the summary statistics on interest rates in Table 2, Panel B). Hence, the average quality of loans seems to have deteriorated in the treated group without a compensating effect in interest rates. The question, therefore, is whether the deterioration in the quality was severe enough to make loans in the treated group have negative NPV on average.

We can compute the cost of capital that is required to make these loans profitable. From the Bank's perspective, loans are profitable if the aggregate interest promised by borrowers is higher than the cost of capital and the expected losses from default (which depend on the recovery rate). When the cost of capital is high and the recovery rate is low, loans are less profitable. Unfortunately, we do not know the cost of capital of the Bank. Yet, we can put some bounds on the cost of the capital required to make lending profitable.

Our calculation shows that in the control group, lending is profitable if the cost of capital is lower than 6.7% (when assumed recovery is 30%) to 7.5% (when assumed recovery is 50%). In the treatment group—where the default rate is higher—lending would be profitable if the cost of capital is lower than 6.0% to 7.0%.

Overall, the difference between the required cost of capital in the control and in the treatment groups is not large. Without additional information about the cost of capital of the

Bank, it is hard to determine whether loans originated by the treated group were bad on average.[26]

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 identify 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 the 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 more than 10% of loans with higher default probabilities (of 15% to 30%). Hence, the marginal loans are those in the 25%–30% default probability bucket.

The marginal loans have very high ex ante probability of default and therefore are candidates for having negative NPV. It is possible, however, that these loans are profitable for the Bank if interest rates are high enough. Therefore, the next stage is to calculate the interest rates on these loans.[27]

[26] There is one caveat to this calculation: It implicitly assumes that the 2004–2005 default rates are 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.

[27] Generally, in commercial lending, loan officers have much discretion in setting interest rates (Cerqueiro, Degryse, and Ongena (2011)).

Figure 5 presents the average interest rates 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. Our calculation shows that in order to compensate for the high default rate of 25%–30%, the credit spread should be at least 12%–21% (depending on the recovery rate assumption). The figure shows that the interest rate charged for loans in both groups in the 25%–30% default probability bucket is 10.5%, on average—higher by only 2.2% than the interest rate charged for the group in the 0%–5% default probability bucket. Hence, these loans with high default probability have negative NPV.

There are two important caveats to this analysis. First, we do not observe other sources of income to the Bank beyond interest. It is possible that the Bank cross-sells products and charges fees for its services. The additional sources of income could affect the profitability of the loans. However, it is hard to justify a shortfall of 12% to 21% of a loan amount with fees. For example, for an average loan of $350,000, the bank would need to generate $50,000 in fees over the life of the defaulted loan. Second, our calculations ignore the fact that the compensation scheme causes loan officers to increase the origination of both good and bad loans. In other words, we show that some loans are very likely to have negative NPV and that these loans were originated because of the incentives that tie compensation to volume originated; however, as discussed in Section 7.1, we cannot reject the hypothesis that commission-based compensation is overall profitable to the Bank.

8 Conclusion

In this paper, we present direct evidence that commission-based compensation causes loan officers to approve too many risky loans. Our evidence shows that the commission-based compensation scheme for 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 be. 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). Third, loans are 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 the risk of default. Hence, the marginal loans in the treatment group have negative NPV.

Is commission-based compensation bad? In the experiment, the commission provided to loan officers was 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 many low-quality loans based on their own judgment. Nevertheless, we are not able to reject the hypothesis that lending in the treated group was not profitable on average.

Future work can extend our study to the residential real estate sector. In residential lending, the incentives are even steeper: commission contracts are often 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 we document in this study. We believe that this direction will be fruitful in understanding the causes of the financial crisis better.

