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ABSTRACT

Firms rarely cut compensation, so little is known about the after-effects when compensation reductions do occur. We use commission reductions at a sales firm to estimate how work effort and turnover change. In response to an 18% decline in sales commissions, corresponding to a 7% decline in median take-home pay, we find turnover increases for the most productive workers. We detect limited effort responses. Turnover and effort responses do not differ based on workers' survey replies regarding expectations of firm fairness or future promotion. The findings indicate that adverse selection concerns on the extensive margin of retaining workers drive the empirical regularity that firms rarely reduce compensation.

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1 Introduction

Firms rarely cut compensation (Gibbons, 1996; Kahn, 1997; Card and Hyslop, 1997; Holden and Wulfsberg, 2009).[1] Accordingly, layoffs are more common than pay reductions during economic downturns (Kaur, 2014; Altonji and Devereux, 2000; Fehr and Goette, 2005), generating a substantial literature attempting to explain wage rigidity (Bewley, 1998). The reason why most compensation contracts appear so rigid remains unclear, in part, because there is little evidence on the consequences of compensation cuts when they do occur. This paper begins to fill this void by analyzing the aftermath of a compensation reduction in a large sales firm. Our analysis and the variation we consider provide a unique view of the link between compensation schemes, worker performance, and turnover.

The literature has advanced two primary reasons for compensation rigidity. The first is the concern that pay reductions will cause the best workers to leave. This adverse selection channel is evident in surveys of managers when asked why they do not reduce compensation.[2] However, providing direct empirical support for the adverse selection channel is difficult. While there is substantial work on the overall elasticity of worker turnover with respect to compensation, adverse selection is about compositional changes in the types of workers who depart. Identifying adverse selection requires data on individual worker productivity that pre-dates any change in contracting terms and a comparison group of unaffected workers who face the same external labor market conditions.

The second reason for compensation rigidity is the concern that worker effort will decrease. Effort reductions are predicted by some neoclassical models and are starker under behavioral models with reference points. Many lab and short-term field studies find that

[1] Based on this evidence, financial economists and macroeconomists have increasingly incorporated wage rigidities into aggregate models of the economy; 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 selection channel, but managers also conjectured that effort responses to compensation reductions would be asymmetric. Bewley (1998) interviewed over 300 business leaders in the northeastern United States during the early 1990s recession, finding the greatest support for morale effects, which were predicted to increase turnover, especially among the better workers because "they are more valuable and can find new jobs more easily."

pay cuts lead to larger effort reductions than the effort increases after pay raises (Kube, Maréchal, and Puppe, 2013). However, there is mixed evidence on whether the magnitude of these effects is large enough for effort adjustment to generate compensation rigidity (DellaVigna, List, Malmendier, and Rao, 2016). This merits further investigation, especially in longer-term employment settings.[3]

Our study uses within firm variation to quantify effort and turnover responses. We use commission reductions that affected a subset of agents in an inbound-sales call-center to examine how full-time employees change their work effort and propensity to leave the firm.[4] The sales agents at the firm are compensated through a mix of fixed wages and commissions, the latter resulting from selling different digital services to customers who call the firm (e.g., cable television, home security, and internet connectivity). During the sample period, two of the firm's six sales divisions reduced expected commissions.[5] The first change reduced expected commissions by about 18%, resulting in a total take-home pay reduction for the average affected worker of about 7%.[6] Three months afterward, a second division manager implemented an even larger commission reduction.

This setting allows us to estimate two sources of heterogeneous responses to the commission reductions. First, granular agent-level performance measures that pre-date the changes make the setting ideal for examining how workers with different baseline productivity levels respond to the wage cuts. The firm's two main measures of on-the-job performance, revenue-per-call (RPC) and adherence to schedule ("uptime," when an agent is available to

[3]These studies estimate changes in effort using a short-term work setting where jobs are only expected to last for several days. There is no focus on extensive margin adjustments through turnover. The setting in Mas (2006) is a longer term field study that analyzes police productivity and pay. Mas identifies reference-point effects, but his setting does not feature pay cuts or performance-based contracts that may mitigate an effort reduction.

[4]All the agents in our sample have an employment contract requiring their on-site presence during scheduled hours, and eighty-five percent of the agents work at least 30-hours a week.

[5]In line with the insider econometrics approach (Bartel, Ichniowski, and Shaw, 2004), interviews with the firm's management, before the announcement of the changes, revealed that the division manager in the first division to implement the change believed responses would be muted. Several other managers expected substantial negative effects.

[6]Rewards for some infrequently sold products did increase, but the ability to substitute sales to these products was limited and did not significantly alter the commission change.

take calls), provide detailed data on worker output across time periods. Classification of agents based on their baseline productivity is also relatively straightforward, as the sales process is invariant over time, agents deal with incoming customer calls individually, and sales opportunities are randomly allocated across agents. Control agents with a similar productivity who face the same external labor market conditions did not experience reduced compensation. Second, we estimate how responses differ based on agent sentiment toward the firm. An innovation in the paper is to use surveys conducted prior to the announcement of the compensation changes to measure how responses differ based on worker sentiment toward the firm and expectations of promotion. As a result of this focus on heterogeneity, identification requirements are less stringent than in a traditional difference-in-differences setting.[7]

The main results support the turnover margin and provide support for managerial fears that compensation reductions result in the loss of highly productive workers. Highly productive agents (those with pre-treatment productivity one standard deviation above the mean)[8] had a 48% increase in attrition relative to the baseline turnover rate. Workers at the average of the pre-change productivity distribution had a negligible change in turnover. This heterogeneous turnover response changed the workforce composition. The turnover of highly productive workers led to a total sales reduction of about 4% over the next five months.[9] The attrition of highly productive workers had such a large impact on sales because a worker one standard deviation above the mean account for 20% more revenue-per-call than the average employee. An important qualifier to this result is that the differential turnover effects are all found in Treated Division 1, where agents' ex-post take-home pay closely match (local)

[7]In particular, we examine how different types of agents, facing the exact same compensation changes and sales conditions, respond differently to the reduction in compensation. A number of tests support the validity of this assumption. For other specifications, we address potential violations of parallel trends with a number of strategies, including different weighting to construct comparable groups of agents to the treated group.

[8]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.

[9]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.

market rates. Agents in Treated Division 2 had higher tenure and were among the top sales people in the firm, earning more than managements' estimates of what could be earned elsewhere. Baseline rates of turnover increased somewhat in this division, but we do not detect differential turnover rates by worker skill.

While all turnover is costly, the loss of highly productive salespeople—those with nontrivial firm-specific human capital—lowers the firm's average yield and profits, as less skilled replacement workers answer incoming calls. Our findings have implications for models of labor market competitiveness viewed through the lens of monopsony. In the baseline monopsony model, described in Manning (2003), the elasticity of turnover with respect to compensation identifies a firm's market power and gives rise to employer rents. If using the baseline monopsony model, we would conclude the firm has significant market power and rents because the elasticity of turnover with respect to a change in earnings is relatively small in magnitude. Here, because we are able to identify how the compositional change in turnover influences output, we conclude the firm's labor market power is instead quite limited. Management estimated that the commission changes would reduce compensation expenses as a fraction of sales by about 3 percentage points. Our estimates that compositional changes in the workforce reduced sales revenue by 4.0 percent at a five month horizon and by 2.7 percent at a three month horizon indicate that any potential rents the firm could capture via labor market power would be quickly dissipated by turnover of productive agents. The offsetting loss of the best workers limits the firm's ability to capture rents, but it is difficult to measure this differential turnover in many other settings.

Regarding the worker effort rationale for compensation rigidity, we find quite limited overall effort changes.[10] The limited effort adjustment is not due to agents misunderstanding the commission changes or econometric misspecification of sales trends or demand. In survey responses, agents accurately predicted the magnitude of reduced take-home pay, and the

[10]We do not address all behavioral concerns, including those about relative pay evident in Dube, Giuliano, and Leonard (2018). Dube et al. (2018) rely on a regression discontinuity design around pay thresholds to estimate turnover responses to own wage and co-worker wage adjustment. Our focus is on how response patterns differ by a worker's own ability.

average treated agent reportedly *increased* his/her effort in response to the changes. A potential explanation, consistent with MacLeod (2003), is that retaliatory responses are more likely when performance rewards are subjective; measurement of output is objective in this setting, and the strong remaining incentive pay within the firm may have damped retaliatory responses.

Another potential explanation for the limited effort response 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 or field studies where compensation is weakly tied to output.[11] The margins of employee response to compensation adjustment are likely to depend on the degree to which pay adjusts with performance. Settings like ours are increasingly prevalent, tying compensation more closely to worker driven revenue (Lemieux, MacLeod, and Parent, 2009).[12]

We then consider direct measures of sentiment and how they may drive heterogeneous effort and turnover responses.[13] In particular, we examine different responses based on agents' surveyed beliefs about firm fairness and future career plans. After the commission reductions, agents who initially rated the firm as highly fair subsequently reported the largest drop in perceived firm fairness (Akerlof and Yellen, 1990). There are, however, no heterogeneous effort or attrition responses, based on perceived fairness, propensity to refer friends to the job, or expectations of near-term promotion.[14]

[11] See Stafford (2015) on how permanent versus transitory changes alter effort supply responses. In a study of executive compensation 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. 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), Gao et al. (2012) is one of the only studies of compensation cuts among executives.

[12] See Makridis and Gittleman (2017) for how performance pay and fixed pay jobs differ over the business cycle. Also see Lazear, Shaw, and Stanton (2016) for an analysis of heterogeneous effort responses when there is fixed pay and unemployment risk.

[13] For an overview of the relevant laboratory-based experiments, see Gächter and Fehr (2002).

[14] 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. 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 unlikely to be important for the interpretation of results, as workers in the treated divisions all experienced

Our findings suggest that much of what is driving compensation rigidity and the resulting adjustment frictions is on the turnover and selection margins, in which the most productive workers exit the firm.[15] Compensation reductions result in the loss of firm-specific human capital and may call for cuts targeted at workers who are either less productive or are less likely to leave the firm.[16] The results also contextualize whether firms have market power to change compensation and, if so, how profit margins might change. Despite limited overall turnover increases and effort adjustment, turnover of highly productive workers limits the flexibility to adjust compensation.[17]

The following section describes the firm, the specific setting, and details of the commission change. Section 3 introduces a parsimonious model to ground predictions. We then discuss data, measurement, and the pre-treatment survey. Section 5 details the estimation strategy

the same changes and mostly interact with co-workers in their same division (divisions sit together) (Cohn, Fehr, Herrmann, and Schneider, 2014). That is, workers on the same team face identical changes, but these events are not likely to spillover to other divisions. Later we test for structural breaks in control divisions and do not find evidence of across-division spillovers.

[15]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.

[16]Depending on the reversibility of effort reductions compared to turnover, these forces also have implications for the ability to experiment and learn the relationship between compensation and output due to adjustment costs (Kerr and Nanda, 2015). On the turnover margin, Bae, Kang, and Wang (2011) and Schmalz (2012) argue that the need to retain employees influences the ability to take on debt, while Lustig, Syverson, and Van Nieuwerburgh (2011) and Eisfeldt and Papanikolaou (2013) underscore the importance of organization-specific capital that shares an implicit claim on the firm. Other 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. Turnover and effort concerns also take center stage in the budding literature on compensation contracting practices to retain workers (Aldatmaz, Ouimet, and Van Wesep, 2014; Oyer, 2004; Oyer and Schaefer, 2005; Kim and Ouimet, 2014; Hochberg and Lindsey, 2010; Lustig et al., 2011).

[17]For the aggregate economy, the results provide evidence on the assumptions behind heterogeneous turnover in job search models (Pissarides, 1994; Postel-Vinay and Robin, 2002).

and the results.

2 Firm Organization

The firm is an inbound sales call-center, with nearly 2,000 individual sales representatives over our sample period. Representatives are organized into six divisions based on the products and services they sell. Heads of two divisions reduced agent commissions at different times. For confidentiality reasons, we label these Treated Division 1 and Treated Division 2. These divisions employed 20% and 7% of the firm's sales force, respectively. The change in Treated Division 2 happened three months after the change in Treated Division 1. This section discusses the relevant institutional details.

