Analyzing the Aftermath of a Compensation Reduction

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Abstract

Wage rigidity creates real and financial frictions, though the real-world drivers of rigidities remain largely unstudied. We use staggered commission reductions at a sales firm to shed light on compensation rigidity, estimating effects on worker turnover and effort. In response to a 17% decline in commissions, we find turnover increases for the most productive workers (adverse selection) but detect limited effort responses and no reciprocity effects. These results from within a firm disentangle the mixed evidence from lab experiments and manage surveys. Our evidence suggests wage rigidity persists due to adverse selection rather than fairness, sentiment, or expectations of promotion.

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1 Introduction

> *"It is hard to take a detached view of wage rigidity, because it is central to intense controversy between Keynesian and neoclassical macroeconomists over whether government economic policy should be used to stabilize aggregate income and employment."* —Truman Bewley, Alfred Marshall Lecture (1998)

The retention of firm specific human resources is an increasingly important aspect of financial and compensation policy (Aldatmaz, Ouimet, and Van Wesep, 2014; Kim and Ouimet, 2014; Schmalz, 2012; Lustig, Syverson, and Van Nieuwerburgh, 2011; Eisfeldt and Papanikolaou, 2013; Berk, Stanton, and Zechner, 2010). Early contributions to the literature recognized that shareholders' relative ease in accessing liquidity meant that firms could serve as efficient risk conduits to insure workers through downwardly rigid wages (Baily, 1974). This wage rigidity is manifest in firms rarely cutting compensation (Gibbons, 1996), and nominal wages infrequently adjust downward in micro-data (Kahn, 1997; Card and Hyslop, 1997; Holden and Wulfsberg, 2009).[1] Accordingly, managers tend to reduce headcount rather than lower wages during economic downturns (Kaur, 2014; Altonji and Devereux, 2000; Fehr and Goette, 2005). Less understood—both by managers and in the extant literature—are the real-world consequences associated with compensation cuts when they do occur. This paper reports the effects of controlled commission cuts in a large sales organization. Our quasi-experiment provides a unique lens to study the link between compensation schemes and firm performance, providing evidence on the primitive economic forces behind wage rigidities entering modern structural production models (Belo, Lin, and Bazdresch, 2014; Favilukis and Lin, 2015).

Managerial surveys and lab studies have advanced two alternate hypotheses for wage rigidities. Survey and interview evidence suggests that managers' reluctance to reduce compensation stems from adverse selection concerns.[2] In contrast, lab studies suggest that wage

[1] Based on this evidence, financial economists and macroeconomists have increasingly incorporated wage rigidities into their models; e.g. Fernández-Villaverde (2010) and Smets and Wouters (2007).

[2] Survey responses from 184 firms collected by Campbell III and Kamlani (1997) emphasized the adverse

cuts could lead to asymmetric changes in productivity due to perceptions that they are inherently unfair, induce asymmetric responses around a reference point, or additional behavioral concerns (Kube, Maréchal, and Puppe, 2013).[3] Understanding which of the two effects dominate carries numerous managerial implications. For example, when designing compensation policy, asymmetric effort response around a reference point limits the ability to experiment and learn the relationship between compensation and effort due to adjustment costs (Kerr and Nanda, 2015). On the other hand, Bae, Kang, and Wang (2011) and Schmalz (2012) argue that the need to retain employees influences the ability to take on leverage, while Lustig et al. (2011) and Eisfeldt and Papanikolaou (2013) underscore the importance of organization-specific capital that shares an implicit claim on the firm. If the turnover margin dominates, then wage reductions will result in the permanent loss of firm-specific assets, whereas the behavioral explanations suggest tamer, transient consequences. These frictions take center stage in the budding literature on retention (Aldatmaz et al., 2014; Oyer, 2004; Oyer and Schaefer, 2005; Kim and Ouimet, 2014; Hochberg and Lindsey, 2010).[4] Finally, distinguishing between different response margins helps to ground the varied assumptions found in aggregate models of the economy; e.g., heterogeneous turnover in job search models (Pissarides, 1994; Postel-Vinay and Robin, 2002) or endogenous effort (Shapiro and Stiglitz, 1984).

This paper leverages a commission cut in an inbound-sales call-center to uncover how employees respond to a nominal compensation reduction. The firm employs agents across six divisions selling different digital services (e.g., cable television packages, cellular phone

selection channel, but managers also conjectured that effort responses to compensation reductions would be asymmetric. Bewley (1998) interviewed over 300 business leaders in the Northeast United States during the early 1990's recession, finding the greatest support for morale effects which were predicted to increase turnover, especially amongst the better workers because "they are more valuable and can find new jobs more easily."

[3]Lab or short-term field studies mostly estimate changes in effort, with little focus on extensive margin adjustment through turnover. A notable exception is Mas (2006) who analyzes police productivity and pay. Although reference-point effects are identified, the study does not feature pay cuts or performance-based pay.

[4]Other important work connecting labor market frictions to financing policy includes (Agrawal and Matsa, 2013; Simintzi, Vig, and Volpin, 2014; Chen, Kacperczyk, and Ortiz-Molina, 2011; Serfling, 2016), whereas (Mueller, Ouimet, and Simintzi, 2017b,a) connect moments of within-firm compensation and performance.

plans, and internet connectivity), and compensates its employees through a mix of fixed wages and commissions. The job setting is conducive to studying productivity because the sales process is invariant over time and across agents; everyone performs similar tasks within a well-known production process. During our sample, two sales divisions changed their commission formulas. Expected commissions in the largest treated division declined by about 17%, resulting in a total take-home pay reduction for the average affected worker of about 7%.[5] Combined with the firm's real-time productivity measures, these changes provide a unique, high-resolution window into workers' responses to a pay reduction.

We use a difference-in-differences strategy to estimate the effects of these reductions on several margins, including worker turnover, sales effort, and non-sales effort.[6] Our setting allows us to study how workers with different characteristics—albeit facing identical incentives and environmental conditions—react to commission cuts, enabling estimates of heterogeneous effects under very general identifying assumptions.

Consistent with the importance of adverse selection concerns, we find highly productive agents differentially exited the firm. Highly productive workers (those with pre-treatment productivity one standard deviation above the mean)[7] had a 28% increase in attrition relative to the average change in turnover rates. To contextualize the costs of the increased turnover, we use our estimates of the change in worker composition to calculate the effect on overall sales revenue. A worker with pre-treatment performance one standard deviation above the

[5]Our estimates of the commission reduction for the smaller treated division suggest even larger compensation reductions, but we lack the data necessary to form an ex-ante estimate of the expected change in pay in the absence of incentive effects.

[6]We address several challenges to ensure an appropriate control group. For example, it is possible that these changes were anticipated by workers prior to their announcement. Another possibility is that the commission reductions were motivated by idiosyncratic division-specific performance trends. Our interviews with the firm suggest workers expected their prior compensation contract to remain unchanged. We also take an insider perspective to understand why managers in the treated divisions instituted the changes, in line with the "insider econometrics" approach Bartel, Ichniowski, and Shaw (2004). Our main empirical strategy relies on the validity of similar pre-period trends between agent types within the same division. This assumption appears valid, allowing an analysis of heterogeneous responses based on within-division differences.

[7]The measure of worker productivity behind these results is based on sales agent fixed effects estimated prior to the first commission reduction, but the results are similar when using measures of average productivity that do not net out the effects of experience.

mean drove between 20-25% more revenue-per-call than an average employee. The change in turnover probabilities for these workers, in levels, was about 1.4 percentage points per week. Because turnover accumulates over time, this would have led to a total sales reduction of about 6% over the next five months.[8] This calculation highlights that while the need to hire and train new workers makes all turnover costly, the loss of highly productive salespeople—those with non-trivial specific human capital—lowers the firm's average yield and profits, as less skilled replacement workers answer incoming calls. An important qualifier to this result is that the effects are all found in one division where agent's ex-post take-home pay closely matches (local) market rates.[9]

Inconsistent with behavioral concerns, we find limited average effort reductions after the commission cuts. This is a particularly striking result given the strong evidence from earlier lab experiments predicting negative reciprocity and lower overall performance. Surveys were conducted following the commission cuts that enable us to better understand the lack of measured effort changes. The survey responses suggest that the average agent *increased* his/her effort in response to the changes. A potential explanation is that the strong incentive pay within the firm dampened retaliatory responses. Another potential explanation is that the permanent nature of the change caused substitution and income effects to offset each other—something that would be hard to find in lab experiments.[10] While we do not find a large aggregate effort change, we do find evidence that the most able workers reduce their effort more than other workers. This heterogeneous effort response is similar to Lazear et al. (2016) and is consistent with a standard, rational labor-supply model of incentives tied to effort.[11]

[8] We use a five month horizon to avoid forecasting changes in sales into a busy hiring season that begins in the late spring and early summer.

[9] Agents in the second division earned more than managements' estimates of what could be earned elsewhere. This second division did not experience differential turnover rates, suggesting that adjustment through turnover may be a function of pay relative to the outside labor market. Inframarginal firms, consistent with standard economic intuition, will see less response than firms that pay closer to market rates (Lazear, Shaw, and Stanton, 2016).

[10] See Stafford (2015) on how permanent versus transitory changes alter effort supply responses.

[11] The margins of employee response to compensation adjustment may be different in settings where pay is performance based. Our setting captures an increasingly prevalent form of compensation that ties compen-

Finally, we consider other factors that may drive heterogeneous effort and turnover responses, helping to distinguish between different explanations for wage rigidity.[12] In particular, we look for different responses based on agents' pre-change assessments of the firm. These measures come from a pre-treatment survey conducted to assess individual worker sentiment toward the firm, beliefs about firm fairness, and future career plans. We expected to find the largest effort and turnover responses among agents who initially rated the firm as highly fair, as these agents subsequently reported the largest drop in perceived fairness (Akerlof and Yellen, 1990). We find, however, no heterogeneous effort or attrition responses based on ex-ante perceived firm fairness, ex-ante propensity to refer friends to the job, or ex-ante expectations of near-term promotion.[13] The estimates here should be interpreted in light of the fact that the firm announced the reductions as necessary for long-run sustainability, though the treated divisions did not experience financial distress prior to treatment.[14]

The results on sales effort stand in contrast to much of the existing literature from short-term experiments. For example, Kube et al. (2013) estimate an elasticity of effort with respect to a wage cut of 0.6 but a near zero-elasticity with respect to a wage increase. Our estimates imply modest elasticities of effort with respect to compensation reductions. In another empirical study of wage reductions, Gao, Harford, and Li (2012) use a sample of discrete pay cuts and find that after executives' compensation is reduced, CEO pay-performance sensitivity increases, allowing executives to restore their pay levels through good firm performance.[15] While their work provides insight into the consequences of compensation

sation more closely to worker driven revenue (Lemieux, MacLeod, and Parent, 2009). Employee responses to contractual adjustments are equally important to micro-found aggregate models.