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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 of origination.
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)–(3)) and originated loans (Columns (4) and (5)) 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)			Approved loans (Control only)	
Dependent variable:	Loan approval (0/1)	Time spent	Internal risk rating	LTV	log(Approved 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)
Requested LTV	0.0471***	0.0401***	0.0444***	-0.6075***	-0.8142***
	(0.0139)	(0.0150)	(0.0068)	(0.0838)	(0.2224)
Requested LTV^2	-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 + $10.35 per percentage point above 80% of goal
100% of goal	$540 + $12.50 per percentage point above 100% of goal
120% of goal	$790 + $14.50 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
Approved (0/1)	0.449	0.497	0.436	0.496	0.512	0.500	0.592	0.491
Withdrawn after being approved (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 loan approval 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) = 3,156								
# 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
Tenure (years)	3.1	2.6	3.1	2.6	3.0	2.6	3.1	2.6
Male (%)	62.9		68.0		64.5		66.9	

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 pretreatment 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 pretreatment 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)	0.019	0.013	0.001	0.007
	(0.029)	(0.030)	(0.013)	(0.025)
Loan officer fixed effects	No	No	No	No
Month fixed effects	No	Yes	No	Yes
Observations	3,192	3,192	3,192	3,192
Adj. R^2	0.07	0.13	0.06	0.08

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)	0.016	0.026	0.014	7.146	3.976	0.043
	(0.064)	(0.183)	(0.056)	(5.871)	(5.068)	(0.138)
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	30,268	30,268	30,268	30,268	30,268	30,268
Adj. R^2	0.07	0.06	0.09	0.06	0.05	0.07

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)	Personal collateral	Requested LTV	Experian business score	Experian personal score	Internal risk rating	Time spent	Application withdrawn	Loan officer salary ($k)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Group B (to be treated in 2005) (0/1)	-0.035	-0.041	0.001	-3.169	-4.176	0.004	0.001	0.003	0.343
	(0.050)	(0.125)	(0.014)	(3.298)	(5.623)	(0.007)	(0.048)	(0.009)	(0.579)
log(Requested amount)			0.036***	-0.013	-0.006	0.004	0.007	0.135	0.773
			(0.011)	(0.010)	(0.014)	(0.018)	(0.026)	(0.057)	(0.818)
Personal collateral (0/1)	0.046	0.022	-0.027	0.033	0.021	-0.007	-0.009	0.030*	0.260
	(0.046)	(0.075)	(0.026)	(0.022)	(0.028)	(0.041)	(0.055)	(0.015)	(0.176)
Requested LTV			0.018***	0.037	0.001**	0.002	0.002	0.070***	0.028
			(0.006)	(0.037)	(0.000)	(0.008)	(0.010)	(0.019)	(0.021)
Requested LTV^2			0.038***	-0.043**	-0.004***	0.004	0.005	0.0407*	0.008
			(0.005)	(0.021)	(0.001)	(0.038)	(0.055)	(0.021)	(0.007)
Experian business score	0.028***	0.047***	-0.064***		0.030***	-0.007***	-0.005	-0.141***	0.265
	(0.008)	(0.008)	(0.015)		(0.008)	(0.003)	(0.003)	(0.050)	(0.420)
Experian personal score	0.0368	0.057***	-0.020	0.029*		-0.035***	-0.045***	-0.091*	0.182
	(0.058)	(0.018)	(0.034)	(0.017)		(0.004)	(0.004)	(0.048)	(0.136)
Loan officer fixed effects	No	No	No	No	No	No	No	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Month fixed effects	Yes	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	14,916
Adj. R^2	0.05	0.07	0.19	0.11	0.10	0.73	0.20	0.07	0.06

