STRATEGIC HUMAN CAPITAL AND ENTREPRENEURSHIP

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Dedicated to my parents who have immersed me in unconditional love and support,
my husband who always understands me and has faith in me,
and my son who makes me strong, happy, and hopeful about the days to come.

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ABSTRACT

STRATEGIC HUMAN CAPITAL AND ENTREPRENEURSHIP

Jiayi Bao

Iwan Barankay

This dissertation consists of three self-contained chapters on strategic human capital and entrepreneurship and explores the causal impacts of specific perks, benefits, and compensation structures on worker behavior and venture outcomes.

Chapter 1 addresses a popular trend in technology companies and startups of offering unlimited vacation as an employee perk. I examine whether unlimited vacation benefits firms, the mechanisms, and the contingencies based on organizational conditions in three empirical settings. Using a combination of text analysis of online reviews, difference-in-differences regression of archival data at a high-tech company, and randomized controlled experiments with online workers, I find that the perk leads to more vacation time, higher subjective productivity, and increased overall labor efficiency. These effects involve multiple mechanisms (sorting, productivity, and engagement) and are contingent on social dynamics, bundled HR practices, and the culture for punishing under-performance.

Chapter 2 shifts the focus from industry trends in firm HR practices to institutional changes that affect employees' access to benefits. Through a difference-in-differences design, I examine how employees' access to the New Jersey Paid Family Leave program impacts the profitability of new ventures. I find that the program adversely affects the likelihood of making profits for the average new venture. The negative effect is stronger for businesses in greater financial stress and with more reliance on incumbent employees. Innovative ventures, however, are more likely to be profitable post treatment.

Chapter 3, joint with Andy Wu, links worker preferences to compensation structure to explain why the distribution of equity compensation is more equal than that of salary in many startups. We propose that workers have different equality preferences for different types of payoffs and test our predictions in an experimental group production game. Results suggest that workers view salary and equity in two separate domains, and they are more inequality averse in the equity domain, implying that firms could benefit from a compensation structure that is more equitable in the equity portion. Furthermore, we find a presentation effect: separation of the two domains is triggered only when equity is shown in a different percentage form from the absolute form of salary.

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OVERVIEW

Human capital is the most critical asset of modern technology and service firms (Bresnahan et al., 2002; David et al., 1998; Machin and Van Reenen, 1998) and has been recognized as a resource of sustainable competitive advantage for businesses (Barney and Wright, 1998; Becker and Huselid, 2006; Campbell et al., 2012a; Wright and McMahan, 1992). Consequently, human capital management has become a strategy imperative for firms and has led to a plethora of economics and management studies on when organizational performance can be improved through specific compensation structures (e.g., Bandiera et al., 2007; Campbell et al., 2012b; Carnahan et al., 2012; Dohmen and Falk, 2011; Lazear, 2000; Oyer and Schaefer, 2005), perks and benefits (e.g., Bloom et al., 2015; Burbano, 2016; Eriksson and Kristensen, 2014; Manchester, 2012), and human resource systems (e.g., Cappelli and Neumark, 2001; Gittell et al., 2010; Huselid, 1995; Koch and McGrath, 1996).

The context of entrepreneurship, especially considering the heterogeneity in its definition (Gartner, 1990), warrants distinctive scrutiny amidst the scholarly interests in strategic human capital for two main reasons. First, insights from research on traditional firms may not apply to entrepreneurial ventures, which are characterized by the liabilities of newness (Stinchcombe, 1965) and high risk (Aldrich and Yang, 2012). These ventures face unique human capital management challenges because they typically lack legitimacy as employer organizations (Hannan and Freeman, 1977; Williamson et al., 2002), do not have formal HR policies or systems for managing employees (Klaas et al., 2000), and are known to compensate employees with less pay and fewer benefits (Burton et al., 2018; Evans and Leighton, 1989; Litwin and Phan, 2013). Second, new perspectives can be generated for human capital research from studying entrepreneurial firms that are characterized by their innovation and growth orientation. Given the fast-paced and flexible nature of these firms, they are more likely to engage in experimentation and pivots (Kerr et al., 2014; Manso, 2016; Pillai et al., 2019), thus are more likely to test different compensation structures, benefits models, and bundles of practices to attract, incentivize, and retain talent.

To date, however, research at the intersection of human capital and entrepreneurship has mostly adopted the upper echelon view and focused on the human capital of the individual entrepreneur (e.g., Davidsson and Honig, 2003; Haber and Reichel, 2007) or the founding team (e.g., Hambrick and Mason, 1984; Yang et al., 2020; Zarutskie, 2010), paying little attention to human capital issues in the management of employees. Studies that do examine the relationship between strategic human resource practices for employees and venture performance, on the other hand, are mostly descriptive, as they typically cannot unbundle specific practices from the human resource system in field settings, nor do they aim to identify the causal effects and specific mechanisms of the practices examined (e.g., Andries and Czarnitzki, 2014; Hayton, 2003; Maes et al., 2005; Rauch et al., 2005; Rauch and Hatak, 2016; Sels et al., 2006; Way, 2002).

This dissertation, consisting of three self-contained chapters on strategic human capital and entrepreneurship, aims to fill these scholarly gaps by providing a causal understanding of how strategic human capital issues in managing employees can affect the performance of entrepreneurial firms. Using a combination of theoretical modeling, difference-in-differences regression, and experimental design, I adopt a multi-method approach to investigate three specific understudied topics in the literature, manifested through three important ongoing phenomena respectively, and explore the interplay of firm practices and characteristics, institutional environments, and individual worker preferences.

Chapter 1 addresses the recent trend of offering unlimited vacation to employees, which is an innovative firm practice that is most popular among technology companies and startup ventures. Given the scant work on the newer, unconventional HR practices that have emerged as a result of the changing workplace, this chapter examines whether unlimited vacation benefits firms, the mechanisms of its effect, and the contingencies based on organizational conditions through three empirical settings. Setting 1 provides background on macro-patterns of unlimited vacation adoption based on qualitative online benefits reviews. Setting 2 illustrates what unlimited vacation does to employees in a large high-tech company through a difference-in-differences design. I find that the perk leads to more vacation time and higher subjective productivity; the latter effect is much larger in close-knit teams but becomes negative in teams with weak interpersonal relationships. In Setting 3, guided by a formal model predicting worker behavior, I conducted a randomized controlled trial with two experiments and hired online workers for a month-long job to cleanly examine the effects of unlimited vacation on firms by itself (n=631). I find that unlimited vacation leads to higher overall labor efficiency through three channels: (1) attracting more high-performers during recruitment, (2) increasing worker productivity in the performance stage, and (3) inducing extra work from more engaged and happier workers. A strong firing threat conditional on performance reduces the slacking rate. A performance-oriented bundled system strengthens the performance gains, but unlimited vacation also improves productivity by itself. This chapter demonstrates how managers can create a highly skilled, productive, and motivated workforce through the perk of unlimited vacation. It further highlights the contingencies based on social dynamics, bundled HR practices, and the culture for punishing under-performance.

In Chapter 2, I shift the focus from industry trends in firm HR practices to institutional changes that affect employees' access to benefits by joining the ongoing policy debate over the business impacts of state-funded paid family leave programs for workers. Despite a large literature on how institutional environments shape venture formation, little is known about how social safety nets for employees at entrepreneurial firms influence business performance post the founding stage. This chapter examines how employees' access to the 2009 New Jersey Paid Family Leave (PFL) program impacts the profitability of new ventures. Using a difference-in-differences design, I find that the state PFL program adversely affects the likelihood of making profits for the average new venture. The negative effect is stronger for businesses in greater financial stress and those that are more reliant on incumbent employees, suggesting two operating mechanisms—the lack of financial resources and the lack of flexibility in staffing—that render new ventures particularly vulnerable to human capital shocks as a result of institutional changes. Innovative ventures, however, experience an asymmetric effect and are more likely to be profitable post treatment. Taken together, this study combines institutional perspectives, employment topics, and human resource considerations to highlight that social safety nets for workers may have unintended consequences for nascent businesses, especially considering the heterogeneity in how ventures can absorb these impacts.

Lastly, motivated by the pattern that the distribution of equity compensation (i.e., stock options) is more equal than the distribution of salary in many startups, Chapter 3, joint with Andy Wu, proposes a possible explanation resulted from unique individual worker preferences. Linking behavioral theory to compensation structure, this chapter examines whether workers have different equality preferences depending on the type of payoff. We design an experimental group production game to examine how workers respond to combinations of different distributions of equity and salary. Results suggest that workers view salary and equity in two separate domains, and they are more inequality averse in the equity domain, implying that firms could benefit from a compensation structure that is more equitable in the equity portion. Furthermore, we find a presentation effect underlying inequality aversion across different payoffs: the separation of the two domains is triggered only when equity is shown in a different percentage form from the absolute form of salary. These results highlight that worker preferences can be contingent on the compensation domain, and more specifically the framing of the domain, and therefore have implications for the design of compensation structure in organizations.

In all, this dissertation sets out to facilitate a scholarly dialogue across the fields of strategy, entrepreneurship, human resource management, and personnel economics through the triangulation of multiple methods. By studying ongoing phenomena, these chapters also hope to generate useful insights for practitioners and policy makers.

CHAPTER 1 : (How) Do Risky Perks Benefit Firms? The Case of Unlimited Vacation

Wharton People Analytics Research Paper Competition Winner, 2020

Best Student Paper Finalist, REER Conference, 2019

Abstract

This paper addresses the recent trend of offering unlimited vacation to employees. While potentially useful for acquiring human capital benefits, unlimited vacation is a risky perk for firms due to the possibility of abuse. Does unlimited vacation actually benefit firms? If so, how? And what are the contingencies based on organizational conditions? I explore the phenomenon in three empirical settings. Setting 1 provides background on macro-patterns of unlimited vacation adoption based on qualitative online benefits reviews. Setting 2 illustrates what unlimited vacation does to employees in a large high-tech company through a difference-in-differences design. I find that the perk leads to more vacation time and higher subjective productivity; the latter effect is much larger in close-knit teams but becomes negative in teams with weak interpersonal relationships. In Setting 3, guided by a formal model predicting worker behavior, I conducted a randomized controlled trial with two experiments and hired online workers for a month-long job to cleanly examine the effects of unlimited vacation on firms by itself (n=631). In Experiment 1, I varied worker type (high- vs. low-performers), work contract (unlimited vacation, capped vacation, or a choice between the two), and firing threat (strong vs. weak). In Experiment 2, I introduced additional treatments to separate out the vacation feature from other typically bundled practices in the unlimited vacation contract. I find that unlimited vacation leads to higher overall labor efficiency through three channels: (1) attracting more high-performers during recruitment, (2) increasing worker productivity in the performance stage, and (3) inducing extra work from more engaged and happier workers. A strong firing threat con-

ditional on performance reduces the slacking rate. A performance-oriented bundled system strengthens the performance gains, but unlimited vacation also improves productivity *by itself*. This paper demonstrates how managers can create a highly skilled, productive, and motivated workforce through the perk of unlimited vacation. It further highlights the contingencies based on social dynamics, bundled HR practices, and the culture for punishing under-performance.

1.1. Introduction

> *"Our vacation policy is 'take vacation.' We don't have any rules or forms around how many weeks per year. Frankly, we intermix work and personal time quite a bit, doing email at odd hours, taking off weekday afternoons for kids' games, etc. Our leaders make sure they set good examples by taking vacations, often coming back with fresh ideas, and encourage the rest of the team to do the same."*
>
> — Netflix Culture Document

In 2004, Netflix introduced its well-known "unlimited vacation policy" that allowed its employees to *take as much vacation as needed and whenever needed*, in an effort to "focus on what people get done, not how many hours or days worked."[1] The idea of unlimited *paid* vacation was revolutionary at the time and thus was slow to gain acceptance. In the last four to five years, however, there has been a spike in its popularity—about 2,000 firms have offered unlimited vacation to their employees[2] and there has been a nearly 200% increase in how frequently unlimited vacation is mentioned in job postings.[3] A main driver for this recent trend is the changing workplace. As firms are experiencing recruiting difficulties and talent shortages (Belenzon and Tsolmon, 2016), workers are increasingly valuing job flexibility and autonomy.[4] Unlimited vacation, mostly paid and implemented with an emphasis on performance rather than face time, not only removes the cap on vacation time but also gives employees more discretion in when to take vacation—a form of schedule flexibility and autonomy in jobs. As stated by the CEO of the Portland startup Mammoth in one of my interviews:[5]

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[1] Netflix (2009). *Freedom & Responsibility Culture*. Retrieved from https://www.slideshare.net/.

[2] I identified 1,901 firms with unlimited vacation using benefits review data on Glassdoor. See Section 1.3 for more details.

[3] Andrew Flowers, "Unlimited Vacation: A Rare but Quickly Growing Job Benefit," *The Indeed Hiring Lab*, June 18, 2019, https://www.hiringlab.org.

[4] Fractl (2016). *Employee Benefits Study: The Cost and Value of Employee Perks.* Retrieved from http://www.frac.tl/employee-benefits-study/.

> *"Firms are forced to look at unlimited vacation since technology is resetting the employer-employee relationship, and employees want more flexibility/autonomy."*

Despite its current popularity, there is no consensus on what unlimited vacation actually does to firms. Anecdotally, we know that some firms that have implemented it claim to have seen benefits. The American multinational conglomerate General Electric argues that unlimited vacation is "a game changer" in how they can "compete for experienced talent,"[6] thus benefiting recruitment. Mammoth reports that unlimited vacation "drives up productivity through induced flexibility for a more motivated workforce,"[7] thus benefiting performance. Others are more agnostic about its benefits. The retailer Target acknowledges that unlimited vacation "removes the liability line for unused vacation on the balance sheet" but suggests it likely has "no other real impacts."[8] On the other hand, unlimited vacation also presents potential costs to firms due to the risk of abuse by indolent workers. As pointed out by an employee at Morningstar, "unlimited vacation rewards only the greedy and those who abuse it."[9]

The tension between the unclear human capital benefits and the potential agency costs highlights that unlimited vacation is a *risky perk* for firms. Unlike traditional benefits like health insurance, pension, stock options, and capped paid vacation that are often formally stated in employment contracts and thus difficult to change ex post, perks are incidental, less likely to be contracted fully, and can be potentially taken away.[10] As a result, the use of employee perks has become an important way to attract, motivate, and retain people, as firms have more leeway to experiment with them. While some perks are not risky—examples include gym membership, standing desks, and free child care, for the costs associated with perk consumption are directly controllable by the firm, other perks are risky and can incur negative consequences that cannot be directly controlled. For instance, corporate sabbatical program faces the risk of employees never coming back, job sharing option comes with the risk of accountability issues, and free workplace alcohol presents the risk of improper behavior.

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[5] From an interview I conducted with the CEO of Mammoth, Nathan Christensen, on December 12, 2018.

[6] Romy Newman, "Why Your Company Needs to Offer Unlimited Vacation," *Inc.*, April 10, 2017, https://www.inc.com.

[7] From an interview I conducted with the CEO of Mammoth, Nathan Christensen, on December 12, 2018.

[8] From an interview I conducted with the Benefits Director of Target on November 26, 2016.

[9] A Glassdoor review made by an employee at Morningstar on July 3, 2015.

[10] This definition of perk follows the Merriam Webster Dictionary, which states that perk is "a privilege, gain, or profit incidental to regular salaries or wages," and is consistent with the concepts of perks illustrated by Marino and Zabojnik (2008) and Rajan and Wulf (2006).

What do we know about these risky perks from research? While a large body of literature has looked at various ways for firms to capture and create value from their human assets through the acquisition of talent externally (Chatterji and Patro, 2014; Kim, 2018), the adoption of strategic HR practices internally (Collins and Clark, 2003; Gittell et al., 2010; Huselid, 1995; Koch and McGrath, 1996), and the use of non-pecuniary incentives such as corporate social responsibility (Burbano, 2016; Carnahan et al., 2017), corporate wellness programs (Gubler et al., 2018), and family-friendly work options (Bloom et al., 2011, 2015; Mas and Pallais, 2017), there is almost no work on the aforementioned newer risky perks that are increasingly gaining traction. Moreover, even though some prior work has shown the important role of human capital management strategy and practices in benefiting recruitment, performance, and retention, the discussion around the unintended consequences, such as increased labor costs (Cappelli and Neumark, 2001; Sels et al., 2006; Way, 2002) or unethical behavior (Lu et al., 2017), is still limited. It is essential, however, to have a wholistic view of how risky perks affect multiple organizational domains to fully evaluate their effectiveness. Lastly, there is little empirical evidence on the unique organizational conditions (Barney and Wright, 1998; Wright et al., 2001) and micro-foundational underpinnings (Coff and Kryscynski, 2011; Felin et al., 2015; Foss, 2011) that help firms sustain the competitive advantages from using risky perks.

This paper aims to shed light on the trade-off in the organizational use of risky perks by focusing on the case of unlimited vacation—a perk that endows schedule flexibility and autonomy to workers but also incurs the risk of abuse. First, does unlimited vacation benefit firms? If so, how? Second, what are the contingencies based on organizational conditions? To this end, I adopt a multi-method approach and exploit three complementary empirical settings to provide a comprehensive study of the unlimited vacation phenomenon. The first two settings are motivational and provide important background on unlimited vacation adoption and preliminary evidence on what it does to workers; the last setting cleanly answers the research questions by examining the overall effect on labor efficiency, drilling down to worker behavior to shed light on mechanisms in both the recruitment and performance stages, and manipulating organizational level cultures and systems to evaluate the contingencies.

The first setting provides background information on the macro-patterns of how unlimited vacation is adopted across firms, utilizing a unique qualitative database of 319,963 online reviews about job benefits and perks during 2014-2018 for 32,988 firms. Unlimited vacation is found to be mostly adopted by emerging companies, but is also gaining popularity in all kinds of firms. Two major themes are uncovered: unlimited vacation is inseparable from organizational systems and cultures that emphasize performance; and its use is contingent upon social interaction.

In the second setting, I turn to a large high-tech company and examine how unlimited vacation is carried out at the micro-level in the field where the perk is available to employees with various job levels and functions. Focusing on a sample of employees who experienced internal transfers from capped vacation roles to unlimited vacation roles, I adopt a difference-in-differences design and evaluate the effect of having access to unlimited vacation on employees' vacation and subjective productivity, treating employees who also experienced transfers but stayed in capped vacation roles as the control group. I find that having access to unlimited vacation increases vacation time and self-reported productivity for employees. Notably, the effect on perceived productivity is much more positive for employees in great teams with supportive social dynamics, but becomes negative for people in bad teams where interpersonal relationships are weak. The partnership with the high-tech company, however, also reveals key challenges in studying the perk in real firm settings. First, the effect on performance is measured subjectively at large, which may or may not translate into productivity for firms, as performance metrics are typically different for jobs with unlimited vacation and jobs with capped vacation. Second, we do not know how much of the effect is due to selection into unlimited vacation roles, how much is due to the actual treatment of unlimited vacation, and how much is due to other changes in the job that always come with the perk. Therefore, the fundamental question remains, does unlimited vacation lead to actual firm benefits by itself after removing all the other complexities?

My third setting answers this question through a longitudinal randomized controlled trial (RCT) with two experiments discussed in the next paragraph. To guide the experimental design and generate testable predictions at the worker level, I establish a theoretical model and elucidate how heterogeneous workers respond to unlimited vacation both in recruitment and in the subsequent performance stage. Workers start by choosing between two types of firms—firms with a capped vacation contract (a cap on vacation but with no performance requirements) and firms with an unlimited vacation contract (no cap on vacation but with a performance requirement)—and then allocate time between work and vacation. Workers who choose unlimited vacation may experience a potential complementarity to productivity, but also face a threat of firing when performance is not on par. Three main predictions come from the model: first, unlimited vacation is more attractive to high-performers than to low-performers, leading to a sorting effect; second, workers are more productive under unlimited vacation than under capped vacation, even after controlling for the sorting effect; third, a strong firing threat conditional on performance reduces the likelihood of slacking.

I test these theoretical predictions in an RCT that consists of two experiments on an online labor market, Amazon Mechanical Turk (MTurk)[11] where I hired workers for a well-paid month-long image-counting job that required working for a 16-minute session on each weekday during four consecutive weeks. Experiment 1 adopted a $2\times3\times2$ design by first assigning workers to either a high-performer or a low-performer treatment through the manipulation of unit effort cost for task completion. Second, I replicated how unlimited vacation and capped vacation are typically contracted in practice where unlimited vacation is bundled with a performance requirement and a removal of face time requirement. Workers were either given an opportunity to choose between the two contracts or were randomly assigned to one of them. Lastly, I varied whether workers experienced a strong or a weak firing threat under unlimited vacation when performance expectation could not be met. Experiment 2 introduced additional contract treatments to separate out the effect of each feature in the unlimited vacation contract. Results show that unlimited vacation leads to actual benefits for firms by improving overall labor efficiency[12] through three different mechanisms. First, it attracts more high-performers in the *recruitment* stage. Second, controlling for the sorting effect, there is an increase in individual worker productivity from unlimited vacation in the *performance* stage. Third, unlimited vacation workers show a high level of engagement, producing extra work outputs beyond their performance requirement in an effort to signal commitment to the job, and they are also happier. A stronger firing threat conditional on performance reduces slacking rate and ensures a higher level of labor efficiency, suggesting the need for appropriate firing culture to effectively curb opportunism. An aligned system that emphasizes performance strengthens the productivity gain, but the unlimited vacation feature also works by itself by contributing about 20-30% to the gain. In all, the findings regarding sorting, productivity, and slacking are consistent with the rational model predictions, and the findings regarding engagement point to additional benefits for firms. Workers also benefit from unlimited vacation themselves as they take more vacation than their capped vacation counterparts.

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[11] https://www.mturk.com/.

This paper makes several contributions and facilitates a dialogue across a number of fields.

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[12] Following Cappelli and Neumark (2001), overall labor efficiency is measured as output per dollar spent on labor.

First, it contributes to the strategic human capital literature in the resource-based view tradition (Becker and Huselid, 2006; Campbell et al., 2012a; Wright and McMahan, 1992) by presenting a new consideration for how firms can capture and create value from their human assets through a risky perk. Moreover, the findings provide insights into the unique organizational systems and cultures that may affect firms' capability in sustaining the competitive advantage from using this perk (Barney and Wright, 1998; Wright et al., 2001). Second, despite the large human resource management literature linking HR practices and organizational outcomes (Appelbaum et al., 2000; Bartel, 1994; Becker and Gerhart, 1996; Datta et al., 2005; Huselid, 1995; Ichniowski et al., 1996; Koch and McGrath, 1996), there is little work on the newer, unconventional HR practices that have emerged as a result of the changing workplace and the contingencies and mechanisms through which these practices take effect. This paper advances the knowledge of new HR trends by providing a wholistic evaluation on the causal effects of unlimited vacation in multiple domains including recruitment, performance, and engagement, along with the potential costs. Third, this paper joins the call for micro-foundations in management studies, especially in multi-level human capital research (Barney and Felin, 2013; Coff and Kryscynski, 2011; Ployhart and Moliterno, 2011), by linking firm-level results to individual-level worker responses. Also adding to the labor and personnel economics literatures on sorting and incentives, the experimental findings provide causal confirmation that non-pecuniary perks can induce self-selection among workers and that schedule flexibility can improve work productivity by itself.

Lastly, this study addresses a topic of growing practitioner interest that we have little knowledge about both theoretically and empirically. The phenomenon has sparked heated debate in practice regarding its positive or negative impact on organizations and workers. Notably, unlimited vacation is most relevant for emerging companies that comprise the majority of firms offering it, as we will see in the first empirical setting. As these entrepreneurial firms focus more on scaling-up challenges regarding human capital management and organizational design (DeSantola and Gulati, 2017), understanding the effects of unlimited vacation and the contingencies can help them make better decisions regarding the adoption of the perk and other innovative HR trends more generally—an implication which I will unpack in the discussion.

The paper proceeds as follows. Section 1.2 outlines the related literature. Section 1.3 provides background on macro-patterns of unlimited vacation adoption through qualitative evidence. Section 1.4 illustrates how unlimited vacation is carried out in a socially complex high-tech firm. Section 1.5 establishes a theoretical model that generates testable predictions about the effect of unlimited vacation. Section 1.6 describes the design of a longitudinal randomized controlled trial that tests the model predictions. Section 1.7 presents the experimental findings. Section 1.8 discusses implications and limitations. Section 1.9 concludes.

1.2. Related Literature

1.2.1. Unlimited Vacation and Benefits through the Recruitment Channel

Recruitment is considered the foundation of organizational performance (Phillips and Gully, 2015), and more so for entrepreneurial firms that are rapidly growing (Olian and Rynes, 1984; Buller and Napier, 1993). How can firms attract and select the talent they desire? Traditionally, the economics literature has focused on how firms can use different forms of compensation models and monetary rewards to achieve this goal, including performance pay (Cadsby et al., 2007; Dohmen and Falk, 2011; Eriksson and Villeval, 2008; Lazear, 2000), convex incentives (Larkin and Leider, 2012), risk-bearing compensation such as equity (Oyer and Schaefer, 2005), deferred compensation such as pensions (Allen et al., 1993; Gustman et al., 1994; Lazear, 1985), and tuition reimbursement program (Manchester, 2012). On the other hand, the strategic human resource management literature typically examines firms' deliberate choices of recruitment practices that are non-pecuniary, such as employer branding, marketing and messaging, sourcing, interviews, referrals, etc. (Phillips and Gully, 2015). Recently, there is a growing interest in how corporate social responsibility can be a potential way for firms to attract high-performers (Bode et al., 2015; Burbano, 2016).

Relatively little attention, however, has been paid to the role of employer-provided perks in inducing the sorting of employees with different characteristics. Oyer (2008) and Eriksson and Kristensen (2014) argue that people sort to firms based on their demand for particular benefits including health insurance, child care, on-the-job meals, flextime, training, and employer-provided PC and Internet. Ye and Tambe (2015) consider a more comprehensive list of work-related perks by examining high-tech firms and conjecture that these perks attract workers who are better at adapting to technological change. While these three studies highlight the relevance of perks in affecting employee choices during recruitment, they are largely descriptive and offer little discussion about the strategic implications and contingencies for firms.

This lack of causal work in how perks can be a tool for strategic recruitment is not surprising due to two problems. First, at the firm level, it is difficult to observe the entire pool of potential candidates since those who are not attracted to the firm (perhaps because the firm does not offer desired perks) are not observed. Second, at the individual level, it is difficult to observe the entire choice set of job offers that may differ in terms of the perks provided since only the revealed preference is usually observed. This paper fills the gap in the literature by providing causal evidence regarding how unlimited vacation—an understudied perk—affects the employee behavior of selection. In particular, my focus is on how such self-selection occurs along the dimension of individual performance, which is an important strategic human capital consideration for firms since higher-performers are the driver for organizational success (Nyberg, 2010; Zucker et al., 2002).

Two characteristics associated with unlimited vacation suggest that the perk may be more attractive to high-performers. First, the schedule flexibility and autonomy endowed by the perk, highly valued by people with certain demographic characteristics, e.g., women with children (Mas and Pallais, 2017), may also be especially attractive to high-performing individuals. For instance, high-performing employees following job exits are more drawn to the career choice of entrepreneurship (Carnahan et al., 2012), which is known to offer more autonomy (Roach and Sauermann, 2015) than jobs in established firms. Second, unlimited vacation is typically implemented in a way that the management focus shifts from work time to performance. Most commonly, the perk comes with a performance expectation. Similar to performance pay schemes that induce the self-selection of the more productive employees (Cadsby et al., 2007; Dohmen and Falk, 2011; Eriksson and Villeval, 2008; Lazear, 2000), the rationale is that high-performing individuals can gain more from the perk of unlimited vacation because they can meet their performance expectation in less time and consequently take more vacation.

1.2.2. Unlimited Vacation and Benefits through the Performance Channel

A plethora of studies have demonstrated the correlations between strategic human resource management and firm-level performance outcomes (Arthur, 1994; Batt, 2002; Bloom et al., 2011; Cappelli and Singh, 1992; Fey et al., 2000; Huselid, 1995; Pfeffer and Villeneuve, 1994). Taking a micro-foundation perspective of strategic human capital (Coff and Kryscynski, 2011), this paper centers on individual worker productivity as a driver for firm-level performance gains. Rajan and Wulf (2006) find supportive evidence that perks are offered when they can improve the productivity of managers. Do the productivity gains hold for non-managerial employees?

A large body of the human resource management (HRM) literature has highlighted the importance of HRM practices in improving worker productivity. Initially, this HRM literature focused on Japanese-influenced employment management and concepts such as job rotation, teamwork, and practices that promote employee involvement (especially training and employment security) and suggested a positive impact of these practices on labor productivity (Katz et al., 1983, 1985; Womack et al., 1990). Later works have then turned to the relationship between productivity and a more diverse range of high-performance work practices such as information sharing, attitude assessment, job design, performance appraisal, promotion, compensation models that recognize and reward merit, etc. (Appelbaum et al., 2000; Bartel, 1994; Becker and Gerhart, 1996; Datta et al., 2005; Huselid, 1995; Ichniowski et al., 1996; Koch and McGrath, 1996). Some of these HRM practices involve the provision of perks to employees.