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 that grant exclusive rights to send mailers, advertise in local media, and purchase geographically based internet search traffic on behalf of the client. Prospective customers engage with the firm when they respond to the marketing promotions by calling an 800-number, corresponding to the product or service in which they are interested. The six sales divisions have agents spread across three geographically distinct call-centers. Each division has its own executive (division manager), with sole discretion to set their salespeople's incentives. Beneath the division manager are multiple teams of roughly 15 sales agents who are supervised by a sales manager. Teams sit together such that each agent is within view of his or her sales manager, though teams in the same division may be located in different establishments.

Inbound calls are routed to divisions based on the products advertised (e.g., satellite television), and the calls are allocated to agents based on 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. 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.

Once an inbound call arrives, it is randomly allocated to idle agents.[18] 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., a service contract covering internet, telephone, and television).

Sales agents spend about 80% of their workday either on calls or waiting for another call to arrive. On average, about 50% of agents' total time at work is spent actively engaged with customers, and time spent on active calls rarely exceeds 75% of the agents total time at work. As a result, agents have down time when waiting for new calls to arrive and have little scope to change the number of calls they receive.

2.2 Agent Compensation and Commission Changes

Agents earn commissions paid on "eligible product revenues." Eligible product revenues are internally imposed transfer prices that, in principal, correspond to the revenues the firm collects from clients whenever the corresponding product or service is sold. These eligible revenues are salient, and managers encourage agents to sell higher-margin items in weekly sales meetings.

These commissions are a significant part of an agent's total compensation package, which consists of a minimal hourly wage for the time at work (on a call, idle at the phone, or

[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).

in meetings with managers),[19] bonuses from temporary promotions imposed either by the firm or the client, and commissions. Commission rates are calculated weekly, and 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 metric employed (and the most salient sales metric inside the firm) is average revenue-per-call. The commission rate also depends on average revenue-per-hour, both of which depend on the eligible revenue mapping 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 other agents' performance metrics. 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.[20]

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 and their ability to master the sales protocol. Accordingly, more seasoned sales agents generate more hourly and per-call revenue than recently hired agents (see Table 1).

The firm occasionally modestly rebalances eligible product revenues to prioritize the sale of new or promotional services over others, but prior to the changes considered in this paper, managers and agents never perceived these rebalancings as pay reductions. Previous

[19]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.

[20]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.

rebalancings involved additional bonuses, as opposed to price cuts.

We learned of the impending compensation change several weeks ahead of its announcement, which—unlike earlier price rebalancings—was expected to have (nontrivial) negative repercussions for all agents in the treated division. Leaders in functional roles within the firm expressed concern that the changes would be met with an exodus of disgruntled agents.[21]

Despite the reluctance of some executives, the commission change was enacted for Treated Division 1 in November of 2016. The division manager believed the internal transfer price between sales and "eligible revenue" was broken. This executive believed the pre-treatment eligible revenue schedule provided suboptimal incentives, encouraging 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. The division manager also believed that the addition of new territory gave him latitude to enact changes. Specifically, in the summer of 2016, a new territory was added which increased call volumes and average commissions per call, causing the division manager to move forward with the the commission schedule adjustment.[22] The change 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 agents. The manager of the division 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

[21]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 earn $15 an hour when first hired and receive $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 earn between $10 and $14 per hour. While the average agent at the study firm enjoys marginally higher earnings than agents at adjacent firms, competitive outside options abound.

[22]In the empirical analysis, we provide more detail about different trends across divisions and how these different trends may influence the interpretation of results.

estimate the ex-ante effect of the rebalancing in Treated Division 2 on overall sales. That is, we could not 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 about 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 a meeting one week before the changes took effect. This was the case for both divisions, albeit the meetings and subsequent changes occurred at different times. For Treated Division 1, the division executive (1) highlighted recent growth in commissions as a function of eligible revenues, (2) stressed the equilibrium steady-state level of commissions, and (3) explained the firm's solution, namely, a massive re-balancing of the eligible revenue schedule. Anonymous surveys provide 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 learn to sell higher-priced products. Survey responses following the announcement in Treated Division 1, however, revealed that agents perceived mean commission reductions of 14% (see Figure 1a).[23] Agents also felt that they would need to work harder in response to the change, and that a significant effort increase would be necessary to make up the gap in earnings (see Figure 1b). In short, agents perceived the changes as reductions in expected compensation.

[23] Our later analysis of revenue changes that weight quantities by old and new prices leads us to conclude there was limited substitution to new products.

3 Motivating Framework

We motivate the analysis with a simple model of heterogeneous agent responses to commission changes as a function of skill differences. Heterogeneous responses are difficult to sign without assumptions, making them empirical objects of analysis. we then consider how turnover changes over the skill distribution affect profitability.

Let e_i denote agent i's sales effort and assume further that his sales revenue, y_i is given by $y_i = \theta_i e_i + \epsilon$ where $\theta_i > 0$ is the agent's skill-level or type, and ϵ is mean-zero noise. To simplify the exposition, all agents are assumed to be risk-neutral and collect a linear share of their revenues, R, in addition to a common fixed wage, α, such that we can represent agent i's expected utility by $U(\alpha, R, \theta_i, e_i) = \alpha + R\theta_i e_i - c(e_i)$. The cost of effort function $c(\cdot)$ is strictly increasing and convex, with $c(0) = c'(0) = 0$. Let e^* denote the unique solution to the agent's problem:

$$e^* = \underset{e}{\text{argmax}} R\theta e - c\left(e\right)$$

such that agent i's value function evaluated at e^* can be expressed as $V(\alpha, R; \theta_i)$.

The optimal effort, e_i^*, is strictly positive, as $c'(0) = c(0) = 0 < R$. Accordingly, the function U has strictly increasing differences in e_i and R, as well as in e_i and θ_i. By application of Topkis's Theorem, both $\frac{\partial e_i^*}{\partial R}$ and $\frac{\partial e_i^*}{\partial \theta_i}$ are themselves strictly positive. However the heterogeneous effort responses across differently skilled agents are captured by $\frac{\partial^2 e_i^*}{\partial R \partial \theta_i}$, for which different conditions are required.

Proposition 1. *An agent's change in effort with respect to commissions is increasing in agent skill, θ, as long as c''' is sufficiently small.*

Proof. See Appendix A2. □

When the agent's costs follow a standard power function; e.g. $c(e) = e^n/n$, then the expression characterizing $\frac{\partial^2 e_i^*}{\partial R \partial \theta_i}$ is strictly positive. We conclude that in most standard settings, agents have weakly larger effort responses to commission changes as their type increases. Ac-

cordingly, we treat intensive margin changes by agent type as an empirical question, and instead turn our attention to the extensive margin.

Beginning with the seminal work of (Burdett and Mortensen, 1998), the job ladder model has been used extensively to capture worker mobility. The standard model maintains an attrition (quit) rate of $Q(w) = \delta + \lambda[1 - F(w)]$, where $\delta > 0$ captures exogenous job destruction, $\lambda \in [0, 1]$ captures search frictions via an arrival rate of outside job opportunities, and w is a random variable with CDF $F(\cdot)$ which denotes the distribution of *fixed* wage offers to the agent from outside firms. We define the agent's reservation wage, $w(\theta_i)^*$, as the lowest fixed-wage yielding an expected utility of $V(\alpha, R; \theta_i)$.[24] To simplify analysis, the agent's type, θ_i, does not influence the agent's expected utility outside of the firm—that is, we assume that agent skill is entirely firm-specific. As the following proposition shows, however, the agent's type will influence his reservation fixed-wage.

Proposition 2. *First, low-skilled agents are more likely to leave the firm than high-skilled agents. Second, the marginal effect of a commission reduction on utility is greatest for high-skilled agents. Third, the distribution of incoming offers ultimately determines if the change in turnover rate is increasing in agent skill.*

Proof. See Appendix A2. □

The intuition behind the first statement in Proposition 2 is relatively straight-forward: because all agents face the same distribution of outside offers, those with the lowest reservation utility—in particular, those who can only extract limited utility from their current employment—are more likely to accept a relatively low outside offer, and hence are the most likely to leave. The second finding is slightly more nuanced; while all agents are more likely to accept an outside offer once their (internal) earnings decrease, a commission reduction has the greatest effect on the agents who sell the most, i.e., the high-type agents, as these are the agents who leverage the most out of the commission rate, R. Accordingly, a drop in

[24] Without loss of generality, we assume that the fixed-wage offers require the agent to exert a fixed level of (un-modeled) effort with known dis-utility.

commissions, R, will result in low-skilled agents (denoted by $\underline{\theta}$) reducing their reservation fixed-wage by $\underline{\Delta} > 0$ and high skilled agents ($\overline{\theta}$) reducing their reservation fixed-wage by $\overline{\Delta} > \underline{\Delta}$, where the change Δ is ultimately determined by the agents' cost function $c(e)$. Without additional structure, the theory cannot parlay the difference in marginal dis-utility into a prediction on quit rates, because while higher types incur a greater reservation wage reduction, in order for the change in quit rate to itself always increase in type, we would need:

$$\int_{w(\underline{\theta})^*}^{w(\underline{\theta})^*+\underline{\Delta}} f(s)ds < \int_{w(\overline{\theta})^*}^{w(\overline{\theta})^*+\overline{\Delta}} f(s)ds \quad \forall\ \underline{\theta} < \overline{\theta},\ \underline{\Delta} \leq \overline{\Delta}.$$

Provided that the density of incoming offers, $f(\cdot)$ is sufficiently uniform, then the higher-type agents respond to a commission decline with greater attrition than their lower-skilled peers, as the extra-marginal support $\overline{\Delta} - \underline{\Delta}$ will overpower any differences in the density (levels) between $f(w(\underline{\theta}))$ and $f(w(\overline{\theta}))$. While Proposition 2 highlights the forces in play at the extensive margin, the marginal effect of reduced commissions on quits across differently skilled agents is ultimately an empirical question. The answer to this question influences how compensation changes map into firm profits.

Proposition 3. *The sensitivity of changes in profits with respect to sales commissions depends on the turnover propensity of highly skilled agents relative to lesser-skilled agents. Turnover of high ability agents mitigates any cost savings from reducing R.*

Proof. We consider a representative sales opportunity allocated to a random agent. Let $g(\theta|R)$ denote the density of agent types at the firm under the commission structure R. Then expected profits for the representative opportunity are

$$(1-R)\int \theta e^*(\theta, R)\, dG(\theta|R).$$

Differentiation with respect to R yields

$$\frac{\partial \pi}{\partial R} = -\int \theta e^*(\theta, R)\, dG(\theta|R) + (1-R)\int \left\{ \theta \frac{\partial e^*}{\partial R} g(\theta|R) + \theta e^* \frac{\partial g(\theta|R)}{\partial R} \right\} d\theta.$$

The first term, $-\int \theta e^*(\theta, R)\, dG(\theta|R)$, is negative, as raising commission while holding sales fixed gives the agent a transfer. When $\frac{\partial g(\theta|R)}{\partial R} = 0$ so that there is no sorting, the sign of the second term is positive, meaning the agent's positive effort response may offset the firms decreased profits from the transfer made to the agent. When $\frac{\partial g(\theta|R)}{\partial R} > 0$, the average quality of the workforce increases with R, further offsetting the firm's decreased profits stemming from marginal transfers to the agent.

□

A reduction in commissions has two different effects: profits increase because of cost savings, while effort reductions offset some of these savings. When the change in the composition of the workforce is greatest for high ability workers, that is $\frac{\partial g(\theta|R)}{\partial R}$ is increasing in θ, the loss of highly skilled workers further offsets the cost savings from the commission changes. The magnitude of the composition and effort changes is an empirical question which we examine after introducing the data.

4 Personnel Data and Survey Instruments

4.1 Personnel and Productivity Data

We assess the consequences of the compensation reductions using highly detailed commission and productivity data provided by the firm. The first week of accessible commission data is July 4, 2015 for divisions other than Treated Division 2, where our data access begins on January 9, 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 data on these output measures 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. The sample is organized by agent-week and runs through June 17, 2017.