[12] An excellent overview of the relevant laboratory-based experiments can be found in (Gächter and Fehr, 2002).

[13] This information is gathered through surveys administered before the compensation changes were announced.

[14] The literature on fairness suggests responses will depend on the context and how the firm frames the changes to compensation (Kahneman, Knetsch, and Thaler, 1986). Relative pay concerns are also unlikely to be important for the interpretation of results, as workers in the treated divisions sit together and report to the same managers Cohn, Fehr, Herrmann, and Schneider (2014). That is, workers on the same team face identical incentive changes.

[15] While a wealth of literature exists on pay-for-performance and compensation contracting in general (Jensen and Murphy, 1990; Mehran, 1995; Hall and Liebman, 1998; Murphy, 1999), this is one of the only empirical studies of compensation cuts among executives, likely because such cuts are so rare. Another form

changes for top managers, there is still very little empirical evidence of workers' responses to compensation changes deep within the organization.[16]

Overall, the results indicate that much of what is driving nominal wage rigidity and adjustment frictions is on the turnover and selection margins, in which the most productive workers leave. This evidence is consistent with Banker, Lee, Potter, and Srinivasan (2015) who study a retailer that increased fixed wages while eliminating an incentive plan. Expected compensation was unchanged in their firm, however, so they are only able to isolate the change in incentives rather than adjustment around a nominal reference point. They find limited effort responses to the changing mix of compensation, but, like our results, they find that increased turnover leads to decreased operating performance. Other related work comes from an early presentation analyzing a reduction in incentive pay at a personnel search firm by Krueger and Friebel (2015). At this firm, incentive pay was reduced, with a small offsetting increase in fixed pay. They find large effort reductions and large increases in turnover, with stronger responses for the most productive workers. These findings align, somewhat, with our results. We believe that context is likely to explain the difference; effort for the personnel search firm in their study is proactive, whereas effort in our case largely responds to performance after a call arrives. The ability of the firm to modulate call arrival and to monitor workers' availability to take calls may limit the extent to which agents reduce effort on the job. The heterogeneous response to incentives, as we later show, suggest the results in Krueger and Friebel (2015) are likely to be in line with a standard, rational model of effort supply, consistent with our evidence.

Our findings add to the understanding of primitive economic forces driving wage rigidity, which is a critical constraint in structural production models (Belo et al., 2014). In particular, wage rigidity, when added to production models, explains equity volatility and premiums, Sharpe ratios, interest rate dynamics, and the downward-sloping equity term structure (Favilukis and Lin, 2015). We complement this literature by investigating the

[16] of compensation rigidity for executives comes through option grants (Shue and Townsend, 2017).

mechanisms underlying wage rigidity, which in turn sheds light on the firm attributes most susceptible to constraints on compensation adjustment. For example, Michaels, Page, and Whited (2016) find combining financial frictions and labor bargaining produces a strong negative relation between leverage and wages. A better understanding of firm vulnerabilities may also help to contextualize the evidence linking labor outcomes to financing frictions (see, e.g., Cantor, 1990; Sharpe, 1994; Benmelech, Bergman, and Enriquez, 2012; Bakke and Whited, 2012; Chodorow-Reich, 2013).[17]

The following section describes the firm, the specific setting, and details of the commission change. We then discuss data, measurement, and a pre-treatment survey. Section 4 introduces a parsimonious model to ground predictions. Section 5 details the estimation strategy and the results.

2 Firm Organization

The firm is an inbound sales call-center with nearly 2,000 sales representatives. The organization independently sought to reduce agent commissions via a wage reduction across two divisions: Treated Division 1 and Treated Division 2 which employed 20% and 7% of the firm's sales force respectively. The change in Treated Division 2 happened 3 months after the change in Division 1. This section discusses the relevant institutional details and provides context for the generality of our results.

2.1 Setting

The firm contracts directly with national TV, phone, and internet providers (clients) to provide marketing and sales services. The firm is awarded regional contracts granting multi-state marketing monopolies such that no other sales organization can send mailers, advertise in local media, or purchase geographically based internet search traffic on behalf of the client.

[17]The labor and finance literature is closely related to a recent literature on costly capital adjustment costs (see, e.g., DeAngelo, DeAngelo, and Whited, 2011; Warusawitharna and Whited, 2016).

Prospective customers engage with the firm when they respond to the marketing promotions by calling a 800-number corresponding to the product or service they are interested in. Across three geographically distinct call-centers, the sales agents are arranged into six divisions, according to the product or service being sold. Each division has its own client-facing executive (division manager) with sole discretion to set their salespeople's incentives. Beneath the division manager are multiple teams of roughly 15 sales agents supervised by a sales manager who reports directly to the division manager.

Inbound calls are routed to divisions based on the supporting client (e.g., satellite television), and the calls are mapped to specific teams either on the basis of where the customer is calling from (as indicated by the 800-number dialed) or to whichever team has idle capacity. The firm absorbs expected temporary fluctuations in call volume (e.g., in response to marketing promotions) by using its existing salesforce via workforce planning, whereas seasonal spikes in call volume (e.g., summers) are handled by adding workers to teams. The formation and dissolution of teams is reserved for very large fluctuations in call volume, such as from the acquisition or loss of a new client or geographical territory.

Sales agents spend most of their workday either on calls or idling at a phone for another call.[18] Teams sit together such that each agent is always within view of their sales manager, though teams in the same division may be located in different establishments. Outside of time spent speaking with customers or waiting for another inbound call, agents are responsible for attending team meetings and having one-on-one discussions with management.

Once an inbound call arrives, it is randomly allocated amongst idling agents. In the absence of available agents, the call enters a queue and is assigned to the next available agent. Agents rely on designated sales protocols and their understanding of the caller's needs to sell the products and services. Products and services have different margin levels for the firm. In most cases, the highest firm-facing margins are earned on the most expensive products (e.g. a satellite subscription with all possible channels) or bundles of services (e.g.

[18]The firm is almost exclusively an *inbound* call-center, with less than 3% of calls being outbound—most of which are agents following up on earlier inbound calls (e.g., returning a dropped call).

a service contract covering internet, telephone, and television).

Managers directly encourage agents to sell higher-margin items in weekly sales meetings where they teach agents proper sales protocols and ensure that they have a full understanding of the products being sold. Successful agents, those who show a high aptitude for selling and assisting others, are eligible for promotions to manager. Extrinsic motivation is provided via commissions paid on "eligible product revenues." To ensure quality and uniformity, every agent has a (constant and confidential) fixed number of calls audited each week, and if any conduct violations are identified in the audited calls, the agent's weekly commission rate is reduced. Eligible product revenues are internally imposed transfer prices which, in principal, correspond to the revenues the firm collects from clients whenever the corresponding product or service is sold. The firm occasionally engages in minor re-balancing of eligible product revenues to prioritize the sale of new or promotional services over others, but prior to the changes consider in this paper, managers and agents never perceived these rebalancings as pay cuts. In most cases, price rebalancing involved additional bonuses as opposed to price cuts.

We learned of an impending compensation change several weeks ahead of its announcement, which-unlike earlier rebalancing–was expected to have (non-trivial) negative repercussions on all agents in the treated division. To whit, adjacent leaders within the firm expressed concern that the changes would be met with an exodus of disgruntled agents. More generally, call-centers provide a good setting for studying attrition as they are notorious for having high turnover (Holman, Batt, and Holtgrewe, 2007), especially in vibrant economies offering ample outside options for similar work.[19]

[19]The average hourly take-home pay, $17.30, of agents in the study firm was similar to that earned by agents in neighboring call-centers. Customer service representatives at a nearby call-center for a global entertainment provider earned $15 an hour when first hired and received $0.50 raises every six months. Agents of another neighboring call-center earned between $14 and $20 per hour, and those of a third firm earned between $10 and $14 per hour. While the average agent at the firm enjoyed marginally higher wages than agents at adjacent firms, competitive outside options abounded.

2.2 Commission Changes

An agent's compensation package consists of a minimal hourly wage for the time at work (on a call, idle at the phone, or in meetings with managers),[20] bonuses from temporary promotions imposed either by the firm or the client, and commissions. Commission rates are calculated weekly, and, as mentioned earlier, the rate decreases if the agent's audited calls violate the firm's policies. Commissions also vary as a function of an agent's performance relative to other agents in the same division. The primary performance metrics employed are average revenue-per-call and average revenue-per-hour, both of which are based on the eligible revenue discussed earlier. Formally, an agent's weekly commission can be expressed as follows:

$$\text{Commission}_i = (\text{Eligible Revenue})_i \times f(\text{Revenue-per-Call/Hour}_i, \text{Revenue-per-Call/Hour}_{-i}, \text{Quality}_i) \quad (1)$$

where $f(.)$ is the commission rate function which is increasing in Revenue-per-Call/Hour$_i$ and Quality$_i$, while decreasing in the other agents' performance metric, Revenue-per-Call/Hour$_{-i}$. Although there is relative performance measurement, the range of variation due to relative performance is about 10% of baseline commissions. More extreme values in the commission rate function are observed, however, when agent's fail their call audits.

On average, the firm pays commissions that are between 5% and 6% of the eligible revenue generated by an agent, with the average agent earning $217 per week in commissions. Commissions constitute approximately 41% of the average take-home pay. Sales success depends largely on an agent's understanding of the products offered and their ability to master the designated sales protocol. Accordingly, more seasoned sales agents generate more hourly and per-call revenue than recently hired agents (see Table 1).

The commission change was enacted for Treated Division 1 in November of 2016. Treated Division 1 added additional territory over the summer of 2016, which raised both call volumes and average commissions per call. The division manager believed the internal transfer price

[20] Sales agents start at an hourly wage of approximately 150% of minimum wage and receive small hourly raises for every three months of tenure, with their hourly rate capped at approximately 200% of minimum wage. Agents who stay with the company beyond a waiting period are eligible for health benefits as well.

between sales and "eligible revenue" was broken and decided to intervene. The pre-treatment *Eligible Revenue* schedule was perceived as providing sub-optimal incentives for agents to sell low-margin and inexpensive products while providing insufficient incentives for agents to sell high-margin and more expensive—albeit more difficult to sell—products. In response to these perceived inefficiencies, the division managers radically rebalanced the eligible revenue schedule, with drastic reductions in the internal transfer price for the most frequently sold products. Using the pre-announcement sales mix of products, the change in revenue schedule was expected to amount to a 17-18% reduction in commissions in the absence of substitution to higher-earning products. The commission rate function, $f(\cdot)$ in equation (1), remained constant.