A caveat remains, however, in interpreting the positive effect of perks on employee productivity in these HRM studies—firms adopting certain HRM practices may have adopted them because they can be particularly useful. This selection into implementation implies potential confounders in the productivity gains discovered. More recent work has started to address such concerns by resorting to randomized field trials, and particularly examining increasingly popular perks that grant workers flexibility and autonomy. Bloom et al. (2015) investigate how *location* autonomy endowed by the work-from-home option incentivizes performance and find that it improves worker productivity. This paper aims to cleanly measure the productivity effect of unlimited vacation—a perk that grants employees autonomy and control over their *schedule*.

Past work has suggested that perks are likely complementary to effort (by reducing the marginal cost of extra work time) (Marino and Zabojnik, 2008; Oyer, 2008) and can enhance productivity when transferring control to employees (Bloom and Van Reenen, 2011; Freeman and Lazear, 1994; Lazear and Shaw, 2007). Specifically, the control over work schedule allows people to work when they are more productive and recharge when they are burnt out, resulting in a more efficient use of work time. Relatedly, Moen et al. (2016) find that flexible work time can reduce employees' perceived stress and improves their job satisfaction. This effect on employee well-being may in turn lead to an increase in productivity. For instance, happier workers who are more satisfied with their job may be more productive, according to early human relation theory (Strauss, 1968), emotion theory (Staw et al., 1994), and recent experimental and empirical evidence (Krekel et al., 2019; Oswald et al., 2015). In addition, workers who feel trusted with the endowed control over their own job may work more productively out of reciprocity (Helper and Henderson, 2014). By these arguments, the perk of unlimited vacation may also contribute to employee productivity improvement. As stated by employees with access to unlimited vacation:

> *"Unlimited vacation…is a huge plus. It allows you to work late nights when you have to and feel comfortable with getting to work later the next morning. It also makes scheduling appointments and planning vacations simple and stress free."* — Glassdoor review by anonymous employee at HubSpot

> *"Unlimited PTO was a terrific benefit. As one of the top performers on the sales team, I could manage my own time, work from wherever I could deliver the best results, and take as much time as necessary to recharge."* — Glassdoor review by anonymous employee at Sizmek

1.2.3. Unlimited Vacation, Its Risks, and Organizational Conditions

While possibly generating strategic benefits to firms, perks can also incur costs. A strand of work has found that high-performance work practices can increase labor costs that offset the productivity raise (Cappelli and Neumark, 2001; Sels et al., 2006; Way, 2002). Perks that endow job autonomy come with their own potential costs due to the risk of abuse by indolent workers—a typical agency problem (Eisenhardt, 1989). For instance, Yahoo rescinded its work-from-home policy in 2013, as its virtual private network (VPN) data suggested that employees who worked from home were slacking off.[13] Broadly, research has confirmed that high job autonomy can increase work-related unethical behavior (Lu et al., 2017). Similarly, unlimited vacation may allow some workers to take too much vacation and under-perform, dragging down overall labor efficiency at the cost of the firm. As a result, the aforementioned performance benefits are only tangible when firms have effective tools in place to manage performance and curb the opportunism of slacking.

What are some solutions that address the agency problem in perk consumption? One possible remedy is to closely monitor whether workers slack or not (Graetz et al., 1986). As the probability of getting caught goes up, workers are less likely to engage in undesirable work behavior (Nagin et al., 2002). However, close monitoring may run counter to the idea of perks that offer autonomy and control, and can be less effective than outcome-oriented contracts that enforce performance management (Eisenhardt, 1989). In particular, posing an output requirement along with a threat of firing (Lazear, 2000) may be particularly helpful in mitigating slacking, especially when the probability of firing enforcement is high (Becker, 1968). As the strategic human resource management literature points out, it is necessary to consider the alignment and fit (Delery and Doty, 1996; Han et al., 2019) with other organizational conditions in maximizing the effectiveness of a single practice. By these arguments, the implementation of unlimited vacation should be more effective when firms bundle the perk with clear performance requirement in its system and appropriate threat of firing punishment in its culture.

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[13] Nicholas Carlson, "How Marissa Mayer Figured Out Work-At-Home Yahoos Were Slacking Off," *Business Insider*, March 2, 2013, businessinsider.com.

1.3. Setting 1: The Background of Unlimited Vacation

In order to characterize the phenomenon of unlimited vacation and provide the background on how the perk is adopted across firms, I created a unique qualitative dataset of online employee benefits reviews. A number of 555,530 firms identified from Crunchbase[14] were searched on Glassdoor[15] to construct a database of 32,988 matched firms with 319,963 benefits reviews and ratings made from 2014 to 2018. Of these firms, 1,901 firms were identified with unlimited vacation through 5,438 publicly available reviews.[16] Linking review data to data on firm characteristics, I first document patterns across firms regarding which firms are more likely to adopt unlimited vacation. Second, focusing on firms that adopt unlimited vacation, I explore the qualitative data and shed light on the common themes regarding how unlimited vacation is typically implemented in practice.

1.3.1. What Firms Adopt Unlimited Vacation

Matching 32,988 firms with reviews data to Crunchbase data on firm characteristics, I identified 11,230 matched firms with 193,659 reviews. In total, 1,318 matched firms provide unlimited vacation as an employee perk. Table 1 shows the results comparing firms with and without unlimited vacation across various characteristics. Firms adopting unlimited vacation tend to fit the description of a typical emerging company—they are younger, smaller, more likely to be located in California, New York and Massachusetts, more heavily clustered in high-tech industries,[17] and less likely to have experienced an IPO or acquisition. Two other variables highlight another important characteristic of firms providing unlimited vacation—these firms tend to be growth-oriented firms with more financing rounds and product market diversity. While emerging companies comprise the majority of the firms offering unlimited vacation, the perk is also gaining popularity in all kinds of other firms in terms of firm age (see Figure A.1 in Appendix), size (see Figure A.2 in Appendix), location,[18] and industry.[19]

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[14] Crunchbase is a widely recognized platform for finding business information about private and public companies.

[15] Glassdoor is a commonly used website where employees and former employees anonymously review companies and their management. It has ratings and reviews for over 600,000 companies worldwide, according to its website in February 2019.

[16] While this figure does not present the true percentage of firms that are adopting unlimited vacation due to potential selection into reviews, the evidence at least shows that this perk has gained popularity among a significant number of firms and thus warrants a scrutiny.

——————**Insert Table 1**——————

1.3.2. How Firms Adopt Unlimited Vacation: Common Themes

From the qualitative reviews, two common themes become clear regarding how unlimited vacation is typically adopted in firms. First, unlimited vacation is rarely a standalone perk and is inseparable from organizational systems and cultures that emphasize performance. As employees often do not describe their benefits and perks in detail when submitting their reviews on Glassdoor, I focus on firms that have at least 30 reviews on Glassdoor, which is the average number of reviews firms have, to ensure that there is enough content that elaborates the implementation of unlimited vacation. For these firms, 56% of the reviews mention some version of "performance requirement" associated with unlimited vacation—examples of keywords include performance, quota, number, hit, goal, conditional on getting work done, etc. For one thing, unlimited vacation is typically a part of a bundled system that emphasizes performance expectation and removes the requirement for face time, as is revealed by the following reviews:

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[17] High tech industries include apps, data analytics, internet services, information technology, messaging communications, software, biotechnology, mobile, science engineering, platforms, and navigation mapping.

[18] Unlimited vacation is found to be offered by firms in 42 states.

[19] Unlimited vacation is found to be offered by firms in 26 non-high-tech industries.

> *"As long as you hit your numbers, you can take many days off."* — Glassdoor review by anonymous employee at Groupon

> *"Unlimited vacation focuses on performance and getting the job done rather than face time."*[20] — Glassdoor review by anonymous employee at HookLogic

For another, unlimited vacation is also often embedded in a culture with some level of firing threat for under-performance:

> *"Unlimited paid vacation—but you have to make your quota or you are fired."* — Glassdoor review by anonymous employee at Zocdoc

> *"You better hit your goals or you'll be fired during your vacation."* — Glassdoor review by anonymous employee at Groupon

Second, the use of unlimited vacation is contingent upon social interaction among teammates and with managers, and the theme of "team" and "manager" appears in 71% of the reviews for firms that have at least the mean number of reviews. For instance:

> *"Unlimited vacation requires coordination within the team functions."* — Glassdoor review by anonymous employee at TrueAccord

> *"Only some managers are okay with it (unlimited vacation)."* — Glassdoor review by anonymous employee at Zocdoc

Together, the qualitative reviews give a delineation of how unlimited vacation is typically implemented in practice that echoes the example at the beginning of this paper about Netflix, a firm known as the "firing machine" by stating "we keep only our highly effective people" in the exact same Culture Document—for employees, there is no limit on vacation time, there is a lot of control over work schedule, there are social dynamics that supports its use, but there are also clear performance expectations in the HR system, as well as a culture of firing in the case of under-performance.

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[20] Face time refers to time spent at one's place of employment.

1.4. Setting 2: A Large High-Tech Company

To unpack how unlimited vacation is carried out in practice and impacts workers at the micro level, I turn to a field context of a large high-tech company who has been experiencing rapid growth in the last few years. There are two types of full-time roles at the firm. On one hand, 361 unique roles are labeled "UTO roles," which correspond to roles with unlimited time-off or, in other words, unlimited vacation. On the other hand, 26 unique roles are labeled "LTO roles," which correspond to roles with limited time off or, in other words, capped vacation. Together, these roles span 10 job levels and 11 job functions. While LTO roles only exist for lower job levels, there is a good proportion of UTO roles at each job level and across all job functions.

Due to the high turnover nature of the company, nobody currently at the firm witnessed the introduction of unlimited vacation (which was non-existent when the firm was initially founded). Therefore, my approach is to focus on employees who experienced a sudden access to unlimited vacation due to an internal transfer from an LTO role to a UTO role. For instance, a COE Team Lead (an LTO role) in the core business job function would transfer to be an Inbound Sourcer (a UTO role) in the HR job function at the same job level, with both roles involving similar skills. Through a difference-in-differences design, I examine the effects of having access to unlimited vacation on vacation and performance by treating a group of employees who also transferred but stayed in LTO roles as the control group. These transfers are typically not related to consideration for job-associated perks, and all other benefits remain the same pre and post transfers. Transfer cases associated with promotions are excluded.

1.4.1. Methods

Data. The sample consists of 352 employees who experienced internal transfers during 2017-2018. The treatment group is defined to be the group of employees who transferred from an LTO role to a UTO role (114 employees) and the control group is defined to be the group of employees who transferred from an LTO role to an LTO role (238 employees). One complication for studying the effect on performance is that performance metrics at the high-tech company are inconsistent for LTO roles and UTO roles and are thus non-comparable. To deal with this challenge, I use a measure of subjective productivity collected in the company's quarterly employee surveys, which the company started in 2017. Specifically, the survey asks employees to rate how strongly they agree or disagree with the statement, "My work stress does not cause my productivity to suffer," based on a Likert Scale (1-6). In all, I have 571 responses for 340 of those transferred employees across four quarters during 2017-2018. As discussed in Section 1.2, an important mechanism through which unlimited vacation may increase productivity is by reducing perceived stress and improving employee well-being. Therefore, this subjective rating allows me to directly study how unlimited vacation affects employee performance on the job through this potential mechanism. For vacation, I have a dataset of 22,290 daily time-off requests for 304 of the transferred employees during 2016-2019 April.

Dependent Variables. The first dependent variable of interest is *Monthly Time Off Days*, i.e., the monthly total amount of time off converted to number of days. I collapse time off requests to monthly level due to the high turnover nature of the company—collapsing to the annual level would significantly reduce power and the total amount of annual time off can be typically understated due to early job termination, which is very common at this company. The second dependent variable is *Subjective Productivity*, a rating based on the aforementioned survey question which takes integer values from 1 to 6. A higher rating indicates a higher perceived level of productivity.

Independent Variables. The first key independent variable is *Treat*, which equals 1 if an employee transferred from an LTO role to a UTO role and equals 0 if an employee transferred from an LTO role to another LTO role. The second key independent variable is *Post*, which equals 1 for time periods after transferring and 0 otherwise. Several other independent variables are considered to examine the contingent effect of unlimited vacation based on the social dynamics at the workplace. Three variables are created to measure how people rate their teams. *Great Team 1* is a binary variable that indicates whether an employee is in a team with great interpersonal relationships. Specifically, employees who indicate that they “strongly agree” or “agree” with the statement “I feel close to people at work” have a value of 1 for this variable; employees who “strongly disagree” or “disagree” with the statement have a value of 0 for this variable. Two other measures are created similarly based on alternative statements that elicit employee perception of teams. *Great Team 2* is created based on ratings for the statement “Most people make a good effort to consult other employees where appropriate.” *Great Team 3* is created based on ratings for the statement “I feel I am part of a team.” Lastly, *Great Manager* is a binary variable created to measure how people rate their managers based on the statement “I feel heard by my manager” and indicates whether an employee has a great relationship with his or her manager.

Analytical Strategy. The main specification is a difference-in-differences design using ordinary least squares regressions on individual-quarter panel dataset (to test the effect on perceived productivity) or individual-month panel dataset (to test the effect on vacation use). The first difference is whether an individual transferred to a UTO role or an LTO role, and the second difference is the time (quarter or month) of transfer. Additional controls include the change in job level, job tenure at transfer, and pre-transfer job level and function.

1.4.2. Results

The treatment and the control groups do not appear to differ significantly in terms of age and marital status, but the treatment group has a slightly larger percentage of men, slightly higher average job level before transfer, and slightly shorter job tenure at transfer. Results are robust controlling for gender and all analyses include controls for pre-transfer job level and job tenure at transfer. Vacation distributions are similar pre-transfer for both groups. For brevity, employee-level summary statistics are reported in Appendix in Table A.1 and Figure A.3.

Results for how unlimited vacation affects employee vacation patterns are reported in Table 2. Across all specifications, there is a consistent considerable increase in vacation time when employees gain access to unlimited vacation. On average, unlimited vacation leads to 0.71-0.84 more days off per month for employees. This effect may even be underestimated as some employees may under-report their vacation time once they move to a UTO role.[21]

——————**Insert Table 2**——————

Results for how unlimited vacation affects subjective productivity are reported in Table 3. As shown by Models (1) and (2), subjective productivity rating increases by 0.44-0.45 when employees gain access to unlimited vacation, which is about 9-10% increase from the baseline level. This positive effect on perceived productivity is significantly larger for employees in great teams, as suggested by the estimated coefficients for the triple-difference terms *Great Team*× *Treat*×*Post* in Models (3)-(5). However, the effect becomes negative for those people in bad teams, as shown by the estimated coefficients for the difference-in-differences terms *Treat*×*Post* in these models. I also find that the perceived productivity gain is larger for employees with great managers, but there is a drop in perceived productivity for people with bad managers, as indicated by Model (6).

——————**Insert Table 3**——————

1.4.3. Discussion

It is worth mentioning that the sample consists of the relatively lower level employees at the high-tech company due to the nature of LTO roles prior to transfer. It appears that even for the lower-tiered employees, the benefits from having access to unlimited vacation are tangible, both in terms of actual time off use and in terms of perceived effect on productivity through the mechanism of reduced work stress.

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[21] One complication for studying the effect on vacation patterns is that employees are no longer required to submit their time off records once they have access to unlimited vacation, though some people still keep track of their vacation time through the time off records. This leads to an issue of potential under-reporting in vacation time for UTO employees. Such a measurement error would be problematic when interpreting a negative effect on vacation use due to access to unlimited vacation, as it might simply be because employees no longer submit time off requests. However, when a positive effect is found, this effect can only be underestimated.

The finding that the effect of unlimited vacation on perceived productivity varies based on relationships with team members and managers highlights the importance of social interaction in shaping performance at workplace (Bandiera et al., 2010; Hasan and Koning, 2019). In this field context, a great team is largely measured by how close the employees are to other team members and how well they communicate with each other. As geographic proximity has been shown to facilitate information sharing and reduce coordination costs for joint projects (Catalini, 2017), social proximity may similarly bring about these benefits through better communication and thus improve employee productivity. People in close-knit teams may also experience large productivity spillovers from other high-performers in their teams (Mas and Moretti, 2009), for instance, through learning about better work practices (Chan et al., 2014), especially regarding how to better manage their time and make full use of the unlimited vacation perk. Teams with strong social ties or supportive managers typically have strong cultures with features of flexibility, openness, and responsiveness that are more likely to improve performance (Denison and Mishra, 1995). Specifically, in these workplace cultures, employees would be less concerned about being viewed negatively by other team members and managers when they take time off and are more likely to be covered when they need to leave on a short notice.

Nevertheless, this setting also reveals key challenges in studying this unlimited vacation perk in real firm settings. First, as performance metrics are inconsistent for jobs with unlimited vacation and jobs with capped vacation, the effect on performance is measured subjectively at large, which may or may not translate into actual productivity for firms. Second, it is difficult to study how much of the observed effects is due to selection into unlimited vacation roles, how much is due to the treatment of unlimited vacation, and how much is due to other changes in the job that always come with the perk.

Therefore, the fundamental question still remains: does unlimited vacation lead to actual benefits for firms in itself? This is what I aim to address in the rest of this paper through a formal model and a randomized controlled trial.

1.5. Theoretical Model and Predictions

To examine how heterogeneous workers respond to unlimited vacation, I establish a three-period model involving a labor-leisure trade-off for workers. I adapt the model of Autor (2001) by assuming workers can self-select into different types of firms, build on Lazear (2000) by imposing a threat of firing when worker output is below a threshold, and follow the punishment model of Becker (1968) by stipulating a probability of firing enforcement in the case of misconduct. The model predictions generate implications for the channels through which and the conditions under which firms can benefit from the provision of unlimited vacation to workers.

1.5.1. Model Setup

Timeline. There are three periods: $t = 1, 2, 3$. At $t = 1$, workers know about their type η and choose between working for firms with vacation regime $R \in \{0, 1\}$. When $R = 1$, the firm offers unlimited vacation to its workers. When $R = 0$, the firm offers capped vacation (capped at $\bar{L}$) to its workers. At $t = 2$, workers receive a pre-determined flat wage $w(R)$, supply labor by choosing vacation time l, and generate output $y = (T - l) \cdot f(\eta|R)$ where T is total time an individual may have. At $t = 3$, firms with unlimited vacation fire workers whose output is below $\underline{Y}$ with probability p.[22] Firms continue to pay remaining workers with the pre-determined flat wage. With probability a, fired workers are rehired immediately by an unlimited vacation firm; with probability b, fired workers are rehired immediately by a capped vacation firm; with probability $(1 - a - b)$, they stay unemployed and receive V_u.

Worker types. The heterogeneous labor force comprises two worker types: high-performers and low-performers. Firms cannot observe worker type at $t = 1$. Worker type is determined by individual performance, $\eta > 0$, where $\eta \in \{\eta_H, \eta_L\}$ and $\eta_H > \eta_L$. The distribution of worker type is characterized by parameter $\rho = \frac{N_L}{N}$, which is the fraction of low-performers in the population.

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[22] I impose an output threshold in the model for two reasons. First, from the practitioner standpoint, it mimics how unlimited vacation is typically bundled in reality with a performance expectation. Second, it is theoretically necessary to have a trade-off within the unlimited vacation contract. Without a condition on performance, sorting is not possible as all workers would simply prefer unlimited vacation over capped vacation. Without the perk of unlimited vacation, sorting is still not possible as all workers would simply prefer a contract with no performance requirement.

Worker output. Actual worker output, y, depends on both labor supply (work time), $T - l$, and productivity (output per unit of work time), $f(\eta|R)$. For each worker, productivity is determined by $f(\eta|R) = \eta(1 + \tau_R)$ where τ_R represents the potential complementarity between the workplace vacation regime and worker performance. This specification of complementarity follows Autor (2001). I further assume $\tau_1 > \tau_0 \geq 0$ following the discussion in Section 1.2, which implies that unlimited vacation likely offers more complementarity than capped vacation as it supposedly transfers control to workers with respect to schedule management, may reduce work stress, or can make workers happier and feel more trusted.

Worker preference and labor supply. At $t = 2$, workers supply labor based on the following utility-maximization problem:

$$\begin{aligned} \max_{l} U(l; R) = w(R) - c(T - l), \quad & \text{s.t. } l \leq \bar{L} & R = 0, \text{capped vacation} \\ & \text{s.t. } l \leq T & R = 1, \text{unlimited vacation} \end{aligned}$$

where $u(\cdot)$ is standard Bernoulli utility function, $c(\cdot)$ is convex and $c(0) = 0$.

Firms. Firms are risk neutral. Each firm chooses from two vacation regimes, $R \in \{0, 1\}$, with no direct costs. When $R = 1$, the firm adopts unlimited vacation and implements a firing rule, i.e., workers whose output is below $\underline{Y}$ will be fired with probability p, $0 \leq p \leq 1$. When $R = 0$, the firm adopts capped vacation and does not implement firing based on output. I also assume that firms may differ in how they value high-performers. Let $x(R)$ be the proportion of high-performers at a firm with vacation regime R. The firm then values its high-performers at $v(x(R))$. $v(\cdot)$ may vary for different firms, and is concave. For instance, growth-oriented firms in high-tech industries may have a particularly high valuation for high-performers. Note that I assume there are many firms and wages are set competitively for either type of firm.

1.5.2. Predictions about Worker Responses

My model generates testable predictions about worker responses both in the recruitment phase of selection into firms (Prediction 1) and in the performance phase of subsequent work behavior (Predictions 2-3). Specifically, the first two predictions establish the main effects of how unlimited vacation can benefit firms through two channels. The last prediction considers the contingency based on the firing culture that punishes under-performance. All proofs are relegated to Appendix A.2.

Once selected into firms, workers under unlimited vacation would either *comply*, producing $\underline{Y}$, or *slack*, producing nothing, given that the utility function is monotonically increasing in vacation time. Whether a worker complies or slacks depends on whether the worker is paid above his or her non-slacking condition:

$$w(1) \geq \frac{2}{p - pa} c(T - L_0) + \frac{b}{1 - a}[w(0) - c(T - \bar{L})] + \frac{(1 - a - b)}{1 - a} V_u$$

where $L_0 = T - \frac{\underline{Y}}{\eta(1+\tau_1)}$. My predictions are derived taking into consideration that the non-slacking condition may or may not hold for either high- or low-performers.

Prediction 1. Sorting. *High-performers are more likely to choose unlimited vacation over capped vacation than low-performers.*

The theory suggests that the reason for the above is that it is more costly for low-performers to meet the output threshold under unlimited vacation. In other words, it is easier for high-performers to produce enough to meet the performance expectation and avoid the risk of getting fired, thus making use of extra vacation days. As a result, high-performers are more likely to self-select into firms with unlimited vacation while low-performers are deterred by the threat of firing and consequently sort into firms with capped vacation. This prediction relies on the premise of repeated interaction between workers and firms; otherwise, low-performers would simply flood into unlimited vacation firms with the intention of not delivering work.

Prediction 2. Productivity. *Worker productivity is higher under unlimited vacation than under capped vacation, even after controlling for the sorting effect.*

This is a result of the assumption that there is a larger work complementarity under the unlimited vacation scheme than under the capped vacation scheme. Unlimited vacation offers workers more schedule flexibility and autonomy so that they can choose to work when they are productive and rest when they are not. Other factors may also contribute to the larger complementarity under unlimited vacation, such as reduced work stress, higher job satisfaction and perceived trust.

Prediction 3. Slacking and Firing Threat. *Under unlimited vacation, workers are more likely to meet the output threshold, i.e., they are less likely to slack, when firing threat is stronger.*

Like Becker (1968), an increase in the probability of getting fired in my context reduces the expected utility from slacking and thus tends to reduce the likelihood of non-compliance. This prediction highlights the importance of bundling unlimited vacation with appropriate performance management tools. Following this prediction, when there is a stronger firing threat, unlimited vacation workers are more likely to work more to achieve the performance requirement and thus take less vacation.[23]

My model also generalizes to the case when workers do not know their type perfectly ex ante but rather receive a signal about their type at $t = 1$. In other words, workers are heterogeneous both in terms of performance type and in terms of their belief about their type. Predictions would remain the same.[24]

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[23] This is a consequence of the production function, more specifically the linear relationship between work time and output, which has no scope for cramming–workers need to work consistently to produce enough output. This is a common feature of daily work tasks for most jobs. This assumption of the production function does not affect the main predictions. Moreover, as long as there is a positive relationship between output and work time, the implication for vacation pattern under a strong firing threat remains the same. For instance, a production function dictating that only exceptional performance matters would still generate the same predictions as long as work output is positively affected by how much time a worker devotes to his or her job.

1.5.3. Implications for Firm Decisions

While the testable model predictions are at the individual worker level, I also formally derive the implications for firm-level vacation scheme decision. A firm choosing capped vacation scheme expects profit:

$$\mathbb{E}[\pi; R = 0] = x(0)(T - \bar{L})\eta_H(1 + \tau_0) + \big(1 - x(0)\big)(T - \bar{L})\eta_L(1 + \tau_0) - w(0).$$

A firm choosing unlimited vacation scheme expects profit:

$$\mathbb{E}[\pi; R = 1] = \begin{cases} \underline{Y} - w(1) + v\big(x(1)\big), & \text{both high- and low-performers comply, or} \\ x(1)\underline{Y} - w(1) + v\big(x(1)\big), & \text{high-performers comply, low-performers slack} \end{cases}$$

Therefore, a firm should adopt unlimited vacation if and only if $\mathbb{E}[\pi; R = 1] \geq \mathbb{E}[\pi; R = 0]$. I find that a firm is more likely to be profitable adopting unlimited vacation when the following statements are true (all proofs are relegated to Appendix A.2):

1. when the firm has greater needs for high-performers (i.e., $v(x)$ is higher for any x)
2. when the firm has a stronger culture of firing conditional on performance (i.e., p is higher)
3. when the firm sees a stronger complementarity gain between unlimited vacation and worker performance (i.e., $\tau_1 - \tau_0$ is higher)

These results are consistent with the empirical observation that unlimited vacation is most widely adopted by fast-growing high-tech emerging companies that have high demand of high-performing employees, typically imbued with the “hire fast, fire fast” mantra, and loaded with jobs tasks that allow high-performers to work better with the control of their own work schedule.

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[24] Predictions 1 would refer to “high belief” and “low belief” workers instead of “high-performers” or “low-performers” as workers do not know their type in the selection phase.

1.6. Setting 3: A Randomized Controlled Trial

1.6.1. Design Overview

Very few existing datasets provide information regarding the adoption of unlimited vacation by firms, and the lack of implementation details as well as disconnection from worker-level responses in these datasets prohibits researchers from generating useful insights. Even in the Setting 1 qualitative dataset where employees discuss this perk in detail, their actual work behavior in response to the perk is unobserved. Moreover, as revealed by the high-tech company in Setting 2, there are many complexities that pose further challenges to empirically test the effects of unlimited vacation *in itself* in real firm settings. Therefore, I resort to a randomized controlled trial that consists of two experiments to cleanly test my model predictions about the consequences of offering unlimited vacation as a perk to workers. The design bridges controlled experiments in labs and field experiments inside companies by replicating a virtual workplace on an online labor market with key elements of existing organizations: long-term repeated interaction between workers and the employer, real-effort tasks, separation of workdays from weekends, and inclusion of paid vacation time.

The goal of Experiment 1 is to rigorously replicate and compare the typical unlimited vacation contract and the typical capped vacation contract in practice, as discussed in Section 1.3, and test the theoretical predictions regarding sorting, productivity, and slacking. Specifically, the unlimited vacation contract differs from the capped vacation contract regarding three features: (1) the absence of a vacation cap, (2) the presence of a performance requirement, and (3) the absence of attendance checks to ensure face time. The goal of Experiment 2 is to separate out the effect of each of these features through additional contract treatments. Both experiments were pre-registered on the Open Science Framework

(OSF).[25]

1.6.2. Sample

Experiment 1. I recruited 691 workers from an online labor market,[26] Amazon Mechanical Turk (MTurk), in late January 2019 via a Qualtrics survey into the study, which was framed as “a four-week-long image-counting job” that required “working for up to 16 minutes per weekday for four consecutive weeks.” The sample was restricted to workers with an HIT approval rate greater than 98% and who were residents in the U.S. I excluded any worker who might have viewed the job during previous pilots. At the end of my recruitment survey, 8 workers indicated that they were either no longer interested in the job or could not commit to a four-week long job and were thus excluded. An additional 13 workers were further dropped due to duplicated IP addresses. A total of 444 workers successfully passed the run-in period, which involved a three-day clicking test (details follow), and hence received an email confirming that they were eligible for the job and asking them to view their work contract through a link; 435 workers opened the link and formed the sample of the treatment assignment; 426 workers confirmed that they would be taking the job and were hired; and 414 workers eventually started the job in early February 2019.

Experiment 2. The recruitment process for Experiment 2 was the same as Experiment 1. I started by recruiting 400 workers from MTurk in early April 2019 for the job.[27] A total of 375 workers remained interested at the end of the recruitment survey; 372 workers remained after dropping duplicated IP addresses; 232 workers passed the clicking test and received the eligibility email for the job; 229 workers opened the work contract link and formed the sample of the treatment assignment; and 217 workers eventually started the job in mid-April 2019.