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

Dependent variable:	log(Originated amount) -log(Requested amount)	Personal collateral	Originated LTV -Requested LTV (%)	Interest rate	Experian business score	Experian personal score	Internal risk rating
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Group B (to be treated in 2005) (0/1)	-0.020	0.325	-0.038	0.001	1.070	1.586	0.003
	(0.050)	(0.568)	(0.061)	(0.016)	(2.204)	(2.431)	(0.009)
log(Requested amount)		0.481		0.034***	-0.010	-0.006	0.003
		(0.439)		(0.010)	(0.009)	(0.012)	(0.015)
Personal collateral	0.053		0.042	-0.023	0.032	0.018	-0.006
	(0.045)		(0.065)	(0.021)	(0.021)	(0.019)	(0.037)
Requested LTV		0.024		0.016***	0.033	0.001**	0.002
		(0.021)		(0.005)	(0.035)	(0.000)	(0.007)
Requested LTV^2		0.006		0.037***	-0.035***	-0.004***	0.004
		(0.004)		(0.005)	(0.022)	(0.001)	(0.032)
Experian business score	0.024***	0.198	0.034***	-0.055***		0.024***	-0.006***
	(0.008)	(0.242)	(0.008)	(0.012)		(0.007)	(0.002)
Experian personal score	0.041	0.167*	0.037***	-0.018	0.022*		-0.032***
	(0.087)	(0.089)	(0.007)	(0.029)	(0.013)		(0.004)
Loan officer fixed effects	No	No	No	No	No	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,740	4,740	4,740	4,740	4,740	4,740	4,740
Adj. R^2	0.07	0.05	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)	0.147***	0.149***	0.282***	0.313***	0.144***	0.145***	0.276***	0.305***
	(0.048)	(0.040)	(0.058)	(0.051)	(0.046)	(0.043)	(0.046)	(0.038)
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 prsnl score	log(Apprv' amount) -log(Req'd amount)	Personal collateral	Approved LTV -Requested LTV (%)	Interest rate (%)	Time spent	Application withdrawn (0/1)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Commission-based compensation (0/1)	7.300***	10.483***	0.146***	-0.055***	0.024***	0.020***	-0.561***	-0.050**
	(2.292)	(3.559)	(0.052)	(0.021)	(0.008)	(0.006)	(0.101)	(0.021)
Personal collateral (0/1)	0.026***	0.001	0.035		0.052	-0.052*	-0.037***	0.028**
	(0.010)	(0.011)	(0.074)		(0.046)	(0.028)	(0.009)	(0.013)
Requested LTV	-0.012***	-0.020***	-0.019***	0.012***		0.018***	0.024**	0.075***
	(0.004)	(0.004)	(0.003)	(0.003)		(0.006)	(0.010)	(0.020)
Requested LTV^2	-0.056***	-0.038***	-0.078***	0.041***		0.074**	0.084***	0.045**
	(0.019)	(0.012)	(0.017)	(0.016)		(0.034)	(0.019)	(0.020)
Experian business score		0.052***	0.053***	-0.0327*	0.034**	-0.084**	-0.068***	-0.126**
		(0.012)	(0.018)	(0.017)	(0.016)	(0.035)	(0.019)	(0.050)
Experian personal score	0.055***		0.046***	-0.011	0.063***	-0.0531	-0.126***	-0.080*
	(0.011)		(0.015)	(0.015)	(0.019)	(0.060)	(0.039)	(0.043)
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	14,359	14,359	14,359	14,359	14,359	14,359	14,359	14,359
Adj. R^2	0.16	0.18	0.17	0.06	0.13	0.23	0.19	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)
	(1)	(2)	(3)	(4)	(5)
Commission-based compensation (0/1)	0.044	0.002	0.004	-0.152	-0.013
	(0.092)	(0.010)	(0.007)	(0.106)	(0.017)
× Internal risk rating (residual)	-0.020**	-0.019**	0.029***	0.132*	0.011
	(0.009)	(0.009)	(0.006)	(0.071)	(0.007)
Personal collateral (0/1)	0.055	0.052	-0.051*	-0.037***	0.028**
	(0.034)	(0.034)	(0.030)	(0.010)	(0.013)
Requested LTV			0.019***	0.029***	0.075***
			(0.006)	(0.010)	(0.020)
Requested LTV^2			0.067***	0.064**	0.044**
			(0.025)	(0.026)	(0.020)
Experian business score	0.027*	0.038*	-0.076**	-0.082***	-0.123**
	(0.016)	(0.021)	(0.035)	(0.021)	(0.049)
Experian personal score	0.060***	0.070***	-0.044	-0.123***	-0.079*
	(0.017)	(0.021)	(0.067)	(0.038)	(0.043)
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	14,359	14,359	14,359	14,359	14,359
Adj. R^2	0.17	0.12	0.23	0.17	0.12