Treated Division 2 had more experienced and higher earning sales agents. The manager for Treated Division 2 believed pay was sufficiently above market that a reduction in commissions would have minimal effects on agent effort and turnover. Due to data limitations, we cannot estimate the ex-ante effect of the rebalancing in Treated Division 2 on overall sales. That is, we were not able to get data on changes in the revenue formula. Because our data only contain sales revenue captured through transfer prices, for Treated Division 2, we do not know the extent to which quantities declined (possibly due to sales effort adjustments) or prices changed. Hence, when estimating how effort responded to treatment, we omit Treated Division 2. However, average commissions declined by 30% for Treated Division 2 after the change. Although we cannot determine whether this decline resulted from a reduction in effort or a change in transfer prices, this division is included in analyses of turnover.

Changes were announced to all employees of the treated divisions at an all-hands meeting less than a week before taking effect (this was the case for both divisions, albeit the meetings and subsequent changes occurred in different months). For Treated Division 1, the divisional executive: (1) highlighted recent growth in commissions as a function of eligible revenues, (2) stressed the equilibrium steady-state level of commissions, and (3) the firm's solution; namely, a massive re-balancing of the eligible revenue schedule. Anonymous surveys pro-

vide no (reported) evidence of leakage to the sales agents prior to the meeting. While we estimated that the average post-treatment decline in commissions would have been 17-18% if sales agents were unable to substitute to new products, the rebalancing was nonetheless communicated as an opportunity for agents to earn more if they could effectively learn to sell higher-priced products. Survey responses following the announcement in Treated Division 1 suggest that many agents realized they would need to work harder in response to the change, reporting they would need to significantly increase their effort to make up the gap in earnings.

3 Data

3.1 Personnel and Productivity Data

We received highly detailed commission and productivity data from the firm. The first week of accessible commission data is July 4th, 2015 for divisions other than Treated Division 2, where our data access begins on Jan. 9th, 2016. In addition to commissions, we have weekly agent-productivity data, including: measures of availability or "adherence" (measuring the fraction of scheduled time an agent is available to answer calls), phone hours, revenue generated per call, revenue generated per hour, and total eligible revenue generated. The first week of accessible productivity data varies by division, but data access commences between February and April of 2016 for all divisions. All six divisions have consistent data beginning in April of 2016, which we use as the start of the main sample. In the analysis of turnover, we add data from 2015 to identify seasonal patterns of turnover. The sample is organized by agent-week and runs through June 17, 2017. Additional worker characteristics data, namely demographics (e.g., birth date, gender, race, marital status) and work history (e.g., start date, termination date, termination reason, previous employment at the firm, etc.) enable us to control for a variety of observable characteristics.

In total, the dataset covers 2,033 sales agents across 61 weeks, for a total of 39,944 agent-

week observations. Table 1 displays summary statistics over the full time-series for treated and the average of control divisions. Agents in Treated Division 1 are similar to those in the control group in terms of the commissions they earn, their tenure with the firm, their average age, and their race composition. Agents in Treated Division 2 have higher tenure and are older than those in Treated Division 1 and the control group. The firm reserves Treated Division 2 for its most proven agents because those positions require mastery of multiple product categories.

Table 2 provides summary statistics for Treated Division 1 in the pre-treatment period by splits of the sample into terciles based on adjusted fixed effects for representatives' log commissions prior to the first treatment date. Later, these adjusted fixed effects are used as measures of agents' pre-treatment productivity. The fixed effects are calculated from a regression that includes the worker's tenure-productivity profile, division-by-week fixed effects to remove common division-level shocks, and worker fixed effects. Thus, the worker fixed effects are interpretable up to a division-level average that is removed through the fixed effects. Accounting for the tenure profile makes this measure one about underlying talent rather than the tenure-commission gradient.[21] The calculation of terciles is done after using a shrinkage procedure on the worker fixed effects to guard against mean reversion or classification being driven by sampling error from a short panel.[22] We base the split of terciles from the shrunk worker effects dated one month prior to the treatment date for Treated Division 1.

As evidenced from Table 2, agents in the top tercile have higher tenure, in line with the firm retaining more productive workers. Demographic characteristics also vary across the

[21] Although those with higher ability are less likely to leave the firm and may have greater tenure. We later comment on robustness to alternative measures.

[22] We first fit a regression of log commissions on worker fixed effects, division-by-week fixed effects, and a cubic spline in tenure. We then take the residuals plus the estimated individual fixed effects from this regression, fit the restricted maximum likelihood random effects estimator, and recover each worker's expected best linear unbiased predictor. The procedure follows Lazear, Shaw, and Stanton (2015) and is similar to an empirical Bayes estimate of permanent productivity; the estimator puts less weight on noisier observations. Log commissions are used rather than commissions per-call or commissions per-hour because commissions data are available in calendar year 2015, but the other measures are not. These same classifications are later used in the turnover sample for placebo tests in an expanded sample using 2015 data.

fixed effects terciles; namely, workers in the highest tercile are older and less likely to be single. Later specifications will control for these characteristics.

The interpretation of our upcoming analysis would be muddled if the treatment itself affected high and low productivity workers based on differences in the mix of products sold in the pre-period. To check for this, we calculate the expected percent change in commissions after treatment based on the sales mix in the pre-treatment period. The variable "Predicted Pct Δ Commission Post-Treatment" reports this measure. The predicted percent changes in commissions due to the pre-period sales mix is similar across each group of workers. Although the top tercile has average weekly commissions that are more than 2.7 times greater than the bottom tercile, the product mix of sales does not slant commission percentage changes towards any one group based on pre-period productivity.

3.2 Survey Instruments

Before the commission changes were announced, a firm-wide survey was administered to assess the general sentiment of the sales agents. Three questions in particular capture the agents' sentiment towards the firm and their work: (1) "Do you think you will be promoted in the future?"; (2) "How likely are you to agree with the following statement, [the firm's] policies, for example on adherence, compensation, and promotion, are justified and fair?"; and (3) "Suppose your friend is looking for a job, how likely are you to recommend them to apply at (redacted)?"

In an effort to quantify any changes in sentiment that occurred as a result of the commission changes, a second survey was administered to agents of Treated Division 1 shortly after the announcement of the changes. These exact same questions were asked again to determine if agents' perceptions of promotion likelihood, firm fairness, and desire to give referrals had changed. In this post-treatment survey we also asked agents how they felt their effort and commission levels would change as a result of the wage cuts.

In this section we report the changes in self-reported agent sentiment, effort, and commis-

sions as the result of the wage cuts for agents in Treatment Division 1. Figure 1a shows that agents in Treated Division 1 had, on average, decreased perceptions of how fair the firm's policies were. Similarly, Figure 1b shows that agents, on average, reported a decreased likelihood to refer their friends to apply to the firm. These results suggest that the commission reductions negatively affected agents' feelings of fairness and loyalty to the firm but did not do so uniformly.

For questions about firm fairness or propensity to refer friends to work, those agents with the most favorable early views about the firm had the largest negative revisions in expectations after treatment. In analyses focused on how sentiment toward the firm or perceptions of fairness influence effort or turnover responses, we use results from the initial survey with the understanding that these initial measures also proxy for changes among treated agents. We do not use changes directly, however, as the follow-up survey is not available in non-treated divisions. The use of the initial survey also guards against losing data due to attrition before the second survey was conducted.

Figure 2 makes clear that the commission change was salient. The mean reported perceived commission change is negative and large, although slightly smaller than the 17-18% expected commission reduction resulting from the change.[23] Figure 3 shows the responses when agents were asked how much harder they would need to work to maintain their prior income levels. Agents overwhelmingly believed that they would need to exert *more* effort to maintain their usual levels of commission.

4 Predictions from a Standard Model of Labor Supply

To ground our empirical work, we posit a simple benchmark model that yields heterogeneous responses based on agent skill. Let $U(R \times e)$ denote an agent's objective function, such that

[23] Using the pre-treatment sales mix, we did not find positive expected changes for employees.

the agent solves:

$$\max_{e} U\left(R \times e\right) - c\left(e\right)/k \tag{2}$$

where R is an eligible revenue-multiplier for a given effort level, e is effort, $U(.)$ is a twice-differentiable, concave utility function over income, $c(e)$ is a twice-differentiable convex cost of effort function, and k is an agent's ability. Higher agent ability shifts the cost of effort downward. The first order condition for the agent's problem is

$$U'\left(R \times e_i\right) R = \frac{c'\left(e\right)}{k}.$$

Totally differentiating the first order condition yields

$$\frac{\partial e^*}{\partial R} = \frac{-U'}{U''R - c''/k}. \tag{3}$$

A prediction about heterogeneous responses follows from how equation (3) changes with k, employee ability. Differentiation yields

$$\frac{\partial^2 e^*}{\partial R \partial k} = \frac{\left[U'c''/k^2\right]}{\left[U''R - c''/k\right]^2} > 0, \tag{4}$$

which shows that more able agents, those with higher k, are more responsive to changes in the commission level. The intuition behind this result is that, for the same marginal benefit of effort, an interior solution for a more able agent is at a less steep point in the marginal cost of effort function, enabling more adjustment. These predictions are distinct from most behavioral theories that do not consider heterogeneous responses. Heterogeneous responses based on worker ability help to distinguish different theories on the sources of agents' adjustment. Evidence of a heterogeneous response suggests this simple framework helps to rationalize the data.

The framework, so far, says nothing about changes in turnover as a function of ability. The incentive to quit is likely to depend on whether the skills of highly able agents are

portable to different production environments and whether the firm is in a competitive market or is paying compensation above what can be found elsewhere. We leave turnover and how it varies with pay and productivity across different divisions as empirical objects to be analyzed.

5 Methodology and Results

This section details the consequences of changing the compensation structure. Section 5.1 describes the identification strategy. Section 5.2 estimates the magnitude of the commission changes and reports the overall effect of the changes on agents' effort. Section 5.3 considers heterogeneity of the observed effects across the distribution of agent productivity in the pre-treatment period. Specifically, Section 5.3.1 reports the extensive margin effects on sales agent turnover and Section 5.3.2 reports the intensive margin estimates of effects on non-sales and sales effort. Finally, Section 5.4 considers heterogeneous effects across sales agents based on their perceptions of firm fairness, expectations of promotion, and sentiment toward the firm.