Online Workers. Considering the long-term nature of the study and potential high attrition rates, I intentionally chose MTurk workers as my sample to get quick access to a large sample of online workers at a reasonable cost. MTurk workers have become a useful sample in the scholarly study of labor and workplace employment issues (Burbano, 2016; Cassar and Meier, 2017; Chandler and Kapelner, 2013; Horton et al., 2011), and more so as firms are increasingly reliant on online labor marketplaces to recruit temporary workers, freelancers, and independent contractors.[28]

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[25] Links: https://osf.io/n54mk/ (Experiment 1); https://osf.io/e3cqb (Experiment 2).

[26] This sample size is determined based on power calculation, which suggests a target sample of 380 workers, as well as an attrition rate of 55% according to several pilots run in July-October 2018.

[27] This sample size is determined based on power calculation using results from Experiment 1, which also suggests an attrition rate of 37%.

To ensure that the workers I hire for the job could be trusted to follow instructions and pay attention to the job requirements, I adopted three main approaches. First, I included a run-in period during which workers needed to pass a clicking test by clicking on a link for three consecutive workdays. This test aimed to make sure that workers could commit to consistently showing up at the online job. Second, I required workers to view their work contract, finish a practice session of the job task, and correctly answer a number of comprehension questions about the job. The comprehension questions were designed to make sure that workers understood multiple aspects of their work contract, including the duration of the job, the number of vacation days they were allowed to take, potential attention checks during work, work output requirements, and rule of dismissal.[29] When questions were answered incorrectly, workers were prompted to review their contract again and retry. When questions were answered correctly, a message would pop up to explain in detail why the choices were correct. Third, workers were asked to click on a link to verify that they understood how the work session would work prior to the start of the job. These approaches combined helped to ensure that workers who were eventually hired did read instructions carefully and understood what the job entailed.

One other concern about the MTurk sample is external validity—whether these temporary online workers will behave differently from regular workers of interest in the context of a vacation study. First, the nature of gig work is to offer temporal flexibility (Lehdonvirta, 2018), so MTurk workers who show up on the platform and sign up for the experimental job would be at a relatively high level of job flexibility when compared to regular workers in full-time jobs. As a result, the increase in job schedule flexibility when MTurk workers choose unlimited vacation over capped vacation for the MTurk job would likely be small, as there is limited scope for enhanced flexibility. For regular full-time jobs, the increase in job schedule flexibility from capped vacation to unlimited vacation can be much larger due to a low baseline level, thus leading to a larger response from workers choosing between firms with different vacation schemes. Therefore, the recruitment gains may be even larger in regular full-time jobs. Second, the performance gains may also be larger for many regular full-timer workers, as the work complementarity due to schedule flexibility offered by unlimited vacation can be larger. For instance, the scope for productivity improvement for an MTurk job can be limited since an MTurk job typically does not require high skills. However, the potential for productivity improvement in regular full-time jobs can be much larger as these jobs are much more complex and allow for more variation in performance. Third, MTurk workers are also less likely to be deterred by the threat of firing, as the stakes of a temporary MTurk job are much smaller than those of a long-term traditional job. This suggests that the performance management tool of firing threat is likely to be even more effective for regular full-time workers. Therefore, the differences between MTurk workers and regular workers suggest that my study offers a conservative test of my predictions.

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[28] Accenture Institute for High Performance (2013). *Trends reshaping the future of HR: The rise of the extended workforce.* Retrieved from https://www.accenture.com/us-en/ /media/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Strategy_3/Accenture-Future-of-HR-Rise-Extended-Workforce.pdf.

[29] I framed firing as "dismissal" in the experiment.

Lastly, to the extent that "vacation" in this temporary non-full-time job may be perceived as different from vacation taken in a long-term full-time job, I conducted a follow-up survey to ask how the workers in my study actually used their vacation time allowed by the job. I ran robustness checks for workers who used vacation in the job for different purposes.

While online workers are a unique population, the rationale behind the findings can be applied to other contexts sharing similar characteristics—where workers are empowered by new technologies and are less reliant on office locations, when job tasks are less dependent on co-workers or customers in real time, and for millennial workers who particularly value flexibility.[30] The job length in the RCT also goes beyond the typical short-term jobs online, as it requires commitment for repeated daily work during an entire one-month period.

1.6.3. Procedures

Experiment 1. The entire experiment lasted 36 days, starting from a Monday in January 2019. On Day 1, I advertised an HIT on MTurk for completing a recruitment survey to show interest for a four-week-long image-counting job. The recruitment survey described the longitudinal nature and the time commitment required for the job, what the image-counting task would look like, and how payments would be made. Workers who confirmed their interest after completing the recruitment survey subsequently entered a run-in period, which involved a clicking test during Days 2-4 that determined eligibility for the job. To pass the clicking test, workers needed to click on a link once each day for three consecutive workdays.

All workers who passed the clicking test were considered eligible for the job and received random treatment assignments (details follow). These workers received a separate email on Day 5, which provided detailed information about their work contract(s) and included a four-minute practice session of the image-counting task. At the end of the practice session, workers received feedback on their performance during the practice session and needed to complete a range of comprehension checks. Depending on treatment, workers either had been randomly assigned a work contract or at this point were asked to choose between an unlimited vacation contract and a capped vacation contract. Workers were subsequently shown the work session interface based on their contract. The daily check-in requirement was then explained to workers, which required workers to check in on each workday to indicate if they would work or take vacation for that workday. Finally, workers were asked to confirm if they were still interested in the job. Those who confirmed interest also answered a few questions about basic demographic information and their work patterns on MTurk, and later received a "congratulations" email on Day 7. This email confirmed that the recipient was hired, provided a summary of the work contract and job requirements for the recipient, gave the recipient a mock session link that could be used repeatedly to get familiarized with the task interface, and asked the recipient to click on a separate link to verify that they had viewed the mock session and understood how the task interface worked prior to the start of the job.

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[30] Deloitte (2016). *The 2016 Deloitte Millennial Survey: Winning Over the Next Generation of Leaders.* Retrieved from https://www2.deloitte.com/content/dam/Deloitte/global/Documents/About-Deloitte/gx-millenial-survey-2016-exec-summary.pdf.

The actual job started on Day 8 and lasted 20 weekdays over four consecutive weeks until Day 33. During each week, Monday through Friday were workdays (weekends were off), and the workers needed to check in on each workday through a daily link to choose between work and vacation. When they chose to work for a day, they would start a 16-minute work session for an image-counting task. At the end of each week, their work was evaluated based on the requirements of their corresponding work contract to determine whether they would be dismissed or they would stay employed. A weekly summary email was then sent to all workers employed in the week regarding their past week performance and the dismissal decision.

For each worker, a follow-up survey was administered upon job termination at any point during the study, which collected information about the perception of the job and the contract, reasons for particular vacation or work behavior during the job, reasons for the decision over contract choice, and reasons for voluntary dropout or dismissal when applicable. The last follow-up survey was sent out on Day 34 to all workers who stayed employed for all four weeks and was collected by Day 36.

Experiment 2. The procedures were the same as Experiment 1 with only one difference—workers were not able to choose between contracts on Day 5 after the practice session, and they were randomly assigned to one of three potential work contracts that aim to separate out the bundled effect of the unlimited vacation contract.

1.6.4. Task

For both experiments, workers worked on the same image-counting task for all workdays. In this task, they were asked to count the number of circles in each given image and submit their answer. Figure 1 presents an example of the task. I chose an image-counting task (Abeler et al., 2011; DeJarnette, 2017) for a number of reasons. First, the task does not require prior knowledge. Second, the task generates precise productivity measures. Third, the task requires costly real-effort and has little entertainment value. Fourth, the task has well-defined levels of difficulty. I can vary the size of the image matrix to make it easy or difficult for workers, and thus vary the unit effort cost for the task.

——————Insert Figure 1——————

Each work session for a non-vacation day lasted 16 non-stop minutes.[31] Once a worker started a work session, it was not possible for the worker to stop and then resume the session.

1.6.5. Treatments

Experiment 1. I adopted a 2×3×2 design with random assignment along three dimensions: worker type, contract, and firing threat under unlimited vacation:

1. *Worker Type.* Workers were first randomly assigned to one of two possible worker type treatments: *high-performer* and *low-performer*. The difference between the two types was the unit effort cost, which I varied by changing the size of the image matrix the worker experienced in the practice session and would be working on in the actual job. In the high-performer treatment, workers counted easy matrices of images that were 7×14 in size. In the low-performer treatment, workers counted difficult matrices of images that were 14×14 in size. In other words, it took less effort for high-performer workers to complete each image-counting task.

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[31] I designed the work sessions to be 16 minutes so that I could more conveniently map each session to an eight-hour working day.

2. *Contract.* Workers were subsequently assigned to three contract treatments randomly: *selection*, *unlimited vacation*, and *capped vacation.* In the selection treatment, workers could choose between two types of labor contracts—an unlimited vacation contract and a capped vacation contract. In the unlimited vacation treatment and the capped vacation treatment, workers were randomly assigned to the respective labor contract and were not aware of the other unassigned contract.

3. *Firing threat.* Lastly, workers who saw the unlimited vacation contract, i.e., those in the selection and the unlimited vacation contract treatments, were randomly assigned to one of two possible firing threat treatments: *weak firing threat* and *strong firing threat.* In the weak firing threat treatment, one out of ten workers who did not comply with the contract would be dismissed at the end of each week. In the strong firing threat treatment, all workers who did not comply with the contract would be dismissed at the end of each week. The baseline firing threat for workers in the capped vacation contract was a strong firing threat.

All 435 workers who passed the run-in period clicking test and opened the link with their contract information were randomly assigned to a treatment. Figure 2 shows how these workers were randomly assigned to the treatments. In all, 426 workers confirmed interest in the job and were eventually hired; 414 workers actually started the job.

————————**Insert Figure 2**————————

Figure 3 lists the details of the capped vacation contract and the unlimited vacation contract. Attendance checks were framed as "attention checks" to workers, and the two terms will be used interchangeably. Under the capped vacation contract, workers could take one vacation day per week. They needed to work until the end of the 16-minute work session for each non-vacation day and pay full attention during the session. There would be attendance checks at random time points, which required them to click on a button within 30 seconds after seeing a pop-up message.[32] There were no output requirements. At the end of each week, all workers who took more than one vacation day and all workers who failed any of the attendance checks would be dismissed from the job.[33] Under the unlimited vacation contract, workers could take as many vacation days as needed per week. They could leave before the end of the 16-minute work session for each non-vacation day, and there were no attendance checks. They must produce at least 80 correctly counted images per week.[34] At the end of each week, all workers in the strong firing threat whose work output did not meet the weekly minimum threshold would be dismissed from the job; one out of ten workers in the weak firing threat whose work output did not meet the weekly minimum threshold would be dismissed from the job. In particular, the unlimited vacation contract resembles how unlimited vacation is typically implemented in practice—apart from being allowed to take as much vacation as possible, workers are often relieved of "face time" and can take vacation more conveniently, yet in the presence of either explicit or implicit performance expectation. Therefore, the unlimited vacation contract captures these three essential aspects: the allowance of unlimited vacation time, the removal of attendance checks that encourage "face time," and the presence of a performance threshold. In contrast, the capped vacation contract installs a cap on vacation time, introduces attendance checks to monitor face time, and does not put in place an explicit requirement for performance.

——————Insert Figure 3——————

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[32] I designed the clicking window to be 30 seconds in a 16-minute work session to mimic a 15-minute break in an eight-hour working day.

[33] In practice, I recognized that workers sometimes experienced technical difficulties with the attention checks (e.g., Internet connection issues, power outages, malfunctioning mouse) that resulted in noncompliance with the attendance checks. Therefore, when a worker failed the attention checks for the first time during the entire job, I issued an email warning to the worker stating that "This is a warning that you did not pass the attention checks in your work session on [date]. Since this is the first time you failed the attention checks, we will give you a second chance. You will not be dismissed for the missed attention checks on [date]. However, from now on, if you miss any of the attention checks in the future, you will be dismissed at the end of the week as specified by your work contract."

[34] I calibrated this output threshold through previous pilots. I set the threshold so that it would be easy for workers in the high-performer treatment to meet but difficult for workers in the low-performer treatment to meet.

Experiment 2. I adopted a 2×3 design with random assignment first along the dimension of worker type as in Experiment 1, *high-performer* and *low-performer*, and then along the dimension of contract, where I introduced two new contracts in additional to the unlimited vacation contract. In total, there are three contract treatments: *unlimited vacation*, *new capped 1*, and *new capped 2*. Firing threat was strong for all treatments, i.e., all workers who did not comply with the contract would be dismissed at the end of each week. Contract details for the two new contract treatments are shown in Figure 4. How workers were randomly assigned to treatments are shown in Appendix in Figure A.4.

————————**Insert Figure 4**————————

1.6.6. Incentives

Incentives were the same for both experiments. All payments were made via MTurk. A worker could earn up to \$46.40 in total from the study. The average final payment for a worker that actually started the job was \$36.90.

Workers received \$0.10 for completing the recruitment survey on Day 1. During the run-in-period clicking test (Days 2-4), workers received \$0.10 for each successful click, which totaled \$0.30 for the three consecutive workdays. Workers who then viewed their work contract and completed their practice session received \$1. Once workers were hired for the job, they would receive a weekly payment of \$11 at the end of each week, as long as they stay employed. The \$11 payment reflected an effective hourly wage of \$8.25 for any worker who would work for five days per week and 16 minutes per day. All vacation time during the job was paid. The job paid well considering that the current federal minimum wage is \$7.25 (in 2019) and the majority of the MTurk workers are earning less than that.[35] Lastly, workers were paid \$1 for completing the follow-up survey.

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[35] Alana Semuels, "The Internet Is Enabling a New Kind of Poorly Paid Hell," *The Atlantic*, January 23, 2018, https://www.theatlantic.com.

1.7. Experimental Findings

Focusing on results from Experiment 1, I first discuss whether unlimited vacation leads to actual benefits for firms by evaluating its effect on overall labor efficiency. I explore the mechanisms and specifically examine the sorting of high-performers in the recruitment channel and the productivity gains in the performance channel, as suggested by Predictions 1 and 2 respectively. A third engagement channel is also discussed. I next turn to the behavior of slacking and provide evidence for Prediction 3 regarding the role of a firing culture that emphasizes performance. Using evidence from Experiment 2, I then decompose the bundled effects of the unlimited vacation contract to shed light on the role of an aligned system that emphasizes performance. Moreover, I discuss whether unlimited vacation benefits workers by focusing on their vacation patterns. The section ends with a number of robustness checks.

1.7.1. Does Unlimited Vacation Lead to Actual Benefits for Firms?

Overall Labor Efficiency. Figure 5 shows that unlimited vacation leads to higher overall labor efficiency, defined as output per dollar spent on labor, than capped vacation—a result that is true across four weeks. Therefore, unlimited vacation does lead to actual benefits for firms. But why? What are the mechanisms?

————————Insert Figure 5————————

Mechanism 1: The Recruitment Channel. Focusing on workers who are in the selection contract treatment, Figure 6 shows that high-performers are about three times more likely than low-performers to choose the unlimited vacation over the capped vacation contract, a medium effect size of 0.55.[36] Even within the same worker type treatment, workers who perform better initially in the practice session are more likely to choose the unlimited vacation contract, as suggested by Figure 7. At each level of cumulative distribution, workers who select into unlimited vacation are mostly those who perform better in the practice session. This pattern of sorting also persists across different firing threat treatments.[37] Overall, the results are consistent with Prediction 1 that unlimited vacation is more attractive to high-performers than to low-performers. At the aggregate level, this sorting mechanism means that unlimited vacation acquires a workforce with more high-performers. In fact, under the capped vacation contract, only 43% of the workers are high-performers, but this number increases to 77% for the unlimited vacation contract.

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[36] Effect size is calculated as (0.32-0.095)/0.41 where 0.32 is the proportion of high-performers choosing unlimited vacation, 0.095 is the proportion of low-performers choosing unlimited vacation, and 0.41 is the sample variance.

——————**Insert Figure 6**——————

——————**Insert Figure 7**——————

But does sorting explain all of the labor efficiency gap between unlimited and capped vacation? I find that a gap still remains when sorting is controlled for by restricting the analysis to workers who cannot select between contracts (see Figure A.5 in Appendix), suggesting that there must be some other mechanisms at play in the performance stage.

Mechanism 2: The Performance Channel. I now turn to the investigation of how workers under unlimited vacation behave post contract selection. More specifically, I evaluate Prediction 2 regarding how worker productivity varies across different contracts. As the self-selection of high-performers into the unlimited vacation contract complicates the interpretation of any potential productivity gains from the unlimited vacation scheme over capped vacation scheme, I separate workers who can choose between contracts from those who are randomly assigned a contract. To measure worker productivity, I calculate weekly productivity for each worker using the number of correctly counted images in a week divided by the total work time during the week (in minutes).[38] As shown in Figure 8, workers under the unlimited vacation contract are significantly more productive than workers under the capped vacation contract. The left subfigure shows the productivity gains due to both sorting and the treatment of unlimited vacation while the right subfigure shows the productivity gains due to the treatment of unlimited vacation exclusively. Even controlling for the sorting effect, there is a 51% increase in worker productivity from the capped vacation to the unlimited vacation contract (mean productivity under capped vacation is 0.97 images per minute while mean productivity under unlimited vacation is 1.46 images per minute). These results are robust when worker type is controlled for and when potential time trends are taken into consideration (See Figure A.6).

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[37] One caveat is that workers appear to be less likely to choose unlimited vacation when there is a stronger firing threat, though the difference is not statistically significant and is mostly driven by high-performers. Interestingly, the strength of the firing threat seems to have a smaller influence on the choice of low-performers. There are several potential reasons. First, some low-performers may select into the unlimited vacation contract and are prepared to slack without caring about the consequences of misconduct, thus paying little attention to the strength of firing threat. Second, some workers may not fully understand their level of performance and have an incorrect perception of how likely they can fulfill their performance expectation. Third, it is possible that some workers in the low-performer treatment are still capable of passing the output threshold, even though the threshold is high. I find that the majority of the low-performers (four out of seven who ended up working for us) may have been overconfident about their ability to pass the threshold in the selection phase and only realized that they couldn't do so once they started the job—they exerted great effort in the task at the beginning of the job. Only one low-performer appears to be an indolent worker whose plan was to slack under unlimited vacation from the very beginning. Two workers selected into unlimited vacation because they were in fact the very capable ones in the low-performer treatment who were nevertheless able to fulfill the performance expectation. In fact, the only indolent worker is in the weak firing threat treatment. This pattern suggests that even with performance feedback, workers may still be over-confident about their ability to perform well on the job, and this over-confidence may be more rampant when workers do not get information about their performance ex ante. Therefore, it is essential to offer workers an opportunity to learn about how they well can do the job early on to induce more accurate self-selection based on underlying performance level.

———————Insert Figure 8———————

Table 4 restates the findings with results from OLS regressions. Model (1) shows the productivity gains from the unlimited vacation over the capped vacation without controlling for the potential sorting effect. Models (2)-(3) show that the productivity gains remain substantial after sorting is controlled. Moreover, controlling for sorting, I find that both high- and low-performers benefit from unlimited vacation in terms of productivity improvement, as is shown in Model (4). However, I do not find a statistically significant difference in the degree of complementarity gains between the two types of worker, as suggested by Model (5).[39]

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[38] The results remain robust if I use an alternative measure of daily productivity (number of correctly counted images in a day divided by the total work time during the day in minutes).

[39] What does matter for the degree of complementarity is how committed a worker is to the job and whether performance management is associated with a strong firing threat. Since organizational commitment may play a role in the effect of HR practices (Kehoe and Wright, 2013), I examine whether the performance gains vary for workers with different levels of job commitment. In a follow-up survey, I asked workers to

——————**Insert Table 4**——————

Overall, I find consistent evidence for Prediction 2 that workers under unlimited vacation are more productive than those under capped vacation due to complementarity gains at the individual level. However, at the aggregate level, whether such productivity raise ultimately leads to higher labor efficiency also depends on how much vacation people take. As payments are the same per unit of labor in the experiments, overall labor efficiency depends on individual worker outputs—a product of individual worker productivity and work time. If unlimited vacation workers are more productive, they could just work really fast and take the most vacation they can by just meeting the performance requirement; and if this were the case, overall labor efficiency under unlimited vacation would be much lower than that under capped vacation (see Figure A.7 in Appendix). Therefore, there must be some other reasons apart from improved worker productivity that have also contributed to the labor efficiency gap after sorting is controlled for.

Mechanism 3: The Engagement Channel. It turns out that apart from the predicted sorting of high-performers and productivity gains, there are additional benefits resulting from the unlimited vacation contract in the domain of worker engagement. Interestingly, workers under the unlimited vacation contract not only comply with the performance requirement, but work beyond expectation most of the time. In fact, 68% of the times, an unlimited vacation worker produces more than 80 correctly counted images per week. Notably, these workers are not simply producing a few more images above the requirement; they on average produce 21% more than what is required (i.e., 16.4 more correctly counted images per week than the 80-image requirement). Are they acting reciprocally? Do they have career concerns? Or are they simply providing more work due to a habit of providing

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rate how strongly they agree or disagree with the statement “I tried my best to fulfill the requirements of my work contract” and generated a proxy for job commitment based on a 7-point Likert scale. A response with a value greater than 4 is considered to be showing high job commitment while workers responding with a value less than 4 are considered to have low job commitment. Regression results (Table A.2 in Appendix) suggest that workers with higher levels of job commitment gain a larger complementarity from the unlimited vacation contract. In addition, the size of the productivity complementarity is much larger when there is a stronger firing threat under the unlimited vacation contract.

good work? When asked about why they produced more than required by the performance requirement, workers who produced extra outputs under the unlimited vacation contract listed the top reason as "I wanted to work more than what was required to signal commitment to the job" (see Figure A.8 in Appendix).

Moreover, the unlimited vacation workers are also happier about their job than the capped vacation workers across a number of dimensions. In a follow-up survey,[40] I asked workers to evaluate a range of statements about the job and their contract (presented in a random order) and rate how strongly they agree or disagree with each statement based on a 7-point Likert scale. Table 5 shows that workers under the unlimited vacation contract rate the job higher in terms of job satisfaction (Questions 1-3), perceived flexibility and autonomy (Questions 4 and 5), time management efficiency (Question 6), and endowed trust by the employer (Question 7, though not statistically significantly so); they also show higher level of consideration for their productivity level when choosing between work and vacation (Question 8).[41]

——————**Insert Table 5**——————

In summary, unlimited vacation not just attracts the high-performers, not just improves worker productivity, but also makes workers more engaged and happier in the job and contribute extra work for no extra pay. Altogether, these mechanisms lead to actual benefits for firms as unlimited vacation improves overall labor efficiency.

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[40] Out of 414 workers who started the job, 394 workers completed the follow-up survey (a 95% response rate).

[41] I restrict to workers who were randomly assigned a contract, stayed in the job for all four weeks, and were under the strong firing threat treatment due to several reasons. First, workers who were able to select a contract would naturally rate their contract better than those who could not select due to revealed preference. Since more workers chose the capped vacation contract, the average ratings for this contract can be artificially higher than the average ratings for the unlimited vacation contract if workers who were able to choose between contracts are included. Second, workers who left the job early were mostly involuntary, i.e., due to firing. Consequently, these workers would naturally rate their contract worse when compared to those who stayed for all four weeks. Since there is a higher rate of attrition under the unlimited vacation contract, the average ratings for this contract can be artificially lower than the average ratings for the capped vacation contract if workers who left the job early are included. Third, the strength of firing threat can potentially affect worker ratings as well, so I control for this potential confounder.

1.7.2. The Role of a Performance-Oriented Firing Culture

While unlimited vacation brings about human capital benefits through multiple channels, it also comes with the risk of abuse by some workers. Figure 9 shows the distribution of weekly output, i.e., the number of correctly counted images, under unlimited vacation and suggests that many workers do slack by failing to meet the performance requirement. Overall, the slacking rate under the unlimited vacation contract is 31%.[42]

——————Insert Figure 9——————

Importantly, I find evidence for Prediction 3 that the strength of firing threat conditional on performance plays a role in how much workers comply with the performance expectation under the unlimited vacation, confirming that the risky perk should be bundled with a performance-oriented firing culture. Figure 10 shows that when there is a stronger firing threat, more workers are complying with performance expectation. Specifically, the slacking rate decreases from 38% to 21%—a 45% decrease. In particular, the benefits of a stronger firing threat in mitigating undesirable behavior mainly come from the actual enforcement of the firing post the first week of the job. As shown by the right panel, the difference in compliance rate becomes sizable starting at week 2 and remains relatively stable going forward. Relatedly, unlimited vacation workers tend to take less vacation when there is a strong firing threat; indolent workers who do not work at all only exist under the weak firing threat (see Figures A.9 and A.10 in Appendix).

——————Insert Figure 10——————

At the aggregate level, a lower slacking rate due to the strong firing threat leads to a higher level of output and ultimately higher overall labor efficiency, as seen in Figure 11. Therefore, an appropriate culture of punishment for under-performance is an effective way to deal with the risk from agency issues. One caveat, however, is that a stronger firing threat under the unlimited vacation contract may on the other hand increase worker turnover, both through voluntary dropout and actual firing of the underperforming workers.[43]

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[42] 22% of the slackers are high-performers vs. 78% are low-performers; 28% of the slackers are under strong firing threat vs. 72% are under weak firing threat.

————————Insert Figure 11————————

1.7.3. The Role of a Performance-Oriented Aligned System

What is the role of a performance-oriented aligned system that bundles unlimited vacation with other practices in the post selection performance stage? As discussed, these features are bundled together to mimic how unlimited vacation is typically implemented in workplaces along with other HR practices. Nevertheless, the question remains: does the unlimited vacation feature work *in itself* in terms of the contribution to the productivity gain? In Experiment 2, I decompose how each feature contributes to the productivity gain by addressing two questions. First, does the productivity gain vanish after attendance checks are removed under the capped vacation contract? Second, does the productivity gain vanish after a performance requirement is instated, in addition to the removal of attendance checks, under the capped vacation contract? Panel A of Table 6 summarizes the new contract treatments in Experiment 2 in comparison to the contract treatments in Experiment 1.

————————Insert Table 6————————

Panel B of Table 6 shows the results comparing estimated coefficients for the productivity gain under the unlimited vacation contract over other contracts, based on Model (1) in Table 4 with additional controls as indicated. I find that the productivity gain is persistent when attendance checks are removed under capped vacation—with a decrease in the size of the estimated coefficient from 0.676 to 0.590—and when a performance requirement is instated in addition to the removal of attendance checks—with a further decrease in the size of the estimated coefficient from 0.590 to 0.151. The decomposition of the total productivity gain to each contract feature suggests that the unlimited vacation feature accounts for 22% of the gain when worker type is not controlled for and about one-third of the gain when worker type is controlled for. Finally, I investigate whether high-performers and low-performers differ in terms of the level of complementarity they experience under various unlimited vacation contract features by including an interaction term into model estimation. I find that high-performers enjoy a larger complementarity to productivity than low-performers resulting from the unlimited vacation feature, but they do not appear to gain more from the other features of the unlimited vacation contract.

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[43] In total, 36 workers under the strong firing threat treatment were still employed in Week 4 under the unlimited vacation; 54 workers under the weak firing threat treatment were still employed in Week 4 under the unlimited vacation.

These findings from Experiment 2 suggest that an aligned HR system with bundled practices that emphasize performance does strengthen the performance gains from unlimited vacation, but the perk also improves worker productivity by itself. Moreover, the unlimited vacation feature is particularly beneficial to the productivity of high-performers.

1.7.4. Worker Vacation Patterns

Having examined whether unlimited vacation would benefit firms and the contingencies based on organizational cultures and systems, I now turn to the discussion of the effect on vacation patterns to shed light on the implication for workers. Under the capped vacation contract, workers are allowed to take at most one vacation day per week. Under the unlimited vacation contract, workers can take as much vacation as needed.[44] If workers are maximizing their utility rationally, they should take one weekly vacation day if they are under capped vacation, and should only work to the extent that they can fulfill the performance expectation if they are under unlimited vacation. Two complexities exist in the prediction of how many vacation days workers will take under unlimited vacation contract. First, high-performers may not work through the entire 16-minute work sessions, and can quit whenever they want. This means that they may take fewer vacation days while taking more vacation time in total. Second, low-performers who do not have the goal of complying with performance expectations will slack and simply take more vacation time and days.

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[44] The output threshold of 80 correctly counted images for the unlimited vacation contract was calibrated to first make it feasible for high-performers to take more than one vacation day per week, provided that they work through the entire 16 minutes for other workdays; and then to make it challenging for low-performers to take more than one vacation day.

Figure 12 presents the distribution of weekly vacation days by worker type and actual vacation scheme absent sorting. First, as expected, both high- and low-performers under the capped vacation cluster at one vacation day per week. Second, workers under the unlimited vacation contract on average take more vacation days than their counterparts under capped vacation—1.04 vacation days for unlimited vacation workers versus 0.79 vacation days for capped vacation workers pooling high-performers and low-performers (p <0.001). While a difference of 0.25 days appears small, the difference in average vacation time under the two contracts is much larger. Workers under the unlimited vacation on average take 12.34 more vacation minutes per week than workers under the capped vacation (p <0.001), which is about 0.77 days in the experimental context (12.34/16). Third, there are many indolent low-performers under the unlimited vacation contract, though the majority strives to achieve the performance expectation by taking zero vacation days.