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 determinants of loan approval decisions. Panel B explores the relation between the internal risk rating (Columns (1) and (2)) or time spent (Columns (3) and (4)), and the predicted likelihood of approval. 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 approved (0/1)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Commission-based compensation (0/1)	0.053***	0.061***	0.030***	0.031**	0.013*	0.017	0.034***	0.040***
	(0.020)	(0.019)	(0.010)	(0.012)	(0.007)	(0.020)	(0.010)	(0.015)
× Internal risk rating (residual)			-0.050***	-0.030***				-0.029***
			(0.013)	(0.009)				(0.009)
× Experian business score				-0.010*				-0.010*
				(0.005)				(0.005)
× Experian personal score				-0.027				-0.028
				(0.018)				(0.018)
× Second half of the month (0/1)					0.027**			0.024*
					(0.013)			(0.012)
× Tenure above median (0/1)						0.030***		0.036***
						(0.008)		(0.008)
× Male (0/1)							0.028***	0.029***
							(0.010)	(0.009)
Internal risk rating (residual)			-0.060**	-0.050**				0.007
			(0.026)	(0.020)				(0.015)
Second half of the month (0/1)					0.007			0.002
					(0.012)			(0.014)
Tenure above median (0/1)						0.002		0.002
						(0.016)		(0.016)
log(Requested amount)		-0.031**	-0.023***	-0.021*	-0.017*	-0.029**	-0.042**	-0.032**
		(0.012)	(0.008)	(0.011)	(0.010)	(0.012)	(0.018)	(0.015)
Personal collateral (0/1)		0.032***	0.023***	0.018**	0.015***	0.036***	0.037***	0.036***
		(0.008)	(0.005)	(0.007)	(0.005)	(0.011)	(0.008)	(0.007)
Requested LTV		-0.016**	-0.017***	-0.015***	-0.013***	-0.024**	-0.024**	-0.019*
		(0.008)	(0.006)	(0.005)	(0.004)	(0.010)	(0.011)	(0.010)
Requested LTV^2		-0.063*	-0.044*	-0.039	-0.027	-0.057	-0.087**	-0.080**
		(0.035)	(0.023)	(0.028)	(0.019)	(0.039)	(0.038)	(0.039)
Experian business score		0.062***	0.046***	0.031*	0.029**	0.053**	0.062***	0.074***
		(0.019)	(0.016)	(0.018)	(0.014)	(0.025)	(0.022)	(0.020)
Experian personal score		0.044***	0.040***	0.037***	0.022***	0.051***	0.044***	0.047***
		(0.011)	(0.008)	(0.008)	(0.005)	(0.013)	(0.010)	(0.012)
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	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	0.18	0.19