In total, the dataset covers 2,033 sales agents across 61 weeks, for a total of 39,944 agent-week observations. We refer to this as the main sample. In the analysis of turnover, we add data from 2015 to identify seasonal patterns of turnover.

Table 1 displays summary statistics over the time-series for treated divisions and the average for 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. 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 experienced agents because those positions require mastery of multiple product categories.

4.2 Baseline Agent Productivity Before the Commission Changes

While our analysis focuses on overall responses, many theories of turnover and heterogeneous responses require an estimate of agent ability prior to the commission reductions. We use data that runs from the beginning of the sample to 6 weeks prior to the first commission reduction (mid-September 2016) to estimate adjusted agent fixed effects that capture heterogeneous skill or ability.

To do so, we use a fixed effects regression analysis of log commissions, an omnibus measure of sales productivity that is available in both the main sample and the turnover sample.[25] The fixed effects are calculated from a regression of log commissions on the worker's tenure profile, division-by-week fixed effects to remove common division-level shocks, and worker fixed effects. Accounting for the tenure profile makes this measure one about underlying talent, rather than the tenure-commission gradient.[26] The worker fixed effects are interpretable up

[25]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.

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

to a division-level average that is removed through the division-by-week fixed effects.

To account for sampling variation in the estimated fixed effects, we use a regularization procedure that is well known in the literature on estimating boss effects or teacher value added. In this procedure, we take the residuals plus the estimated individual fixed effects from the above 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 sequences of data. We call the resulting output the adjusted fixed effects. The adjusted fixed effects guard against mean reversion or classification being driven by sampling error from a short panel.

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. We base the split of terciles from the shrunk worker effects dated six weeks 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 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 differently because of the mix of products sold before the change. To check for this, we calculate the expected percentage 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 percentage changes in commissions due to the pre-period sales mix are 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 percentage

changes in commissions towards any one group based on pre-period productivity.

4.3 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 [the firm]?"

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 effective date of the changes. These same questions were asked again to determine whether agents' perceptions of promotion likelihood, firm fairness, and desire to give referrals 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 commission changes.

In this section, we document the changes in self-reported agent sentiment, effort, and commissions, as the result of the cuts for agents in Treatment Division 1. Figure 2a shows that agents in Treated Division 1 had, on average, decreased perceptions of how fair the firm's policies were. Similarly, Figure 2b 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 reduced agents' feelings of fairness and loyalty to the firm but did not do so uniformly.

For questions about firm fairness or the propensity to refer friends to work, those agents with the most favorable early views of 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.

4.4 Division Trends Pre-Dating the Commission Changes

Figure 3 shows the evolution of average commissions by division, along with changes around the treatment dates. Note that there is an 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 an increasing commission level that is absent in the weeks before July 23. This increase, according to interviews with firm's management, was caused by the addition of new territories from which sales agents fielded calls.[27]

As a result of the run-up period, many of our results focus on differential changes within treated divisions, allowing us to compare agents who had the exact same exposure to the run-up period. For specifications that focus on overall effects, we detail a number of different strategies to account for this "run-up" period in section 5.2. In the remainder of the paper, we discuss how this period might change the interpretation of results.

4.5 Agents Understood the Commission Changes

Despite some agents' willingness to supply labor at the earliest parts of the "run-up" period and in other, less-lucrative divisions, agents' expectations of the future are important. The sales agents expected the pre-event commission levels to be permanent, and their revised expectations about firm fairness and quality (Figures 2a and 2b) reflect that these events were unanticipated. Manager interviews indicated that cuts of this magnitude were

[27]For example, the new territory may have been home to fewer competitors, in which case the agents could more easily up-sell callers into buying products and services with higher commission-eligible revenues.

unprecedented.

As discussed previously, Figure 1a makes clear that the commission change was salient.[28] Figure 1b depicts agents' estimates of 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.

5 Empirical Strategy and Results

This section details the consequences of changing the compensation structure. We begin by focusing on turnover, as this is the margin that we find ultimately matters most. We then analyze intensive margin changes in sales. We discuss potential identification issues and the checks or tests for these issues throughout this section.

It should be noted that our estimation of changes in work effort are conditional on remaining at the firm. As turnover takes time to accumulate, however, we observe almost all treated workers with at least some sales data in the post-reduction period.

5.1 Changes in Turnover

We provide preliminary evidence on how the composition of the workforce changes after the commission cuts by plotting the average adjusted worker fixed effects for control divisions and Treated Division 1. Because the fixed effects are estimated using data that ends six weeks prior to the event date, we can assess whether the fixed effects (normalized to the event date) track one another in the pre-event period. Changes in the average of worker fixed effects summarize how turnover differs by workers' skill in treated and control divisions.

Figure 4 displays the results. Like many sales firms, there is positive selection by worker quality over time, captured by the upward trend in average fixed effects in all divisions.

[28] The mean reported perceived commission change is negative and large, although slightly smaller than the 17–18% expected commission reduction resulting from the change. Using the pre-treatment sales mix, we did not find positive expected changes for employees.

However, there is clear evidence that average worker quality begins to deteriorate in Treated Division 1 within several weeks of the announcement of the commission cut. This divergence in worker fixed effects happened only after the change in commissions was announced.

We examine this more formally using a difference-in-differences estimator over a longer panel. Estimates of the *extensive margin* effects of commission reductions on turnover utilize the extended data, predating the commission reductions by at least a full calendar year for each division (the data begins in July of 2015 for Treated Division 1 and January 2016 for Treated Division 2). Our goal is to model how turnover changes overall, and by worker skill, after each event. We run separate regressions for events in Treated Division 1 and Treated Division 2 rather than pooling the data, as the underlying tenure and worker skill for these divisions differs dramatically.

The model captures how the turnover probability changes for a given level of worker experience after accounting for different turnover rates by division and seasonal time periods. We account for how exit likelihood changes by worker tenure with a flexible function $g(TimeAtRisk)$, capturing how the baseline turnover hazard changes with time at the firm. We then include combinations of division and time fixed effects to capture permanent heterogeneity across divisions or seasonal shocks that may be correlated with treatment. The model we estimate is:

$$\begin{aligned} Turnover_{it} = \alpha + TimeControls + g(TimeAtRisk) + X_{it}\beta_1 + \sum_j (Div_j + \\ Post_j Div_j \delta_1 + Placebo_j Div_j \delta_2 + \sum_k (Het_k Div_j Post_j \delta_{3k} + Het_k Div_j Placebo_j \delta_{4k} + \\ Het_k \beta_2 + Het_k Post_j \beta_3 + Het_k Placebo_j \beta_4 + Het_k Div_j \beta_5)) + \varepsilon_{it}. \end{aligned} \tag{2}$$

The dependent variable is an indicator that the week in question is worker $i's$ last week in the firm. After the worker leaves, he or she is no longer included in the sample, so this specification acts like a discrete time hazard model. The parameter δ_1 captures the average change in turnover probability, conditional on tenure and time controls, after the commission

cut occurs in division j. This is indicated by $Post_j$, the post-treatment indicator interacted with Div_j, a division fixed effect. The $Post_j$ indicator is always zero for untreated divisions and is collinear with time fixed effects.

We include baseline measures of worker skill as heterogeneous characteristics, captured by Het_k, and their interaction with post-event indicators. 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 baseline productivity.[29] 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. For heterogeneous measures of skill level, Het_k is the z-score of the worker's log-commission fixed effect estimated from data ending six weeks prior to the first commission reduction. The specification allows for k to index any heterogeneous characteristic, as in later specifications we also examine how worker sentiment toward the firm affects turnover patterns after the commission change. The parameter δ_{3k} captures different responses based on characteristic Het_k. A fully saturated set of indicators for missing categories of heterogeneous characteristics is also included for those sales reps who do not have data available.

Table 3 displays the results, split by Treated Division 1 and Treated Division 2. The columns of this table correspond to different combinations of $TimeControls$ to account for differences in seasonality and division trends in turnover. Due to the fact that we only have a small number of divisions and an even smaller number of treated groups, we perform inference using a combined randomization inference and wild bootstrap procedure that is designed to estimate critical regions under clustering with few treated clusters (MacKinnon and Webb, 2018). These tests are displayed in the bottom rows of the table for δ_1 and δ_3.

We find evidence of adverse selection in turnover. Columns 1 and 4 include time fixed

[29]Recall, from the discussion in Section 4.5 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.

effects that remove common turnover changes affecting all divisions (e.g., end of the summer high call volume season). In Treated Division 1, we do not find an increase in turnover overall, but we find a shift in the composition of turnover. Workers who had higher sales productivity in the pre-period, as proxied by their z-scores, were relatively more likely to leave the firm in Treated Division 1 after the commission reduction. This result is consistent with Figure 4. The point estimates across columns indicate that Treated Division 1 agents with pre-period performance one standard deviation above the mean had turnover rates that increased by between 1.5 to 2.1 percentage points in a given week relative to treated agents with average performance. These effects are precisely estimated and are robust to the estimation procedure, including the addition of workers' tenure profiles in the first stage.[30] This turnover increase is relative to an overall sample mean of about 0.036, indicating a substantial increase compared to baseline rates. In Treated Division 2, we do not detect this heterogeneous effect, but instead find a small increase in the average turnover rate. Agents in Treated Division 2 are highly productive agents, so they are already in the right tail of the firm-wide productivity distribution.[31]

Seasonal turnover patterns, as indicated by the zero coefficients on the placebo period, do not drive the results.[32] Specifications in Columns 2 and 5 augment the examination of seasonality by including division-by-week of the calendar year fixed effects. These specifications compare turnover rates for the division against turnover rates in the same week of the last calendar year, but unlike the placebo approach, offer more flexibility by division. The results remain broadly similar. A final approach includes division-by-time fixed effects to

[30] These results are qualitatively similar when agent fixed effects are estimated omitting the tenure polynomial.

[31] 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 commissions was greater in percentage terms in Treated Division 2, their lack of turnover may be due to the fact that agents in the division continued to have post-treatment commissions that are significantly higher, on average, than those of Treated Division 1 and control divisions.

[32] We augment the intensive margin sample with earlier data containing personnel records, turnover data, 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. For estimating δ_{4k} we estimate the z-score using data from the prior year.

identify heterogeneous attrition patterns; this specification only identifies δ_{3k} and δ_{4k}. The heterogeneous turnover patterns in Treated Division 1 remain.

To quantify the adverse selection offset for firm profits as described in 3, 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 19%. 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. Taking the sum of the change in turnover probability multiplied by average revenue-per-call across each bin gives us 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 commission cut reduced average revenue-per-call by about 4% at the end of this five month period in Treated Division 1. Balancing this cut is a reduction in compensation expense. Management's criteria for evaluating the change uses a reduction in commission expenses from 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. However, as worker churn at the firm spikes prior to the busy summer sales season—both due to new hiring and attrition—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 subsections, we consider whether agents reduced their sales effort and availability to take calls. Before getting there, we address threats to identification.

5.2 Addressing Empirical Hurdles

The turnover regressions overcome a number of empirical hurdles because of the presence of employment data over multiple years. Challenges remain when considering estimated responses on the *intensive margin*, as multiple years of data are not available for all divisions. There are several strategies we use to ensure the non-treated divisions constitute an appropriate control group.

Different Trends: To account for pre-treatment differences in sales or commission trends, we include division-specific linear time trends. Some specifications also re-weight data from other divisions to match patterns prior to the event in Treated Division 1. We use a propensity score reweighting procedure for this purpose, leaving six weeks of data to assess divergence between the re-weighted controls and Treated Division 1 prior to the event date.[33] Demand is stochastic and seasonal. Some demand changes may be 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 check whether lags of the average division commissions one year prior to the week in question change the results. We use these commission data because we lack sales data from the prior year. Results are little changed with or without these controls.

Spillovers to the 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 A.2 describes the break tests and plots the parameter estimates from various specifications of these break tests.