——————**Insert Figure 12**——————

Interestingly, under the unlimited vacation, high-performers take zero vacation days 40% of the time and low-performers take zero vacation days 47% of the time. At first glance, this evidence seems to confirm the concern often discussed in media that unlimited vacation may make people take less vacation.[45] Yet, the reality is much more nuanced. For those high-performers who take zero vacation *days* under unlimited vacation, they in fact take very similar vacation *time* per week (12.86 minutes on average) when compared to an average high-performer under capped vacation (13.50 minutes on average) with no statistically significant difference (p-value is 0.666), but they simply spread out the vacation time and take it more conveniently. On the other hand, low-performers who do not take any weekly vacation days under the unlimited vacation actually work more per week in terms of total time (71.14 minutes on average) than low-performers under the capped vacation (65.25

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[45] Jonathan Chew, "Why Unlimited Vacation May Sound Better Than It Really Is," *Fortune*, March 10, 2016, http://fortune.com.

minutes on average), with a difference statistically significant at the 0.1% level. Moreover, even within the high-performer treatment group, those who take zero vacation days under the unlimited vacation contract tend to be the workers with lower initial performance in the practice session prior to the job. Overall, these results indicate that unlimited vacation workers on average take more vacation time, though the low-performers in this group may need to work more.

1.7.5. Robustness Checks

I conduct a number of robustness checks to address concerns about the idiosyncrasies of the MTurk worker sample and the potential differential attrition rates due to voluntary dropouts across contracts. Specifically, I examine whether the main benefits from unlimited vacation are robust regarding the sorting effect, productivity gains, and extra work from happier workers. I also evaluate whether the effect of strong firing threat holds true in terms of mitigating undesirable work behavior and whether vacation patterns under the two contracts remain similar.

The first concern is regarding whether vacation means very different things to online workers in a temporary job when compared to full-time workers in long-term jobs in physical offices. In the follow-up survey, I explicitly asked workers how they usually used their vacation time in the experiment. MTurk workers do vary in terms of how they spend their vacation time (see Figure A.11). Some workers used their vacation time in the experimental job to work on other MTurk jobs or their primary job other than MTurk work. Nevertheless, 54% of the workers still used their vacation time mainly for relaxation or entertainment, dealing with family or medical issues, spending time with family, and running chores and errands. I restrict my analyses to this 54% of the worker population and all results remain robust. A similar concern is that workers on MTurk may have other work/life commitments that force them into taking vacation on certain days. To address this concern, I restrict my analyses to workers who reveal that they work on MTurk seven days a week (40% of the sample) and find that all results remain robust.

Another concern is that the rate of voluntary dropouts may differ for unlimited and capped vacation contracts. Under the capped vacation contract, workers may decide to drop out early once they fail their attendance checks at a given time in a work session since they know for sure that they will be dismissed at the end of week. As the weekly payment is fixed, there are no additional benefits to the workers from working more. For this reason, it is possible that the average weekly output or productivity is lower for the capped vacation workers due to earlier dropouts. To address this concern, I restrict my analyses to workers who did check in every workday during a week to exclude those who dropped out early (94 workers). I also exclude the capped vacation workers who failed attendance checks (29 workers). All results remain robust. Moreover, the benefits of unlimited vacation regarding sorting, productivity, and inducing extra work from workers become even stronger. The effect of a strong firing threat also becomes more prominent in nudging workers to comply more and produce more.

Finally, I control for a range of worker characteristics for evaluating the productivity gains from unlimited vacation. The result remains robust after controlling for gender, race, education, work status (full or part time), hourly earnings for primary job, how often people work on MTurk (days and hours), when they typically work on MTurk, and how much they usually earn on MTurk.

1.8. Discussion

Implications for firms

First, the sorting benefits from unlimited vacation through the recruitment channel would depend on the organizational need for high-performers, and are likely most pronounced for *growth-oriented firms* with a large demand for top talent.[46] Examples include both small startups in the scaling-up phase and big technology companies in the high-growth stage. Second, the productivity raise through the performance channel due to the unlimited vacation feature itself suggests that this perk may be a substitute for complex and costly performance monitoring, especially for those *resource-constrained nascent ventures.* Third, the engagement benefits from offering unlimited vacation to workers imply that the employment contract becomes more relational as workers feel happier and more committed, which can be a potential way to improve retention at *high-turnover technology firms.* In all, unlimited vacation appears to be a relevant consideration for entrepreneurial firms of all kinds, as well as other types of firms that compete with these firms on the basis of human capital.

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[46] Patty McCord, "Hiring the Best People," interview with *Harvard Business Review*, January 2, 2018, https://hbr.org.

Firms should also consider their unique organizational conditions when evaluating the contingencies in the aforementioned benefits. Across my three empirical settings, I find that at least three things matter: supportive social dynamics with healthy interpersonal relationships, a strong culture of punishment for under-performance, and an aligned HR system that reinforces the focus on performance rather than face time. In particular, bureaucratic firms typically have strict policies to govern inappropriate behavior in the workplace, but entrepreneurial firms may lack clear policies or credible punishment devices to deal with potential slacking and thus would rely more on the culture of punishment. This does not imply, however, that firms should aim for a stressful and hostile workplace culture. Rather, firms should set explicit performance expectations, conduct transparent performance evaluations, and employ consistent policies for both rewards and penalties.

Implications for workers

Implications for workers are mixed. While an average worker under unlimited vacation is happier and is able to take more vacation than his or her counterparts under capped vacation, I do find that a good number of unlimited vacation workers in my RCT end up taking no vacation *days* at all. At first glance, this observation seems to confirm a common concern in the media that "'unlimited vacation' is code for 'no vacation.'"[47] Yet, the reality discovered by my study is that high-performers in this group actually take about the same total vacation *time* as their counterparts under capped vacation, for they tend to spread out vacation time more conveniently by leaving work earlier on workdays, rather than take a day or two off completely. Low-performers who take zero vacation days, on the other hand, do appear to be working more than their capped vacation fellows. It turns out that unlimited vacation may be a reward for high-performers only.

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[47] Megan McArdle, "'Unlimited Vacation' Is Code for 'No Vacation,'" *Bloomberg*, September 30, 2015, https://www.bloomberg.com.

Limitations

Admittedly, my theory leaves out a number of other potential benefits firms may acquire by adopting an unlimited vacation scheme: avoiding the end of year chaos when employees all rush to use the pre-granted vacation days, eliminating the HR burden of tracking and managing vacation time, and dodging the additional liability line of unused and accrued vacation on the balance sheet. These forces may co-exist; nevertheless, the gains from unlimited vacation through the recruitment, performance, and engagement channels uncovered in this study are sizable enough for firms to consider this perk more seriously.

A few limitations are also worth noting about the external validity of the experimental results. First, the RCT took place online, which could not fully capture all relational aspects in the workplace from the interaction between people. For instance, workers may take little vacation under unlimited vacation when they feel pressured to stay on the job to ensure job security[48] or to impress the higher-ups.[49] Nevertheless, the finding about sorting is likely unaffected. Moreover, survey evidence suggests that some of the relational aspects remain in effect even in the online experimental context as workers indicate that they supplied more work to signal commitment to the job. Most importantly, results from the field setting suggest that even in a socially complex workplace environment, workers on average tend to take more vacation and experience improved subjective productivity due to access to the perk of unlimited vacation. Second, "vacation" may not necessarily reflect actual vacation for MTurk workers, as 45% of the workers spent time on other MTurk tasks or even their primary job during the "vacation" time for the experimental job. Yet, vacation may not necessarily be vacation for real workers either. It is increasingly common for regular workers to use their time outside their main job to engage in other forms of gig work or entrepreneurial endeavor, e.g., driving for Uber, picking up some coding task on Elance, or launching a project on Kickstarter. Third, I use an image-counting task in the design so that output and productivity can be measured precisely. However, some potential features of work tasks are not captured such as creativity, meaningfulness, and interdependence. My theoretical model predicts that the scope for complementarity between the work nature and schedule autonomy also matters for the degree of benefits resulting from unlimited vacation. I expect that the performance gains would be more pronounced for jobs that are creative and independent, but may be obscure for roles that require intensive real-time interaction with co-workers or customers. I leave this for future research.

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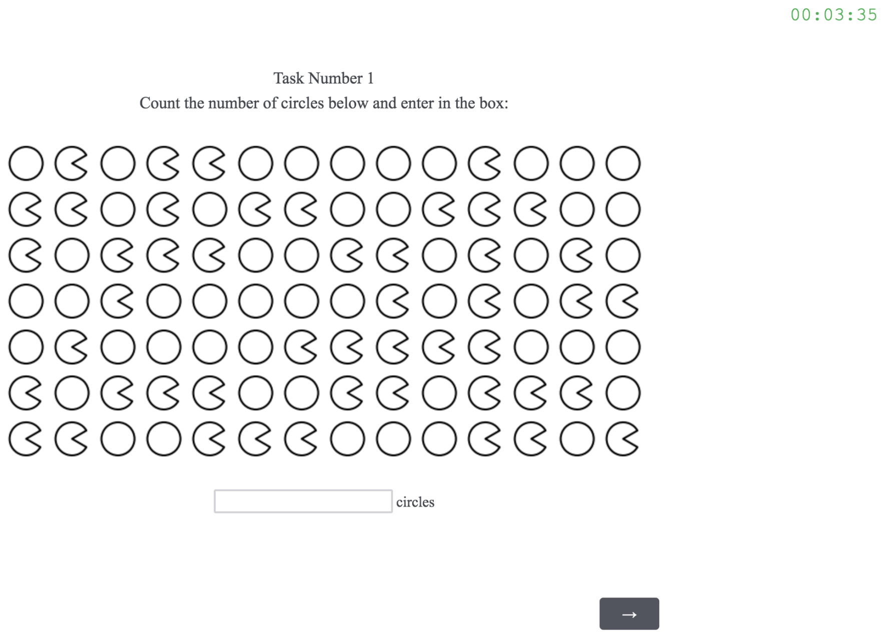
[48] Trent Gillies, “Take all the time you need: The rise of ‘unlimited vacations’,” *CNBC*, December 20, 2015, http://www.cnbc.com.

[49] Susan Milligan, “The Limits of Unlimited Vacation,” *Society for Human Resource Management*, March 1, 2015, https://www.shrm.org.

1.9. Conclusion

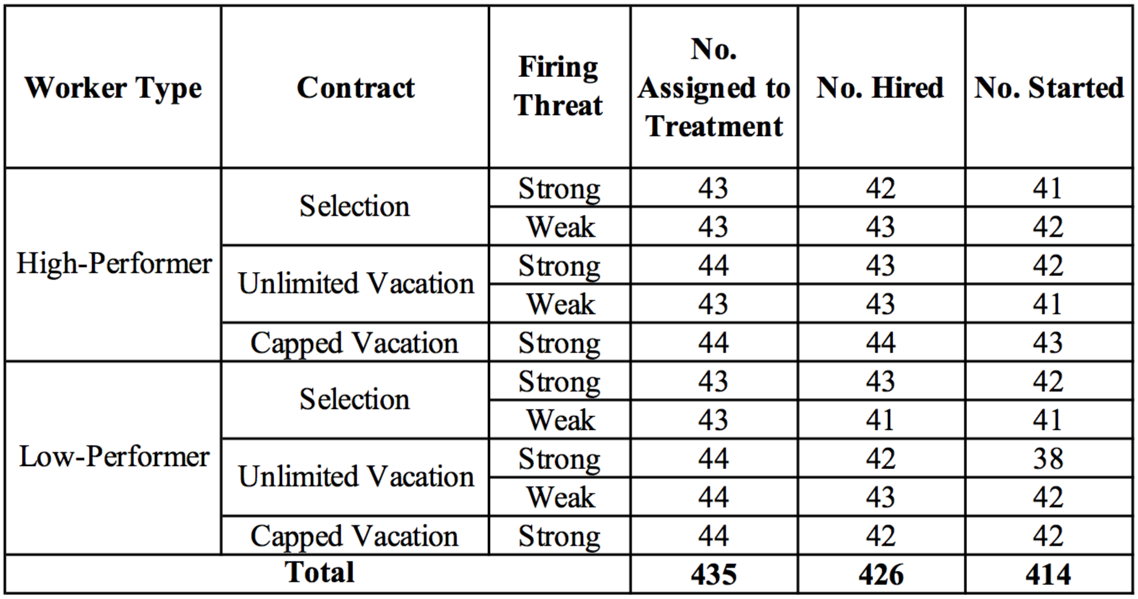
My study addresses a topic with emerging relevance and importance in practice—how firms can use new, innovative, non-pecuniary, but risky perks like unlimited vacation to achieve strategic benefits in talent recruitment and management. Through three complementary empirical settings, this paper provides a wholistic view on the phenomenon of unlimited vacation by shedding light on its trade-offs in multiple HR domains and the contingencies based on various organizational conditions. I find empirical evidence that unlimited vacation offers human capital benefits by improving overall labor efficiency through three major ways: (1) attracting high-performers in recruitment, (2) creating complementarity to work that makes people more productive, and (3) inducing extra work outputs from happier workers. Aligned HR practices including a clear performance requirement and a removal of attendance checks lead to strengthened gains in the performance stage. However, I also show that the perk is indeed risky—it may hurt productivity in teams with nonsupportive social dynamics and it can encourage slacking when there is a weak culture of punishment for under-performance. Together, this paper demonstrates how managers can create a highly skilled, productive, and motivated workforce through the perk of unlimited vacation. It further highlights the organizational conditions that are essential for sustaining the competitive advantage from this superior human capital pool.



Task Number 1

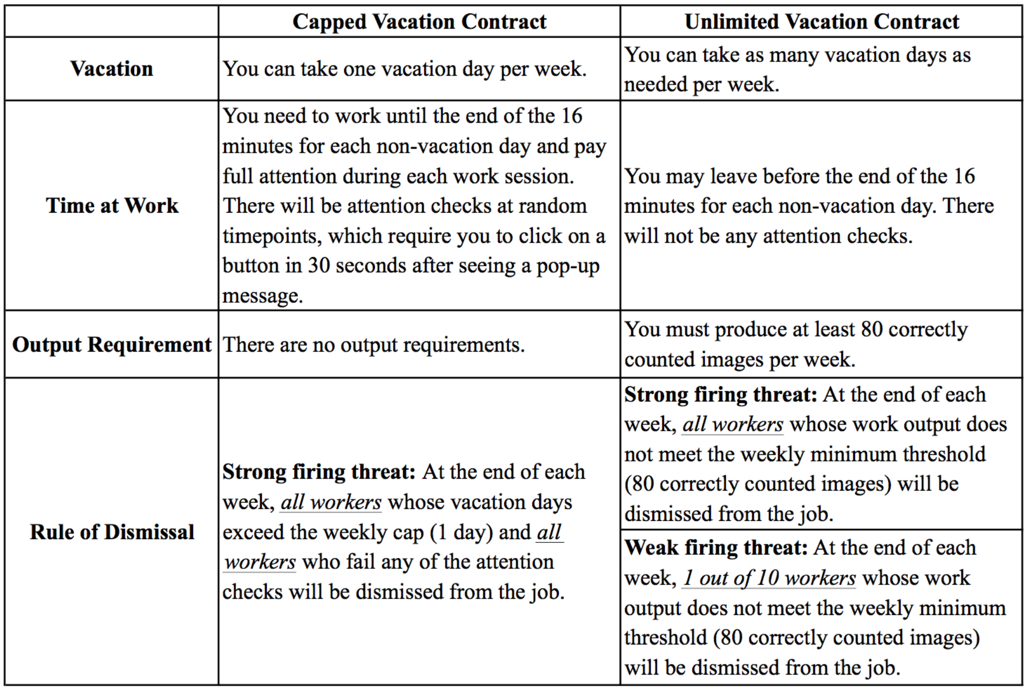
Count the number of circles below and enter in the box:

Figure 1: **Task in Setting 3.** This is an example of the image-counting task for workers in the high-performer treatment in Setting 3 (RCT). Workers in the low-performer treatment worked on images twice the size.



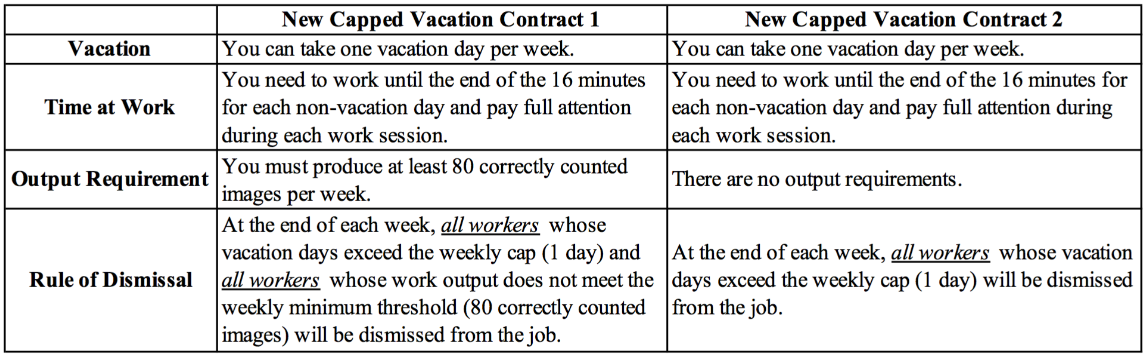
Worker Type	Contract	Firing Threat	No. Assigned to Treatment	No. Hired	No. Started
High-Performer	Selection	Strong	43	42	41
		Weak	43	43	42
	Unlimited Vacation	Strong	44	43	42
		Weak	43	43	41
	Capped Vacation	Strong	44	44	43
Low-Performer	Selection	Strong	43	43	42
		Weak	43	41	41
	Unlimited Vacation	Strong	44	42	38
		Weak	44	43	42
	Capped Vacation	Strong	44	42	42
Total			**435**	**426**	**414**

Figure 2: **Treatments (Experiment 1) in Setting 3.** This table shows treatment assignment based on worker type, contract, and firing threat in Setting 3 (RCT). 435 workers were assigned randomly to the treatments. 426 workers confirmed interest in the job and were hired. 414 workers started the job.



	Capped Vacation Contract	**Unlimited Vacation Contract**
Vacation	You can take one vacation day per week.	You can take as many vacation days as needed per week.
Time at Work	You need to work until the end of the 16 minutes for each non-vacation day and pay full attention during each work session. There will be attention checks at random timepoints, which require you to click on a button in 30 seconds after seeing a pop-up message.	You may leave before the end of the 16 minutes for each non-vacation day. There will not be any attention checks.
Output Requirement	There are no output requirements.	You must produce at least 80 correctly counted images per week.
Rule of Dismissal	**Strong firing threat:** At the end of each week, *all workers* whose vacation days exceed the weekly cap (1 day) and *all workers* who fail any of the attention checks will be dismissed from the job.	**Strong firing threat:** At the end of each week, *all workers* whose work output does not meet the weekly minimum threshold (80 correctly counted images) will be dismissed from the job.
		Weak firing threat: At the end of each week, *1 out of 10 workers* whose work output does not meet the weekly minimum threshold (80 correctly counted images) will be dismissed from the job.

Figure 3: **Contracts (Experiment 1) in Setting 3.** This table shows the details for the capped vacation contract and the unlimited vacation contract in Setting 3 (RCT).



	New Capped Vacation Contract 1	**New Capped Vacation Contract 2**
Vacation	You can take one vacation day per week.	You can take one vacation day per week.
Time at Work	You need to work until the end of the 16 minutes for each non-vacation day and pay full attention during each work session.	You need to work until the end of the 16 minutes for each non-vacation day and pay full attention during each work session.
Output Requirement	You must produce at least 80 correctly counted images per week.	There are no output requirements.
Rule of Dismissal	At the end of each week, *all workers* whose vacation days exceed the weekly cap (1 day) and *all workers* whose work output does not meet the weekly minimum threshold (80 correctly counted images) will be dismissed from the job.	At the end of each week, *all workers* whose vacation days exceed the weekly cap (1 day) will be dismissed from the job.

Figure 4: **Contracts (Experiment 2) in Setting 3.** This table shows the details for the two new contracts introduced in Experiment 2 in Setting 3 (RCT).

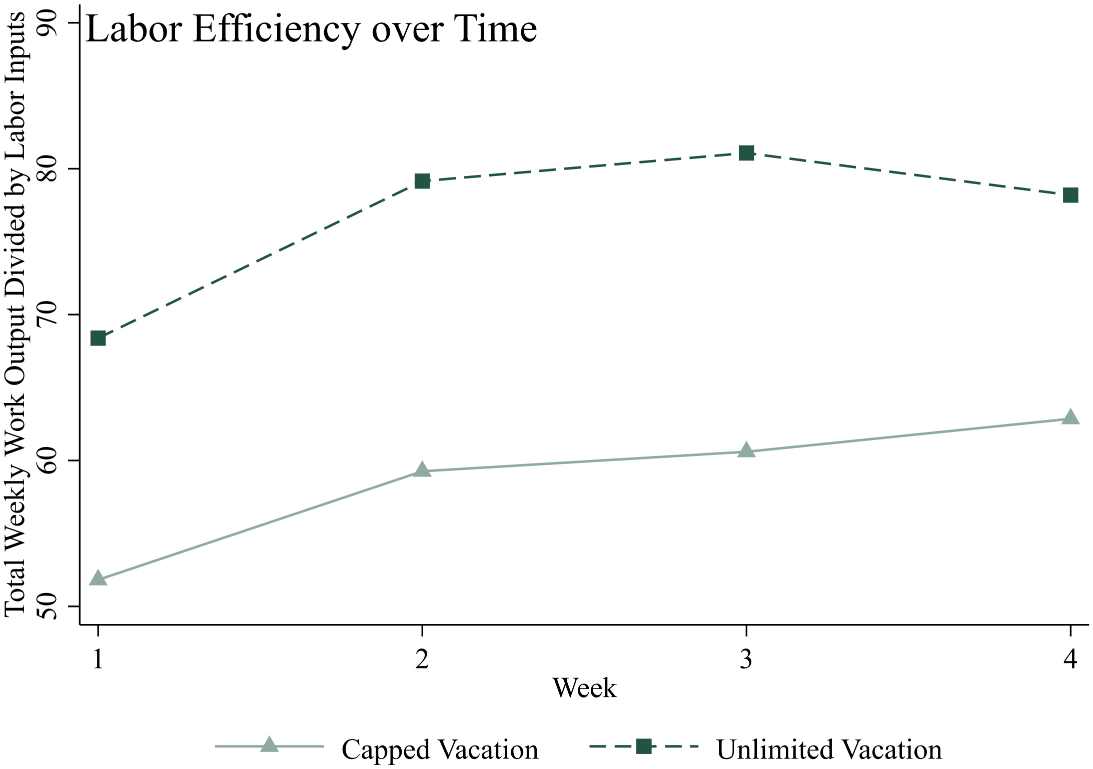


Figure 5: **Overall Labor Efficiency in Setting 3.** This figure shows overall labor efficiency by contract over time in Setting 3 (RCT) for all workers in Experiment 1.

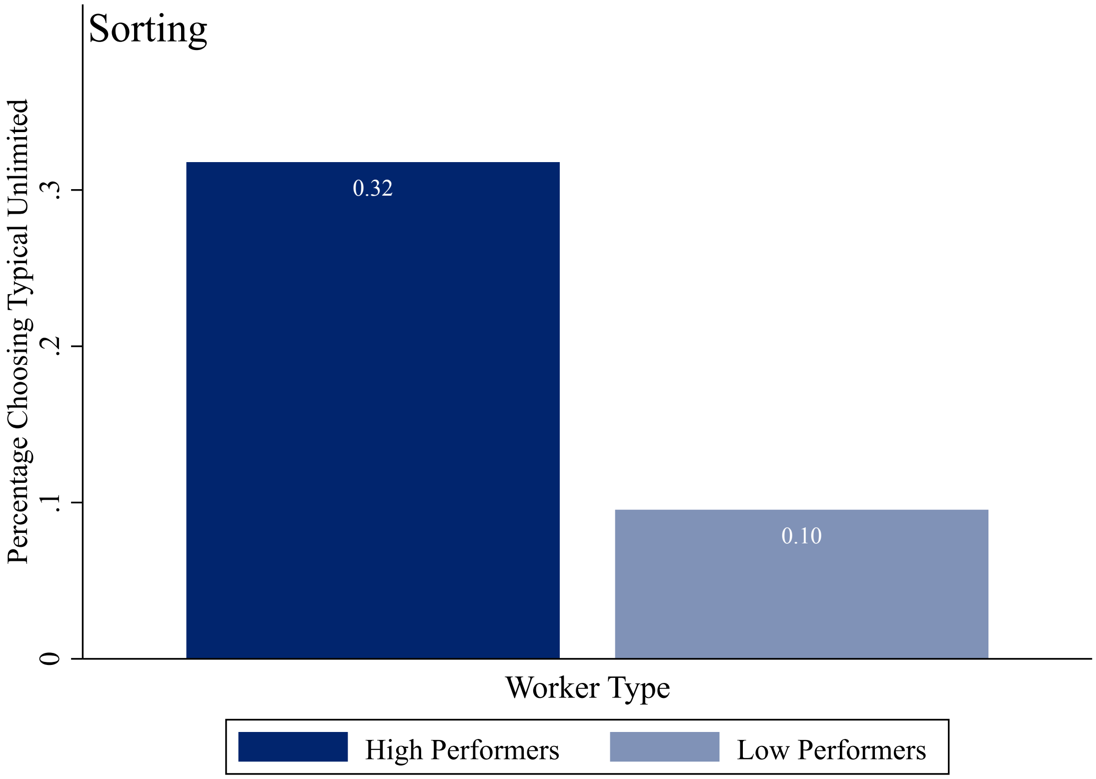


Figure 6: **Sorting by Worker Type in Setting 3.** This figure shows the percentage of workers choosing unlimited vacation by worker type treatment in Setting 3 (RCT), using only workers who are in the selection contract treatment ($N = 169$). The difference between the proportions is statistically significant at the 0.1% level.

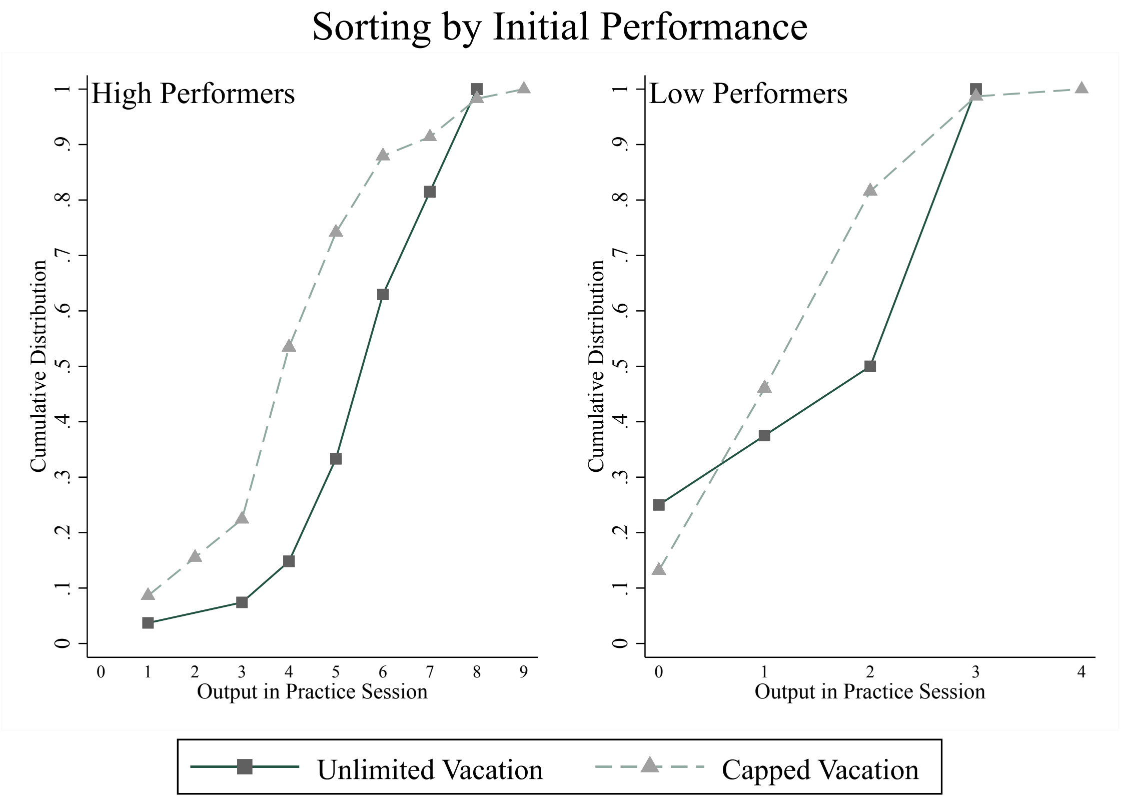


Figure 7: **Sorting by Initial Performance Across Worker Type Treatments in Setting 3.** This figure shows the cumulative distribution of workers choosing the unlimited vacation or the capped vacation contract in Setting 3 (RCT), controlling for worker type treatment. Only workers who are in the selection contract treatment are used ($N = 169$).