5.1 Methodology: Estimation Strategy

We use several reduced form strategies to identify the causal effects of the compensation cuts.

5.1.1 Estimating Changes in Effort

The first specification used to estimate the main effects of the compensation change on a particular *intensive margin* outcome of interest, y_{it}, is a difference-in-differences regression with the following form:

$$y_{it} = \alpha_i + t + X_{it}\beta_1 + \sum_j (Div_j + Trend_j + Post_j \times Div_j\delta_1) + \varepsilon_{it}. \tag{5}$$

The main parameter of interest is δ_1, which captures the change due to treatment after the commission change occurs in division j, indicated by $Post_j$. The $Post_j$ indicator is always zero for untreated divisions. All specifications include a time fixed effect, t, division fixed effects, Div_j, and division-specific time trends, $Trend_j$. The matrix X_{it} has a cubic spline in tenure and a third order polynomial in age, along with fixed effects for ethnicity, gender, call-center location, and marital status. Some specifications include α_i, a worker fixed effect.[24]

This specification accounts for average differences across divisions or average differences across time periods, but the estimates may be biased under division specific time trends that don't follow the linear functional form, other secular demand shifts, or division-specific seasonality that correlates with treatment. We return to these issues after laying out estimation of heterogeneous effects and estimates of turnover.

A second specification identifies heterogeneous effects across sales agents based on their pre-treatment performance or survey responses on firm fairness, the propensity to refer a friend (sentiment), or the likelihood of expected promotion. This specification adds interactive effects to equation (5):

$$\begin{aligned} y_{it} = \alpha_i + t + X_{it}\beta_1 + \sum_j (Div_j + Trend_j + Post_j Div_j \delta_1 + \\ \sum_k (Het_k Div_j Post_j \delta_{2k} + Het_k \beta_2 + Het_k Post_j \beta_3 + Het_k Div_j \beta_4)) + \varepsilon_{it}. \end{aligned} \tag{6}$$

Here k indexes a particular heterogeneous characteristic. The parameter δ_{2k} captures different responses based on Het_k. For differences based on survey answers, Het_k is a binary category based on the median of the survey response in the pre-treatment period. For measures of skill level, Het_k is the z-score of the worker's log-commission fixed effect.[25] A fully saturated set of indicators for missing categories of heterogeneous characteristics is also

[24] Differences in the within-worker versus OLS estimates can be attributed to attrition from the firm.

[25] We use z-scores to standardize the fixed effects across the treatment and control groups and to facilitate interpretation of parameters, as a unit change in the z-score corresponds to a standard deviation of the underlying productivity measure.

included for those sales reps who do not have data available.

A final specification is robust to shocks across divisions or seasonality, but the main effect, δ_1, is not estimable. This specification adds division-by-week fixed effects to equation (6), resulting in:

$$\begin{aligned} y_{it} = \alpha_i + X_{it}\beta_1 + \sum_j (Div_j \times t + \sum_k (Het_k Div_j Post_j \delta_{2k} + \\ Het_k\beta_2 + Het_k Post_j\beta_3 + Het_k Div_j\beta_4)) + \varepsilon_{it}. \end{aligned} \tag{7}$$

5.1.2 Estimating Changes in Turnover

Estimates of the *extensive margin* effects of commission reductions on turnover require different specifications, while leveraging additional sources of variation. It should be noted that worker fixed effects are not estimable because we have a single-spell of data on each worker. In each specification, we include a flexible function $g(TimeAtRisk)$, capturing how the baseline turnover hazard changes with time at the firm for the individual worker. The model we estimate is:

$$\begin{aligned} Turnover_{it} = \alpha + TimeControls + g(TimeAtRisk) + X_{it}\beta_1 + \sum_j (Div_j + \\ Post_j Div_j \delta_1 + Placebo_j Div_j \delta_2 + \sum_k (Het_k Div_j Post_j \delta_{3k} + Het_k Div_j Placebo_j \delta_{4k} + \\ Het_k\beta_2 + Het_k Post_j\beta_3 + Het_k Placebo_j\beta_4 + Het_k Div_j\beta_5)) + \varepsilon_{it}. \end{aligned} \tag{8}$$

We use a variety of different fixed effects strategies for $TimeControls$ to account different for date-specific turnover rates or division trends. One set of specifications includes time fixed effects that remove common turnover changes affecting all divisions (e.g., end of the summer high call volume season). Another strategy tests for whether seasonal turnover patterns drive the results by including placebo indicators for treated divisions one year prior to the effective treatment date.[26] Other specifications include division-by-week of the calendar year fixed

[26] We augment the intensive margin sample with earlier data containing personnel records, turnover data,

effects, meaning the specification compares turnover rates for the division against turnover rates in the same week of the last calendar year. A final approach includes division-by-time fixed effects to identify heterogeneous attrition patterns; this specification only estimates δ_{3k} and δ_{4k}.

5.1.3 Addressing Empirical Hurdles

The turnover regressions overcome a number of empirical hurdles, but many remain when considering estimates of overall effects on the *intensive margin.* There are several strategies we use to ensure the non-treated divisions constitute an appropriate control group.

Different Trends: Figure 4 shows the evolution of average commissions by division, along with changes around the treatment dates. It is important to note the upward trend in commissions for Treated Division 1 relative to the other divisions in the months before the compensation cuts occurred. We refer to this as the "run-up" period. From July 23, 2016 up to the November commission changes, agents in Treated Division 1 realized a steady, positive increase in commission levels that is absent in the weeks before July 23. This increase, according to interviews with firm management, was caused by the addition of new, lucrative territories from which sales agents fielded calls,[27] and sales agents expected this increase in commission levels to be permanent.

To account for this run-up in commissions, we include division-specific trends in each specification. Some specifications re-weight data from other divisions to match the run-up experienced in Treated Division 1.[28] Figures 5a and 5b provide details on the fit of the re-weighted estimates. The figure notes describe the procedure.

It is clear from these figures that the per-call fit is better than the overall fit for the match-

and log commissions beginning in July of 2015. Data on sales and other effort measures begins in April of 2016. The turnover data from the calendar year prior to the commission changes allows us to assess whether seasonal turnover patterns are responsible for the results.

[27] For example, the new territory may be home to fewer competitors, in which case the agents could more easily up-sell callers into buying more eligible revenue packages.

[28] We use a propensity score re-weighting estimator, with the propensity score for Treated Division 1 estimated with data that ends one month before the treatment announcement date.

ing estimators, suggesting that the new territories also yielded an up-tick in call volume. As a result, we prefer specifications at the per-call level to remove potential demand confounders when interpreting changes in effort supply. These per-call measures of productivity allow us to measure output while controlling for demand.[29]

Seasonality: Some demand changes are forecastable and show up in headcount adjustments by the firm. Other demand changes are more subtle, but may surface as a seasonal trend from past data. To account for division-level seasonality that isn't captured by common time fixed effects, we also include leads and lags of the average division commissions one year prior to the week in question.

Spillovers to Control Group: To test another identifying assumption, the lack of spillovers to control divisions, we conduct structural break tests for the control group. These results suggest minimal spillovers to the control group. Figure 6 describes the break tests and plots the parameter estimates from various specifications of these break tests.

5.1.4 Heterogeneous Effects

As previously mentioned, the validity of difference-in-differences identifying assumptions are not necessary for an analysis of differential effects across agent skill level because we leverage within-division variation. The specification in equation (7) is used to test whether agents within the same treated division respond differentially depending on their pre-treatment characteristics, e.g., skill level, willingness to give referrals, expectations for future promotions, and perceptions of fairness. These heterogeneous parameters can be estimated using within-division-time fixed effects without appealing to parallel trends across divisions. How differences between types of agents evolve–in treated and control divisions–helps to visualize the sources of variation. Figures A.1 and A.2 plot the evolution of within-division differences by worker ability and worker perceptions of firm fairness over time.

[29] Given that the divergence between the re-weighted control group trend and the trend for Treated Division 1 occurs before treatment begins, we suspect demand changes are responsible for divergence in the levels measures.

5.2 Estimates of Overall Effects on Agents' Commissions and Effort

This section documents the magnitude of the compensation changes, detailed in Section 2.2, by estimating equation (5) *without* heterogeneous effects by agent. We use a variety of specifications and test the effect of the changes on agents' commissions, availability, and sales effort. Propensity-score weighted regressions and specifications with fixed effects provide preliminary evidence of the intensive margin (changes in effort).[30]

Panel A of Table 3 reports that commissions per call decreased in Treated Division 1 by 15-17% in the re-weighted OLS and FE specifications—Columns (3) and (6), respectively. These changes are similar to the predicted decreases, which limits the scope for changes in effort.

The firm also tracks a well-defined and precisely measured availability metric called "adherence." Adherence is the fraction of time an agent spends performing job-related tasks, as opposed to shirking—e.g., opting out of answering incoming calls.[31] It can be thought of as a micro analogue of labor supply; if the sales floor has high (low) levels of adherence, the local labor supply is high (low), and the firm treats it as such; i.e, individual adherence problems are quickly addressed by team managers, and repeated failures to meet one's adherence threshold is a fireable offense. To investigate agent availability, Panel B estimates the change in adherence. These estimates show that, on average, agents do *not* change their adherence in response to the commission reductions. We next consider the change in sales effort by estimating the change in log revenue-per-call if (1) the commission structure had *not* changed (Panel C) and (2) if the commission structure had always been at the new levels (Panel D). In these specifications, we take quantities as given and apply the product-level revenue mapping for the respective commission regimes. Control divisions' mapping is con-

[30] The effect of the compensation changes on the extensive margin (turnover) is discussed in Section 5.3.

[31] Adherence is technically measured as the sum of an agent's time available to receive a call and his time on calls, divided by the total time he is logged/clocked into the phone system (i.e., not in meetings, or on scheduled breaks).

stant throughout the period. We find minimal evidence of changes in log revenue-per-call in these specifications. Survey evidence, reported in Figure 7, also suggests that workers did not respond to the commission change by decreasing their effort. Specifically, we asked agents how their actual effort changed after the commission reductions took effect. The modal response was that it did not change, and the median and mean responses suggest an increase in effort. This evidence suggests that the change in commissions we observed is mostly due to the compensation structure change and not to changes in post-treatment effort.