Parallel Trends for Heterogeneous Agents Within Division: The validity of the difference-in-differences parallel trend assumption is not necessary for an analysis of differential effects across agent skill level because we leverage within-division variation. That

[33] Figures A.1b and A.1a provide details on the fit of the re-weighting estimates and suggest the procedure performs well when targeting "per-call" commissions or performance metrics. Section A.1 in the appendix describes the procedure in detail.

is, heterogeneous responses can be estimated using division-by-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.3 and A.4 plot the evolution of within-division differences by worker ability and worker perceptions of firm fairness over time, suggesting parallel trends within division.

Substitution to Different Products Mitigates the Commission Changes: Whether agents were able to reduce the impact of the commission changes because of substitution to other products is an empirical question that we examine in detail later. The approach is to estimate whether sales revenue becomes more heavily weighted to items with more favorable relative prices under the new revenue mapping function. Although there were some relative price changes that may have given rise to agent substitution, we find that agents were not able to offset the commission reductions by changing their mix of products sold. That is, the overall change in commissions per call that we estimate closely follow the predicted reductions given the pre-change product mix.

5.3 Changes in Effort

The first specification for estimating effects on the *intensive margin* of worker effort is a difference-in-differences regression with the following form:

$$y_{it} = \alpha_i + t + X_{it}\beta_1 + \sum_j (Div_j + Trend_j + Post_j \times Div_j\delta_1) + \varepsilon_{it}. \tag{3}$$

All specifications include time fixed effects, 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.[34]

Equation 3 accounts for average differences across divisions or average differences across

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

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.

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 (3) that closely mirror those used in the analysis of turnover:

$$\begin{aligned} y_{it} = \alpha_i + t + X_{it}\beta_1 + \sum_j (Div_j + Trend_j + Post_j Div_j \delta_1 + \\ \sum_k (Het_k Div_j Post_j \delta_{2k} + Het_k \beta_2 + Het_k Post_j \beta_3 + Het_k Div_j \beta_4)) + \varepsilon_{it}. \end{aligned} \tag{4}$$

When only heterogeneous effects are required, division-by-time fixed effects are added to equation (4), resulting in:

$$\begin{aligned} y_{it} = \alpha_i + X_{it}\beta_1 + \sum_j (Div_j \times t + \sum_k (Het_k Div_j Post_j \delta_{2k} + \\ Het_k \beta_2 + Het_k Post_j \beta_3 + Het_k Div_j \beta_4)) + \varepsilon_{it}. \end{aligned} \tag{5}$$

We present estimates for a variety of different dependent variables meant to capture effort changes. We focus on Treated Division 1, as we cannot measure how sales change in Treated Division 2 separately from a change in the eligible revenue schedule. As a result, we cannot separate effort changes from the change imposed by management.

The results of the first estimation are contained in Table 4. Panel A contains results for a measure of availability to take calls, or "adherence," the fraction of time an agent spends performing sales-related tasks.[35] 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),

[35] 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).

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. Estimates in Panel A show that, on average, agents do *not* change their adherence in response to the commission reductions. We also find minimal differences in "conversion," or the fraction of calls for which any sale is made (Panel B).

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 constant throughout the period. Note that these specifications hold prices fixed at either the pre-change or the post-change level, so they do not reflect the mechanical adjustments to sales revenue from the formula adjustment. We find minimal evidence of changes in log revenue-per-call at the old prices. In specifications using the new prices in Panel D, we estimate positive coefficients with OLS. That the OLS coefficients are positive in Panel D might indicate some effort substitution to more lucrative products after the change, but these results are somewhat imprecise. Panel E attempts to quantify how these changes affect commissions, with log commission per call changes that are negative but roughly in-line with the ex-ante estimate of an 18% per-call commission reduction in Table 2.

Survey evidence, reported in Figure 5, 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 were that effort increased. This evidence suggests that the change in commissions we observed is mostly due to the compensation structure change and not to reductions in effort.

While we find no meaningful evidence that effort decreased due to the commission change, we ultimately find some evidence of changes in worker composition. However, surprisingly

these changes are not evident in the results on intensive margin responses. The typical approach to assess sorting in productivity data like these would be to compare OLS estimates and estimates with worker fixed effects (Lazear et al., 2016; Lazear, 2000). The OLS estimate is the combination of the within-agent change in effort and the between-agent change in worker composition. Estimates with worker fixed effects or estimates on the balanced sample isolate the within-agent change in effort. That the OLS estimates and fixed effects estimates are so similar in Table 4 might suggest less sorting than found in our analysis of turnover. This comparison is misleading, however, when there are heterogeneous effort responses that depend on a worker's type. In the following subsection, we estimate that more skilled agents have larger drops in effort than less skilled agents in Treated Division 1 after the change. As a result, the relative decline in effort by workers with high pre-period z-scores in Treated Division 1 masks the sorting in the productivity data.

5.4 Heterogeneous Effort Responses by Pre-Treatment Productivity

Table 5 reports that highly productive agents *decrease* their sales effort relative to less productive agents. These results come from estimations of equation 4 and include worker fixed effects. The reduction holds across all three measures of sales (Panels B - D) and is reasonably precisely estimated. The results also remain when restricting to a balanced panel or when using weighted regressions. We also find similar (unreported) results when splitting the sample of agents above or below the median pre-period z-score. These results suggest that heterogeneous effort changes are responsible for the similarity in OLS regressions and regressions with agent fixed effects.

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.

5.5 Do Fairness, Firm Sentiment, or Promotion Expectations Affect Agent's Turnover 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 announcement of 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 4.3. 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 6 supports our earlier finding that highly productive workers are more likely to increase turnover rates

after the commission changes relative to average workers in Treated Division 1. We do not, however, find any significant heterogeneity in treatment effect across responses to the three survey questions. The point estimates on the differential turnover for referral, promotion, and fairness are close to zero and are not statistically significant. 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 7, 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 or sales effort across the distribution of reciprocation and engagement.

6 Conclusion

In this paper we examine the turnover and effort responses to a reduction in sales commissions. Our analysis provides foundations for compensation rigidity, which is a constraint in many aggregate models of the economy (Belo, Lin, and Bazdresch, 2014). Surveys and short-term experimental studies provide different mechanisms underlying 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. Extant research predicts that workers will react to compensation reductions by adjusting their effort or by leaving the firm altogether. Observing workers' reactions to a compensation reduction in our sales setting provides a direct line of sight into the constraints facing managers, 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. Although we find limited reductions in overall effort for the employees who remain in the firm, we do find some effort reductions among the most highly able workers.

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 at a personnel search firm. We hypothesize that the muted effort changes may be due to income effects, consistent with high-powered performance incentives in our setting. This interpretation is consistent with Esteves-Sorenson (2017), who finds that the introduction of performance-based pay overcomes behavioral based responses that might suggest larger effort reductions in other contexts.

A series of surveys intended to capture beliefs about firm fairness, promotion prospects, and sentiment were used to assess whether worker sentiment influences effort supply or departure decisions. These surveys indicated substantial variation in beliefs across agents. Even though the surveys 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 compensation reductions as agents with more dismal expectations.

Finally, while overall turnover rates did not spike dramatically after the compensation reductions, the increased turnover of highly skilled agents provides a nuanced perspective on whether the firm has market power over labor inputs. Our findings suggest an important qualification to the common approach of inferring monopsony power after estimating the elasticity of turnover rates with respect to compensation. A less than perfectly elastic labor supply to the firm is typically thought to indicate that the firm has some market power because of a wedge between the marginal revenue product of labor and workers' labor supply. In our analysis, the limited turnover elasticity overstates the firm's market power because the loss of highly skilled agents offsets the labor cost savings brought about by the compensation

reductions.

References

Agrawal, Ashwini K, David A Matsa. 2013. Labor unemployment risk and corporate financing decisions. *Journal of Financial Economics* **108**(2) 449–470.

Akerlof, George A, Janet L Yellen. 1988. Fairness and unemployment. *The American Economic Review* **78**(2) 44–49.

Akerlof, George A., Janet L. Yellen. 1990. The fair wage-effort hypothesis and unemployment. *The Quarterly Journal of Economics* **105**(2) 255–283.

Aldatmaz, Serdar, Paige Ouimet, Edward Van Wesep. 2014. The option to quit: The effect of employee stock options on turnover .

Altonji, Joseph G, Paul J Devereux. 2000. The extent and consequences of downward nominal wage rigidity. *Research in labor economics*. Emerald Group Publishing Limited, 383–431.

Bae, Kee-Hong, Jun-Koo Kang, Jin Wang. 2011. Employee treatment and firm leverage: A test of the stakeholder theory of capital structure. *Journal of Financial Economics* **100**(1) 130–153.

Banker, Rajiv D, Seok-Young Lee, Gordon S Potter, Dhinu Srinivasan. 2015. An empirical examination of the impacts from termination of a performance-based incentive plan .

Bartel, Ann, Casey Ichniowski, Kathryn Shaw. 2004. Using" insider econometrics" to study productivity. *The American Economic Review* **94**(2) 217–223.

Belo, Frederico, Xiaoji Lin, Santiago Bazdresch. 2014. Labor hiring, investment, and stock return predictability in the cross section. *Journal of Political Economy* **122**(1) 129–177.

Bewley, Truman F. 1998. Why not cut pay? *European Economic Review* **42**(3-5) 459–490.

Burdett, Kenneth, Dale Mortensen. 1998. Wage differentials, employer size, and unemployment. *International Economic Review* **39**(2) 257–73.

Campbell III, Carl M, Kunal S Kamlani. 1997. The reasons for wage rigidity: evidence from a survey of firms. *The Quarterly Journal of Economics* **112**(3) 759–789.

Card, David, Dean Hyslop. 1997. Does inflation" grease the wheels of the labor market"? *Reducing inflation: Motivation and strategy*. University of Chicago Press, 71–122.

Chen, Huafeng, Marcin Kacperczyk, Hernan Ortiz-Molina. 2011. Do nonfinancial stakeholders affect the pricing of risky debt? evidence from unionized workers. *Review of Finance* **16**(2) 347–383.

Cohn, Alain, Ernst Fehr, Benedikt Herrmann, Frédéric Schneider. 2014. Social comparison and effort provision: Evidence from a field experiment. *Journal of the European Economic Association* **12**(4) 877–898.

DellaVigna, Stefano, John A List, Ulrike Malmendier, Gautam Rao. 2016. Estimating social preferences and gift exchange at work. Tech. rep., National Bureau of Economic Research.

Dube, Arindrajit, Laura Giuliano, Jonathan Leonard. 2018. Fairness and frictions: The impact of unequal raises on quit behavior. Tech. rep., National Bureau of Economic Research.

Eisfeldt, Andrea L, Dimitris Papanikolaou. 2013. Organization capital and the cross-section of expected returns. *The Journal of Finance* **68**(4) 1365–1406.

Esteves-Sorenson, Constanca. 2017. Gift exchange in the workplace: Addressing the conflicting evidence with a careful test. *Management Science* .

Fehr, Ernst, Lorenz Goette. 2005. Robustness and real consequences of nominal wage rigidity. *Journal of Monetary Economics* **52**(4) 779–804.

Fernández-Villaverde, Jesús. 2010. The econometrics of dsge models. *SERIEs* **1**(1-2) 3–49.

Gächter, Simon, Ernst Fehr. 2002. Fairness in the labour market. *Surveys in Experimental Economics*. Springer, 95–132.

Gao, Huasheng, Jarrad Harford, Kai Li. 2012. Ceo pay cuts and forced turnover: Their causes and consequences. *Journal of Corporate Finance* **18**(2) 291–310.

Gibbons, Robert. 1996. Incentives and careers in organizations .

Gruman, Jamie A, Alan M Saks. 2011. Performance management and employee engagement. *Human Resource Management Review* **21**(2) 123–136.

Hall, Brian J, Jeffrey B Liebman. 1998. Are ceos really paid like bureaucrats? *The Quarterly Journal of Economics* **113**(3) 653–691.

Hochberg, Yael V, Laura Lindsey. 2010. Incentives, targeting, and firm performance: an analysis of non-executive stock options. *The Review of Financial Studies* **23**(11) 4148–4186.