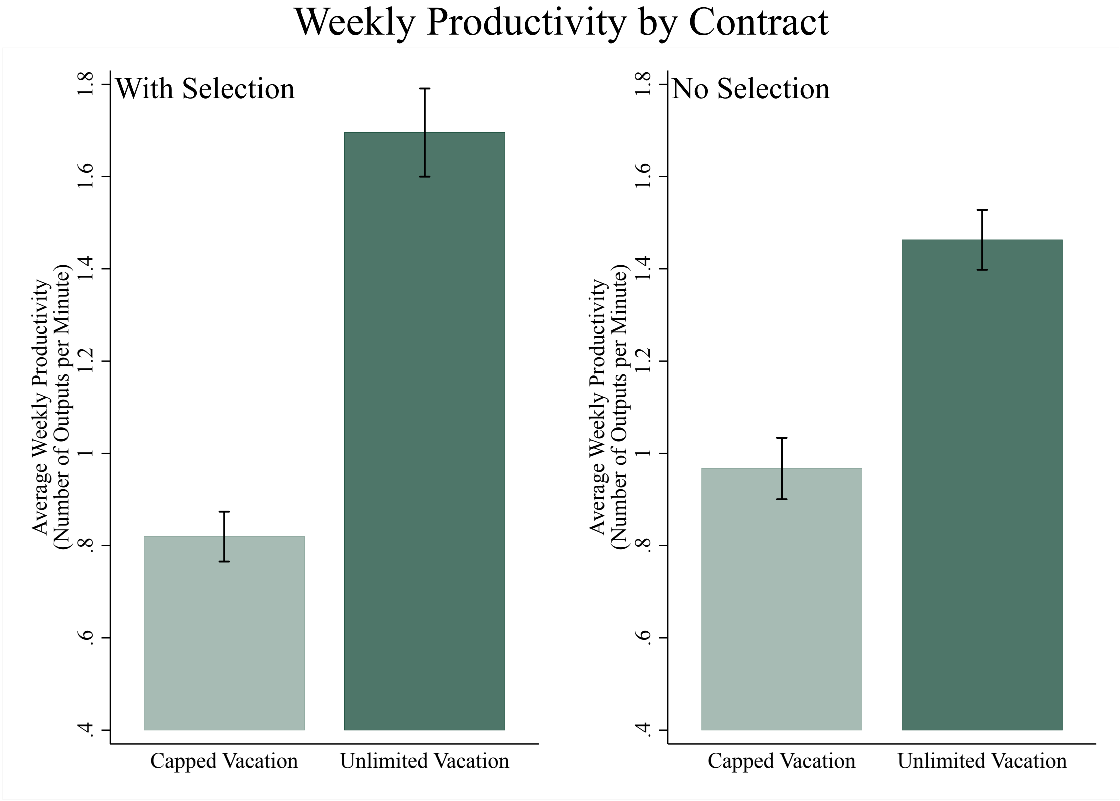


Figure 8: **Weekly Productivity by Contract in Setting 3.** This figure shows the average weekly productivity (number of outputs per minute) by the vacation contract separately for workers who can choose between two contracts (left subfigure) and workers who are randomly assigned a contract (right subfigure) in Setting 3 (RCT). The difference between the means is statistically significant difference at the 0.1% level for both subfigures.

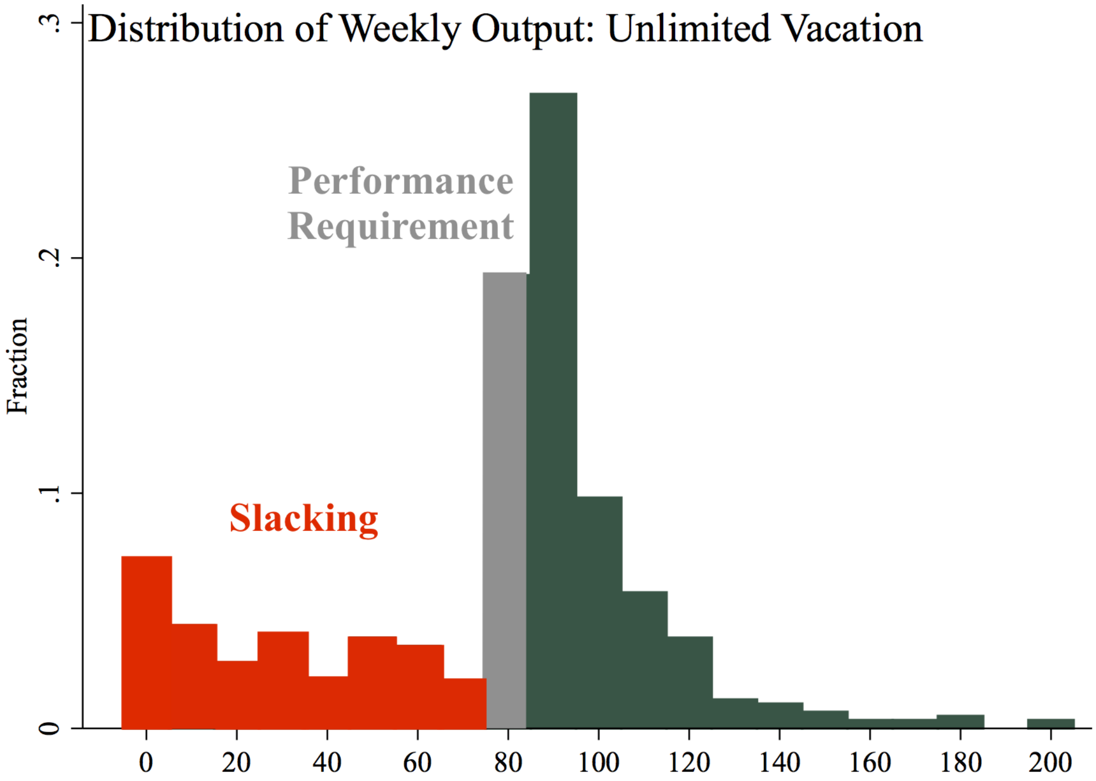


Figure 9: **Distribution of Weekly Output under Unlimited Vacation in Setting 3.** This figure shows the distribution of weekly output under unlimited vacation in Setting 3 (RCT). Weekly output is defined as the number of correctly counted images per week. The gray bar shows the performance requirement, i.e., 80 correctly counted images per week. The red bars indicate cases of slacking, which is defined as not meeting the performance requirement.

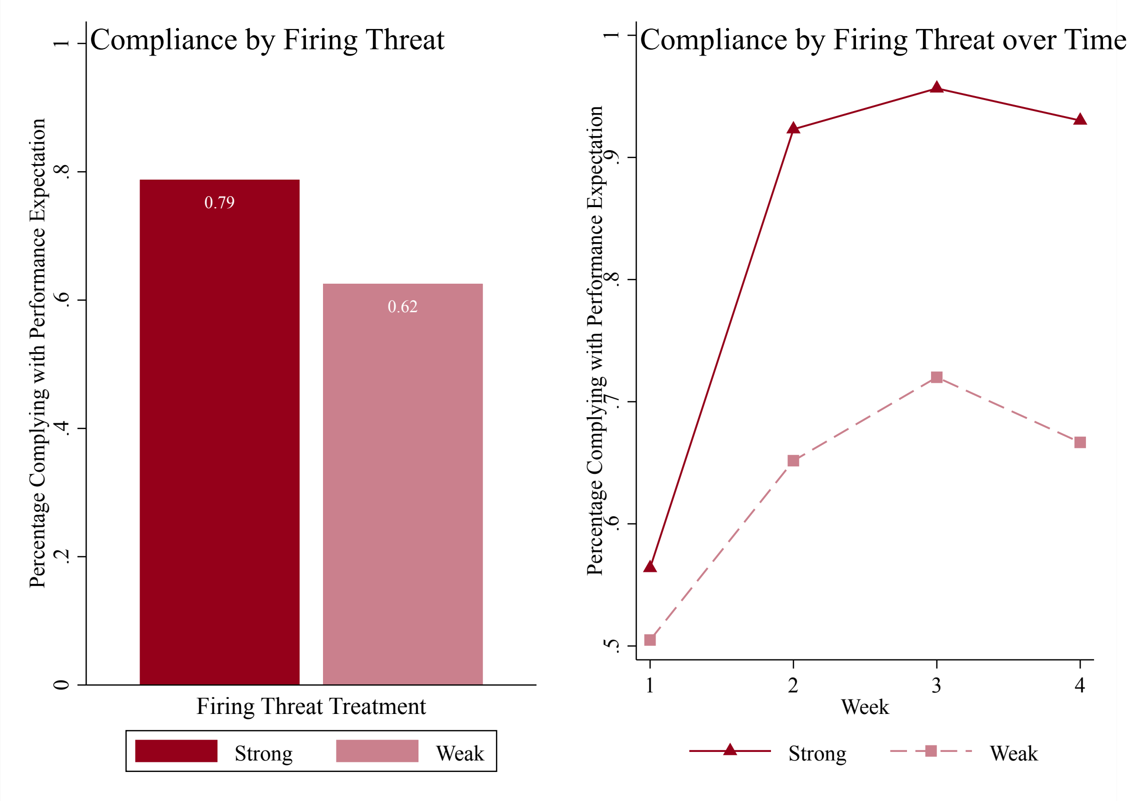


Figure 10: **Compliance by Firing Threat in Setting 3.** This figure shows the percentage of workers complying with the performance expectation, i.e., meeting the output threshold, by firing threat in Setting 3 (RCT), using workers who work under the unlimited vacation. The left subfigure shows the percentage of complying workers by firing threat pooling together all 4-week data. The difference between the proportions is statistically significant at the 0.1% level. The right subfigure shows the percentage of complying workers by firing threat over time. The difference between the proportions at each week is statistically significant at the 0.1% level, except for Week 1 (p-value = 0.204).

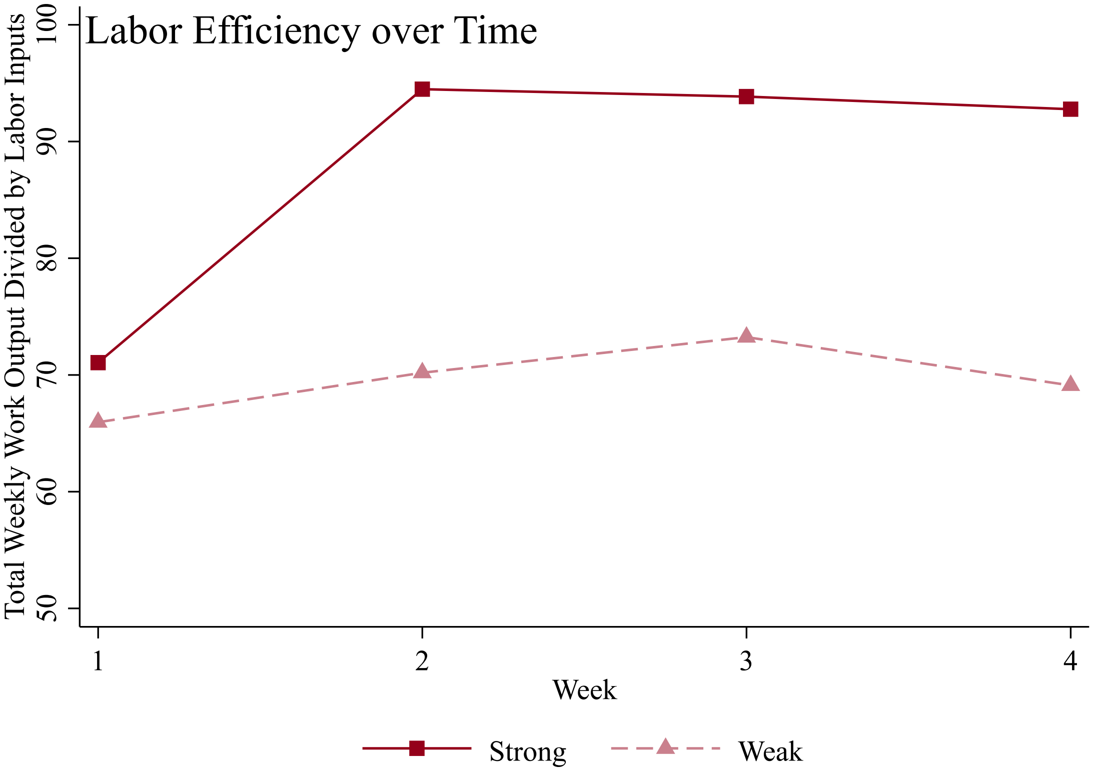


Figure 11: **Labor Efficiency over Time by Firing Threat in Setting 3.** This figure shows overall labor efficiency by firing threat treatment using workers who work under the unlimited vacation in Setting 3 (RCT).

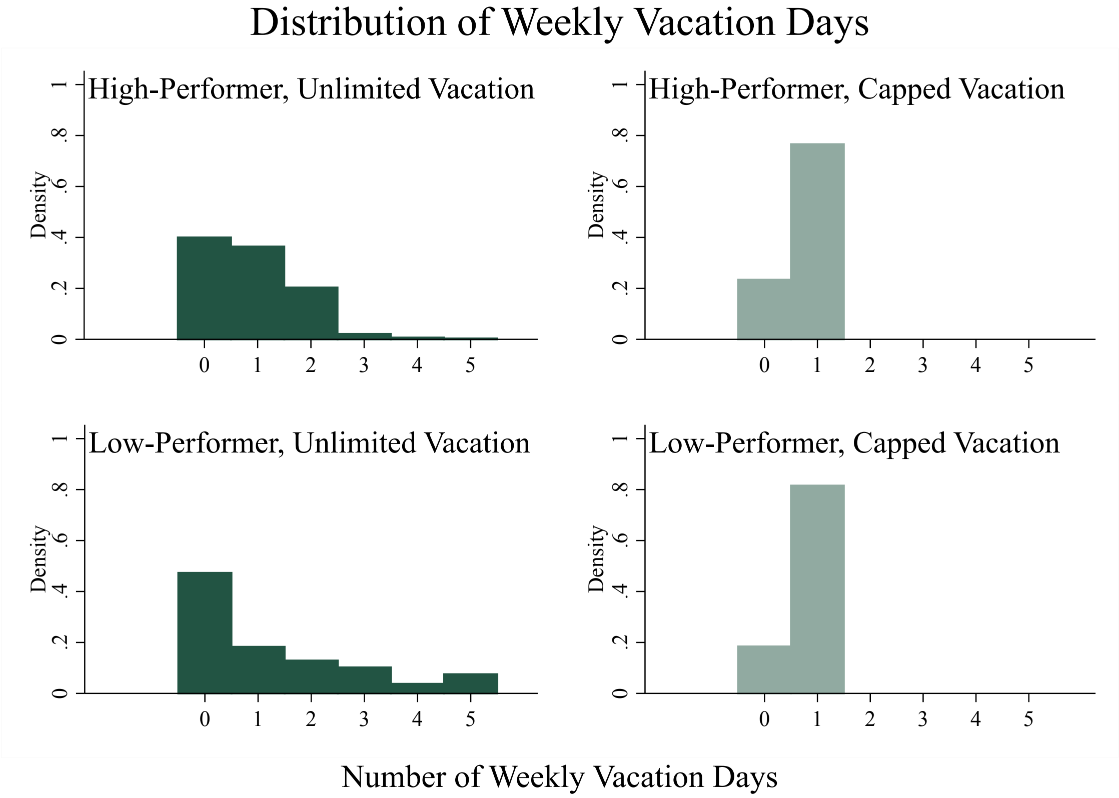


Figure 12: **Distribution of Weekly Vacation Days in Setting 3.** This figure shows the distribution of weekly vacation days by worker type treatment and actual vacation scheme in Setting 3 (RCT), restricting to workers who cannot choose between contracts, i.e., no sorting. The top left subfigure shows the distribution for high-performers under the unlimited vacation, with a mean of 0.88 vacation days. The top right subfigure shows the distribution for high-performers under the capped vacation, with a mean of 0.77 vacation days. The bottom left subfigure shows the distribution for low-performers under the unlimited vacation, with a mean of 1.27 vacation days. The bottom right subfigure shows the distribution for low-performers under the capped vacation, with a mean of 0.82 vacation days.

Table 1: **Firm Characteristics by Vacation Type in Setting 1.** This table compares firms with and without unlimited vacation across various characteristics in Setting 1 (Glassdoor). Firm size is coded numerically into rankings in terms of number of employees. A numeric value of 3 represents 51-250 employees, and a numeric value of 4 represents 251-500 employees. Product diversity is measured as the number of category groups the firm is associated with.

	Capped Vacation			**Unlimited Vacation**			**Difference**
	Mean	S.D.	*N*	Mean	S.D.	*N*	*p*-value
Firm Age in Years	27.23	30.83	9530	12.85	13.85	1300	< 0.001
Firm Size (Numeric Coding)	4.04	2.00	8902	3.44	1.59	1150	< 0.001
Location in CA, NY, MA	0.39	0.49	9912	0.66	0.47	1318	< 0.001
High Tech Industry	0.51	0.50	9912	0.75	0.43	1318	< 0.001
IPO or Acquired	0.41	0.49	9912	0.22	0.42	1318	< 0.001
Funding Rounds	1.57	2.14	9912	3.30	2.51	1318	< 0.001
Product Diversity	2.13	1.58	9912	2.99	1.56	1318	< 0.001

Table 2: **Effect on Vacation in Setting 2.** This table shows the regression results for evaluating changes in vacation pattern due to unlimited vacation in Setting 2 (a large high-tech company). Models (2)-(4) restrict to employees who did not experience a change in job function due to the transfer. Models (2) and (3) control for job functions pre-transfer. Robust standard errors are reported in parentheses and are clustered at the individual level in Model (4). * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$ **** $p < 0.001$.

	Dependent Variable: Monthly Time Off Days			
	(1)	(2)	(3)	(4)
Treat	0.130*	-0.050	-0.020	
	(0.078)	(0.153)	(0.151)	
Post	-0.274***	-0.181*	0.125	0.115
	(0.084)	(0.094)	(0.117)	(0.123)
Treat × Post	0.838****	0.766***	0.765***	0.707**
	(0.218)	(0.261)	(0.262)	(0.292)
Change in Job Level		0.055	-0.019	
		(0.087)	(0.088)	
Job Level before Transfer		0.281	0.272	
		(0.196)	(0.196)	
Job Tenure (Months) at Transfer		0.006	0.003	
		(0.005)	(0.006)	
Year Fixed Effects	No	No	Yes	Yes
Individual Fixed Effects	No	No	No	Yes
Constant	2.101****	1.646****	1.808****	2.302****
	(0.037)	(0.228)	(0.286)	(0.168)
Observations	3436	2982	2982	2982

Table 3: **Effect on Subjective Productivity in Setting 2.** This table shows the regression results for evaluating subjective productivity gain from unlimited vacation in Setting 2 (a large high-tech company). Models (2)-(6) control for job functions pre-transfer and restrict to employees who did not experience a change in job function due to the transfer. Robust standard errors are reported in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$ **** $p < 0.001$.

	Dependent Variable: Subjective Productivity					
	(1)	(2)	(3)	(4)	(5)	(6)
Treat	-0.274	-0.980**	-0.195	-1.141	-1.660*	-0.884
	(0.188)	(0.438)	(0.950)	(0.702)	(0.984)	(0.695)
Post	-0.275**	-0.228	-0.107	-0.216	0.661	0.324
	(0.136)	(0.143)	(0.691)	(0.530)	(0.863)	(0.544)
Treat × Post	0.453*	0.438*	-2.156*	-1.053	-2.117*	-1.704*
	(0.249)	(0.256)	(1.117)	(0.815)	(1.178)	(0.961)
Change in Job Level		-0.100	-0.171	0.106	-0.234	-0.194
		(0.173)	(0.204)	(0.184)	(0.170)	(0.189)
Job Level before Transfer		0.721	0.406	1.088**	1.060**	0.566
		(0.458)	(0.566)	(0.544)	(0.468)	(0.365)
Job Tenure (Months) at Transfer		-0.002	-0.000	-0.006	-0.005	0.006
		(0.008)	(0.010)	(0.009)	(0.009)	(0.009)
Great Team 1			1.008**			
			(0.478)			
Great Team 1 × Post			-0.224			
			(0.719)			
Great Team 1 × Treat			-0.757			
			(0.918)			
Great Team 1 × Treat × Post			3.053***			
			(1.160)			
Great Team 2				1.244***		
				(0.388)		
Great Team 2 × Post				-0.074		
				(0.548)		
Great Team 2 × Treat				-0.545		
				(0.768)		
Great Team 2 × Treat × Post				1.827**		
				(0.877)		
Great Team 3					1.705***	
					(0.586)	
Great Team 3 × Post					-1.007	
					(0.876)	
Great Team 3 × Treat					0.349	
					(0.941)	
Great Team 3 × Treat × Post					2.706**	
					(1.210)	
Great Manager						1.311****
						(0.333)
Great Manager × Post						-0.610
						(0.559)
Great Manager × Treat						-0.028
						(0.682)
Great Manager × Treat × Post						2.088**
						(0.990)
Constant	4.731****	4.145****	3.687****	2.837****	2.571***	3.231****
	(0.094)	(0.494)	(0.812)	(0.733)	(0.832)	(0.529)
Observations	571	496	356	353	394	406

Table 4: **Weekly Individual Worker Productivity in Setting 3.** This table shows the regression results for evaluating productivity gain from the unlimited vacation contract in Setting 3 (RCT). The dependent variable is weekly productivity (number of outputs per minute). All models include week fixed effects. Robust standard errors clustered at the individual level are reported in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$ **** $p < 0.001$.

	Dependent Variable: Weekly Productivity (Number of Outputs per Minute)				
	(1)	(2)	(3)	(4)	(5)
Unlimited Vacation	0.645****	0.631****	0.512****	0.416****	0.483****
	(0.062)	(0.066)	(0.083)	(0.065)	(0.113)
Selection		-0.032	-0.151*	-0.102*	-0.099*
		(0.065)	(0.082)	(0.054)	(0.054)
Unlimited Vacation × Selection			0.376***	0.147	0.160*
			(0.125)	(0.092)	(0.089)
High-Performer				0.770****	0.815****
				(0.055)	(0.058)
Unlimited Vacation × High-Performer					-0.116
					(0.122)
Constant	0.674****	0.693****	0.767****	0.420****	0.394****
	(0.040)	(0.055)	(0.063)	(0.040)	(0.045)
Observations	1274	1274	1274	1274	1274

Table 5: **Follow-Up Survey Ratings in Setting 3.** This table shows the average ratings for survey questions based on a 7-point Likert scale separately for workers under the unlimited vacation and for workers under the capped vacation in Setting 3 (RCT). For each survey question, the respondent indicates how strongly he/she agrees or disagrees with the statement. A rating of 1 indicates "Strongly Disagree" and a rating of 7 indicates "Strongly Agree." A higher rating indicates that the respondent more strongly agrees with the statement. Actual order of question was randomized. The analysis restricts to workers who were randomly assigned a contract, stayed for the entire job, and were under the strong firing threat treatment.

	Survey Question	Unlimited Vacation ($N = 33$)	Capped Vacation ($N = 57$)	p-value
1.	In general, I was satisfied with this job.	6.52	6.16	0.041
2.	All in all, this job was great.	6.21	5.70	0.021
3.	This job was very enjoyable.	5.30	4.61	0.031
4.	My work contract offered me flexibility.	6.70	6.16	0.009
5.	My work contract offered me autonomy.	6.30	6.00	0.088
6.	My work contract allowed me to manage my time efficiently.	6.64	6.37	0.066
7.	I felt trusted by the employer under my work contract.	6.39	6.09	0.107
8.	I usually did not consider my level of productivity when deciding between working and taking vacation.	2.85	4.19	0.002

Table 6: **Unbundling the Unlimited Vacation Contract in Setting 3.** This table shows treatments that unbundle the unlimited vacation contract in Setting 3 (RCT). Panel A of this table summarizes the contract features of new contract treatments in Experiment 2, in comparison to the treatments in Experiment 1. Panel B of this table examines how each aspect of the unlimited vacation contract contributes to the productivity gain over the capped vacation contract, based on Model (1) in Table 4 with additional controls as indicated. All workers included are those who cannot choose between contracts and are under a strong firing threat. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$ **** $p < 0.001$.

Panel A. Contract Treatments

	Unlimited Vacation	New Capped 1	New Capped 2	Capped Vacation
Vacation Cap	No	Yes	Yes	Yes
Attendance Checks	No	No	No	Yes
Performance Requirement	Yes	Yes	No	No
Rule of Dismissal	All workers who breach any aspect of the contract are dismissed			

Panel B. Productivity Difference between Unlimited Vacation vs. Treatment

	New Capped 1	New Capped 2	Capped Vacation
Feature Separated Out	Vacation Feature	Performance Requirement	Attendance Checks
Baseline			
Estimated Coefficient	0.151**	0.590****	0.676****
Contribution	22%	65%	13%
Controlling for Worker Type			
Estimated Coefficient	0.157***	0.358****	0.509****
Contribution	31%	39%	30%
Interaction with High-Performer			
Estimated Coefficient	0.251**	not statistically significant	-0.538**

CHAPTER 2 : Social Safety Net and New Venture Performance: The Case of New Jersey Paid Family Leave Program

Kauffman Knowledge Challenge Grant Recipient, 2018

Abstract

Despite a large literature on how institutional environments shape venture formation, little is known about how social safety nets for employees at entrepreneurial firms influence business performance post the founding stage. This paper examines how employees' access to state-sponsored paid family leave impacts the profitability of new ventures by exploiting the 2009 New Jersey Paid Family Leave (PFL) program. Using a difference-in-differences design, I find that the state PFL program adversely affects the likelihood of making profits for the average new venture. The negative effect is stronger for businesses in greater financial stress and those that are more reliant on incumbent employees, suggesting two operating mechanisms—the lack of financial resources and the lack of flexibility in staffing—that render new ventures particularly vulnerable to human capital shocks as a result of institutional changes. Innovative ventures, however, experience an asymmetric effect and are more likely to be profitable post treatment. Taken together, this study combines institutional perspectives, employment topics, and human resource considerations to highlight that social safety nets for workers may have unintended consequences for nascent businesses, especially considering the heterogeneity in how ventures can absorb these impacts.

2.1. Introduction

The relationship between institutional environments and entrepreneurship has been extensively explored by strategy, entrepreneurship, and economics research, which has highlighted how regulatory changes, such as easier access to capital (Chatterji and Seamans, 2012), lenient bankruptcy laws (Eberhart et al., 2017), business-friendly tax policy (Bruce and Mohsin, 2006; Gentry and Hubbard, 2000), and lower firm registration costs (Castellaneta et al., 2020), can spur the founding of new ventures. Despite the large focus on factors that directly impact barriers to venture formation, little consideration has been given to social safety nets for individuals working at new ventures that impact business operation post the founding stage.[1]

On one hand, economic security provided by work-related government-sponsored social safety net programs, such as unemployment insurance, disability insurance, and paid family leave, may allow otherwise hesitant workers to more comfortably join, perform, and stay at small, nascent ventures that are known to pay less (Burton et al., 2018; Evans and Leighton, 1989) and be prone to failures (Aldrich and Yang, 2012). The possibility of human capital benefits suggests that the institutional capital from social safety nets may be converted to firm-level competitive advantages (Chang and Wu, 2014; Oliver, 1997). On the other hand, such programs may also incur unintended human resource burden for new ventures, as they need to bear the associated administrative costs and deal with staffing issues, for instance, when workers are more likely to go on family leave. These costs can be particularly challenging for firms facing the liabilities of newness and smallness, as they tend to lack formal HR systems and flexibility in staffing (Cardon, 2003; Cardon and Stevens, 2004). Therefore, it remains unclear whether and how social safety nets for venture employees would affect the performance of new ventures.

This paper sheds light on this ambiguity by examining how employees' access to state-funded paid family leave impacts the profitability of new ventures. Paid family leave warrants scrutiny since it is one of the social safety net programs that receive the most public attention and ongoing policy debate.[2] While only five states, California, New Jersey, Rhode Island,

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[1] The scant work on the relationship between social safety nets and entrepreneurship has examined food stamp programs (Olds, 2016b), the State Child Health Insurance Program (Olds, 2016a), and Medicare qualification (Fairlie et al., 2011), but only to the extent of how these social safety net programs impact the founding person in terms of entrepreneurial entry.

[2] Tierney Sneed, "Paid Family Leave Is Primed for a National Debate," March 23, 2015, *U.S. News*, https://www.usnews.com/.

New York, and Washington, currently offer state-funded paid family leave for workers, an increasing number of states, including Massachusetts, Connecticut, Oregon, and the District of Columbia, have all enacted their own versions of Paid Family Leave (PFL) programs that will soon start to provide the benefit, and the legal prospects of national paid family leave are being discussed.[3] Moreover, the study of paid family leave offers strategic guidance for small, nascent ventures deliberating over the provision of additional benefits and perks that would complement the worker social safety nets supported by the government. As workers are demanding more paid maternity and paternity leave in the changing labor market,[4] small businesses are showing strong interests in offering such benefits in the hope of attracting, incentivizing, and retaining employees.[5] Hence, it is critical for both policy-makers and practitioners to understand the consequences and contingencies of employee access to paid family leave for small, new ventures.