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 applications		All applications	
	(1)	(2)	(3)	(4)
Commission-based compensation (0/1)	-0.069***		-0.133***	
	(0.022)		(0.042)	
× Predicted approval probability 0.0÷0.2		-0.014		-0.165***
		(0.029)		(0.035)
× Predicted approval probability 0.2÷0.4		-0.045		-0.134***
		(0.029)		(0.035)
× Predicted approval probability 0.4÷0.6		-0.087***		-0.060*
		(0.030)		(0.032)
× Predicted approval probability 0.6÷0.8		-0.050*		-0.098**
		(0.027)		(0.036)
× Predicted approval probability 0.8÷1.0		-0.017		-0.144***
		(0.032)		(0.032)
Predicted approval probability 0.0÷0.2		-0.013		0.031
		(0.029)		(0.020)
Predicted approval probability 0.2÷0.4		-0.015		0.014***
		(0.031)		(0.005)
Predicted approval probability 0.4÷0.6		-0.013		-0.003
		(0.030)		(0.012)
Predicted approval probability 0.6÷0.8		-0.014		-0.017
		(0.030)		(0.027)
Predicted approval probability 0.8÷1.0		-0.016		-0.037
		(0.030)		(0.040)
log(Requested amount)	0.042**	0.039**	0.126***	0.120***
	(0.016)	(0.017)	(0.032)	(0.035)
Personal collateral (0/1)	-0.038***	-0.036***	-0.048***	-0.048***
	(0.012)	(0.012)	(0.014)	(0.012)
Requested LTV	-0.032***	-0.029***	0.034***	0.032**
	(0.010)	(0.010)	(0.014)	(0.015)
Requested LTV^2	0.142***	0.139***	0.076***	0.079***
	(0.037)	(0.036)	(0.029)	(0.025)
Experian business score	-0.059**	-0.055**	-0.095***	-0.109***
	(0.025)	(0.023)	(0.020)	(0.020)
Experian personal score	-0.065***	-0.060***	-0.144***	-0.174***
	(0.012)	(0.011)	(0.044)	(0.047)
Loan officer fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes
Observations	30,268	30,268	30,268	30,268
Adj. R^2	0.68	0.68	0.43	0.45

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)	0.012***	0.012***	0.012***	0.011***
	(0.003)	(0.003)	(0.004)	(0.003)
Interest rate (%)			0.039***	0.035**
			(0.014)	(0.014)
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 (Panel A) and by nonfundamental factors (Panel B). 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)
Commission-based compensation (0/1)	0.002	0.004**	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
× Internal risk rating (residual)	0.007					0.007
	(0.011)					(0.011)
× Time spent (residual)		0.046***				0.019
		(0.015)				(0.015)
× Loan approved (residual)			0.054***			0.024**
			(0.012)			(0.011)
× Originated LTV (residual)				0.035***		0.018
				(0.011)		(0.014)
× log(Originated amount) (residual)					0.183***	0.070
					(0.048)	(0.044)
Internal risk rating (residual)	0.086***					0.036**
	(0.016)					(0.015)
Time spent (residual)		0.023				0.014
		(0.018)				(0.015)
Loan approved (residual)			0.049***			0.028**
			(0.012)			(0.012)
Originated LTV (residual)				0.024**		0.035**
				(0.011)		(0.016)
log(Originated amount) (residual)					0.179***	0.058
					(0.047)	(0.043)
log(Originated amount)	0.071***	0.009	0.028	0.026	0.010	0.009
	(0.022)	(0.026)	(0.021)	(0.021)	(0.026)	(0.027)
Personal collateral (0/1)	-0.061	-0.052	-0.049	-0.043	-0.063	-0.059
	(0.042)	(0.039)	(0.036)	(0.035)	(0.044)	(0.041)
Experian business score	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Experian personal score	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Originated LTV	0.015**	0.013**	0.013**	0.012**	0.016**	0.014**
	(0.007)	(0.006)	(0.005)	(0.005)	(0.007)	(0.007)
Originated LTV^2	0.038***	0.035***	0.033***	0.028***	0.035***	0.033***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interest rate (%)	0.060***	0.055***	0.042***	0.041***	0.058***	0.049***
	(0.014)	(0.016)	(0.014)	(0.012)	(0.016)	(0.017)
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	0.25	0.26	0.27	0.29	0.31