Holden, Steinar, Fredrik Wulfsberg. 2009. How strong is the macroeconomic case for downward real wage rigidity? *Journal of monetary Economics* **56**(4) 605–615.

Jensen, Michael C, Kevin J Murphy. 1990. Performance pay and top-management incentives. *Journal of political economy* **98**(2) 225–264.

Kahn, Shulamit. 1997. Evidence of nominal wage stickiness from microdata. *The American Economic Review* **87**(5) 993–1008.

Kahn, William A. 1990. Psychological conditions of personal engagement and disengagement at work. *Academy of management journal* **33**(4) 692–724.

Kahneman, Daniel, Jack L Knetsch, Richard Thaler. 1986. Fairness as a constraint on profit seeking: Entitlements in the market. *American Economic Review* 728–741.

Kaur, Supreet. 2014. Nominal wage rigidity in village labor markets. Tech. rep., National Bureau of Economic Research.

Kerr, William R, Ramana Nanda. 2015. Financing innovation. *Annual Review of Financial Economics* **7** 445–462.

Kim, E, Paige Ouimet. 2014. Broad-based employee stock ownership: Motives and outcomes. *The Journal of Finance* **69**(3) 1273–1319.

Krueger, Miriam, Guido Friebel. 2015. How bad are pay cuts? and why? .

Kube, Sebastian, Michel André Maréchal, Clemens Puppe. 2013. Do wage cuts damage work morale? evidence from a natural field experiment. *Journal of the European Economic Association* **11**(4) 853–870.

Lazear, Edward P. 2000. Performance pay and productivity. *American Economic Review* **90**(5) 1346–1361.

Lazear, Edward P, Kathryn L Shaw, Christopher Stanton. 2016. Making do with less: working harder during recessions. *Journal of Labor Economics* **34**(S1) S333–S360.

Lazear, Edward P, Kathryn L Shaw, Christopher T Stanton. 2015. The value of bosses. *Journal of Labor Economics* **33**(4) 823–861.

Lemieux, Thomas, W Bentley MacLeod, Daniel Parent. 2009. Performance pay and wage inequality. *The Quarterly Journal of Economics* **124**(1) 1–49.

Lustig, Hanno, Chad Syverson, Stijn Van Nieuwerburgh. 2011. Technological change and the growing inequality in managerial compensation. *Journal of Financial Economics* **99**(3) 601–627.

MacKinnon, James G, Matthew D Webb. 2018. Wild bootstrap randomization inference for few treated clusters. Tech. rep., Queens Economics Department.

MacLeod, W Bentley. 2003. Optimal contracting with subjective evaluation. *American Economic Review* **93**(1) 216–240.

Makridis, Christos, Maury Gittleman. 2017. Does 'performance pay'pay? wage flexibility over the great recession .

Manning, Alan. 2003. *Monopsony in motion: Imperfect competition in labor markets*. Princeton University Press.

Mas, Alexandre. 2006. Pay, reference points, and police performance. *The Quarterly Journal of Economics* **121**(3) 783–821.

Mehran, Hamid. 1995. Executive compensation structure, ownership, and firm performance. *Journal of Financial Economics* **38**(2) 163–184.

Mueller, Holger M, Paige P Ouimet, Elena Simintzi. 2017a. Wage inequality and firm growth. *American Economic Review* **107**(5) 379–83.

Mueller, Holger M, Paige P Ouimet, Elena Simintzi. 2017b. Within-firm pay inequality. *The Review of Financial Studies* **30**(10) 3605–3635.

Murphy, Kevin J. 1999. Executive compensation. *Handbook of labor economics* **3** 2485–2563.

Oyer, Paul. 2004. Why do firms use incentives that have no incentive effects? *The Journal of Finance* **59**(4) 1619–1650.

Oyer, Paul, Scott Schaefer. 2005. Why do some firms give stock options to all employees?: An empirical examination of alternative theories. *Journal of Financial Economics* **76**(1) 99–133.

Pissarides, Christopher A. 1994. Search unemployment with on-the-job search. *The Review of Economic Studies* **61**(3) 457–475.

Postel-Vinay, Fabien, Jean-Marc Robin. 2002. Equilibrium wage dispersion with worker and employer heterogeneity. *Econometrica* **70**(6) 2295–2350.

Schmalz, Martin C. 2012. Managing human capital risk .

Serfling, Matthew. 2016. Firing costs and capital structure decisions. *The Journal of Finance* **71**(5) 2239–2286.

Simintzi, Elena, Vikrant Vig, Paolo Volpin. 2014. Labor protection and leverage. *The Review of Financial Studies* **28**(2) 561–591.

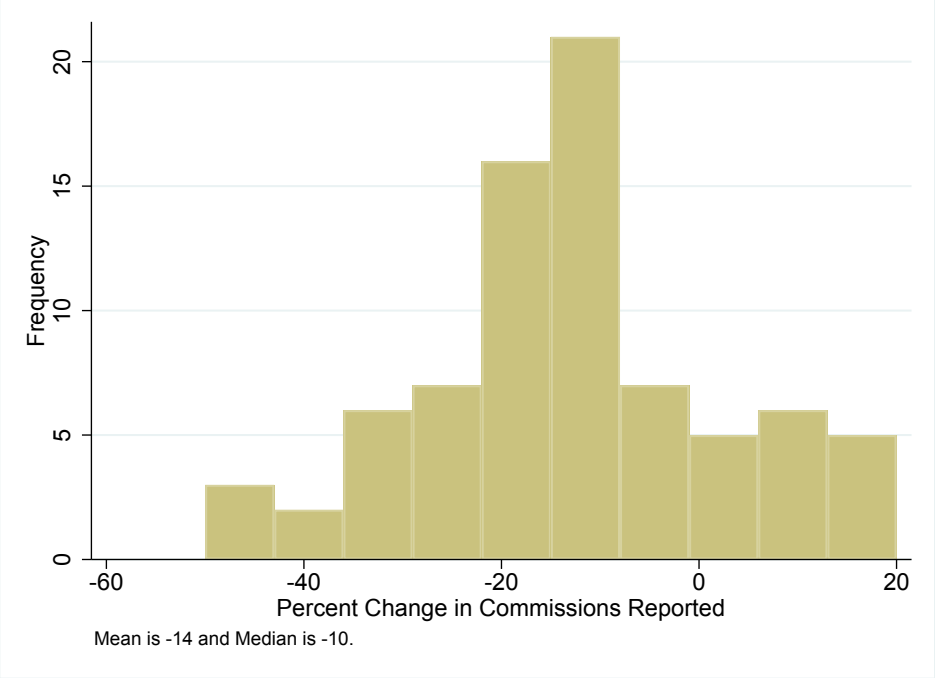
Smets, Frank, Rafael Wouters. 2007. Shocks and frictions in us business cycles: A bayesian dsge approach. *American Economic Review* **97**(3) 586–606.

Stafford, Tess M. 2015. What do fishermen tell us that taxi drivers do not? an empirical investigation of labor supply. *Journal of Labor Economics* **33**(3) 683–710.

Figures and Tables

Figure 1: Reported Change in Commissions and Effort Required to Maintain Earnings in Treated Division 1

(a) Reported Change in Commissions

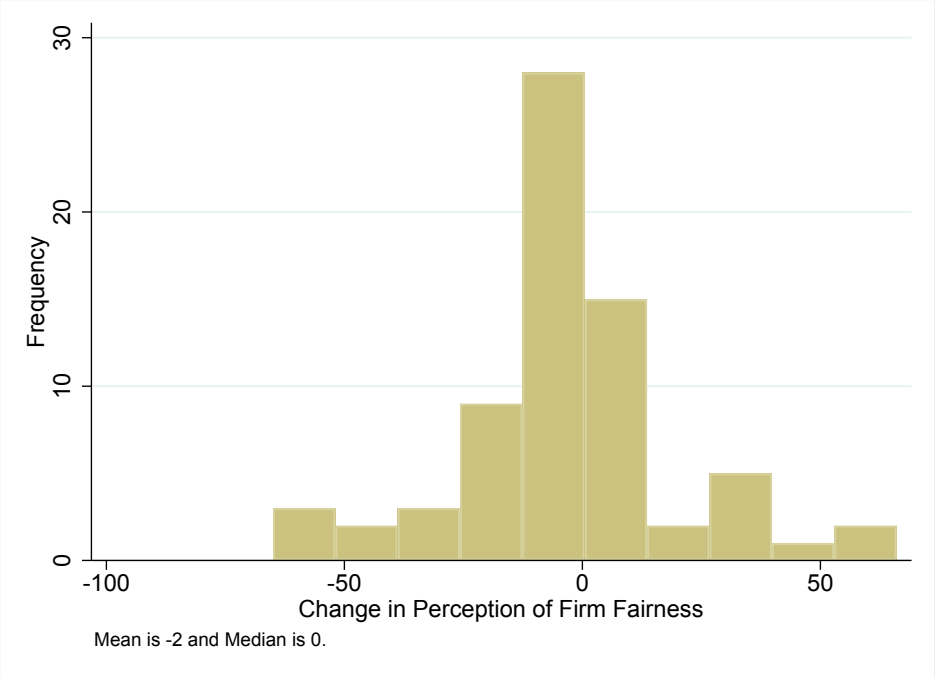


(b) Reported Change in Effort Needed to Maintain Pre-Event Earnings

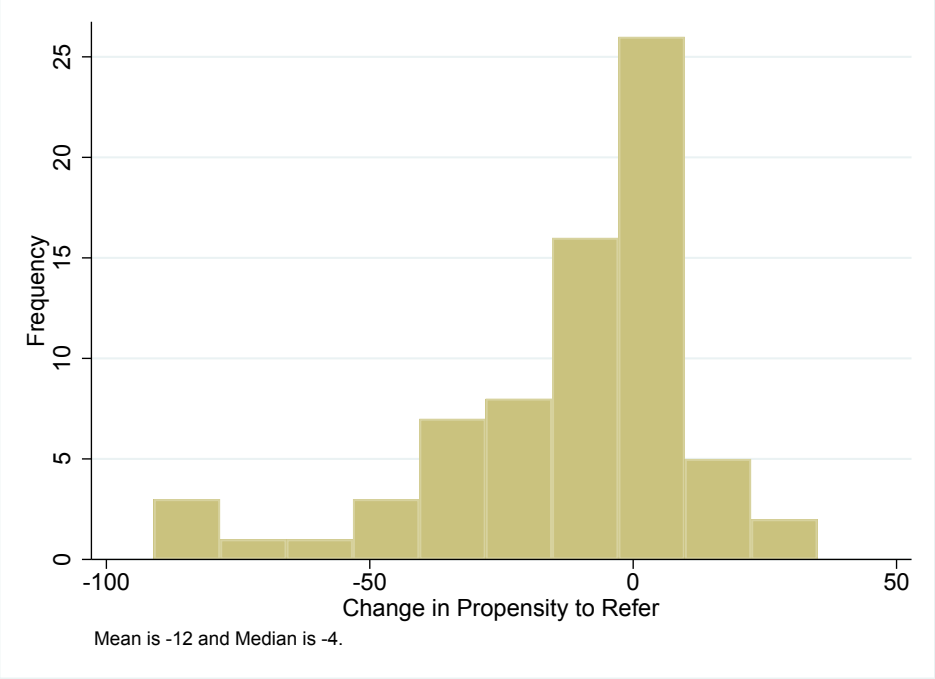
Note: Average reduction in per-call commissions under the altered formula is 18%. The first histogram displays survey responses to a question asking how actual commissions changed after the commission reduction went into effect relative to the pre-period. The second histogram displays responses to a question asking how much effort would need to change to maintain the level of earnings prior to the reduction. Sample is Treated Division 1.