While we find no meaningful evidence that effort decreased due to the commission change, we do find some evidence for changes in worker composition. Specifically, the OLS estimates in Column (1) of Panel A (Table 3) report a larger decrease in commissions per call than estimates with individual fixed effects, Column (4), and the estimates using a balanced panel, Column (5). In the following section, we investigate the effect of the commission changes on turnover, and consider whether the changes affected highly skilled workers more or less than low skilled workers. We then return to heterogeneous effort responses as suggested by the comparison of OLS and fixed effects results for log commissions.

5.3 Heterogeneous Effects by Pre-Treatment Productivity

To identify heterogeneity in skill, we use the standardized z-score of adjusted worker fixed effects in the pre-treatment period to capture differences in worker productivity.[32] We interact our continuous z-score estimates with the main effect Treated×Post, and then we estimate the heterogeneous effects of the commission cuts on turnover and effort.

[32]Recall, from the discussion in Section 3.2 that this measure is estimated by regressing the log of commissions on a spline in tenure, division-by-week fixed effects, and employee fixed effects for the period before the changes occurred. We combine the residuals from this regression with the employee fixed effects, use a shrinkage procedure, and take the z-score.

5.3.1 Turnover

Here we consider the effect the commission cuts had on the propensity of sales agents to leave the firm. Perhaps the most cited reason for wage rigidity is that cuts in wages will lead to increased turnover, and the best employees will be the ones that leave (Campbell III and Kamlani, 1997).

To examine turnover, we use a linear probability model, detailed in Section 5.1.2. We do not find evidence of an overall increase in turnover likelihood for agents with average ability, as the results in the first row of Table 4 show a statistically insignificant, and economically small decline in turnover propensity. The estimates in the second row, however, provide evidence that the commission cuts differentially affected the turnover propensity of high- versus low-productivity workers. We analyze this by interacting the productivity-based z-score with indicators for being in a treated division and the post-period. The point estimates indicate that treated agents with pre-period performance one standard deviation above the mean had turnover rates that increased by 1.4% more in a given week than treated agents with average performance. These estimates are precisely estimated, and the results are robust to the different specifications and to the inclusion of a placebo test, Columns (2)–(4).[33] This turnover increase is relative to an overall sample mean of about 0.036, indicating a substantial increase compared to baseline rates.

The observed heterogeneous effect is concentrated within Treated Division 1. Columns (5) and (6) include all control agents but restrict the sample of treated agents to those in Division 1 and Division 2, respectively. It is only in Division 1 that highly skilled agents are more likely to turnover than are lesser skilled agents. Even though the reduction in commission was actually greater in Treated Division 2, we suspect their lack of turnover may be due to the fact that agents in Division 2 sell different items to a unique subset of

[33]The placebo test treats observations after the first week of November, 2015 as the placebo "post-period" for Treated Division 1 and after the last week of February, 2016 as the "post-period" for Treated Division 2. This provides an additional control for seasonality by investigating whether behavior in the post-treatment weeks in the past year drives the results. If turnover spikes occurred, on average at these times in the absence of commission changes, we would find a heterogeneous effect in the placebo test.

clients; their commissions are significantly higher, on average, than those of Treated Division 1 even after treatment. The potential commissions of agents in Division 2 would be difficult to replicate in another firm, suggesting that these agents may have fewer attractive outside options than do agents in Division 1.[34]

These results are robust to the specification of the tenure spline when estimating the worker productivity z-score. Table A.2 in the appendix provides results when the z-score is calculated without including the tenure profile in the first-step productivity regression.

The turnover likelihood for treated, low-to-average productivity workers did not appear to increase; i.e., there was no mass exodus from the firm in response to the wage changes for those workers at the bottom of the productivity distribution. Treated highly productive agents, however, increased their turnover rates relative to treated, average-skill workers, suggesting adverse selection and wider outside opportunities for highly skilled agents.

To quantify the adverse selection cost, we compute how revenue-per-call changes as a function of the workforce composition shifts in underlying ability. The empirical relationship suggests that a one standard deviation change in the productivity z-score increases expected revenue-per-call by about 20%. Using historical data predating the commission reduction, we calculate average revenue-per-call as a function of the productivity z-score at the midpoint of 20 different bins. We then take the sum of the change in turnover probability multiplied by average revenue-per-call across each bin to arrive at the total impact on productivity. We concentrate on effects at a horizon five months after the cuts, as turnover and hiring both increase as the summer approaches. Through the turnover channel, the cut reduced average revenue-per-call by about 5.8% at the end of this five month period. Balancing this cut is a reduction in compensation expense. Commissions declined from over 9% of total revenue to about 5-6% of revenue, meaning the total effect on firm profit was small over the 5 month horizon. At horizons longer than about five months, because turnover accumulates, the adverse selection channel would overtake the cost savings from the commission reductions.

[34]Standard models suggest that top performers would turnover more in the division that is paid less, because the relative outside option is more appealing for agents that earn smaller commissions.

However, because churn at the firm—both new hiring and attrition—spikes prior to the busy summer sales season, this relatively short planning horizon may have limited the long-term consequences to the firm.

The turnover channel, and especially differential turnover of highly skilled workers, appears to be a primary reason for rigid compensation arrangements. In the following section, we consider whether highly productive agents reduced their sales effort and availability relative to average productivity agents.

5.3.2 Heterogeneous Effort Responses

While the results in Table 5.2 suggest that treated agents, in aggregate, did not change their sales effort and adherence, there may have been a heterogeneous effect across productivity levels. Highly productive agents, for instance, may have responded to the reduced marginal incentives by adjusting their adherence downward—e.g., reduce the fraction of time at the office when they are staffing calls—as such a response could result in fewer frictions than quitting and fewer income effects than reducing sales effort. Table 6 does not find any evidence of a heterogeneous effect on adherence across the distribution of agent productivity. This result is robust to restricting the sample to a balanced panel and to using propensity score-weighted regressions.

Next we consider whether highly productive agents responded to the wage cuts by differentially adjusting their sales effort relative to less productive agents. Upon taking an inbound call from a customer, an agent is free to choose how much effort to expend in an attempt to generate sales revenue. Low effort is manifest in a poor conversion rate—the fraction of calls that result in a sale—and in low revenues per call. To investigate the effect of wage cuts on sales effort we use three different measures of sales effort: conversion rate; log revenue-per-call (RPC) using old revenue-per-product prices; and log revenue-per-call using new revenue-per-product amounts. Table 6 reports that highly productive agents *decrease* their sales effort relative to less productive agents. This finding holds across all three

measures of sales effort and is reasonably precisely estimated, as it generally holds when restricting to a balanced panel or when using weighted regressions.

Thus far we have identified significant decreases in commissions for agents in the treated divisions as the result of the compensation changes. We have also documented evidence of heterogeneous responses across the distribution of agent productivity levels. Specifically, highly productive agents are more likely to increase their turnover rates and reduce their sales effort relative to less productive agents. In the next section, we explore other differential effects by considering three different dimensions of agent heterogeneity: (1) an agent's propensity to refer friends to work at the firm, (2) an agent's perception of their likelihood to be promoted in the future, and (3) an agent's perceptions regarding the fairness of the firm.

5.4 Do Fairness, Firm Sentiment, or Promotion Expectations Affect Agent's Quit and Effort Responses?

We investigate whether agents respond differently to the commission changes based on their feelings of reciprocity towards (Akerlof and Yellen, 1988; Kahn, 1990) and engagement with the firm (Gruman and Saks, 2011). To this end, agents were surveyed prior to the first commission reduction about their willingness to give referrals, about their future promotion prospects, and about their perceptions of firm fairness. The exact wording of these questions is provided in Section 3.2. We use these survey responses to test for differential treatment effects across agents' feelings of reciprocation and engagement. Such heterogeneity could exist because increased feelings of reciprocation and engagement may help agents overcome the compensatory set-back of the commission changes. On the other hand, those agents with positive pre-treatment responses have the greatest capacity to revise perceptions downward, and consequently, decrease effort.

It is important to note that in Treated Division 1, it was agents with the most favorable pre-treatment views of the firm (and their prospects in it) that had the largest negative

changes in sentiment measures after the commission reductions went into effect. We first investigate whether there is heterogeneity in the likelihood of turnover based on differences in responses to these survey questions. Accordingly, we separately interact the treatment indicator with indicators for high referral likelihood, belief that promotion is likely, and that the worker's reported firm fairness score is above the median score of 85. Table 7 supports our earlier finding that highly productive workers are more likely to increase turnover rates after the commission changes relative to average workers.[35] We do not, however, find any significant heterogeneity in treatment effect across responses to the three survey questions. In the full sample, Columns (1)–(4), the point estimates on the differential turnover for referral, promotion, and fairness are close to zero and not statistically significant. Similarly, when restricting the sample of treated agents to those in Division 1 or Division 2 (reported in Columns (5) and (6), respectively), the estimates remain statistically insignificant. Taken together, these results fail to find a differential turnover propensity across various proxies for reciprocation and engagement.

A similar analysis to the one above is performed to investigate heterogeneous treatment effects on sales and adherence based on the pre-treatment survey responses. The results of this analysis are reported in Table 8, and they support our earlier finding that highly productive workers reduce their sales effort after the commission changes relative to average workers. We do not, however, find any evidence of statistically significant heterogeneity in treatment effect on adherence—i.e., availability—or sales effort across the distribution of reciprocation and engagement.

6 Conclusion

Our work helps to micro-found wage rigidity, which is a critical constraint in many aggregate models in finance and macroeconomics (Belo et al., 2014). Survey- and laboratory-based

[35]This is evident by the positive and statistically significant coefficients on the triple interaction term in Columns (1)–(4).

studies provide disparate predictions about how workers respond to reduced compensation, though—to the best of our knowledge—ours is one of the first quasi-experiments to report on the real-world implications of compensation reductions within an actual firm. Broadly speaking, the extant research predicts that the agents will react by adjusting their effort or by leaving the firm altogether. Observing the agents' reactions to the compensation change provides a direct line of sight into the constraints facing managers as they respond to shocks, providing context for how these constraints might vary with different financial or compensation contracts (Aldatmaz et al., 2014; Kim and Ouimet, 2014; Oyer, 2004; Oyer and Schaefer, 2005). We find support for theories emphasizing adverse selection in turnover, showing that the most productive sales agents differentially increased their propensity to leave the firm after the compensation reduction relative to less capable agents. Although we find limited reductions in overall effort for the employees who remain in the firm, we do find some reductions among the most highly able workers.