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

Panel B: Likelihood of Default—Sensitivity to Nonfundamental Factors

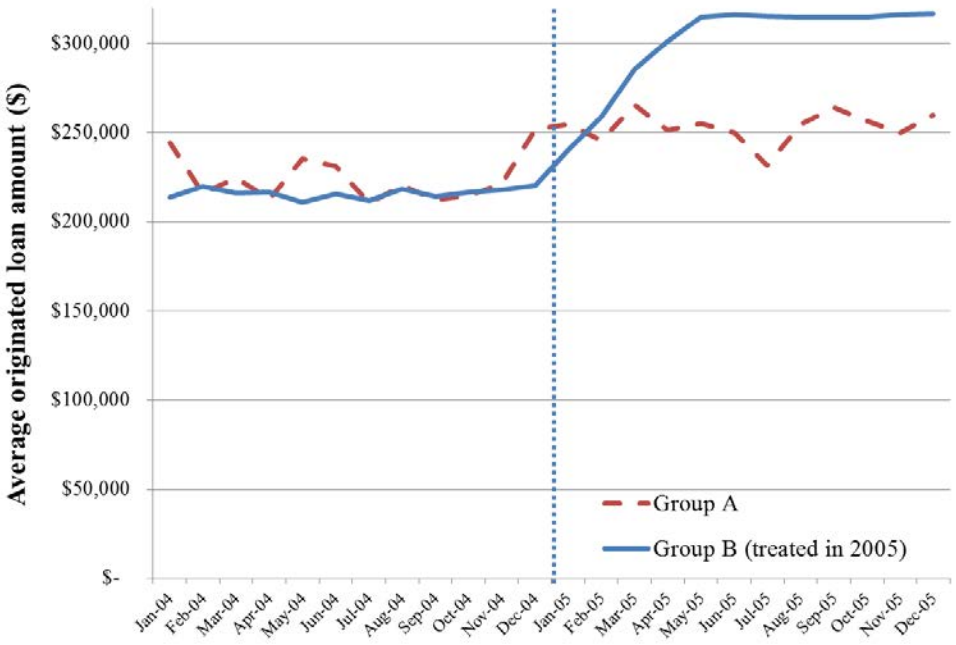
	Dependent variable: Defaulted within 12 months (0/1)				
	(1)	(2)	(3)	(4)	(5)
Commission-based compensation (0/1)	0.002	0.002	0.001	0.003	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
× Second half of the month (0/1)	0.003***				0.003***
	(0.001)				(0.001)
× Tenure above median (0/1)		0.002*			
		(0.001)			
× log(Salary)			0.002**		
			(0.001)		
× Male (0/1)				0.004***	0.004***
				(0.001)	(0.001)
Second half of the month (0/1)	0.001				0.001
	(0.001)				(0.001)
Tenure above median (0/1)		0.001			
		(0.001)			
log(Salary)			0.001		
			(0.001)		
Male (0/1)				0.001	0.001
				(0.001)	(0.001)
log(Originated amount)	0.081***	0.055***	0.050***	0.059***	0.060***
	(0.024)	(0.017)	(0.016)	(0.019)	(0.019)
Personal collateral (0/1)	-0.043	-0.031	-0.030	-0.037	-0.036
	(0.027)	(0.025)	(0.027)	(0.029)	(0.030)
Experian business score	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Experian personal score	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Originated LTV	0.011**	0.010**	0.010**	0.012**	0.0128***
	(0.006)	(0.004)	(0.004)	(0.005)	(0.005)
Originated LTV^2	0.035***	0.029***	0.031***	0.036***	0.037***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interest rate (%)	0.038***	0.036***	0.033***	0.038***	0.036***
	(0.010)	(0.009)	(0.011)	(0.011)	(0.011)
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	11,164	11,164	11,164	11,164	11,164
Adj. R^2	0.21	(0.2118)	(0.2105)	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.