Figure 2: Change in Reported Perceptions of The Firm for Treated Division 1

(a) Change in Reported Perceptions of Firm Fairness

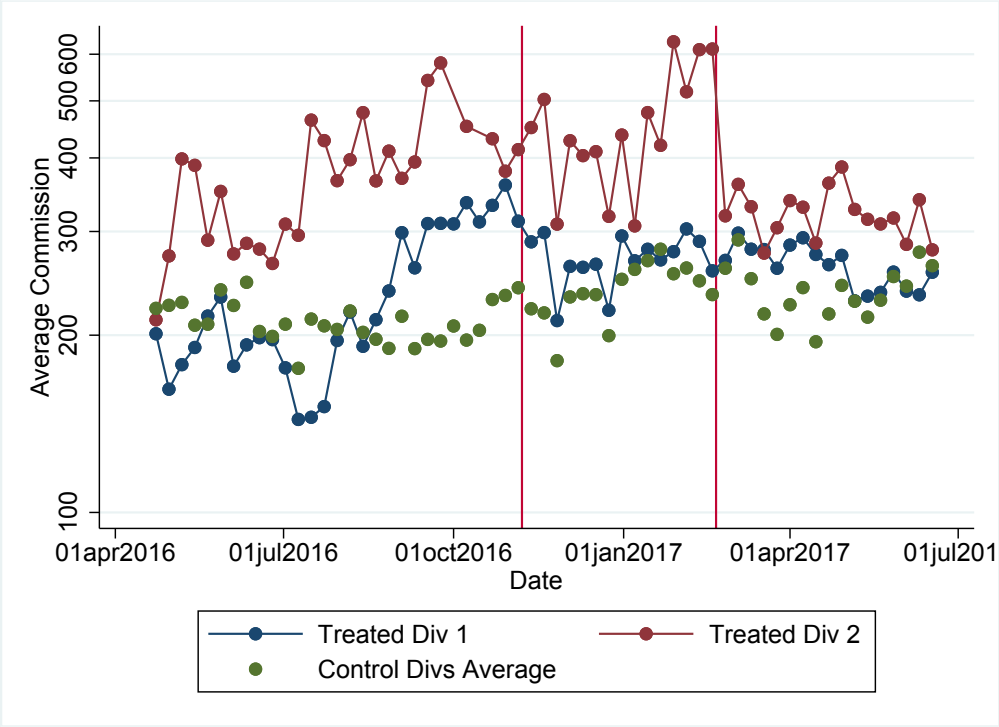


(b) Change in Reported Propensity to Refer Friends to the Firm



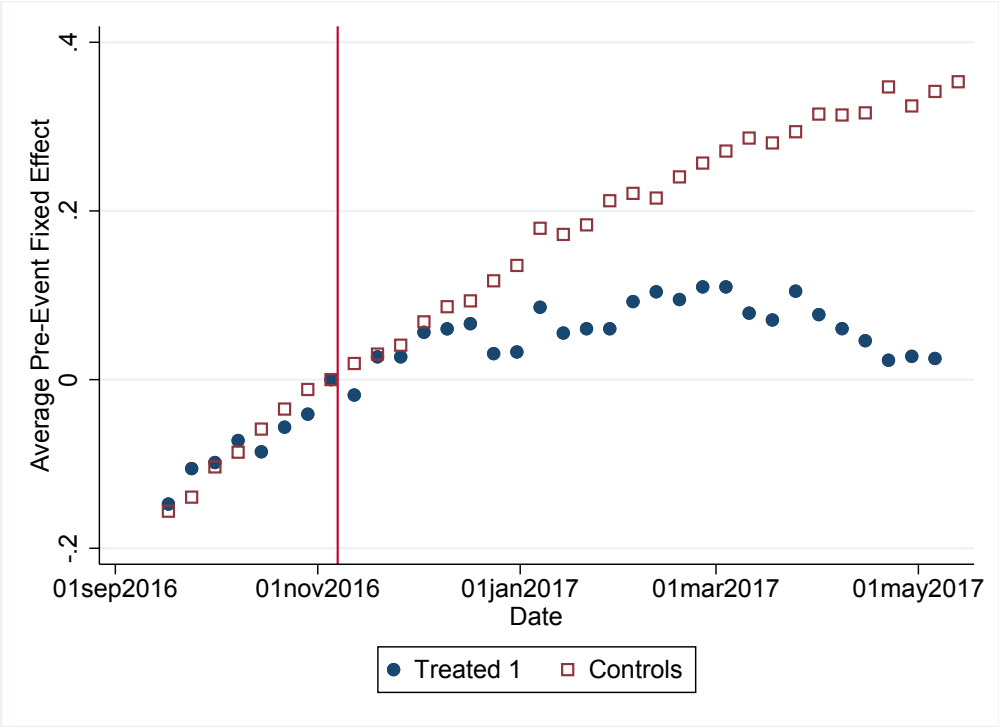
Note: Figures plot changes in sentiment between surveys. The unit of analysis is a sales agent present in both survey waves. Median baseline fairness score in the first survey is 85. Measured change is similar when asking about team members' perceptions of firm fairness. Median propensity to refer friends to the firm is 93 in the first survey.

Figure 3: Average Commissions in Treated and Control Divisions



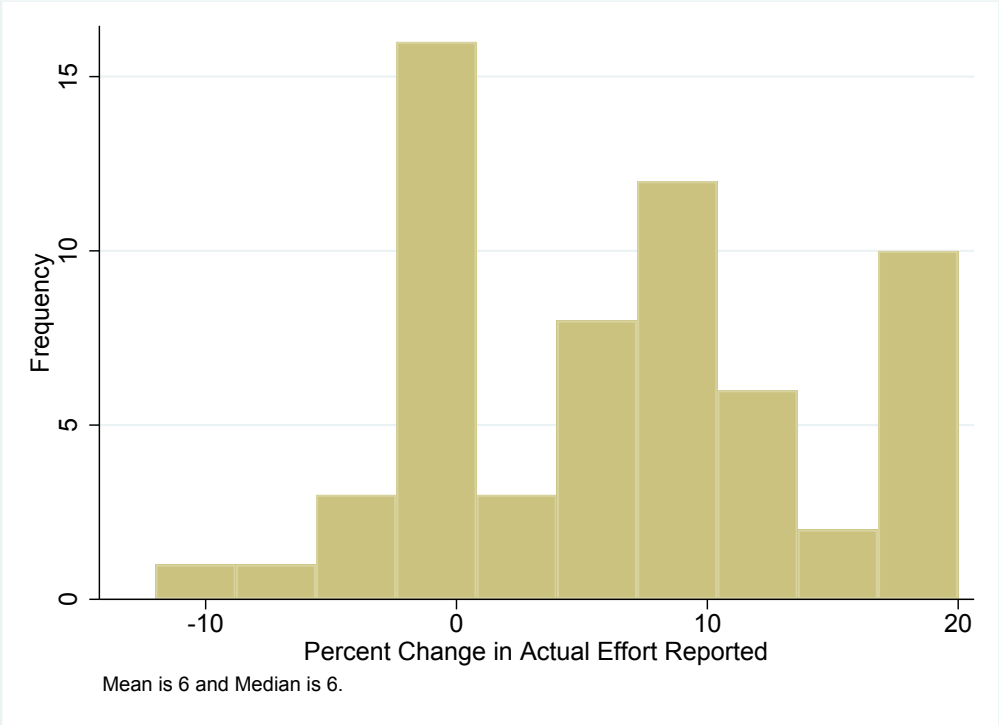
Note: Average commission per worker for workers with 30+ days of tenure. Vertical axis uses logarithmic scale. First vertical line corresponds to the Treated Division 1 event date. Second vertical line corresponds to Treated Division 2 event date.

Figure 4: Average Worker Productivity Fixed Effects (Estimated Prior to Announcement Date) in Treated Division 1 and Control Divisions



Note: Average adjusted log commission fixed effects for Treated Division 1 and control divisions. Series are normalized to correspond at the announcement date, captured by the vertical line. The plot begins at September 5, 2016, which was the last week for the pre-event estimation period to recover the fixed effects.

Figure 5: Reported Change in Actual Effort, Agents in Treated Division 1



Notes: 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
main			
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

Notes: 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 4.3 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
main			
Commission	191.45	321.78	473.48
	(183.77)	(224.46)	(360.39)
Adherence to Schedule	0.81	0.85	0.84
	(0.15)	(0.10)	(0.10)
Total Calls	68.43	71.15	73.74
	(27.00)	(24.19)	(25.07)
Tenure (days)	156.42	222.65	717.06
	(63.74)	(114.83)	(483.69)
Predicted Pct Δ Commission Post-Treatment	-0.18	-0.18	-0.17
	(0.03)	(0.03)	(0.03)
Age	23.43	23.46	28.24
	(4.59)	(3.81)	(8.63)
Single	0.82	0.74	0.56
	(0.38)	(0.44)	(0.50)
White	0.72	0.73	0.73
	(0.45)	(0.45)	(0.45)
Male	0.70	0.79	0.72
	(0.46)	(0.41)	(0.45)
Survey Response to Firm Fairness is 85+	0.57	0.48	0.33
	(0.50)	(0.50)	(0.47)
Likelihood to Refer Friend	0.67	0.63	0.50
	(0.47)	(0.48)	(0.50)
Believes Promotion is Likely	0.61	0.81	0.58
	(0.49)	(0.39)	(0.50)
Survey Questions Missing	0.42	0.18	0.09
	(0.49)	(0.38)	(0.29)
Observations	175	164	179

Notes: 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.

Table 3: Linear Probability Model Estimates of Turnover, Separate Estimates for Each Treated Division

	Treated Div 1			Treated Div 2		
Fixed Effects:	Time	Time and Div x Week-of-Year	Div x Time	Time	Time and Div x Week-of-Year	Div x Time
	(1)	(2)	(3)	(4)	(5)	(6)
	b/se	b/se	b/se	b/se	b/se	b/se
Treated x Post	-0.006	-0.006		0.013**	0.023*	
	(0.004)	(0.007)		(0.004)	(0.010)	
Treated x Post x Sales Z Score	0.021**	0.015**	0.016*	-0.011	0.002	-0.013
	(0.007)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)
Treated x Placebo	0.000			0.010		
	(0.004)			(0.007)		
Treated x Placebo x Sales Z Score	-0.006		-0.002	0.010***		0.012***
	(0.004)		(0.004)	(0.003)		(0.003)
Mean DV	0.037	0.037	0.037	0.036	0.036	0.036
Observations	51497	51497	51497	45328	45328	45328
P on Treated x Post x Z-Score	0.018	0.084	0.100	0.239	0.684	0.684
P on Treated x Post	0.480	0.315	.	0.125	0.389	.

Notes: Models in Columns 1-3 include Treated Division 1 and control divisions. Models in Columns 4-6 include Treated Division 2 and control divisions. Two forms of inference are presented, one using standard errors clustered by manager (see parentheses) and the second using p-values with division-level clusters (see the final two lines) computed using the wild cluster bootstrap randomization inference procedure in MacKinnon and Webb (2018). The estimates come from a linear probability turnover model that includes a 5th order polynomial for time at risk. Placebo means an indicator for the date 52 weeks prior to the treatment date for that division. The z-score is the standardized measure of agent's pre-treatment individual productivity estimated as their adjusted fixed effect according to the procedure in Lazear et al. (2015). For additional details see section 4.2. Specifications in Columns 2 and 5 have division by week-of-year fixed effects to account for seasonality. Specifications in Columns 3 and 5 add division-by-week fixed effects.