A series of surveys intended to capture beliefs about firm fairness, promotion prospects, and sentiment were used to assess whether worker sentiment influences their effort supply or turnover decisions. These surveys, including a proxy for expectations of firm fairness, indicated substantial variation in beliefs across agents. Even though the survey provided disparate views of the firm, workers who expected the firm to provide fair treatment or a future promotion have similar effort and turnover responses in the face of commission cuts as agents with more dismal expectations.

The increase in turnover is consistent with a subset of results on worker turnover in Krueger and Friebel (2015), who study a reduction in performance pay among a personnel search firm. The effort response is also consistent with Gao et al. (2012). We hypothesize that the muted effort changes may be due to income effects because of the strong performance incentives in our setting.

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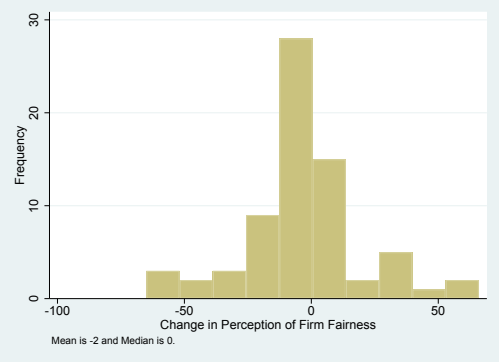
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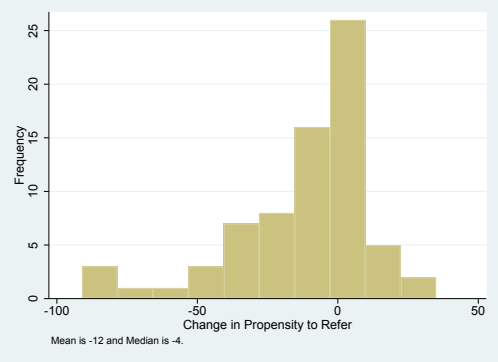
Tables and Figures

Figure 1: Change in Reported Perceptions of The Firm for Treated Division 1

(a) Change in Reported Perceptions of Firm Fairness

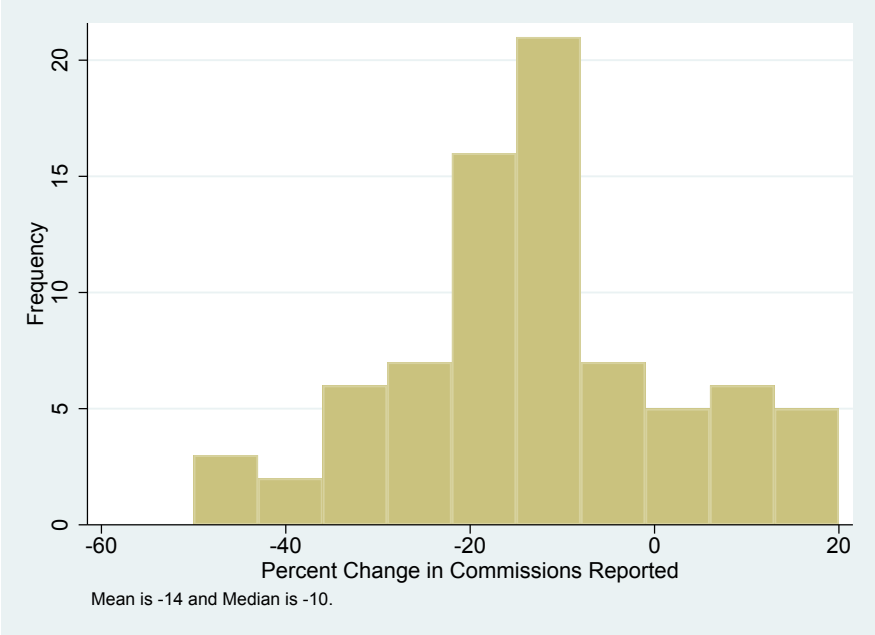


(b) Change in Reported Propensity to Refer Friends to the Firm



Note: Median fairness score is 85. Measured change is similar when asking about team members' perceptions of firm fairness. Median propensity to refer friends to the firm is 93.

Figure 2: Reported Change in Commissions for Treated Division 1



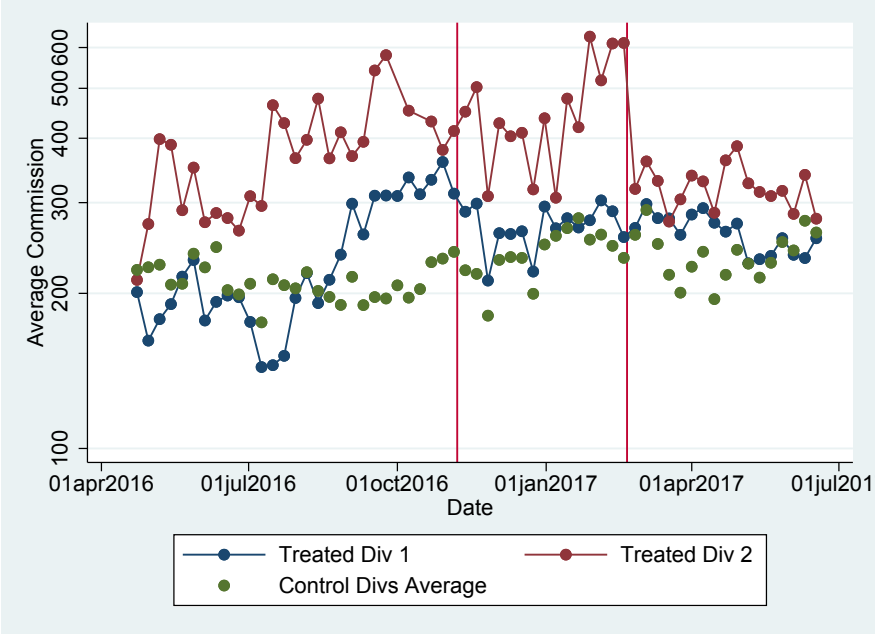
Histogram displays survey responses to a question asking how actual commissions changed after the commission reduction went into effect relative to the pre-period. Sample is Treated Division 1.

Figure 3: Reported Change in Effort Needed to Maintain Prior Earnings, Treated Division 1



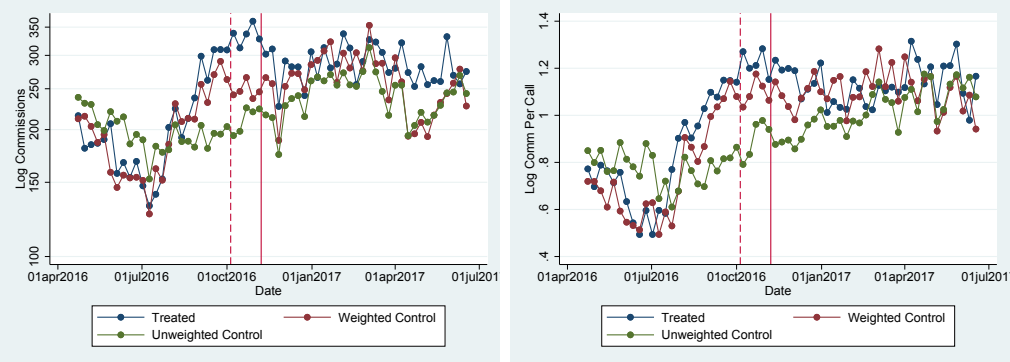
Histogram displays survey responses to a question asking how much effort would need to change to maintain the pre-period commission level after the commission reduction went into effect. Sample is Treated Division 1.

Figure 4: Average Commissions in Treated and Control Divisions



Average commission per worker for workers with 30+ days of tenure. Vertical axis uses logarithmic scale. First vertical line corresponds to the Treated 1 event date. Second vertical line corresponds to Treated 2 event date.

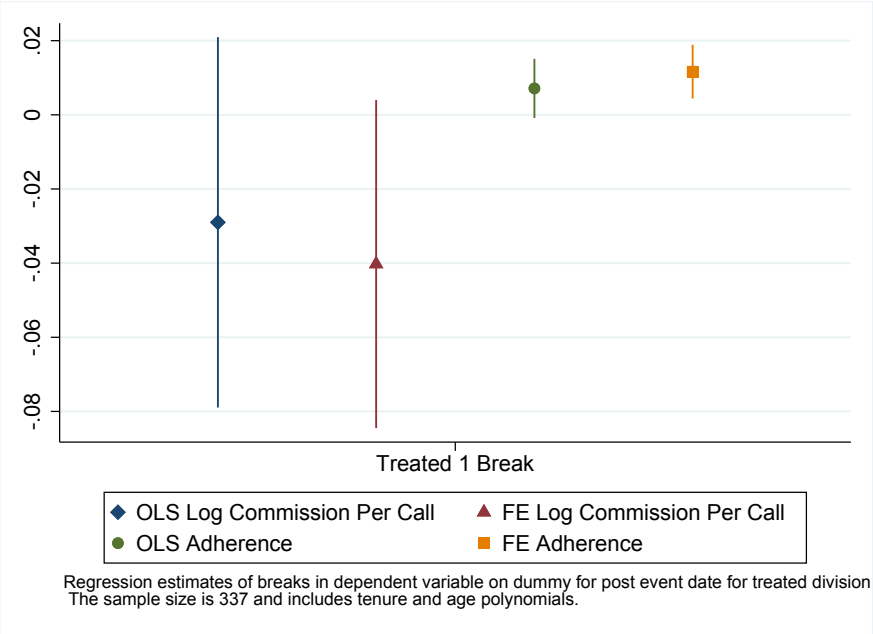
Figure 5: Re-weighted Commissions and Log Commissions Per Call for Treated Division 1