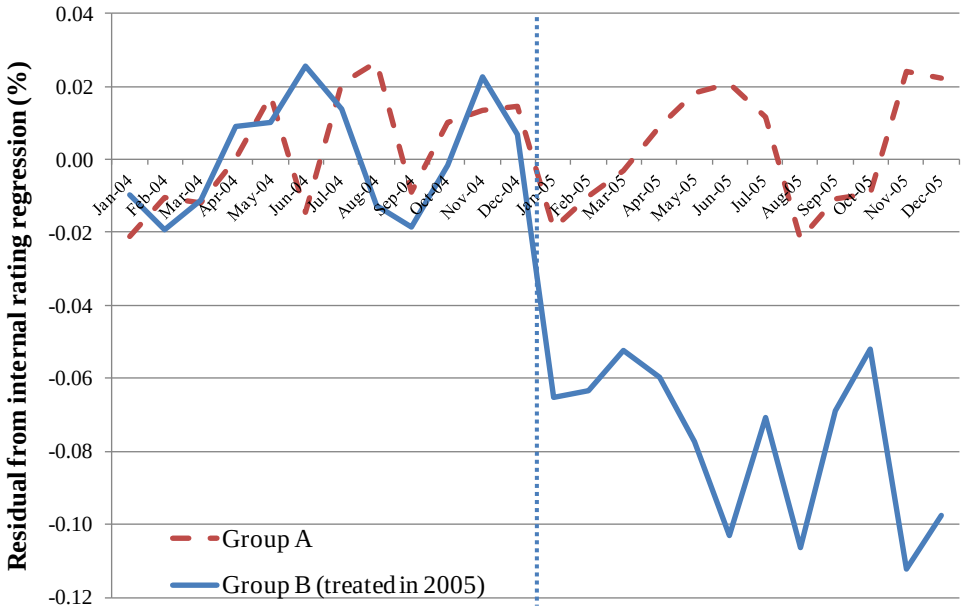
	Dependent variable: log(Salary ($))		
	(1)	(2)	(3)
Commission-based compensation (0/1)	0.082***	0.075***	0.066***
	(0.020)	(0.014)	(0.016)
× Tenure above median (0/1)		0.025**	
		(0.011)	
× Male (0/1)			0.036***
			(0.011)
Tenure above median (0/1)		0.006	
		(0.014)	
Male (0/1)			0.007
			(0.012)
Month fixed effects	Yes	Yes	Yes
Observations	3,192	3,192	3,192
Adj. R^2	0.54	0.57	0.69

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



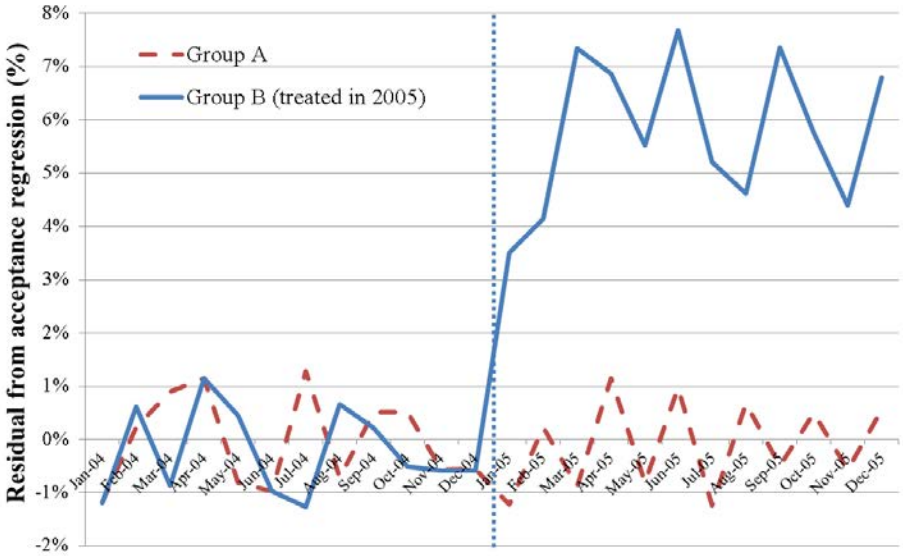
The chart shows the average loan size. Loan sizes are averaged within group (Groups A and B) and month.