Table 4: Difference-in-Differences Estimates of Changes in Effort

	OLS	OLS w Pre Avg.	OLS Re-Weighting	FE	Balanced	FE Re-Weighting
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Adherence, or Availability to Answer Calls						
	b/se	b/se	b/se	b/se	b/se	b/se
Treated x Post	0.012	0.007	0.021	0.013	0.008	0.014
	(0.010)	(0.011)	(0.013)	(0.008)	(0.009)	(0.011)
Observations	32540	27206	13074	32540	14218	13074
Panel B: Conversion Rate (Fraction of Calls with Positive Sales)						
	b/se	b/se	b/se	b/se	b/se	b/se
Treated x Post	0.007	0.008	0.001	0.004	0.003	-0.000
	(0.009)	(0.008)	(0.008)	(0.006)	(0.006)	(0.006)
Observations	33044	27800	12628	33044	13981	12628
Panel C: Log Revenue Per Call at Old Prices						
	b/se	b/se	b/se	b/se	b/se	b/se
Treated x Post	0.047	0.044	0.002	-0.002	0.005	-0.001
	(0.056)	(0.046)	(0.037)	(0.035)	(0.043)	(0.035)
Observations	35366	29801	13851	35366	15071	13851
Panel D: Log Revenue Per Call at New Prices						
	b/se	b/se	b/se	b/se	b/se	b/se
Treated x Post	0.113*	0.125**	0.038	0.068*	0.071	0.036
	(0.054)	(0.045)	(0.038)	(0.034)	(0.044)	(0.035)
Observations	35366	29801	13851	35366	15071	13851
Panel E: Log Commission Per Call						
	b/se	b/se	b/se	b/se	b/se	b/se
Treated x Post	-0.185**	-0.124*	-0.098	-0.179***	-0.174***	-0.106
	(0.068)	(0.051)	(0.061)	(0.049)	(0.050)	(0.068)
Observations	35071	29518	13820	35071	14955	13820

Notes: Sample includes Treated Division 1 and control divisions. Errors are clustered by direct manager. To conserve space we omit the wild cluster bootstrap P-values, but the effort increases in Panel D are not significant at conventional levels. All models have fixed effects for time, division, office location, ethnicity, gender, and marital status as well as division-specific time trends and seasonal controls. Seasonal controls include leads-and-lags of average division-level commissions 1 year prior to the week in question. To account for experience effects, all models include cubic splines for tenure with the firm and a cubic polynomial in age. 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 6 weeks prior to treatment. The estimation sample includes the data post-dating the propensity score estimation period 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 Appendix A.1 and Figures A.1b and A.1a. The balanced sample conditions on workers who are present prior to July of 2016 and after April of 2017. Differing numbers of observations across panels reflect small differences in data availability across time for different divisions.

Table 5: Within-Worker Difference-in-Differences Estimates of Heterogeneous Effort Responses.

		Balanced	Re-Weighted		Balanced	Re-Weighted
	(1)	(2)	(3)	(4)	(5)	(60)
Panel A: Adherence						
	b/se	b/se	b/se	b/se	b/se	b/se
Treated x Post	0.014	0.008	0.016			
	(0.008)	(0.009)	(0.010)			
Treated x Post x Sales Z Score	-0.004	0.000	-0.005	-0.003	-0.000	-0.005
	(0.004)	(0.004)	(0.007)	(0.004)	(0.004)	(0.007)
Mean DV	0.803	0.820	0.822	0.803	0.820	0.822
Observations	32540	14218	13034	32540	14218	13034
Panel B: Conversion Rate						
	b/se	b/se	b/se	b/se	b/se	b/se
Treated x Post	0.009	0.003	0.002			
	(0.006)	(0.006)	(0.007)			
Treated x Post x Sales Z Score	-0.018***	-0.011*	-0.014**	-0.018***	-0.011**	-0.016**
	(0.004)	(0.005)	(0.005)	(0.003)	(0.004)	(0.005)
Mean DV	0.265	0.282	0.305	0.265	0.282	0.305
Observations	33044	13981	12587	33044	13981	12587
Panel C: Log Pseudo-Revenue Per Call at Old Prices						
	b/se	b/se	b/se	b/se	b/se	b/se
Treated x Post	0.010	-0.004	0.005			
	(0.037)	(0.043)	(0.030)			
Treated x Post x Sales Z Score	-0.055*	-0.032	-0.043	-0.044	-0.019	-0.051*
	(0.027)	(0.031)	(0.025)	(0.023)	(0.026)	(0.025)
Observations	35366	15071	13810	35366	15071	13810
Panel D: Log Pseudo-Revenue Per Call at New Prices						
	b/se	b/se	b/se	b/se	b/se	b/se
Treated x Post	0.082*	0.064	0.043			
	(0.036)	(0.043)	(0.029)			
Treated x Post x Sales Z Score	-0.062*	-0.046	-0.047	-0.049*	-0.029	-0.053*
	(0.026)	(0.031)	(0.024)	(0.022)	(0.025)	(0.025)
Observations	35366	15071	13810	35366	15071	13810
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 Appendix A.1). 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: Turnover Changes do not Reflect Sentiment, Perceived Fairness, and Promotions Expectations

	Treated Div 1			Treated Div 2		
Fixed Effects:	Time	Time and Div x Week-of-Year	Div x Time	Time	Time and Div x Week-of-Year	Div x Time
	(1)	(2)	(3)	(4)	(5)	(6)
	b/se	b/se	b/se	b/se	b/se	b/se
Treated x Post	-0.008	-0.005		0.005	0.014	
	(0.010)	(0.013)		(0.008)	(0.011)	
Treated x Post x Sales Z Score	0.012	0.014**	0.010	-0.011	0.004	-0.013
	(0.006)	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)
Referral Likelihood	-0.002	-0.002	-0.002	-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	0.004	0.004	0.010	0.009	0.007
	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)	(0.008)
Promotion Likely	-0.008***	-0.008***	-0.009***	-0.009***	-0.009***	-0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Treated x Post x Promotion	-0.011	-0.011	-0.011	-0.001	-0.000	-0.002
	(0.011)	(0.011)	(0.011)	(0.013)	(0.014)	(0.014)
Believes Firm is Fair	-0.005*	-0.006**	-0.005*	-0.004*	-0.005**	-0.005*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Treated x Post x Firm Fair	0.009	0.009	0.009	-0.003	0.000	-0.002
	(0.009)	(0.009)	(0.009)	(0.016)	(0.017)	(0.018)
Mean DV	0.037	0.037	0.037	0.036	0.036	0.036
Observations	51497	51497	51497	45328	45328	45328
P on Treated x Post x Z-Score	0.039	0.037	0.157	.	.	.
P on Treated x Post	0.702	0.831	.	.	.	.

Notes: See notes for specification in Table 3 and definitions of survey measures in the text. Note that, due to sparsity of survey responses in Treated Division 2, we do not have sufficient variation to perform the randomization and bootstrap inference procedure.

Table 7: Heterogeneous Effort Responses Based on Sentiment, Perceived Fairness, and Promotions Expectations.

	Adherence	Conversion	Log Pseudo Rev Per Call Old Prices	Log Pseudo Rev Per Call New Prices
	(1)	(2)	(3)	(4)
	b/se	b/se	b/se	b/se
Treated x Post x Sales Z Score	-0.004	-0.018***	-0.047*	-0.049*
	(0.005)	(0.004)	(0.022)	(0.022)
Treated x Post x High Refer	0.013	0.005	0.008	0.024
	(0.009)	(0.007)	(0.040)	(0.037)
Treated x Post x Promotion	-0.011	-0.007	-0.053	-0.058
	(0.007)	(0.008)	(0.039)	(0.037)
Treated x Post x Firm Fair	-0.006	0.008	0.059	0.061
	(0.009)	(0.009)	(0.033)	(0.031)
Observations	32540	33044	35366	35366

Notes: See notes for specification in Table 5. These estimates have worker fixed effects and division-by-week fixed effects.

Appendix

A.1: Reweighting Estimators

This section provides details about the implementation of the reweighting estimators that attempt to match individuals in control accounts with individuals in Treated Division 1. The purpose is to match individuals' sales trajectories.

The first step is to estimate the probability of being in Treated Division 1. We use the data from the pre-period for this purpose but hold out the data one month prior to the commission reduction announcement. The second step is to use the propensity score from this estimation procedure to form weights which will be used in later regressions. The third step is to assess how well the reweighting estimates fit, using a "hold out" sample of data one month prior to the treatment period. In the first step, we estimate logit models where the dependent variable is being in Treated Division 1. Each worker present in the pre-treatment period for Treated Division 1 and the control divisions enters the sample once. The first month of available data includes the X variables and demographic characteristics in levels. The regressors in X are an indicator for male, the agent's age, and individual agent level monthly averages of log commissions, log commission per call, log revenue, log total calls, tenure, and adherence. For each of the regressors on productivity or utilization, we also include one and two month differences over future months to capture trends in these measures. We then estimate the logit model and form $\hat{P}$, the predicted probability of being in Treated Division 1.

The weights in the second step are formed as $W_i = Treated_i + (1 - Treated_i)\frac{\hat{P}}{1-\hat{P}}$ where $\hat{P}$ is the treatment probability estimated from a logistic regression on pre-period data and $Treated_i$ indicates the worker is in Treated Division 1.

Figures A.1b and A.1a assess fit, making it clear that per-call fit works reasonably well. Fit for overall revenue is not as good, suggesting that the new territories 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.[36]

[36] Given that the divergence between the re-weighted control group trend and the trend for Treated Division

A2: Proofs

Proof of Proposition 1

The goal is to show that the marginal effect of skill, θ, on agent i's effort response to a change in commissions is directly proportional to the curvature of the agents' cost function. Specifically:

$$\frac{\partial^2 e_i^*}{\partial R \partial \theta_i} \propto \left(c''\left(e_i^*\right)\right)^2 - c'''\left(e_i^*\right) R\theta_i. \tag{.6}$$

By the first order condition we have $R\theta_i = c'\left(e_i^*\right)$. Differentiating both sides yields $\theta_i = c''\left(e_i^*\right)\frac{\partial e_i^*}{\partial R}$ and $R = c''\left(e_i^*\right)\frac{\partial e_i^*}{\partial \theta_i}$. Differentiating twice yields: $1 = c'''\left(e_i^*\right)\frac{\partial e_i^*}{\partial R}\frac{\partial e_i^*}{\partial \theta_i} + c''\left(e_i^*\right)\frac{\partial^2 e_i^*}{\partial R \partial \theta_i}$, substituting the earlier terms and rearranging yields:

$$\frac{\partial^2 e_i^*}{\partial R \partial \theta_i} = \frac{\left(c''\left(e_i^*\right)\right)^2 - c'''\left(e_i^*\right) R\theta_i}{\left(c''\left(e_i^*\right)\right)^3},$$

which completes the proof as $c'' > 0$ by assumption.

Proof of Proposition 2

Because the optimal effort e_i^* is increasing in type (see proof to Proposition 6), revealed preference implies that the agents' expected utility $V(\alpha, R; \theta_i)$ is increasing in type, therefore so is $w(\theta_i)^*$. Accordingly, there exists a set of fixed-wage offers with positive density which is sufficient to lure low-skilled agents away from the firm, but insufficient to attract their higher-skilled counterparts. The fact that all agents face the same distribution of incoming, outside offers completes the argument.

By definition, $w(\theta_i)^*$ is the lowest external, fixed-wage offer that yields utility $V(\alpha, R; \theta_i)$ to agent i. Because the agents' value function is increasing in R (see proof to Proposition 6 for the symmetric argument made over type), a lower commission rate, R, will always decrease agents' reservation fixed-wage, $w(\theta_i)^*$. To prove the second statement, we show that $\frac{\partial^2 w(\theta_i)^*}{\partial R \partial \theta_i} > 0$, which suffices as the distribution of outside offers is held constant. Abusing notation, in what follows let

1 occurs before treatment begins, we suspect demand changes are responsible for divergence in the levels measures.