(a) Commissions Per Week, log Scale (b) Log Commissions per Call

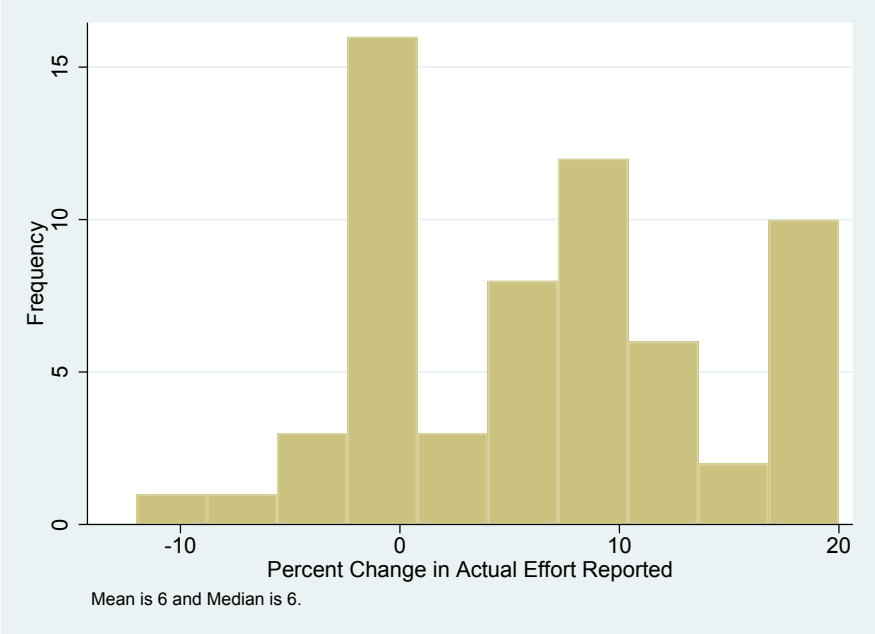
Unweighted and propensity score re-weighted comparison of controls and Treated Division 1. The dashed line represents the end of the period used for estimating the propensity score weights. Differences in the per-call and overall commissions between October 2016 and November 2016 are due to an increase in call volume. Overall commission levels are displayed on a log scale. The weights are formed as $W = \frac{P}{1-P}$ where P is the treatment probability estimated from a logistic regression on pre-period data. Each worker present in the pre-treatment period for Treated Division 1 and the control divisions enters the sample once, and the model is an indicator for treated division 1 on tenure, age, an indicator for being male, the baseline rate of commissions in the first month of the sample, and month-to-month changes in log commissions and the log number of calls.

Figure 6: Parameter Estimates and Confidence Intervals for Structural Break Tests in the Control Divisions



Structural break tests come from regressions using the control sample. The figure reports the post-treatment indicator parameter estimate and confidence interval. The dependent variable is in the legend, and each regression includes a post-treatment indicator for Treated Division 1, the matrix of agent characteristics X_{it}, division fixed effects, and trends for each division. Specifications with "FE" add worker fixed effects.

Figure 7: Reported Change in Actual Effort, Treated Division 1



Histogram displays survey responses to a question asking how much effort actually changed in response to the change in commission policy. Sample is Treated Division 1.

Table 1: Summary Statistics By Treated And Control Divisions Over the Main Sample Period

	Treated 1	Treated 2	Controls
	(1)	(2)	(3)
	mean/sd	mean/sd	mean/sd
Commission	225.61	366.38	199.64
	(224.17)	(277.63)	(188.51)
Adherence to Schedule	0.81	0.79	0.80
	(0.13)	(0.14)	(0.12)
Tenure (days)	308.66	622.71	377.39
	(379.47)	(560.58)	(464.23)
Age	25.42	28.85	26.04
	(7.06)	(7.95)	(7.28)
Single	0.61	0.46	0.52
	(0.49)	(0.50)	(0.50)
White	0.67	0.63	0.68
	(0.47)	(0.48)	(0.47)
Male	0.71	0.69	0.70
	(0.45)	(0.46)	(0.46)
Survey Response to Firm Fairness is 85+	0.48	0.28	0.43
	(0.50)	(0.45)	(0.49)
Believes Promotion is Likely	0.71	0.52	0.71
	(0.45)	(0.50)	(0.45)
Likelihood to Refer Friend	0.61	0.64	0.60
	(0.49)	(0.48)	(0.49)
Survey Questions Missing	0.43	0.37	0.45
	(0.50)	(0.48)	(0.50)
Observations	7920	2776	29248

The main sample period is from April, 2016 to June, 2017. Summary statistics are for agent-week observations pooled over the treatment and pre-treatment periods. The Commission measure is average weekly commissions. Adherence to schedule is a measure of availability, capturing the ability to take calls. See section 3.2 for details about survey questions.

Table 2: Summary Statistics for Treated Division 1 Over the Month Prior to Treatment, Split by Shrunk Residual Commission Terciles

	Bottom Third	Middle Third	Top Third
	Shrunk Commission Fixed Effects		
	(1)	(2)	(3)
	mean/sd	mean/sd	mean/sd
Commission	179.29	332.04	481.43
	(173.27)	(222.93)	(359.96)
Adherence to Schedule	0.81	0.84	0.84
	(0.15)	(0.11)	(0.08)
Total Calls	68.18	71.40	73.57
	(26.90)	(24.18)	(24.92)
Tenure (days)	170.16	219.29	736.19
	(99.38)	(114.19)	(475.79)
Predicted Pct Δ Commission Post-Treatment	-0.18	-0.18	-0.18
	(0.03)	(0.03)	(0.03)
Age	23.60	23.60	28.27
	(4.94)	(3.77)	(8.62)
Single	0.80	0.72	0.56
	(0.40)	(0.45)	(0.50)
White	0.70	0.73	0.73
	(0.46)	(0.44)	(0.45)
Male	0.68	0.82	0.72
	(0.47)	(0.38)	(0.45)
Survey Response to Firm Fairness is 85+	0.54	0.50	0.36
	(0.50)	(0.50)	(0.48)
Likelihood to Refer Friend	0.64	0.64	0.50
	(0.48)	(0.48)	(0.50)
Believes Promotion is Likely	0.62	0.82	0.58
	(0.49)	(0.38)	(0.50)
Survey Questions Missing	0.41	0.17	0.09
	(0.49)	(0.38)	(0.29)
Observations	179	169	179

Cross-sectional summary statistics for Treated Division 1. For Treated Division 2, see Table A.1 in the Appendix. Each column represents an approximate tercile of the distribution of productivity in the pre-treatment division. Individual productivity is calculated from a regression of log commissions on worker fixed effects, division-by-week fixed effects, and a cubic spline in tenure. We then take the residuals plus the estimated individual fixed effects from this regression, fit the restricted maximum likelihood random effects estimator, and recover each worker's expected best linear unbiased predictor. The procedure follows Lazear et al. (2015) and is similar to an empirical Bayes estimate of permanent productivity. The predicted percentage change in commission post-treatment is calculated based on the pre-treatment sales mix for each agent. The predicted percentage change in commissions is not available for Treated Division 2. The average actual change in commissions for Treated Division 2 was 30%.

Table 3: Difference in Differences Estimates for Per Call Changes in Commissions and Log Revenue

	OLS	OLS w Pre Avg.	OLS Re-Weighting	FE	Balanced	FE Re-Weighting
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Treatment Effect Estimates For Log Commissions Per Call						
Treated x Post	-0.300***	-0.252***	-0.172*	-0.263***	-0.250***	-0.152*
	(0.057)	(0.049)	(0.067)	(0.048)	(0.055)	(0.060)
Observations	35071	29518	13234	35071	14955	13234
Panel B: Adherence, or Availability to Answer Calls						
Treated x Post	-0.017*	-0.013	0.002	-0.009	-0.007	-0.002
	(0.009)	(0.008)	(0.010)	(0.007)	(0.009)	(0.010)
Observations	32540	27206	12477	32540	14218	12477
Panel C: Log Revenue Per Call at Old Prices						
Treated x Post	-0.037	-0.044	0.003	-0.054	-0.071*	0.010
	(0.036)	(0.031)	(0.037)	(0.030)	(0.031)	(0.035)
Observations	35366	29801	13247	35366	15071	13247
Panel D: Log Revenue Per Call at New Prices						
Treated x Post	0.014	0.016	0.005	0.007	-0.008	0.016
	(0.036)	(0.031)	(0.036)	(0.030)	(0.032)	(0.033)
Observations	35366	29801	13247	35366	15071	13247

Notes: Sample includes Treated Division 1 and control divisions. Errors are clustered by employee. All models have fixed effects for time, division, office location, ethnicity, gender, and marital status. To account for experience effects, all models include cubic splines for tenure with the firm and a cubic polynomials in age. Division time-trends and seasonal controls are included in all panels. Seasonal Controls include leads-and-lags of average division-level commissions 1 year prior to the week in question. The specification in column 2 includes the average of the dependent variable in the pre-treatment period. Specifications in columns 3 and 6 use a re-weighting estimator based on the treatment propensity score. The propensity score estimation period ends 1 month prior to treatment. The estimation sample includes the data from 1 month prior to treatment until the end of the sample, meaning that the data used for matching are not included in the model. For notes on estimating the propensity score, see Figures 5a and 5b. The balanced sample conditions on workers who are present prior to July of 2016 and after April of 2017.

Table 4: Linear Probability Model Estimates of Turnover

	Time FE	Time FE	Time and Div x Week-of-Year FE	Div x Time FE	Div x Time FE Only Treated 1	Div x Time FE Only Treated 2
	(1)	(2)	(3)	(4)	(5)	(6)
Treated x Post	-0.006	-0.007	-0.008			
	(0.004)	(0.004)	(0.007)			
Treated x Post x Z Score	0.014***	0.014***	0.014***	0.011**	0.025***	-0.006
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.006)
Treated x Placebo		0.005				
		(0.006)				
Treated x Placebo x Z Score		0.000	0.001	0.002	-0.008*	0.008**
		(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Mean DV	0.036	0.036	0.036	0.036	0.037	0.036
Observations	54286	54286	54286	54286	51497	45328

Notes: Models include Treated Divisions 1 and 2 and control divisions, with additional data pre-dating the sales sample period as detailed in the text. Errors are clustered by employee. The results come from a linear probability turnover model that includes a 5th order polynomial for time at risk. Specifications in column 3 have division by week-of-year fixed effects to account for seasonality. Placebo means an indicator for the date 52 weeks prior to the treatment date for that division. The Z-Score is a transformation of the individual productivity measures calculated from the pre-treatment period. This measure comes from a regression of log commissions on worker fixed effects, division-by-week fixed effects, and a cubic spline in tenure. We then take the residuals plus the estimated individual fixed effects from this regression, fit the restricted maximum likelihood random effects estimator, and recover each worker's expected best linear unbiased predictor. The procedure follows Lazear et al. (2015) and is similar to an empirical Bayes estimate of permanent productivity.