Figure 2. Internal Risk Rating (Residual) over Time and across Groups



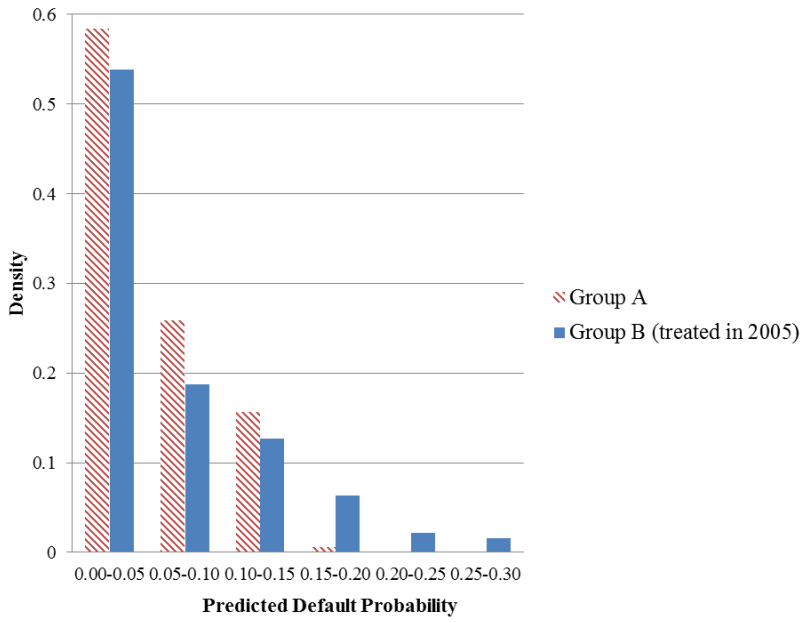
The chart shows the average residual from the internal rating regression (see Appendix B). The residuals are averaged within group (Groups A and B) and month.

Figure 3. Approval Rate (Residual) over Time and across Groups



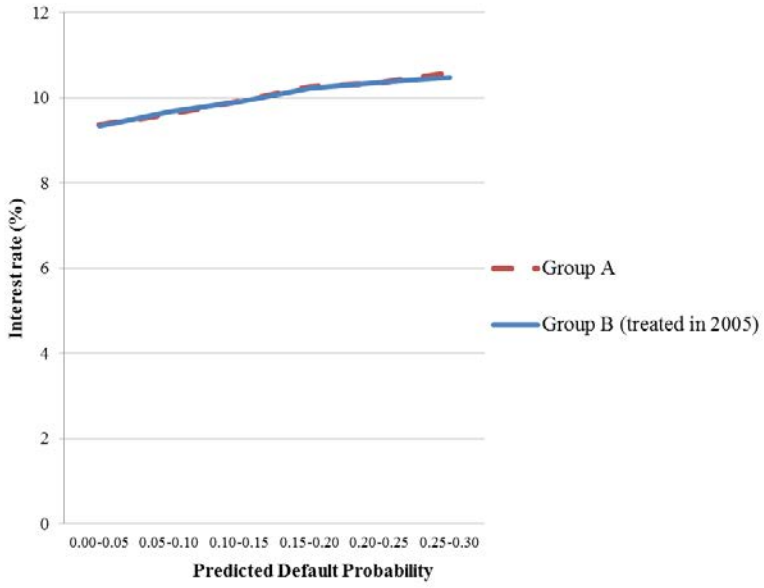
The chart shows the average residual from the approval regression (see Appendix B). The residuals are averaged within group (Groups A and B) and month. Note that while the sample used in the regression includes only the control sample, the residuals are calculated for the entire sample and therefore do not have a mean of zero.

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 the logged originated amount, personal collateral indicator, Experian business and personal credit scores, originated LTV, originated LTV-squared, and interest rate.