While state-sponsored PFL programs have been shown to encourage more use of paid family leave (Rossin-Slater et al., 2013), which is widely recognized as beneficial to individual workers through improved economic security (Stanczyk, 2019), maternal health (Chatterji and Markowitz, 2008), and subsequent employment probabilities (Baum and Ruhm, 2016), there is little empirical evidence on how these programs affect businesses. On one hand, state PFL programs are typically funded through employee payroll taxes and present no direct costs to employers, so they on the surface are "free" for small, nascent ventures that often lack the resources to offer paid family leave themselves. The relief of economic insecurity for employees may alleviate the recruiting and retention challenges faced by entrepreneurial firms (Cardon and Stevens, 2004) or may even improve employee productivity through reduced cognitive burden and stress (Kaur et al., 2019), thus leading to human capital benefits for venture performance. On the other hand, these state PFL programs may become an unintended burden for emerging companies that face unique challenges in managing employee leave given their small staff sizes,[6] both in terms of finding replacement workers timely and dealing with loss in productivity from employing temporary substitutes, thus negatively impacting venture performance when employees become more likely to take family leave.

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[3] Joyce Beebe, "To Win the Federal Paid Family Leave Debate, Allow States to Lead the Way," September 30, 2019, *The Hill*, https://thehill.com/.

[4] Fractl (2016). *Employee Benefits Study: The Cost and Value of Employee Perks.* Retrieved from http://www.frac.tl/employee-benefits-study/.

[5] Tim Shaw, "Key Takeaways from BPC's Survey of Small Business Views on Paid Family Leave," June 24, 2019, *Bipartisan Policy Center*, https://bipartisanpolicy.org/.

Given these opposing consequences, this study aims to empirically estimate the average effect of workers' access to state-sponsored paid family leave on new venture performance and explore its contingencies. I do so by exploiting a natural experiment, a state PFL program introduced in 2009 that entitles workers in New Jersey to take up to six weeks of paid family leave,[7] and by focusing on a longitudinal panel (2004-2011) of newly formed businesses from the Kauffman Firm Survey (Farhat and Robb, 2014).

Using a difference-in-differences design, I find that the average effect of the state PFL program on the profitability of new ventures is negative. This effect is robust both when New Jersey is compared to all other states and when New Jersey is compared only to Pennsylvania—a common comparison state for New Jersey in difference-in-differences analyses (Card and Krueger, 2000; Card and Levine, 2000). I then evaluate two potential mechanisms to explain the negative effect—the lack of resources to hire new worker substitutes and the lack of flexibility in staffing—that affect firms' ability to deal with shocks to their human capital stock. I find evidence for both. Firms in financial stress, which prevents them from hiring new workers, are more negatively affected by the PFL program than those in good financial standing. Moreover, firms that rely heavily on the availability of existing employees (i.e., are inflexible in their staffing), either because they have fewer employees or because they are service-based, are more negatively affected than larger, product-based firms. These findings for the average nascent firm do not, however, apply to ventures in high-tech industries or with patents, as the results show a positive effect of the state PFL program on venture profitability for those innovative ventures.

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[6] Benjamin Romano, "Washington's New Paid-Leave Law Does Not Protect Jobs of Workers at Small Firms," December 17, 2019, *The Seattle Times*, https://www.seattletimes.com/.

[7] New Jersey was the second state to enact a PFL program; the first was California in 2004.

Overall, this study makes several contributions. First, it presents a new consideration for the research on institutional theory and strategic management (Zhao et al., 2017), and specifically in the context of entrepreneurship (Bruton et al., 2010; Tolbert et al., 2011). Whereas past work has focused on how institutional factors such as legal environment, culture, and industry tradition influence venture formation (e.g., Eberhart et al., 2017; Eesley, 2016; Eesley et al., 2016) and subsequent founder decisions (e.g., Baron et al., 1999; Burton and Beckman, 2007), my research identifies another institutional channel—social safety nets for employees—that affects venture performance post the founding stage due to implications for human capital management. Second, this paper contributes to the research on entrepreneurship and strategic human capital (Campbell et al., 2012b; Carnahan et al., 2012; Chatterji and Patro, 2014) by shedding light on when better worker benefits may lead to financial gains for ventures. Specifically, I show that ventures with sufficient financial resources and staffing flexibility to manage employee leave are more likely to make profits when their employees have better access to paid family leave. Lastly, my findings have important policy and practitioner implications, given the ongoing debate on paid family leave regulation and human resource trends in the changing labor market.

The paper is organized as follows. Section 2 provides the institutional context: state-sponsored PFL programs. Section 3 outlines the theoretical background for considering the impact of state PFL programs on new ventures. Section 4 describes the data and empirical strategy. Section 5 presents the main results and tests of mechanisms. Section 6 concludes by discussing implications and limitations.

2.2. State-Sponsored Paid Family Leave Programs

The foundations of the modern social safety nets in the United States began during the 1930s under the New Deal administration of Roosevelt, but it was not until the 1970s that work requirements were first added for welfare recipients to emphasize the importance of work and reward working (Nightingale and Holcomb, 2003). In the following two decades, work has gradually become the core of the U.S. social safety net, and much legal consideration has been given to programs and regulations that will improve work conditions and work-based employee benefits (Nelson, 1991). One of those considerations is work-family balance. The Family and Medical Leave Act (FMLA) of 1993 specifically focused on the need for working individuals to balance work and family responsibilities by mandating employers to provide eligible employees with up to 12 weeks of job-protected leave for family and medical reasons.[8] Yet, the family leave granted by the law is unpaid and does not apply to employees at small businesses or those with short work tenure, for instance, at nascent ventures.

Lacking a national mandate for paid family leave in the United States, several states have made their own attempts to address this issue. California was the first state to enact its Paid Family Leave (PFL) program, which took effect in 2004 and offered wage replacements for individuals who took time off work to care for a seriously ill family member or bond with a new minor child. New Jersey then implemented a similar PFL program that took effect in 2009. The next decade witnessed rapidly growing state-level interest—Rhode Island, New York, and Washington started paying out benefits through their PFL programs in 2014, 2018, and 2020 respectively; Massachusetts, Connecticut, Oregon, and the District of Columbia have all enacted their own versions of PFL programs that will soon go into effect. More states are now considering PFL legislation, and the possibility of a federal paid family leave initiative has been discussed.[9] For workers at small and nascent ventures who typically lack access to standardized employer-provided paid family leave, state-level legislative efforts are meaningful, as the PFL benefits may be their only source of income during family leave.

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[8] FMLA applies to all public agencies, all public and private elementary and secondary schools, and companies with 50 or more employees. Employees are eligible for leave if they have worked for their employer at least 12 months, at least 1,250 hours over the past 12 months, and work at a location where the company employs 50 or more employees within 75 miles. Whether an employee has worked the minimum 1,250 hours of service is determined according to FLSA principles for determining compensable hours or work. Eligible reasons include (i) birth and care of the newborn child of an employee, (ii) placement with the employee of a child for adoption or foster care, (iii) to care for an immediate family member (i.e., spouse, child, or parent) with a serious health condition, or (iv) to take medical leave when the employee is unable to work because of a serious health condition.

[9] Stephen Miller, "States Impose Paid Family Leave as Congress Weighs National Policy," March 21, 2019, *Society for Human Resource Management*, https://www.shrm.org/.

This paper focuses on the 2009 New Jersey Paid Family Leave (PFL) program given the Kauffman Firm Survey (KFS) timeframe (2004-2011). The program was signed into law on May 2, 2008 and took effect on July 1, 2009. Specifically, eligible employees could receive up to six weeks of paid family leave in a year in the form of partial wage replacements to care for an ill relative or bond with a new child.[10] The weekly benefit payments equal two-thirds of the employee's average weekly wage, up to a maximum benefit cap per week.[11] This program, which covers nearly all public and private employees, including nearly all part-time workers, is financed entirely by mandated employee payroll deductions; in other words, employers make no contribution. In its first year of commencement, the New Jersey PFL program approved 14,127 claims for family leaves, and it approved over 300,000 claims up until 2018.[12] Recently, a new bill was signed into law that would double the New Jersey PFL benefits period to 12 weeks (or 56 days for intermittent leave) and increase the maximum weekly payment to $842, beginning July 2021. While the New Jersey PFL has received widespread favorable public opinion from working individuals (White et al., 2013), there is no consensus about its business implications, as opponents of the program are particularly worried about costs for employers to find replacement workers.[13]

In what follows, I review the past literature that sheds light on the effect of a PFL social safety program for employees on the performance of nascent ventures.

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[10] Employees are eligible for paid leave if they have worked for their employer for 20 base weeks, and earned at least 1,000 times the New Jersey minimum wage during that time.

[11] The exact benefit cap was $524 in 2009 and has been adjusted every year since then. The amount is indexed to the average wage of workers in the state.

[12] New Jersey Department of Labor and Workforce Development, Division of Temporary Disability and Family Leave Insurance, https://myleavebenefits.nj.gov/about/stats/.

[13] Nicholas Pugliese and Trenton Bureau, "New Jersey Workers Could Get Twice as Much Time Off with Expanded Family Leave," February 6, 2019, *northjersey.com*, https://www.northjersey.com/.

2.3. Theoretical Background

Before I discuss how employee access to state PFL programs may impact new venture performance, it is important to understand the key characteristics of newly founded businesses that present them with unique challenges in human capital management. One major challenge faced by nascent ventures is the absence of competitive advantages in terms of recruiting, managing, and retaining employees. Known to have "the liabilities of newness" (Stinchcombe, 1965), nascent firms face high risks of failure (Aldrich and Yang, 2012), lack legitimacy as an employer organization (Hannan and Freeman, 1977; Williamson et al., 2002), and typically do not have formal HR policies or systems for managing employees (Klaas et al., 2000). These firms also tend to not have sufficient financial resources to attract and incentivize employees with competitive compensation and benefits (Burton et al., 2018; Evans and Leighton, 1989; Litwin and Phan, 2013). Another big challenge that new firms often encounter is the lack of dynamic capability to weather unexpected, negative shocks to their human capital stock, either due to limited financial resources (Bruderl and Schussler, 1990) or due to the difficulty in maintaining staffing flexibility (Cardon, 2003).

On one hand, state PFL programs offer opportunities to nascent venture owners for mitigating the first human capital management challenge through improved economic security for employees (Stanczyk, 2019), thus potentially leading to human capital benefits and a positive effect on venture performance. As workers access paid family leave, this added layer of economic security may broaden their job choice set, allowing otherwise hesitant workers to more confidently join and stay at new businesses that are risky, uncertain, and less generous about compensation packages. Apart from alleviating recruiting and retention difficulties for nascent ventures, the availability of paid family leave may directly impact employee productivity through several channels. For one, the extra source of income during family leave may encourage employees to use family leave more comfortably (Baum and Ruhm, 2016; Rossin-Slater et al., 2013), thus resulting in better maternal health (Chatterji and Markowitz, 2008) and children's health and development (Berger et al., 2005; Rossin, 2011). The improved work-family balance and general employee well-being in turn suggest that employees may be more likely to perform better after they return to their work (Gubler et al., 2018; Moen et al., 2016). For another, employees may simply be more productive by knowing that they can have access to paid family leave in the future, as a relief of economic insecurity can reduce cognitive burden and stress and thus benefit decision-making processes (Kaur et al., 2019). Therefore, state-sponsored paid family leave programs may have a positive effect on new venture performance through improving the hiring, productivity, and retention of labor.

On the other hand, state PFL programs can lead to unintended human resource consequences for nascent ventures due to another human capital management challenge—the lack of dynamic capability to deal with unexpected human capital shocks—even though these firms do not need to directly pay for the family leave themselves. Specifically, as more employees choose to take family leave as they gain access to state PFL programs, this will incur additional burden for small, new firms in terms of finding temporary substitutes and managing potential turnover. Two specific mechanisms may be at play that can lead to a negative effect on organizational performance for newly founded businesses. First, nascent ventures may not have sufficient financial resources at their discretion to weather the additional costs associated with finding replacements for workers on leave. The costs associated with hiring and training temporary workers of equal skill can far exceed those for paying incumbent employees (Von Hippel et al., 1997), thus leading to increased human resource expenses. Second, the small size at inception for most new firms, especially those that are service-based, suggests that every existing employee may be irreplaceable for daily operations. Absence of any current workers may result in significant loss in productivity, even when temporary substitutes can be found in time (Herrmann and Rockoff, 2012), possibly resulting in reduced revenue. Hence, state PFL programs that benefit employees can actually have a negative impact on venture employers that lack financial resources and staffing flexibility.

When considering the aforementioned human capital management challenges faced by new ventures, it is also important to distinguish startups, i.e., the technology and product-based businesses that are growth-oriented, from other small businesses (Cardon, 2003). While the former receive the most media attention and coverage, the latter comprise the majority of the newly founded businesses in the United States (Goldschlag and Miranda, 2016) and are more likely to reap human capital benefits from the state PFL programs through the additional layer of economic security for their high proportion of middle- and low-income workers who do not have access to employer-provided paid family leave (Nyström, 2019). On the flip side, these non-technology/product-based businesses are also more likely to encounter financial constraints and suffer from temporary loss of staff, thus being subject to unintended human resource burden caused by state PFL programs. These two opposing effects highlight the ambiguity in predicting the overall effect of state PFL programs on new venture performance and whether the overall effect differs for innovative vs. non-innovative ventures.

The goal of the empirical analyses is to first estimate the average effect of state-sponsored paid family leave for employees on the performance of new ventures and then shed light on the underlying mechanisms by evaluating the contingencies in its effect. In summary, while possible strategic human capital benefits regarding hiring, incentivizing, and retaining labor suggest a positive overall effect on venture performance, a lack of financial resources or staffing flexibility to cope with employee leave points to a negative impact.

2.4. Methodology

2.4.1. Data

There are two major challenges concerning the empirical study of nascent ventures in the context of institutional changes that affect their workforce and human capital management for employees. First, longitudinal data that track new ventures from the very beginning of founding are rare (Reynolds and Curtin, 2007). Newly formed businesses are less visible to researchers and it is difficult to observe them on a large scale (Yang and Aldrich, 2012). Consequently, entrepreneurship scholars mostly resort to registration data that only include ventures that survived long enough to be recorded or only cover a period of ventures' lifespan (Aldrich et al., 1989; Kalleberg et al., 1990). Second, there is a lack of representative longitudinal datasets that include information on how new ventures manage their employees. Empirical studies at the intersection of entrepreneurship and human resources tend to concentrate on the high-tech industries, be less geographically diverse, and mostly use cross-sectional data (Dabić et al., 2011). Other research that exploits longitudinal new firm data across various industries and locations tends to focus on human capital within the founding team exclusively rather than among non-founder employees (e.g., Yang et al., 2020).

To overcome these challenges, the analyses in this paper use the panel data from the Kauffman Firm Survey (KFS), the largest longitudinal study (2004-2011) of newly formed businesses in the United States (Farhat and Robb, 2014). Because no single comprehensive national business register of newly formed businesses is available as a frame, the Dun and Bradstreet (D&B) database was chosen as the sampling frame source for KFS. The population of interest was stratified in the KFS data based on industrial technology level and founder gender, and oversampled within high- and medium-tech industries. The data provide a single-cohort panel that tracks the same group of businesses from a common starting point (birth in 2004). The definition of a new business is a business that started as an independent business, through the purchase of an existing business, or by the purchase of a franchise in the 2004 calendar year in the United States. A wide range of time-varying variables are included in the data to indicate the human resource practices adopted as well as measures with respect to human resource expenses.

I restrict the sample to firms with non-missing information on location, industry, and the total number of employees. Firms that changed their state location during the sampling timeframe or had been merged or sold are excluded. Firms that do not have any employees are further excluded. The final sample consists of 11,544 firm-year observations for 2,496 unique firms covering 50 states (as well as Washington, D.C.) and 25 economic sectors (including 441 NAICS industries).

2.4.2. Variables

The main dependent variable for evaluating venture performance is whether a business has profits or not in a given year. I focus on financial performance due to the heterogeneity in venture types and industries,[14] and specifically consider profitability, as it is a common measure of venture performance in the strategy and entrepreneurship literature (e.g., Delios and Beamish, 2001; Vanacker et al., 2017)—the ability to earn profits requires the firm not only to create value, but also to capture the value it creates (Cool and Schendel, 1988) and thus is directly related to the firm's competitive advantage. The choice of a binary measure is due to the concern that profit amounts may be subject to potential distortions as a result of different accounting procedures (McGee et al., 1995). For simplicity, the dependent variable, *Has Profits*, takes value 1 if the business has profits greater than or equal to zero in a given year and 0 otherwise. All the results remain unchanged if break-even cases (4.4% of the data) are excluded.

The main independent variable is the post-treatment dummy, $Treatment \times Post$, or in other words, the interaction between *Treatment* and *Post*, where *Treatment* takes value 1 for firms in New Jersey and 0 otherwise, and *Post* takes value 1 for observations post the start of the New Jersey PFL program (i.e., from 2009 onwards) and 0 otherwise. A parsimonious set of time-varying variables are included to control for other factors that can directly impact firm profitability, including a firm's financial capital (*Equity Injection*, i.e., the amount of dollars injected into the business), human capital (*Firm Size*, i.e., the total number of employees), and human capital management practices that can affect the productivity of its human capital pool. The practice variables include *Paid Vacation*, *Paid Sick Leave*, *Health Plan*,

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[14] For instance, service- vs. product-based ventures may have different needs for employment growth; high-tech vs. non-high-tech ventures have different needs for innovation; it is also difficult to have a consistent measure of labor productivity across different industries.

Retirement Plan, *Stock Ownership*, *Bonus Plan*, *Tuition Reimbursement*, and *Flex Time or Job Sharing*, which are all binary and indicate whether a firm offers the corresponding benefit to employees.

To understand the underlying mechanisms, I decompose profitability into its key components to examine how the state PFL impacts venture revenue and expenses. *Revenue* represents the total money received from sales of goods, services, or intellectual property in a given year. Expenses in a given year are separated into *Payroll Expenses*, which includes all payments to full-and part-time employees such as wages, salaries, and benefits, and *Non-Payroll Expenses*, which includes all other business expenses.

Several additional variables of pre-treatment firm characteristics are considered to evaluate the contingencies in the effect of state PFL on profits. First, I define *Average Financial Stress Score Pre-Treatment* to be the pre-treatment average of a firm's annual financial stress score from the Dun & Bradstreet (D&B) database and use it as a proxy for the firm's financial resources. The D&B financial stress score predicts a business's likelihood of experiencing financial stress over the next 12-month period, and its value ranges from 1 to 100.[15] A high score indicates good financial standing and a lower probability of failure. Second, I consider two variables that would impact how reliant a firm is on its existing employees, *Average Firm Size Pre-Treatment* (the pre-treatment average of the total number of employees) and *Service Firm* (a binary indicator of whether the firm is service-based vs. product-based). Small firms and those service-based firms that typically remain small are less flexible in terms of staffing than large, product-based firms (Cardon, 2003). Third, to clearly distinguish the innovative and high-growth technology startups from other small businesses that are more likely to recruit middle-/low-income workers and provide few benefits, I create a binary variable, *High-Tech Firm*, to indicate whether a firm is in a high-technology industry and a binary variable, *Patent Firm*, to indicate whether a firm has any patents pre-treatment.

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[15] Dun & Bradstreet defines a financially stressed company as one that obtains legal relief from creditors, ceases operations with debts outstanding, goes into receivership or reorganization, or makes an arrangement for the benefit of creditors over the next 12-month period.

As is common in the literature, I use the natural logarithm of a number of measures that are more subject to the impact of outliers (*Equity Injection*, *Revenue*, *Payroll Expenses*, and *Non-Payroll Expenses*), calculated as $\log(x{+}0.01)$ where x represents the variable. Table 7 provides the descriptive statistics of all the variables used in the analyses at the firm-year level. As can be seen, these new ventures are financially constrained, as the median level of equity injection is 0 dollars (exp(-4.61)) and the average financial stress score pre-treatment is relatively low (35.32 out of 100). They are small, with an average number of five employees, and are mostly service-based firms (80%). The median firm does not provide any typical benefits to employees. While the KFS population is oversampled within high-tech industries, high-tech firms and firms with patents still account for only 18% and 7%, respectively, of the observations,[16] confirming that most new ventures are not the typical innovative startup with abundant cash and growth-orientation. Table 8 presents the pairwise correlations.

——————**Insert Table 7**——————

——————**Insert Table 8**——————

2.4.3. Empirical Strategy

The analyses adopt a difference-in-differences design using ordinary least squares regressions on the firm-year panel data. The first difference is determined by *Treatment*, i.e., in vs. out of New Jersey, and the second difference is determined by *Post*, i.e., before vs. after 2009. The main specification is as follows:

$$\textit{Has Profits}_{i,t} = \beta_0 + \beta_1 \textit{Treatment}_i \times \textit{Post}_t + \alpha_i + \delta_t + \boldsymbol{\gamma}'\boldsymbol{X}_{i,t} + \epsilon_{i,t}$$

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[16] At the firm level, high-tech firms account for 16% of the firms in the sample and firms with patents account for 6% of the firms in the sample.

where i indexes firms; t indexes years; α_i and δ_t are firm and year fixed effects respectively; $\boldsymbol{X}$ is the vector of control variables; ϵ is the error term. In all specifications, standard errors are clustered at the state level to account for potential serial correlation of observations within the same state (Bertrand et al., 2004). The coefficient of interest is β_1, which captures the change in *Has Profits* following the start of the New Jersey PFL program. Alternative dependent variables, including revenue (logged), payroll expenses (logged), and non-payroll expenses (logged), are used in regressions that decompose venture profitability.

To further evaluate the contingencies of the average effect, a triple-difference strategy is adopted and the following regression is estimated:

$$\begin{aligned} \textit{Has Profits}_{i,t} = {} & \beta_0 + \beta_1 \textit{Treatment}_i \times \textit{Post}_t + \beta_2 h_i \times \textit{Post}_t + \beta_3 h_i \times \textit{Treatment}_i \times \textit{Post}_t \\ & + \alpha_i + \delta_t + \boldsymbol{\gamma}' \boldsymbol{X}_{i,t} + \epsilon_{i,t} \end{aligned}$$

where h is a pre-treatment firm characteristic, e.g., *Average Financial Stress Score Pre-Treatment*, *Average Firm Size Pre-Treatment*, *Service Firm*, *High-Tech Firm*, or *Patent Firm*. The coefficient of interest is β_3, which captures the heterogeneous effects of the state PFL program based on venture characteristics.

2.5. Results

2.5.1. Main Results

Table 9 reports the main results for the effect of New Jersey's PFL program on venture profitability. Across all specifications, the PFL program consistently has a statistically significant negative effect on new ventures' probability of having profits. As indicated by the estimated coefficients for $Treatment \times Post$, controlling for differences in financial capital, human capital, and human capital management practices, new ventures whose workers have access to state-sponsored paid family leave due to the program experience a 7% decrease in the likelihood of having profits.

——————**Insert Table 9**——————

Figure 13 suggestively illustrates this negative effect by displaying graphically the mean of *Has Profits* for treated and untreated ventures, respectively. The vertical line denotes the timing of the start of the New Jersey PFL program. There is a generally upward time trend as the sample consists of the same group of businesses newly formed in 2004, and the more profitable businesses are more likely to survive and remain in the sample over time. The dip post 2006 is likely caused by the 2007-2008 financial crisis, but the upward trend is restored post 2008, implying that the negative effect observed post 2009 on New Jersey ventures relative to other ventures is not a result of the crisis. In fact, while New Jersey ventures are more likely to be profitable than ventures in other states, the gap between the two lines in Figure 13 starts to shrink immediately following 2009, as the slope becomes flatter for treated ventures but steeper for untreated ventures.

——————**Insert Figure 13**——————

Overall, there is a negative average effect of state-sponsored paid family leave for employees on the profitability of new ventures, which does not appear to coincide with a possible negative effect of the 2007-2008 financial crisis. A fully saturated model with year-specific treatment effects is also considered to visually check the pre-trend prior to treatment (e.g., Castellaneta et al., 2020, Figures 2-4), available upon request. Similar to the pattern displayed by Figure 13, there is an upward pre-trend from 2008 to 2009, which is reverted downwards post the start of the New Jersey PFL program.

2.5.2. Robustness Checks

A number of robustness checks are conducted in Table 10 to verify the negative main effect. First, to address the concern that treated firms (those in New Jersey) may not be comparable to untreated firms (those outside New Jersey) and that treated firms only comprise a small portion of the sample (3%), Model 1 re-evaluates the effect of the New Jersey PFL program by comparing the profitability of treated ventures with those ventures in an adjacent state, Pennsylvania. The choice of Pennsylvania as a comparison state for New Jersey in difference-in-differences analyses is common in the economics literature (Card and Krueger, 2000; Card and Levine, 2000). After restricting the sample to firms in New Jersey or Pennsylvania, treated firms account for 45% of the data, and the negative effect on venture profitability doubles.

Second, because California is another state (and the only other state) that has a state-sponsored PFL program (started in 2004) during the data timeframe, it is possible that the observed main effect also captures some of the difference between the long-term effects and the short-term effects of state PFL programs. Model 2 thus excludes observations for ventures in California and a robust negative effect is found.

Third, due to the nascent nature of these ventures, some of them consist of founders exclusively. While founder-employees can also opt in for the state PFL coverage, these individuals are fundamentally different from the joiner-employees (Roach and Sauermann, 2015). For instance, founders may be less likely to take family leave as they are the key decision makers for the day-to-day business operation.[17] Therefore, Model 3 excludes the cases where all the employees are founder-employees and shows a robust negative effect that is also stronger.

Fourth, considering the heterogeneity in venture industry, Model 4 includes industry fixed effects based on the 5-digit NAICS industry code and shows consistent results.

——————**Insert Table 10**——————

The rest of the analyses examine the contingencies in this robust negative effect of the state PFL program on venture profitability and shed light on the possible contributing mechanisms.

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[17] Lottie O'Conor, "Back to Work Within a Week: Maternity Leave When You're Self-Employed," December 7, 2017, *The Guardian*, https://www.theguardian.com/.

2.5.3. Mechanisms

The negative main effect of the state PFL program on venture profitability suggests that the unintended human resource consequences outweigh the potential human capital benefits. To further verify this point, I decompose profitability into its key components—revenue and expenses. On one hand, if nascent ventures experience gains in hiring, incentivizing, and retaining employees as a result of additional worker social safety net, they should see improved labor productivity and possibly higher revenue. On the other hand, if ventures encounter extra burden in managing more employee leave, they should see increased human resource expenses when employee leave incurs additional costs for employers to find replacement workers (Von Hippel et al., 1997), or even a reduction in revenue when employee leave leads to loss in firm productivity (Herrmann and Rockoff, 2012). Therefore, the overall negative effect may either come from a decrease in revenue or from an increase in expenses.

Table 11 presents the findings from profits decomposition. Treated ventures experience a 76.5% loss in revenue post the start of the New Jersey PFL program, as shown in Model 1, as well as a 93.7% spike in payroll expenses, as shown in Model 2, both contributing to lower profits. The program, however, does not appear to affect other non-payroll expenses, as shown in Model 3, confirming that the program does not coincide with other market changes in the costs of materials, rent, interests on loans, machinery or equipment, etc. These results suggest that employee access to state-sponsored paid family leave does not yield sufficient human capital benefits and are most consistent with the reasoning that a negative effect on profits is induced through two channels at the same time—increased costs associated with worker replacement and loss in labor productivity due to temporary employee leave.

——————**Insert Table 11**——————

The prospects of higher human resource costs can be particularly worrisome for nascent ventures because they are financially constrained, hindering their ability to hire new worker substitutes in a timely manner (Bruderl and Schussler, 1990). The possibility of loss in productivity due to employee leave can also loom large for ventures that are small at inception and rely more heavily on incumbent employees since it is difficult for them to maintain flexibility in staffing (Cardon, 2003). In Table 12, I specifically test these two characteristics of nascent ventures—the lack of financial resources and the lack of staffing flexibility—as the operating mechanisms underlying the negative main effect of the state PFL program on venture profitability.

Availability of financial resources. First, Model 1 of Table 12 examines how the effect of treatment is contingent on the financial standing of the venture, which is used as a proxy for the availability of financial resources. While the main treatment effect is negative, ventures in good financial standing are less likely to be impacted negatively, as is indicated by the positive estimated coefficient for the triple-difference term, *Average Financial Stress Score Pre-Treatment* × *Treatment* × *Post*. In other words, new ventures that are more subject to financial resource constraint and stress are more negatively impacted by the state PFL program. Specifically, treated ventures that have an average pre-treatment financial stress score above $49.4 = 0.247/0.005$, which are about 25% of the venture population, in fact are more likely to make profits after their employees have access to state-sponsored paid family leave.

Staffing flexibility. I also investigate how the treatment effect on profitability is contingent on factors that affect ventures' staffing flexibility. Specifically, firm size and venture business type are evaluated. Model 2 shows that large firms are less negatively impacted by the treatment than small firms, as is indicated by the positive estimated coefficient for the triple-difference term, *Average Firm Size Pre-Treatment* × *Treatment* × *Post*. For firms with a total of more than $18.6 = 0.093/0.005$ employees, the treatment effect becomes positive, though this is rarely the case for nascent ventures. Model 3 shows the differential treatment effects for service-based versus product-based firms. While product-based firms do not appear to be directly affected by treatment, service-based firms experience a 10%

decrease in the likelihood of making profits, as is indicated by the estimated coefficient for the triple-difference term, *Service Firm* × *Treatment* × *Post*. These two findings suggest that firms that are more reliant on existing employees, for instance, small firms and service-based firms, are more negatively impacted as their employees start to have access to state-sponsored paid family leave.