Table 5: Within-Worker Difference-in-Differences Estimates of Adherence Changes

		Balanced	Re-Weighted		Balanced	Re-Weighted
	(1)	(2)	(3)	(4)	(5)	(6)
Treated x Post	-0.002	-0.005	0.001			
	(0.008)	(0.009)	(0.011)			
Treated x Post x Z Score	-0.006	-0.001	-0.010	-0.005	-0.001	-0.011
	(0.006)	(0.009)	(0.008)	(0.006)	(0.009)	(0.008)
Mean DV	0.803	0.820	0.822	0.803	0.820	0.822
Observations	32540	14218	12477	32540	14218	12477
Time x Div FE				X	X	X

Notes: Sample includes Treated Division 1 and control divisions. Errors are clustered by employee. All models include worker fixed effects and fixed effects for time, division and office location. To account for experience effects, all models include cubic splines for tenure with the firm and a cubic polynomials in age. Division time-trends and seasonal controls are included in Columns 1-3. Specifications in Columns 3 and 6 use a re-weighting estimator based on the treatment propensity score (see notes for Figures 5a and 5b). The balanced sample in Columns 2 and 5 conditions on workers who are present prior to July of 2016 and after April of 2017. Estimates in Columns 4-6 include division-by-time fixed effects, so only heterogeneous effects are identified.

Table 6: Within-Worker Difference-in-Differences Estimates of Various Per-Call Measures of Sales Productivity.

		Balanced	Re-Weighted		Balanced	Re-Weighted
	(1)	(2)	(3)	(4)	(5)	(60)
Panel A: Conversion Rate						
Treated x Post	-0.008	-0.010	-0.003			
	(0.006)	(0.007)	(0.007)			
Treated x Post x Z Score	-0.017***	-0.011**	-0.015**	-0.017***	-0.009*	-0.016**
	(0.005)	(0.004)	(0.005)	(0.005)	(0.004)	(0.005)
Mean DV	0.265	0.282	0.305	0.265	0.282	0.305
Observations	33044	13981	12223	33044	13981	12223
Panel B: Log Pseudo-Revenue Per Call at Old Prices						
Treated x Post	-0.063*	-0.069*	0.040			
	(0.029)	(0.031)	(0.032)			
Treated x Post x Z Score	-0.069**	-0.048	-0.082***	-0.054*	-0.028	-0.083***
	(0.024)	(0.029)	(0.023)	(0.023)	(0.026)	(0.023)
Observations	35366	15071	13247	35366	15071	13247
Panel C: Log Pseudo-Revenue Per Call at New Prices						
Treated x Post	-0.010	-0.019	0.040			
	(0.029)	(0.031)	(0.032)			
Treated x Post x Z Score	-0.073**	-0.058*	-0.079***	-0.057*	-0.037	-0.080***
	(0.023)	(0.029)	(0.023)	(0.023)	(0.027)	(0.023)
Observations	35366	15071	13247	35366	15071	13247
Time x Div FE				X	X	X

Notes: This specification mirrors the previous table. See those notes for details about the specification.

Table 7: Linear probability turnover models with interactions for fairness, sentiment, and promotion expectations

	Time FE	Time FE	Time and Div x Week-of-Year FE	Div x Time FE	Time FE, Only Treated 1	Time FE, Only Treated 2
	(1)	(2)	(3)	(4)	(5)	(6)
Treated x Post	-0.006	-0.007	-0.007			
	(0.009)	(0.009)	(0.010)			
Treated x Post x Z Score	0.015***	0.012**	0.012**	0.009*	0.016**	-0.012
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.006)
Referral Likelihood	-0.003	-0.003	-0.003	-0.002	-0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Treated x Post x High Refer	0.005	0.005	0.004	0.003	0.004	0.006
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.016)
Promotion Likely	-0.006**	-0.007**	-0.007**	-0.007**	-0.007**	-0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Treated x Post x Promotion	-0.009	-0.009	-0.008	-0.008	-0.011	-0.003
	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.016)
Believes Firm is Fair	-0.005*	-0.004*	-0.004*	-0.005*	-0.004	-0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Treated x Post x Firm Fair	0.006	0.007	0.007	0.007	0.007	-0.002
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.023)
Mean DV	0.036	0.036	0.036	0.036	0.037	0.036
Observations	54286	54286	54286	54286	51497	45328

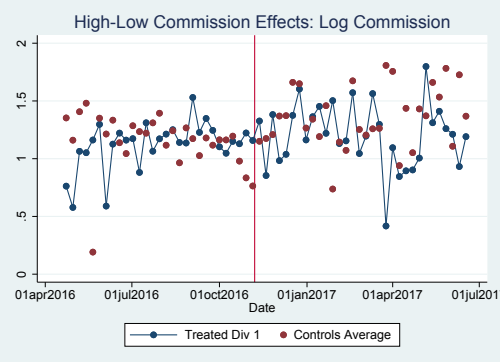
Notes: See notes for specification in Table 4.

Table 8: Heterogeneous effort based on firm fairness assessments, sentiment, and expectations of future promotion.

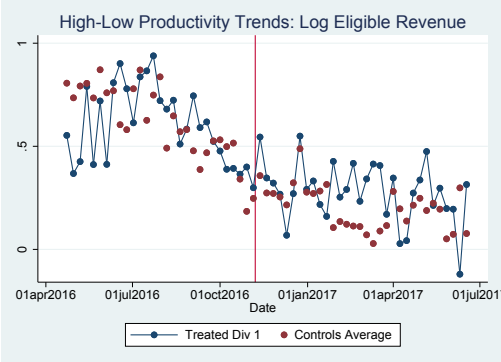
	Adherence	Conversion	Log Pseudo Rev Per Call Old Prices	Log Pseudo Rev Per Call New Prices
	(1)	(2)	(3)	(4)
Treated x Post x Z Score	-0.006	-0.018***	-0.058*	-0.059*
	(0.006)	(0.005)	(0.025)	(0.024)
Treated x Post x High Refer	0.013	0.001	0.008	0.026
	(0.010)	(0.010)	(0.048)	(0.045)
Treated x Post x Promotion	-0.015	-0.011	-0.071	-0.083
	(0.010)	(0.011)	(0.052)	(0.051)
Treated x Post x Firm Fair	-0.009	0.005	0.048	0.053
	(0.010)	(0.010)	(0.046)	(0.044)
Observations	32540	33044	35366	35366

Notes: See notes for specification in Table 6. These estimates have worker fixed effects and division-by-week fixed effects.

Figure A.1: Triple-Differences Variation in Trends by Worker Type: Ability Heterogeneity

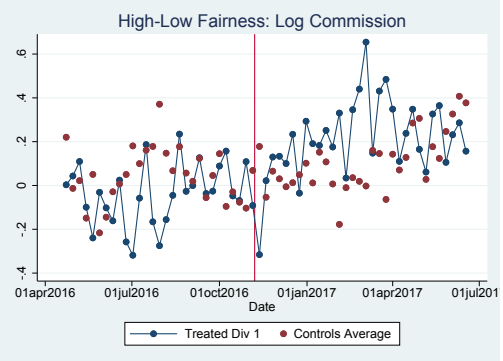


(a) Log Commissions by Median Ability

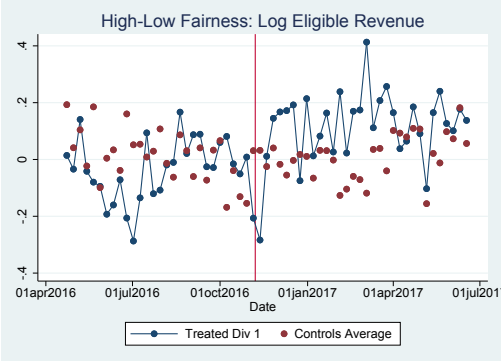


(b) Log Revenue by Median Ability

Figure A.2: Triple-Differences Tests of Parallel Trends: Fairness Heterogeneity



(a) Log Commissions by High Fairness



(b) Log Revenue by High Fairness

Table A.1: Summary Statistics for Treated Division 2 Over the Month Prior to Treatment, Split by Shrunk Residual Commission Terciles

	Bottom Third	Middle Third	Top Third
	Shrunk Commission Fixed Effects		
	(1)	(2)	(3)
	mean/sd	mean/sd	mean/sd
Commission	350.61	508.85	759.16
	(239.36)	(295.93)	(323.45)
Adherence to Schedule	0.76	0.78	0.81
	(0.21)	(0.15)	(0.12)
Total Calls	55.69	45.53	49.80
	(21.50)	(15.74)	(12.57)
Tenure (days)	393.84	693.33	1329.82
	(239.60)	(371.90)	(470.82)
Age	28.41	31.59	31.91
	(8.60)	(8.76)	(9.70)
Single	0.78	0.47	0.36
	(0.42)	(0.50)	(0.48)
White	0.92	0.27	0.68
	(0.27)	(0.45)	(0.47)
Male	0.69	0.82	0.56
	(0.47)	(0.39)	(0.50)
Survey Response to Firm Fairness is 85+	0.30	0.39	0.18
	(0.46)	(0.49)	(0.39)
Likelihood to Refer Friend	0.67	0.59	0.58
	(0.48)	(0.50)	(0.50)
Believes Promotion is Likely	0.70	0.54	0.50
	(0.46)	(0.50)	(0.51)
Survey Questions Missing	0.22	0.09	0.12
	(0.42)	(0.29)	(0.33)
Observations	51	45	50

Cross-sectional summary statistics for Treated Division 2. Note that the predicted percentage change in commissions is not available for agents in Treated Division 2. The actual change in average commissions after treatment was 30%.

Table A.2: Linear Probability Model Estimates of Turnover with alternative Z-Score Estimate

	Time FE	Time FE	Time and Div x Week-of-Year FE	Div x Time FE	Div x Time FE Only Treated 1	Div x Time FE Only Treated 2
	(1)	(2)	(3)	(4)	(5)	(6)
	b/se	b/se	b/se	b/se	b/se	b/se
Treated x Post	-0.010*	-0.010*	-0.011			
	(0.004)	(0.004)	(0.007)			
Treated x Post x Pre-Nov. Z Score	0.010*	0.010*	0.011**	0.009*	0.016**	-0.013*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Treated x Placebo		0.005				
		(0.006)				
Treated x Placebo x Pre-Nov. Z Score		0.000	0.000	0.002	-0.002	0.015***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Mean DV	0.036	0.036	0.036	0.036	0.037	0.036
Observations	54286	54286	54286	54286	51497	45328

Notes: This table replicates Table 4 in the text but uses an alternative estimate of the Z-score of agent productivity. This alternative estimate omits the tenure spline from the estimate of the Z-score, which takes an average of productivity without removing gains from experience.