U denote $U(\alpha, R, \theta_i, e_i^*)$ and hence $U' = \frac{\partial U}{\partial e} = 0$. Accordingly, we have:

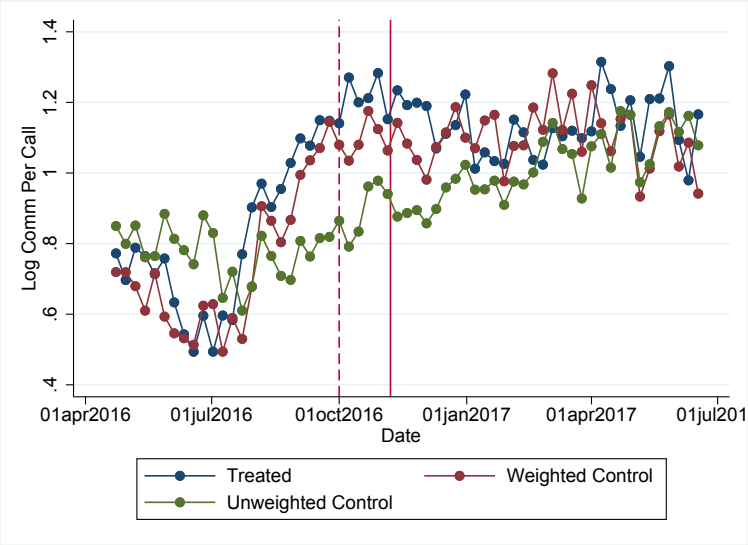
$$\begin{aligned} \frac{dV}{dR} &= \frac{\partial U}{\partial R} + U'(e_i^*)\frac{\partial e_i^*}{\partial R} = \frac{\partial U}{\partial R} \\ \frac{d^2V(\alpha, R, \theta_i, e_i^*)}{dRd\theta_i} &= \frac{\partial^2 U}{\partial R \partial \theta_i} + \frac{\partial U}{\partial R}U'(e_i^*)\frac{\partial e_i^*}{\partial \theta_i} \\ &= \frac{\partial^2 U}{\partial R \partial \theta_i} = 2e_i^* > 0, \end{aligned}$$

where the final inequality holds by the strict convexity of $c(\cdot)$ and the fact that both $c(0)$ and $c'(0)$ are equal to zero.

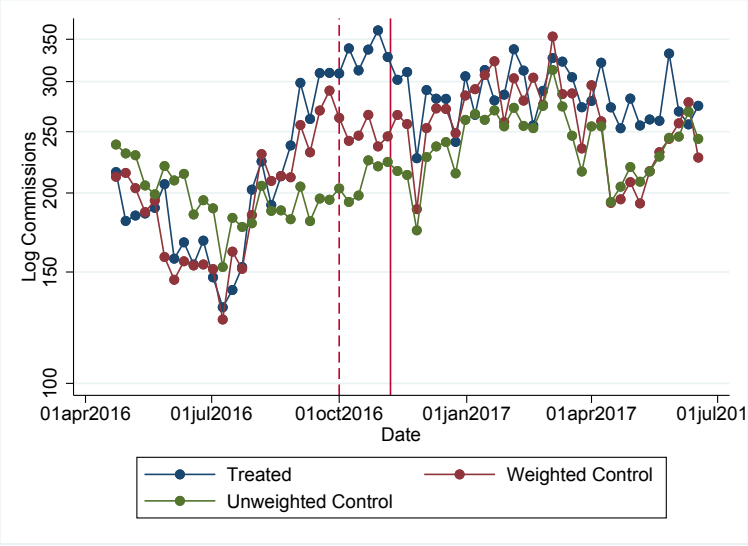
The change in turnover rates requires differentiating the quit function and depends on the density $f(\cdot)$ at different points in the support of reservation wages.

A3: Appendix Tables and Figures

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



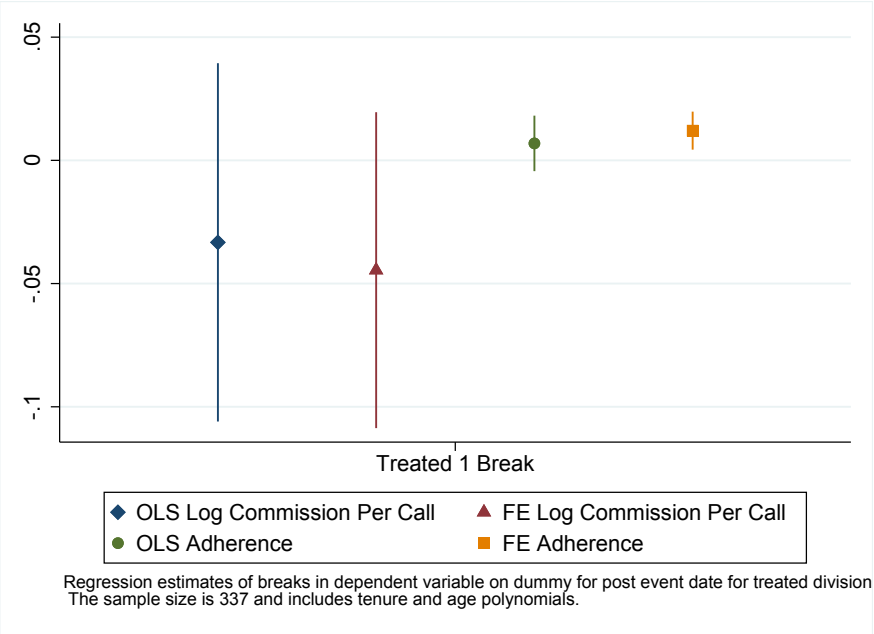
(a) Log Commissions per Call



(b) Commissions Per Week, log Scale

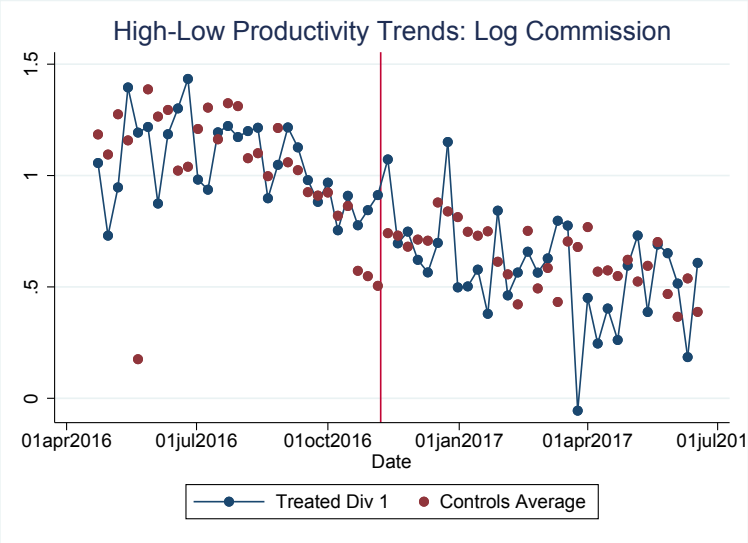
Note: Unweighted and propensity score re-weighted comparison of controls and Treated Division 1. The dashed line represents the end of the period used for estimating the propensity score weights. Differences in the per-call and overall commissions between late September 2016 and November 2016 are due to an increase in call volume. Overall commission levels are displayed on a log scale.

Figure A.2: Parameter Estimates and Confidence Intervals for Structural Break Tests in the Control Divisions

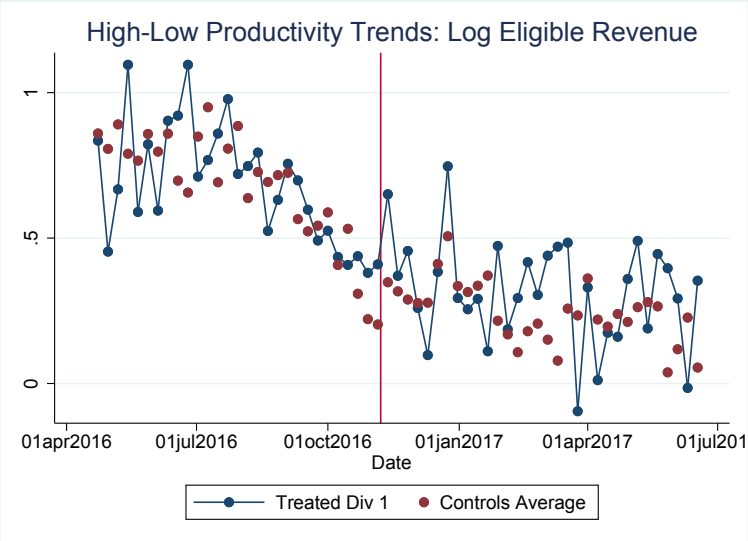


Note: Structural break tests come from regressions using the control sample. The figure reports the post-treatment indicator parameter estimate and confidence interval. The dependent variable is in the legend, and each regression includes a post-treatment indicator for Treated Division 1, the matrix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

Figure A.3: Parallel Trends by Worker Type within Division: Ability Heterogeneity

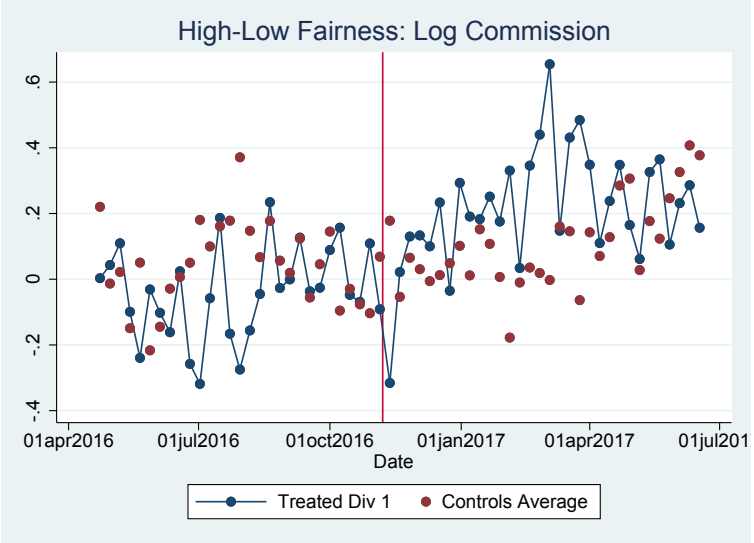


(a) Log Commissions by Median Ability

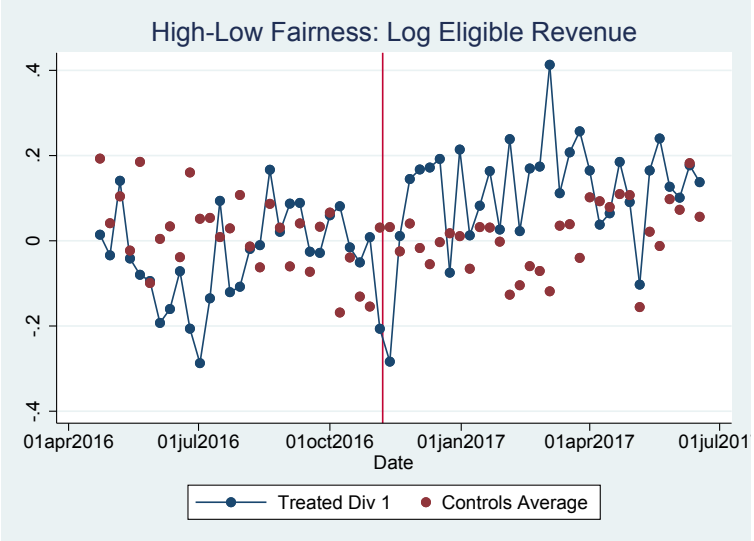


(b) Log Revenue by Median Ability

Figure A.4: Parallel Trends by Worker Type within Division: 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
main			
Commission	351.99	553.91	718.60
	(241.26)	(312.82)	(335.50)
Adherence to Schedule	0.75	0.79	0.80
	(0.22)	(0.15)	(0.13)
Total Calls	55.87	46.47	48.96
	(22.11)	(15.84)	(12.69)
Tenure (days)	329.53	651.64	1367.34
	(92.27)	(356.62)	(424.14)
Age	26.20	29.74	33.56
	(4.04)	(7.42)	(10.32)
Single	0.77	0.56	0.28
	(0.43)	(0.50)	(0.45)
White	0.91	0.27	0.68
	(0.28)	(0.45)	(0.47)
Male	0.74	0.73	0.64
	(0.44)	(0.45)	(0.48)
Survey Response to Firm Fairness is 85+	0.22	0.49	0.09
	(0.42)	(0.51)	(0.29)
Likelihood to Refer Friend	0.63	0.68	0.50
	(0.49)	(0.47)	(0.51)
Believes Promotion is Likely	0.67	0.54	0.50
	(0.48)	(0.50)	(0.51)
Survey Questions Missing	0.23	0.09	0.12
	(0.43)	(0.29)	(0.33)
Observations	47	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%.