——————Insert Table 12——————

These contingencies based on venture characteristics, including financial standing, firm size, and venture business type, highlight the heterogeneous treatment effects of the state PFL program and provide suggestive evidence for multiple mechanisms at play. For one thing, the lack of financial resources implies that new ventures are particularly burdened with increased costs associated with worker replacement. For another, the lack of staffing flexibility indicates greater loss in productivity due to temporary employee leave.

2.5.4. Innovative Ventures

In the end, I distinguish innovative, high-growth startups from other nascent, small businesses that are not innovation- and growth-driven. While startups receive considerable media coverage and public attention, they constitute only a small portion of the nascent venture population. These ventures are different from the typical new firm, especially with respect to human capital management strategy (Cardon, 2003). Specifically, I define innovative ventures to either be in the high-technology industries, as is indicated by *High-Tech Firm*, or have patents prior to treatment, as is indicated by *Patent Firm*. They should be less likely to be subject to the aforementioned mechanisms of a negative effect due to potential employee family leave since they are more likely to be in better financial standing, be larger at inception, and be product-based, according to $t-$tests based on these venture characteristics.

Table 13 shows the results for comparing the effect of the New Jersey PFL program on innovative ventures with its effect on other businesses. Across the two models, the state

PFL program has a robust and strong negative baseline effect on non-innovative ventures (a 8.8%-13.7% decrease in the likelihood of having profits). For innovative ventures, however, there is an increase in the likelihood of having profits following treatment, ranging from $4.9\% = 0.186 - 0.137$ for high-tech firms to $5.3\% = 1.141 - 0.088$ for firms with patents. While it might be argued that the high-skilled employees at innovative ventures should not be impacted by the state PFL program, either because they are well paid and do not care about the relatively small capped wage recovery or because they are more work-centric and are less likely to take family leave, these findings suggest that there is a non-negligible effect, and innovative businesses actually reap benefits from this additional layer of employee social safety net. In other words, the effect of the state PFL program on venture profitability is asymmetric—it negatively impacts those that are already strained but positively affects those that are already blooming.

——————**Insert Table 13**——————

2.6. Discussion and Conclusion

Institutional environments have been found to have considerable impacts on firms (Zhao et al., 2017) and particularly on entrepreneurial ventures (Bruton et al., 2010; Tolbert et al., 2011). Ample scholarship has examined how institutional channels including legislation, culture, and industry tradition can influence venture formation and founder decisions. But little research has paid attention to those institutional factors that affect employees working at new ventures and thus have significant implications for venture performance post the founding stage. A strand of work has started to highlight the importance of connecting employment topics to the study of entrepreneurship (Burton et al., 2019). This paper sheds light on how social safety nets for workers can have consequences for the profitability of nascent businesses by studying the case of the New Jersey Paid Family Leave program. While state-sponsored paid family leave is generally known to be beneficial to individual workers, its overall effect on employers is ambiguous due to the tension between the potential human capital gains from a more productive workforce and the unintended human resource burden from replacing workers on leave.

Studying a large cohort of newly formed businesses, I find that the average effect of state PFL program on venture profitability is negative, which comes from both an increase in payroll expenses and a decrease in revenue. Further analyses generate findings that are consistent with two explanations of the unique human capital management challenges faced by nascent, small ventures—these ventures lack the financial resources to cope with the additional costs for finding temporary workers and they lack the staffing flexibility to absorb the loss in productivity. These results, however, do not apply to innovative ventures that constitute a small portion of the business sample, as they appear to be more likely to make profits post treatment.

Policy implications

These findings are extremely meaningful amidst ongoing policy debate over the expansion of state paid family leave programs and the possibility of a federal paid family leave initiative. The asymmetric effects found for innovative versus non-innovative ventures highlight the importance for policy-makers to recognize the heterogeneity among nascent firms. While researchers and the media typically focus on the innovative startups when discussing entrepreneurship, the often neglected majority of new businesses are in fact non-innovative and can be extremely vulnerable to institutional changes and thus are more likely to bear the burden of unintended consequences.

Paradoxically, even though social safety net programs like state PFL programs are designed to reduce economic inequality in the working population, they may backfire and widen the income inequality between certain groups of workers. For instance, if the financially strained businesses are negatively impacted while the resource-abundant businesses are positively affected, the inequality between high-income and low-income workers would worsen. Moreover, in the case of state PFL programs, if most new firms are struggling when employees access paid family leave, this may exacerbate the gender wage gap for low-income workers as employers avoid hiring women in their child-bearing years.

Therefore, policy-makers should actively evaluate the business implications in designing social safety net programs pertaining to workers. Cash subsidies or tax relief for employers may be bundled with state-sponsored benefits for employees to protect not only the vast majority of new, small businesses but also the disadvantaged workers at these ventures.

Managerial implications

It is important for managers to understand the impacts of employees' access to paid family leave on businesses either to form dynamic capabilities to weather external changes or to reinforce competitive advantages through human capital management. For one, new ventures that are particularly vulnerable to human capital shocks as a result of institutional policy changes should develop contingency plans for possible employee leave, even though such human resource considerations are typically not a priority for them. For instance, these ventures may establish reliable channels for finding substitute workers, locate outsourcing partners in advance, develop internal training and reward systems that encourage employees to acquire skills for multiple roles, etc.

For another, ventures with more financial resources and staffing flexibility, especially those high-growth and product-based innovative ventures, may consider even better employer-provided paid family leave benefits for employees after estimating the additional costs of doing so, as they appear to experience a positive effect on profitability when paid family leave becomes accessible to their employees. In these cases, better paid leave firm policy that promotes work flexibility and work-family balance may lead to human capital benefits through attracting, incentivizing, and retaining talent, hence leading to higher labor efficiency and firm productivity.

Limitations and directions for future research

This study highlights a new direction for entrepreneurship research by connecting employee social safety nets with venture performance. A few limitations are worth noting. First, the focus of this paper is on venture profitability, a short-term performance measure that indicates a firm's ability to create and capture value. This outcome variable choice allows me to examine a wide range of ventures that may differ significantly in terms of type, industry, objective, etc. However, a caveat is that the results can be subject to survival bias, as only the surviving venture-year observations are included in the sample. The estimated negative effect of the state PFL program in this paper is thus likely understated if the program also leads to more business closures for treated ventures. Future research can extend this line of study by considering other outcome measures, such as long-term survival and innovation. For instance, analyses addressing differential venture survival rates can devote more attention to the marginal businesses that are particularly prone to fail; exploring innovation outcomes such as patent counts may shed light on those ventures that are more likely to benefit from improved social safety nets for employees.

Second, the discussion of the possible operating mechanisms is hinged on firm-level patterns since employee-level data are not observed. Future research would ideally look at how the uncovered effects are influenced by actual leave use and employee characteristics that reflect replacement costs and difficulties such as wage level, skill sets, work tenure, etc. Furthermore, scholars can explicitly study how similar social safety net programs affect the recruitment, performance, and retention of workers with more detailed employee data. In particular, the mechanisms for potential human capital gains are not the focus of this paper; because an overall negative effect is found, the efforts are spent on exploring the mechanisms leading to negative impacts on venture profitability. For instance, it is unclear why innovative ventures benefit from the state PFL program. Employees at innovative ventures may be more productive on the job due to better physical and mental health from taking more family leave or due to reduced cognitive burden of expected economic insecurity during future family leave. Future work in other empirically settings can elaborate on the other side of the asymmetry and unpack the specific channels leading up to a positive effect.

Lastly, this paper focuses on one specific type of social safety net program for employees through a single natural experiment. More work can be done to extend this line of inquiry through examining a wider range of social safety net programs that affect worker benefits and labor market conditions, such as staggered reforms for improving worker access to health insurance in multiple states and the introduction of state-level business tax credit for employers that provide employee-friendly benefits.

Conclusion

Overall, the findings in this study highlight that social safety nets that benefit workers may have unintended negative consequences for new businesses, as ventures differ in terms of their ability to absorb such impacts. I hope that these results can encourage more work that combines institutional perspectives, employment topics, and human resource considerations to deepen the understanding of entrepreneurial performance.

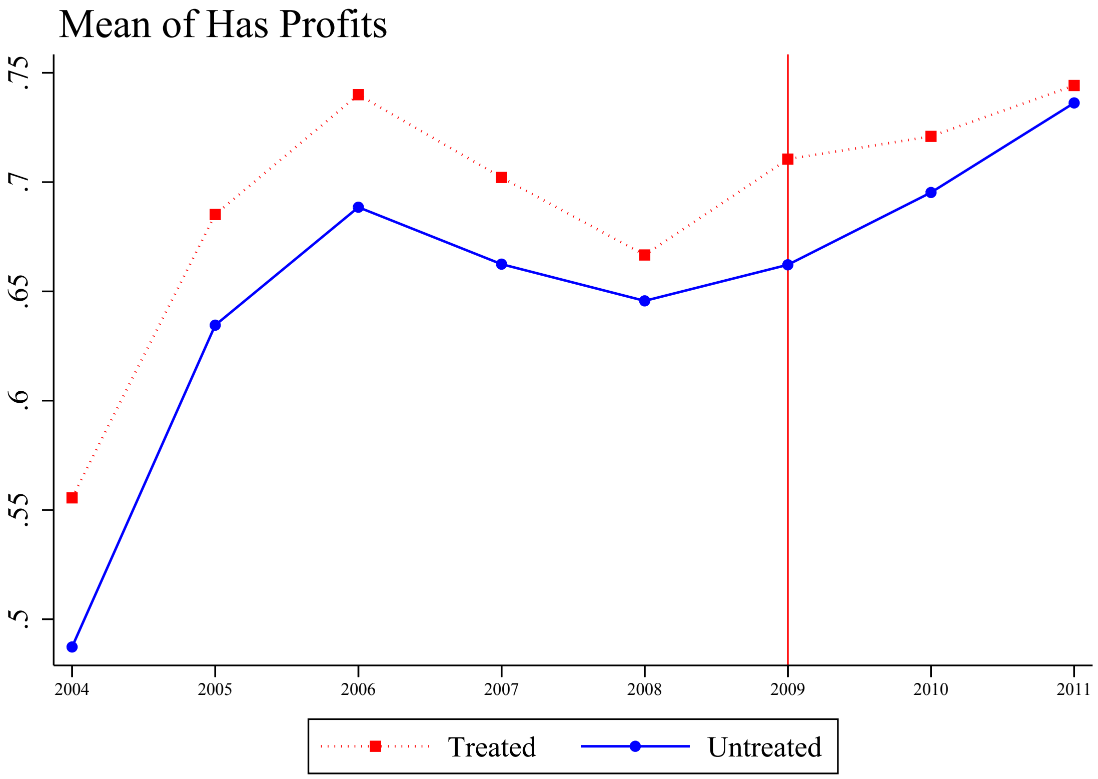

Figure 13: **Proportion of New Ventures with Profits by Treatment.** This figure shows the proportion of new ventures that have profits over time by treatment. The x-axis indicates year, and the y-axis shows the average of *Has Profits* across all ventures. The dotted line shows the proportion over time for treated ventures, i.e., ventures in New Jersey; the solid line shows the proportion over time for untreated ventures, i.e., ventures outside New Jersey. The vertical line highlights the timing of the start of the New Jersey PFL program.

Table 7: **Summary Statistics.** This table presents the summary statistics for the sample. Due to data confidentiality, minimum and maximum values are not reported. Binary variables are indicated with (0/1). Logarithm refers to the natural logarithm of the variable plus 0.01. The human resource practices refer to those for full-time employees.

VARIABLE	**COUNT**	**MEAN**	**MEDIAN**	**STD. DEV.**
Has Profits (0/1)	11,444	0.64	1.00	0.48
Treatment (Location in New Jersey, 0/1)	11,544	0.03	0.00	0.17
Equity Injection ($, Logged)	11,323	1.16	-4.61	6.97
Firm Size	11,544	5.08	2.00	10.40
Paid Vacation (0/1)	9,151	0.42	0.00	0.49
Paid Sick Leave (0/1)	9,152	0.34	0.00	0.47
Health Plan (0/1)	9,165	0.35	0.00	0.48
Retirement Plan (0/1)	9,163	0.18	0.00	0.38
Stock Ownership (0/1)	9,132	0.07	0.00	0.25
Bonus Plan (0/1)	9,141	0.27	0.00	0.44
Tuition Reimbursement (0/1)	9,148	0.10	0.00	0.30
Flex Time or Job Sharing (0/1)	9,155	0.41	0.00	0.49
Revenue ($, Logged)	11,310	8.84	11.29	6.44
Payroll Expenses ($, Logged)	11,432	4.71	9.21	7.76
Non-Payroll Expenses ($, Logged)	10,887	9.58	10.70	4.49
Average Financial Stress Score Pre-Treatment	11,276	35.32	34.63	18.01
Average Firm Size Pre-Treatment	11,496	4.80	2.40	7.79
Service Firm (0/1)	11,544	0.80	1.00	0.40
High-Tech Firm (0/1)	11,544	0.18	0.00	0.38
Patent Firm (0/1)	11,491	0.07	0.00	0.26

Table 8: **Correlations.** This table presents the pairwise correlations for the sample. Binary variables are indicated with (0/1). Logarithm refers to the natural logarithm of the variable plus 0.01. The human resource practices refer to those for full-time employees.

	VARIABLE	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1.	Has Profits (0/1)	1.00									
2.	Treatment (Location in New Jersey, 0/1)	0.03	1.00								
3.	Equity Injection ($, Logged)	-0.31	-0.04	1.00							
4.	Firm Size	0.06	-0.02	-0.04	1.00						
5 .	Paid Vacation (0/1)	0.12	-0.02	-0.07	0.28	1.00					
6.	Paid Sick Leave (0/1)	0.10	0.01	-0.02	0.22	0.75	1.00				
7.	Health Plan (0/1)	0.13	0.01	-0.04	0.29	0.49	0.42	1.00			
8.	Retirement Plan (0/1)	0.15	0.01	-0.09	0.24	0.34	0.31	0.39	1.00		
9.	Stock Ownership (0/1)	-0.05	-0.01	0.11	0.08	0.11	0.14	0.13	0.14	1.00	
10.	Bonus Plan (0/1)	0.15	-0.01	-0.07	0.25	0.44	0.38	0.33	0.27	0.09	1.00
11.	Tuition Reimbursement (0/1)	0.06	-0.01	-0.02	0.16	0.25	0.24	0.20	0.22	0.09	0.29
12.	Flex Time or Job Sharing (0/1)	0.06	0.01	0.03	0.09	0.30	0.29	0.20	0.18	0.12	0.26
13.	Revenue ($, Logged)	0.27	0.01	-0.17	0.19	0.30	0.25	0.26	0.20	0.00	0.22
14.	Payroll Expenses ($, Logged)	0.15	0.00	-0.09	0.31	0.48	0.38	0.37	0.27	0.02	0.34
15.	Non-Payroll Expenses ($, Logged)	0.07	-0.02	-0.02	0.19	0.28	0.23	0.25	0.17	0.07	0.18
16.	Average Financial Stress Score Pre-Treatment	0.10	-0.01	-0.07	0.11	0.21	0.20	0.21	0.16	0.04	0.13
17.	Average Firm Size Pre-Treatment	0.02	-0.03	-0.00	0.81	0.30	0.21	0.29	0.21	0.06	0.25
18.	Service Firm (0/1)	0.09	0.01	-0.07	-0.07	-0.04	-0.06	-0.02	0.04	-0.10	0.01
19.	High-Tech Firm (0/1)	0.01	0.05	-0.01	0.00	0.09	0.11	0.14	0.08	0.16	0.04
20.	Patent Firm (0/1)	-0.09	0.04	0.11	0.12	0.11	0.13	0.12	0.12	0.29	0.01

	VARIABLE	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
11.	Tuition Reimbursement (0/1)	1.00									
12.	Flex Time or Job Sharing (0/1)	0.18	1.00								
13.	Revenue ($, Logged)	0.13	0.14	1.00							
14.	Payroll Expenses ($, Logged)	0.16	0.23	0.39	1.00						
15.	Non-Payroll Expenses ($, Logged)	0.12	0.11	0.37	0.25	1.00					
16.	Average Financial Stress Score Pre-Treatment	0.06	0.09	0.18	0.20	0.20	1.00				
17.	Average Firm Size Pre-Treatment	0.15	0.07	0.18	0.32	0.20	0.14	1.00			
18.	Service Firm (0/1)	0.05	-0.03	-0.02	-0.01	-0.08	-0.01	-0.07	1.00		
19.	High-Tech Firm (0/1)	0.07	0.14	0.05	0.04	0.01	0.05	-0.02	-0.02	1.00	
20.	Patent Firm (0/1)	0.02	0.09	-0.01	0.04	0.06	0.02	0.12	-0.22	0.19	1.00

Table 9: **Main Results, Difference-in-Differences Estimates.** This table presents the main results for the effect of New Jersey's PFL program on venture profitability. Robust standard errors in parentheses are clustered at the state level. $^{*}p < 0.10$ $^{**}p < 0.05$ $^{***}p < 0.01$.

	Dependent Variable: Has Profits			
	(1)	(2)	(3)	(4)
Treatment × Post	-0.024*	-0.023*	-0.066***	-0.066***
	(0.012)	(0.013)	(0.013)	(0.013)
Post	0.024*		-0.010	
	(0.012)		(0.013)	
Equity Injection ($, Logged)			-0.010***	-0.009***
			(0.001)	(0.001)
Firm Size			0.003**	0.002**
			(0.001)	(0.001)
Paid Vacation			0.037	0.032
			(0.023)	(0.022)
Paid Sick Leave			0.004	0.003
			(0.016)	(0.016)
Health Plan			0.031**	0.027*
			(0.015)	(0.015)
Retirement Plan			0.079***	0.075***
			(0.019)	(0.020)
Stock Ownership			0.013	0.019
			(0.022)	(0.022)
Bonus Plan			0.061***	0.057***
			(0.013)	(0.014)
Tuition Reimbursement			0.038*	0.041*
			(0.022)	(0.022)
Flex Time or Job Sharing			0.022*	0.022*
			(0.013)	(0.013)
Constant	0.638***	0.521***	0.556***	0.507***
	(0.004)	(0.011)	(0.011)	(0.016)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	No	Yes	No	Yes
Observations	11,444	11,444	8,794	8,794

Table 10: **Robustness Checks.** This table presents the results for the robustness checks. Robust standard errors in parentheses are clustered at the state level. $^{*}p < 0.10$ $^{**}p < 0.05$ $^{***}p < 0.01$.

	Dependent Variable: Has Profits			
	(1) Comparing with PA	(2) Excluding CA	(3) Non-Founder Employees	(4) Industry Fixed Effects
Treatment × Post	-0.132*	-0.058***	-0.077***	-0.064***
	(0.020)	(0.013)	(0.013)	(0.014)
Equity Injection ($, Logged)	-0.009	-0.009***	-0.009***	-0.009***
	(0.003)	(0.001)	(0.001)	(0.001)
Firm Size	-0.001	0.003*	0.002***	0.002**
	(0.003)	(0.001)	(0.001)	(0.001)
Paid Vacation	-0.102	0.034	0.020	0.029
	(0.034)	(0.025)	(0.020)	(0.023)
Paid Sick Leave	0.108	0.000	0.001	0.007
	(0.088)	(0.018)	(0.016)	(0.016)
Health Plan	0.133	0.021	0.028	0.030*
	(0.040)	(0.016)	(0.018)	(0.017)
Retirement Plan	0.034	0.084***	0.077***	0.071***
	(0.008)	(0.021)	(0.019)	(0.019)
Stock Ownership	-0.005	0.020	0.038*	0.019
	(0.074)	(0.025)	(0.023)	(0.025)
Bonus Plan	0.076	0.052***	0.056***	0.058***
	(0.091)	(0.014)	(0.016)	(0.014)
Tuition Reimbursement	0.025	0.036	0.047**	0.050**
	(0.133)	(0.024)	(0.022)	(0.022)
Flex Time or Job Sharing	0.075	0.026*	0.018	0.018
	(0.057)	(0.014)	(0.015)	(0.014)
Constant	0.533**	0.508***	0.500***	0.664***
	(0.023)	(0.019)	(0.019)	(0.060)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	586	7,852	7,879	8,794

Table 11: **Decomposing Profitability.** This table presents the results for decomposing profitability as the dependent variable. Robust standard errors in parentheses are clustered at the state level. *$p < 0.10$ **$p < 0.05$ ***$p < 0.01$.

	Dependent Variables:		
	Revenue (Logged) (1)	Payroll Expenses (Logged) (2)	Non-Payroll Expenses (Logged) (3)
Treatment × Post	-0.765***	0.937***	-0.009
	(0.132)	(0.147)	(0.100)
Equity Injection ($, Logged)	-0.004	0.003	0.008
	(0.009)	(0.007)	(0.008)
Firm Size	0.043***	0.053***	0.015**
	(0.012)	(0.013)	(0.007)
Paid Vacation	0.737***	1.550***	0.187
	(0.203)	(0.234)	(0.251)
Paid Sick Leave	0.671***	0.790***	0.072
	(0.223)	(0.233)	(0.210)
Health Plan	0.431*	0.817***	0.524***
	(0.234)	(0.265)	(0.176)
Retirement Plan	0.313	0.058	0.293
	(0.265)	(0.244)	(0.209)
Stock Ownership	0.311	-0.487	0.166
	(0.294)	(0.306)	(0.215)
Bonus Plan	0.292	0.767***	-0.053
	(0.178)	(0.123)	(0.180)
Tuition Reimbursement	-0.002	0.039	0.542**
	(0.278)	(0.238)	(0.230)
Flex Time or Job Sharing	0.285	0.779***	0.097
	(0.174)	(0.148)	(0.157)
Constant	5.297***	2.833***	8.327***
	(0.167)	(0.244)	(0.194)
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	8,714	8,775	8,277

Table 12: **Testing the Mechanisms.** This table presents the results for testing the mechanisms underlying the main negative effect of state PFL program on new venture profitability. Robust standard errors in parentheses are clustered at the state level. *$p < 0.10$ **$p < 0.05$ ***$p < 0.01$.

	Dependent Variable: Has Profits		
	(1)	(2)	(3)
Treatment × Post	-0.247***	-0.093***	0.010
	(0.036)	(0.012)	(0.034)
Equity Injection ($, Logged)	-0.009***	-0.009***	-0.009***
	(0.001)	(0.001)	(0.001)
Firm Size	0.002**	0.003***	0.002**
	(0.001)	(0.001)	(0.001)
Paid Vacation	0.031	0.032	0.032
	(0.023)	(0.022)	(0.022)
Paid Sick Leave	0.003	0.003	0.003
	(0.017)	(0.016)	(0.016)
Health Plan	0.026*	0.027*	0.027*
	(0.015)	(0.015)	(0.015)
Retirement Plan	0.073***	0.076***	0.075***
	(0.020)	(0.020)	(0.020)
Stock Ownership	0.019	0.020	0.019
	(0.022)	(0.022)	(0.022)
Bonus Plan	0.057***	0.056***	0.056***
	(0.014)	(0.014)	(0.014)
Tuition Reimbursement	0.046**	0.042*	0.042*
	(0.022)	(0.021)	(0.022)
Flex Time or Job Sharing	0.022*	0.022*	0.022
	(0.013)	(0.013)	(0.013)
Average Financial Stress Score Pre-Treatment × Post	0.000		
	(0.001)		
Average Financial Stress Score Pre-Treatment × Treatment × Post	0.005***		
	(0.001)		
Average Firm Size Pre-Treatment × Post		-0.002	
		(0.001)	
Average Firm Size Pre-Treatment × Treatment × Post		0.005***	
		(0.001)	
Service Firm × Post			-0.033
			(0.032)
Service Firm × Treatment × Post			-0.101***
			(0.033)
Constant	0.507***	0.506***	0.507***
	(0.016)	(0.016)	(0.016)
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	8,628	8,770	8,794

Table 13: **Innovative Ventures.** This table presents the results comparing the heterogeneous treatment effects for innovative ventures versus other businesses. Robust standard errors in parentheses are clustered at the state level. *$p < 0.10$ **$p < 0.05$ ***$p < 0.01$.

	Dependent Variable: Has Profits	
	(1)	(2)
Treatment × Post	-0.137***	-0.088***
	(0.015)	(0.013)
Equity Injection ($, Logged)	-0.009***	-0.009***
	(0.001)	(0.001)
Firm Size	0.002**	0.002**
	(0.001)	(0.001)
Paid Vacation	0.032	0.033
	(0.022)	(0.022)
Paid Sick Leave	0.003	0.003
	(0.016)	(0.016)
Health Plan	0.027*	0.027*
	(0.015)	(0.015)
Retirement Plan	0.071***	0.075***
	(0.020)	(0.020)
Stock Ownership	0.020	0.018
	(0.022)	(0.022)
Bonus Plan	0.056***	0.057***
	(0.014)	(0.014)
Tuition Reimbursement	0.042*	0.042*
	(0.021)	(0.022)
Flex Time or Job Sharing	0.023*	0.022*
	(0.013)	(0.013)
High-Tech Firm × Post	0.043	
	(0.034)	
High-Tech Firm × Treatment × Post	0.186***	
	(0.035)	
Patent Firm × Post		0.014
		(0.048)
Patent Firm × Treatment × Post		0.141***
		(0.050)
Constant	0.507***	0.506***
	(0.016)	(0.016)
Firm Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Observations	8,794	8,768

CHAPTER 3 : Inequality Aversion Across Different Payoffs: Presentation Effect of Equity Compensation

Wharton People Analytics Research Paper Competition Finalist, 2017

This chapter is based on my master's thesis; current version is joint work with Andy Wu

Abstract

Do workers have different equality preferences depending on the type of payoff? In startups that typically offer equity compensation (i.e., stock options), the distribution of equity compensation often differs substantively from the distribution of cash salary. We design an experimental group production game to examine how workers respond to combinations of different distributions of equity and salary. Results suggest that workers view salary and equity in two separate domains, and they are more inequality averse in the equity domain, implying that firms could benefit from a compensation structure that is more equitable in the equity portion. Furthermore, we find a presentation effect underlying inequality aversion across different payoffs: the separation of the two domains is only triggered when equity is shown in a different percentage form from the absolute form of salary. These results highlight that worker preferences can be contingent on the compensation domain, and more specifically the framing of the domain, and therefore have implications for the design of compensation structure in organizations.

3.1. Introduction

With the rise of the gig economy and the gaining popularity of entrepreneurial exploration, modern workers, especially the skilled ones, are demanding more from their employers other than the traditional paycheck. To attract, incentivize, and retain talent in such a time, firms are increasingly reliant on a combination of different payoffs for their workers. For instance, a compensation package consisting of salary plus equity, which links worker compensation to the performance of the overall firm, has become the standard when startups recruit talent. At the same time, workers still care about how they fare in compensation relative to their peers (Cullen and Perez-Truglia, 2018), and such concerns loom greater as tech startups are leading a trend into pay transparency.[1] Workers at the low end of the scale unsurprisingly dislike the gap in compensation (Akerlof and Yellen, 1988, 1990; Clark and Oswald, 1996; Card et al., 2012) while workers at the high end of the scale may also view compensation inequality negatively as it may harm team cohesion (Levine, 1991).

Therefore, there is a growing need for understanding workers' equality concerns over the simultaneous distribution of different kinds of payoffs. While the prior literature has empirically examined how compensation inequality affects work behavior, job satisfaction, and retention (Charness and Kuhn, 2007; Card et al., 2012), following the seminal work of Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) that establish the theoretical construct of inequality aversion, it remains an open question as to whether and how inequality aversion may vary across different forms of payoff. In this paper, we center our discussion on two common types of compensation in the modern workplace—salary versus equity. The decision to focus on equity and salary is both driven by the prevalence of such combinations in industry practice and also grounded in the interest of the incentive literature to compare revenue sharing schemes and fixed-payment schemes (Eriksson and Villeval, 2008; Dohmen and Falk, 2011). We aim to shed light on two questions: Can workers have distinct preferences for equality in equity versus equality in salary? If so, when will this happen?

Anecdotal evidence suggests that workers may be asymmetrically averse to inequality across the two compensation domains, and firm-level compensation structures are being designed in response to this. Consider the case of the technology sector, where compensation packages consisting of both salary and equity are common for all workers, from management to entry-level.[2] Several major technology firms—such as the online payment firm Stripe, the video streaming service Twitch, the job search engine Indeed, and the online dating platform eHarmony—exhibit an *equality-in-equity* compensation strategy, i.e., they offer potential employees the same levels of equity compensation but very different salaries across different job ranks and functions.[3] Joel Spolsky, the co-founder and CEO of the technology firm Stack Exchange, argues that equity in particular should be "split equally among everyone in the layer," where the layer refers to employees hired in the same cohort as opposed to founders or investors, because "fairness, and the perception of fairness, is much more valuable than owning a large stake." Even when equality is preferred by employees in equity allocations, in some cases workers may even prefer outright inequality in salary.[4] Given these observations, we suspect that workers may dislike inequality in equity ownership more than inequality in cash salary.

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[1] Tanza Loudenback, "More tech companies have stopped keeping employee salaries secret – and they're seeing results", *Business Insider*, May 3, 2017.

We propose a behavioral theory of *domain-contingent inequality aversion*, where "domain" refers to the form of the payoff.[5] Building on the general notion of inequality aversion (Fehr and Schmidt, 1999), we argue that workers dislike inequality and their preferences may differ depending on the type of compensation. The established construct of inequality aversion stems from behavioral observations that individuals are concerned about their social standing and economic payoffs relative to others (Bracha et al., 2015; Bolton and Ockenfels, 2000; Charness and Grosskopf, 2001; Clark and Oswald, 1996; Marr and Thau,

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[2] In the technology setting, compensation comparisons are less commonly drawn between recently hired employees and early employees, and even less so between late employees and founders and investors, who receive substantial equity shares in the firm. Social comparisons are strongest among members of an in-group with a shared group identify (Chen and Li, 2009), and the in-group in this setting is the employees of a similar hiring cohort. Workers also exhibit baseline social preferences towards their employers consistent with theories of warm glow and social norms (DellaVigna et al., 2016), which suggests that recently hired employees would be more tolerant of the large equity shares of the founders and investors who serve as the de facto employer.

[3] Based upon compensation packages offered by firms in 2015 on AngelList, a popular online job-posting site for technology firms.

[4] Rachel Sugar, "A CEO raised his company's minimum wage to $70,000 a year, and some employees quit because of it," *Business Insider*, July 31, 2015.

[5] "Domain" typically refers to the context of decision-making when it appears in the discussion of context-dependent risk preferences (Bonem et al., 2015; Weber et al., 2002) and social preferences (Bao and Ho, 2015; De Oliveira et al., 2009). Furthermore, Schoemaker (1990) uses the phrase "payoff domain" to distinguish gains from losses in monetary outcomes. In our theory, "domain" refers to the payoff form, and more specifically equity versus salary, which can be a particular context for social preference to take place.

2014), and they prefer equality under certain circumstances. He and Villeval (2017) further find that individuals express more inequality aversion when making proposals to the group than when they decide in isolation, suggesting that equality preferences may differ depending on the decision-making environment. Our concept of domain-contingent inequality aversion adapts such a context-dependent view of inequality aversion and extends the basic theory by postulating that workers view cash salary and equity compensation as distinct domains that impact individual inequality aversion differently. More specifically, we assume that employees are more inequality-averse in the equity domain than in the salary domain.

We incorporate domain-contingent inequality aversion into a theoretical model to derive the results for workers' effort choices. We show that inequality in equity has a *negative asymmetric effect* on effort while inequality in salary may have a *positive asymmetric effect* on effort. The negative asymmetric effect of inequality in equity distinguishes the domain-contingent inequality aversion model from standard models of inequality aversion. We then hypothesize over the condition when the separation of two compensation domains will be triggered. In particular, we suspect that how equity is presented may impact whether or not it is viewed as a distinct domain from salary. In practice, equity compensation is typically dictated in a unique percentage form to indicate a share of ownership—a very different format from cash salary. Research has shown that the "relative" percentage framing and the "absolute" cash framing can make people have differential subjective valuations despite having the same underlying value (DelVecchio et al., 2007; González et al., 2016; Kleber et al., 2016). We speculate that the distinction between equity and salary will be mitigated if equity is presented in the same format as salary, i.e., in the common dollar unit. As a result, we predict that domain-contingent inequality aversion is only present when equity and salary are presented in different formats. Finally, we consider the firm-level implication of domain-contingent inequality aversion by assuming that management takes such worker preferences into account and optimizes the compensation strategy over the entire group of employees. We argue that, in the presence of a negative asymmetric effect of inequality in equity and a positive asymmetric effect of inequality in salary, the *equality-in-equity* strategy is optimal for firms with a fixed equity compensation budget.

To test our model predictions, we conduct an experiment to identify domain-contingent inequality aversion and whether these worker preferences are driven by how equity and salary are presented. In a within-subject design, participants experience seven scenarios of group production with different compensation schemes reflecting varied distributions of salary and equity. Participants can increase the probability of group success at a personal cost. We complement the experiment with a between-subject design to test whether there is a presentation effect that drives the separation of the two compensation domains. In the control group, participants view equity in the same format as salary, i.e., experiment points. In the treatment group, participants view equity in a different format, i.e., as a percentage. The only difference between the two groups is the presentation of equity, mirroring the forms that equity compensation is presented to employees in practice. Our experiment offers evidence for the existence of domain-contingent inequality aversion. We further find a presentation effect underlying inequality aversion in the two different payoffs, as the negative asymmetric effect of inequality in equity only appears when equity is presented differently from salary in its percentage form.

This paper makes several contributions. First, we propose a behavioral theory of *domain-contingent inequality aversion*, which represents a new consideration for the labor economics and management literature on the subject of employee incentive compensation and its link to worker and firm performance. We are the first to highlight the distinction between inequality in equity compensation and inequality in salary compensation. In the spirit of Chen and Li (2009), who argue that social preferences for equality depend on the identity of the comparison group, we argue that social preferences for equality also depend on the domain where the inequality occurs. Second, we provide experimental results for how individuals respond to intra-group compensation distributions when different types of payoffs are used simultaneously. Using output share to mimic equity and flat payment to mimic salary, we are also the first to test experimentally how compression in output share affects individual contribution when flat payment is present and when the value of the share is uncertain. Third, we identify a presentation effect that drives the separation of domains for equality preferences. Fourth, as equity is becoming increasingly a popular component of compensation, our findings have practical implications, particularly for technology firms, for the optimal allocation of equity among their workers.

The paper proceeds as follows. Section 3.2 presents our theoretical model of domain-contingent inequality aversion. Section 3.3 lays out the experimental design and Section 3.4 discusses the results. Section 3.5 concludes.

3.2. Theoretical Model

We present a model of domain-contingent inequality aversion that builds upon a standard group production model with stochastic output and convex cost function (Nalbantian and Schotter, 1997) but adopts a different stochastic form.[6] Adapting the fairness model of Benjamin (2015), we assume inequality aversion of the form in Fehr and Schmidt (1999). Under domain-contingency, we write distinct functions for inequality aversion in salary and inequality aversion in equity. We employ this model to generate hypotheses that we test experimentally.

3.2.1. Model Setup

We consider two risk-neutral[7] workers $i \in \{1, 2\}$ in a firm engaged in a group task with output $\tilde{V}$ exerting effort e_i with homogeneous cost function $C(e_i) = e_i^2$.[8] The individual payoff consists of a salary x_i and an equity payoff y_i which is a share of the group output

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[6] In contrast to Nalbantian and Schotter (1997), we adopt a stochastic form involving a binary output that simplifies the model. Moreover, this setup links better with the treatments in our empirical experiment by allowing us to present the subjects with a fixed number of experimental points in the case of group success to keep treatments equivalent.

[7] Risk neutrality is an appropriate simplifying assumption for deriving predictions to be tested in a laboratory setting since people are approximately risk neutral when stakes are small (as is in the lab) according to the expected-utility theory.

[8] We choose this specification for model tractability and also for a convex cost function.

$\tilde{V}$. The group production process is a binary lottery where

$$\tilde{V} = \begin{cases} V, & \text{with probability } p(e_1 + e_2) \qquad \text{Group “Succeeds”} \\ 0, & \text{otherwise.} \qquad\qquad\qquad\quad\; \text{Group “Fails”} \end{cases}$$

assuming $p(e_1 + e_2) = k(e_1 + e_2)$ with $k > 0$.[9] Salary is a fixed payment regardless of the outcome of group output, which does not elicit more effort from a self-interested agent absent the introduction of social preferences. However, the equity share can affect the individual's optimal effort. The value of equity is $y_i\tilde{V}$ for share y_i.

Without loss of generality, we consider the problem from the perspective of worker $i = 1$. Given compensation structure x_1, x_2, y_1, y_2 and worker 2's effort choice e_2, the problem faced by worker 1 is

$$\max_{e_1} \quad \mathbb{E}u(e_1; e_2, x_1, x_2, y_1, y_2) = p(e_1 + e_2) \cdot u_{\text{Success}} + [1 - p(e_1 + e_2)] \cdot u_{\text{Failure}} \tag{3.1}$$

$$\text{where} \quad u_{\text{Success}} = x_1 + y_1 V - C(e_1) - (D_X + D_Y), \text{ and} \tag{3.2}$$

$$u_{\text{Failure}} = x_1 - C(e_1) - D_X. \tag{3.3}$$

D_X represents the worker's inequality aversion in the salary domain and has the form

$$D_X = \alpha_x\Big(\max\{(x_2 - C(e_2)) - (x_1 - C(e_1)), 0\}\Big) \tag{3.4}$$

$$+ \beta_x\Big(\max\{(x_1 - C(e_1)) - (x_2 - C(e_2)), 0\}\Big). \tag{3.5}$$

α_x is the degree of inequality aversion in salary when the worker is in a disadvantageous position, i.e., having lower utility than the other worker in the salary domain, and β_x denotes the degree of inequality aversion in salary when the worker is in an advantageous position, i.e., having higher utility than the other worker in the salary domain.

The variable D_Y represents the worker's inequality aversion in the equity domain when the group “succeeds” and takes the form

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[9] We choose this linear specification for model tractability.

$$D_Y = \alpha_y\Big(\max\{(y_2 - y_1)V, 0\}\Big) + \beta_y\Big(\max\{(y_1 - y_2)V), 0\}\Big). \tag{3.6}$$

D_Y only appears when the group succeeds, as group output and value of equity is zero when the group fails. α_y is interpreted as the degree of inequality aversion in equity when the worker is in a disadvantageous equity position, and β_y denotes the degree of inequality aversion in equity when the worker is in an advantageous equity position.

In the model, we assume all workers are self-interested, and thus are more inequality-averse when they are in the disadvantageous position than when they are in the advantageous position ($\alpha_x > \beta_x, \alpha_y > \beta_y$). We also assume that both disadvantageous and advantageous workers are averse to inequality, but only to an extent: the disutility caused by inequality cannot exceed the value of such inequality ($1 > \alpha_x, \alpha_y, \beta_x, \beta_y > 0$). Finally, both disadvantageous and advantageous workers are more averse to inequality in equity than to inequality in salary ($\alpha_y > \alpha_x, \beta_y > \beta_x$).

3.2.2. Implications for the Worker

Domain-Contingent Inequality Aversion

Let the utility-maximizing effort of worker i be denoted by e_i^*. Without loss of generality, we focus on e_1^*. We first examine how the compensation package (salary and equity) of worker 1 and the package of the other worker affect worker 1’s equilibrium effort choice. These are standard results and are left to the Appendix (see Propositions A.1-A.3). Following Benjamin (2015), we derive our key results in Propositions 1-2 which predict how workers respond to inequality in equity under different model assumptions. All proofs are relegated to the Appendix.

Proposition 1. Optimal Effort Response to Inequality in Equity Under Domain-Contingent Inequality Aversion. *Let* $y_2 = y_0$*, then* $\frac{\lim_{y_1 \uparrow y_0} \frac{\partial e_1^*}{\partial y_1}}{\lim_{y_1 \downarrow y_0} \frac{\partial e_1^*}{\partial y_1}} > 1$*. Relative to equality in equity* ($y_1 = y_2 = y_0$)*, effort responds more to equity cuts* ($y_1 < y_0$) *than to equity raises* ($y_1 > y_0$)*.*

Inequality in equity has a *negative asymmetric effect* on effort. A change in y_1 affects the choice of e_1^*, and the change in the choice of e_1^* in turn may affect inequality aversion in the salary domain, causing e_1^* to readjust. By the assumption that the employee is more inequality averse in the equity domain, we conclude the effect of equity must outweigh the effect of salary. Moreover, the assumption that the worker is self-interested suggests that disadvantageous equity positions (equity cuts) outweigh the effect of advantageous equity positions (equity raises), thus yielding Proposition 1. As we note in the proof of this proposition, the negative asymmetric effect is stronger (i.e., $\frac{\lim_{y_1 \uparrow y_0} \frac{\partial e_1^*}{\partial y_1}}{\lim_{y_1 \downarrow y_0} \frac{\partial e_1^*}{\partial y_1}}$ is larger) when α_y or β_y is larger.

The negative asymmetric effect of inequality in equity, stated in Proposition 1, is a unique result of our domain-contingent inequality aversion model. In the next proposition, we compare this result with implications from a model with no inequality aversion (i.e., no inequality aversion terms at all in the utility function) and a model with non-domain-contingent inequality aversion (i.e., no separation of salary and equity payoff in the inequality aversion terms).

Proposition 2. Optimal Effort Response to Inequality in Equity Absent Domain-Contingent Inequality Aversion. *Let* $y_2 = y_0$*. Let* $\tilde{e}_1$ *be worker 1's optimal effort choice absent inequality aversion. Let* $\hat{e}_1$ *be worker 1's optimal effort choice under non-domain-contingent inequality aversion. Then* $\frac{\lim_{y_1 \uparrow y_0} \frac{\partial \tilde{e}_1}{\partial y_1}}{\lim_{y_1 \downarrow y_0} \frac{\partial \tilde{e}_1}{\partial y_1}} = 1$ *and* $\frac{\lim_{y_1 \uparrow y_0} \frac{\partial \hat{e}_1}{\partial y_1}}{\lim_{y_1 \downarrow y_0} \frac{\partial \hat{e}_1}{\partial y_1}} = 1$*. Relative to equality in equity* ($y_1 = y_2 = y_0$)*, effort responds symmetrically to equity cuts* ($y_1 < y_0$) *and equity raises* ($y_1 > y_0$)*.*

In contrast to the prediction of the domain-contingent inequality aversion model, Proposition 2 says that models absent domain-contingent inequality aversion predict a symmetric effect of inequality in equity on effort. Propositions 1 and 2 together suggest that the negative asymmetric effect of inequality in equity is uniquely derived from the domain-contingent inequality aversion assumption. Models without this assumption do not exhibit this effect. Therefore, we conclude that this negative asymmetric effect is a unique manifestation of domain-contingent inequality aversion. Since we hypothesize that workers have domain-contingent inequality aversion in equity and salary, we have the following hypothesis.

Hypothesis 1. Domain-Contingent Inequality Aversion. *There is a negative asymmetric effect of inequality in equity, i.e., workers respond more to equity cuts than to equity raises.*

We also derive additional results regarding how the employee responds to inequality in salary (see Proposition A.4) and how the worker's response to inequality in salary relates to his response to inequality in equity (see Proposition A.5). These results are left to the Appendix.

Separation of Domains

Furthermore, we hypothesize that the separation of the equity and the salary domains are triggered by whether or not equity is presented in the same format as salary. In other words, when equity is presented differently from salary, it is perceived as a distinct domain that can trigger domain-contingent inequality aversion. As a result, we are more likely to observe the negative asymmetric effect of inequality in equity. When equity is presented in the same format as salary, workers no longer experience more inequality aversion in the equity domain and we may not observe the negative asymmetric effect of inequality in equity. Therefore, we hypothesize that domain-contingent inequality aversion, tested through the existence of a negative asymmetric effect of inequality in equity, is more likely to appear when equity is presented differently from salary.

Hypothesis 2. Presentation Effect of Equity *The negative asymmetric effect of inequality in equity is more likely to occur when equity is presented in a different format from salary.*

3.2.3. Implications for the Firm

The propositions and hypotheses in Section 3.2.2 provide testable predictions for our laboratory experiment and also have implications for compensation decisions. Hypothesis 1 is particularly pertinent for a firm having a fixed employee equity pool, a situation faced by most firms issuing equity compensation. Firms that allocate a fixed total equity to employees devise a scheme to maximizes the total effort of their workers. According to Hypothesis 1, the negative asymmetric effect of inequality in equity on effort suggests that equitable distribution of equity is the optimal compensation strategy. The optimal strategy of salary compensation is less clear since firms may not set aside a fixed amount of cash for their employees. Yet, salary dispersion may be justified when inequality in salary has a positive asymmetric effect on effort under conditions specified in Proposition A.4. In the presence of a negative asymmetric effect of inequality in equity and a positive asymmetric effect of inequality in salary, the *equality-in-equity* strategy (same equity but different salary) is the optimal strategy for firms.[10] According to Hypothesis 2, such a negative asymmetric effect would more likely be present when equity is presented in its distinct form which suggests our next hypothesis.

Hypothesis 3. Total Group Effort. *Equality in equity is more likely to induce the highest total group effort when equity is presented in a different format from salary.*

Moreover, while our model considers a two-worker case, the implications for equity compensation can be easily extended to any firm with a fixed employee equity pool. The case of companies consisting of two worker types of equal numbers is clearly a direct extension of the two-worker case. In fact, even when there are unequal numbers of multiple worker types, any deviation from general equality will lead to a reduction in total effort in the presence of a negative asymmetric effect of inequality in equity.[11]

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[10] The current version of this paper focuses on predictions for workers' effort choices since our lab experiment only examines responses to predetermined compensation packages. In future work, we plan to derive equilibrium results by solving the firm's problem rigorously as in Benjamin (2015).

3.3. Experimental Design

We test our hypotheses using an experimental design borrowed from Charness and Kuhn (2007) and Kessler (2010), which enables us to impose a quadratic effort cost function and a linear production function to match the model specifications.

We recruited 960 workers from Amazon Mechanical Turk (MTurk) to participate in a 15-minute study via Qualtrics during October and November 2016. MTurk workers have become a useful sample in the study of worker effort and multi-person games (Chandler and Kapelner, 2013; Dreber et al., 2013; Rand et al., 2015; Jordan et al., 2016; Balasubramanian et al., 2017). In particular, many studies have shown there are no significant differences between the experimental results from MTurk and those derived from physical lab settings for various types of economic games (Horton et al., 2011; Suri and Watts, 2011; Amir et al., 2012). To ensure participants pay attention to experimental materials, we conducted comprehension checks at the beginning of the experiment after the participants read the instructions. Each participant needed to correctly answer comprehension questions related to the instructions in order to proceed with the study. These questions were designed to make sure that participants understood the rules of the experiment and the factors affecting their earnings. When questions were answered incorrectly, participants were offered a new set of comprehension questions. Participants who failed three attempts were excluded from the study and were only paid their guaranteed payment. The comprehension checks screened out 186 participants, resulting in a sample size of 774 workers.

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[11] Suppose there are T types of workers. a_t is the number of workers of type t, $t = 1, 2, ..., T$. Suppose the equity pool for workers is fixed. Under equality in equity, each worker receives equity share of the total pool $y = \frac{100}{\sum_{t=1}^{T} a_t}$. Let e be the optimal effort provided by each worker when everyone receives y. Under inequality in equity, suppose there are S types of workers getting less than y, then there are $T - S$ types of workers getting more than or equal to y with at least one type of workers getting more than y. Without loss of generality, let $t = 1, ..., S$ be the types of workers getting less than y. Let y_t be the equity share of the total pool received by a type t worker and let e_t be the optimal effort provided by this type of worker. Since the equity pool is fixed, we have $\sum_{t=1}^{S} a_t y_t + \sum_{t=S+1}^{T} a_t y_t = 100 = y \sum_{t=1}^{T} a_t$, thus yielding $\sum_{t=1}^{S} a_t(y_t - y) = \sum_{t=S+1}^{T} a_t(y - y_t)$. In the presence of negative asymmetric effect of equality in equity, we have $\frac{\text{total increase in effort}}{\text{total decrease in effort}} = \frac{\sum_{t=1}^{S} a_t(e_t - e)}{\sum_{t=S+1}^{T} a_t(e - e_t)} < \frac{\sum_{t=1}^{S} a_t(y_t - y)}{\sum_{t=S+1}^{T} a_t(y - y_t)} = 1$, so there is a reduction in total effort.

Participants were told this study investigated individual decision making and behavior. They were informed that they could earn bonus money in addition to their guaranteed payment (\$0.25) based on their decisions in the study. The experiment had a within-subject design with each participant experiencing 7 scenarios (in a random order) of group production with different compensation schemes. In each scenario, a participant was paired with a random partner (new for each scenario), and each received a flat payment to mimic salary and a share of group output to mimic equity. Payoffs were denoted in experiment points with each point worth \$0.001. Compensations for both people were public. Then, both participants had the opportunity to increase the probability of group success at a personal cost. Group output was $V = 500$ if the project succeeded but was zero if the project failed. Participants did not get any feedback during the 7 scenarios about the group outcome. In the end, one of the 7 scenarios was randomly selected to determine the final earnings of the participants. Compensation depended on decisions made by both participants in the group and the realization of group output. Basic demographic information including gender, education, race, and work experience was collected at the end of the experiment. Instructions were conveyed in a neutral language without mentioning concepts of effort, equity, salary, firm, or worker.

The experiment was further complemented by a between-subject design to test the presentation effect that may trigger the separation of compensation domains. There are two groups: *control* and *percentage treatment*. The only difference between these two groups is the presentation of the output share. We presented output share as a percentage instead of in experiment points in the percentage treatment group. For example, while workers in the control group were presented with an offer of 250 experiment points as their share of a total group output of 500 points, workers in the percentage treatment group were presented with the equivalent 50% of output share. In a real world context, these two presentations mirror the two ways that equity compensation can be presented to workers, grounding this design in an external valid fashion. In principle, the description of the output share does not change the real value of the output share, but only how it is presented to the participants.

Compensation levels are displayed in Table 14. There were three possible levels of flat payment (high, medium, low) and three possible levels of output share (high, medium, low). The control group comprised 387 workers , for which output share was presented in experiment points. 387 workers were in the percentage treatment group, for which output share was presented in percentage form.

——————**Insert Table 14**——————

Table 15 summarizes the seven individual-level scenarios experienced by each participant (in a random order). We can collapse the individual-level scenarios into group-level conditions based on output share and flat payment equality/inequality. There are four group-level conditions in total: general equality, equality in share, equality in flat payment, and general inequality. We call a higher payoff in either flat payment or output share as an *advantageous* position and a lower payoff is designated a *disadvantageous* position. Each scenario is named first by the group-level condition, and then by the advantageous or disadvantageous position of the participant. Note that we set the value of inequality in share for a successful project, e.g., $(60\% - 40\%) \times 500 = 100$, equal to the inequality in flat payment, i.e., $300 - 200 = 100$.

——————**Insert Table 15**——————

In each scenario, participants made a private decision to increase the probability of group project success at a personal cost. The cost schedule shown in Table 16 was identical for all participants across all scenarios. We refer to the number of points sacrificed to increase project success probability as one's contribution. There are 5 possible contribution choices that increase quadratically for each increment in success probability. The square root of this privately stated level of contribution is interpreted as our measure of unobservable effort. Each unit of effort would increase the probability of success linearly by $k = 4\%$. This type of stated effort measure is common in the experimental economics literature, especially studies on worker compensation and productivity in group production (Nalbantian and Schotter, 1997; Charness and Kuhn, 2007; Clark et al., 2010; Harbring and Irlenbusch, 2011). The advantage of our effort measure is that we could exactly impose a quadratic effort cost function and a linear production function in the experiment and directly test our predictions in Section 3.2. Based on the design parametrization, the optimal effort for a self-interested worker is 4, 5, or 6 when the output share is 40%, 50%, or 60% respectively. Our model of inequality aversion suggests that actual worker effort choices should deviate from these values.

——————**Insert Table 16**——————

The average payment for participants was \$0.47 with an average response time of 20.8 minutes and a median response time of 9.3 minutes. While the payment appears low, it is within the range for a typical MTurk job that lasts around 10-20 minutes.[12] \$0.25 is guaranteed and the rest of the payment depends on the actual decisions of both participants in a group based on a randomly selected scenario, which can range from \$0.15 to \$0.59.

3.4. Results

We first describe simple summary statistics of individual effort. We then report a regression analysis that tests our Hypothesis 1 regarding domain-contingent inequality aversion and evaluates Hypothesis 2 that a presentation effect drives the separation of domains. We conclude the section by providing suggestive evidence for Hypothesis 3 that offering the same equity but different salaries induces the highest total group effort only in presence of domain-contingent inequality aversion.

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[12] Based on the study of Society for Industrial and Organizational Psychology, \$0.75 is a reasonable rate for a 30-minute survey (Link: http://www.siop.org/tip/oct11/03barger.aspx). This means the reasonable rate is \$0.25-\$0.50 for a job that lasts around 10-20 minutes.

3.4.1. Summary Statistics of Individual Effort

Table 17 reports summary statistics for all individual-level scenarios. In both control and percentage treatment groups, individual effort is higher in high payoff ("advantageous") scenarios and lower in low payoff ("disadvantageous") scenarios, relative to the general equality scenario. At the individual scenario level, the differences between the control group and the percentage treatment group are not statistically significant, except for the general inequality (disadvantageous) scenario in which individuals in the percentage treatment group provide less effort than those in the control group on average. According to Table 17, the average effort choice under the general equality scenario is 5.45, suggesting that risk-aversion is unlikely a dominant factor in our experiment since a risk-averse agent would choose an effort level below 5 in this scenario absent any inequality.

——————Insert Table 17——————

Figure 14 shows the distribution of individual effort choices under each scenario, pooling the control and the percentage treatment groups. We group the 7 individual scenarios into 4 general group-level conditions: general equality, equality in share, equality in flat payment, and general inequality. The distributions tend to shift to the right for workers in the advantageous scenarios. Specifically, workers with both higher flat payment and higher output share than their partners (in the general inequality condition) exhibit the largest rightward shift. The rightward shift to higher effort choices also is slightly more prominent in the equality-in-share condition than in the equality-in-flat-payment condition. On the other hand, the distributions tend to shift to the left for workers in the disadvantageous scenarios. In particular, workers with both low flat payment and low output share than their partners (in the general inequality condition) exhibit the largest leftward shift. Comparing the equality-in-share condition and the equality-in-flat-payment condition, we see that fewer workers choose the lowest effort and more workers choose the highest effort when there is no inequality in share.

Another pattern from Figure 14 is that an effort choice of 5 appears to be the modal choice in the general equality condition and all the disadvantageous individual scenarios. A potential concern is that workers randomly pick an effort choice across 3 to 7 and in expectation would pick a choice of 5. We evaluate this concern by examining the mean effort choices reported in Table 17 and find that the mean effort choice is statistically significantly different from 5 for most scenarios ($p < 0.001$ for scenarios (a)-(d) and scenario (f), $p < 0.05$ for scenario (e)), except for scenario (g). Therefore, we do not believe that workers tend to choose an effort level of 5 as a result of randomizing over all effort choices. On the other hand, our model predicts that the optimal effort choice is 5 under the general equality scenario since workers should not experience inequality aversion. Some workers do choose other effort levels, with more people choosing levels above 5. We do not believe these non-optimal choices are due to inattentiveness since the change in mean effort choice under the general equality scenario is not statistically significant when we restrict the sample to workers with longer response time (10 minutes and above). A number of these most attentive workers still choose effort levels above 5, leading to a mean effort choice of 5.38 (statistically significantly different from 5 with $p < 0.001$). Two possible reasons for these high effort choices are pure altruism and risk-seeking behavior, especially when the financial stake in the experiment is relatively small. While some workers may exhibit these preferences, the two theories cannot generate the negative asymmetric effect of inequality in equity in Hypothesis 1 that is only predicted by the domain-contingent inequality aversion theory. In particular, risk-seeking preference suggests a positive asymmetric effect of inequality in equity, i.e., workers respond more to equity raises than to equity cuts.

——————**Insert Figure 14**——————

Figure 15 shows the average individual effort choice by the grouped scenarios. In the equality-in-flat-payment condition (but inequality in share), workers in the disadvantageous position on average provide less effort than those in the disadvantageous position of the equality-in-share condition. Workers in the advantageous position on average provide less effort than those in the advantageous position of the equality-in-share condition, though not significantly so. The patterns provide some evidence that inequality in different domains can affect effort provision differently. Relative to the general equality condition, redistributing flat payment within the group while holding share equal appears to have a symmetric effect on effort.[13] That is, higher flat payment increases effort by approximately the same amount that lower flat payment decreases effort. However, relative to the general equality condition, redistributing output share within the group while holding flat payment equal appears to have a negative asymmetric effect on effort.[14] Lower share decreases effort more than the increase in effort from higher share.

——————Insert Figure 15——————

We further examine how effort responds to different compensation schemes by collapsing the 7 individual scenarios based on the level of output share and flat payment respectively. Table 18 Panel A reports the summary statistics for all output share levels, and Panel B displays statistics for all flat payment levels. Suggestively, Panel A shows that effort on average responds to high and low output share almost symmetrically relative to medium level in the control group but responds to low output share more negatively in the treatment group. From Panel B, we see that effort appears to respond more negatively to low flat payment in the treatment group compared to the control group and, at the same time, responds more positively to high flat payment, though not significantly so for the latter. Before we formally test these patterns from the two panels and examine our hypotheses regarding inequality aversion in different domains, we notice that Panel B alone shows that workers clearly exhibit quite strong general inequality aversion consistent with the form predicted by Fehr and Schmidt (1999) since they respond heavily to inequality in flat payment, which is in contrast to the prediction of the neoclassical model that flat payment should not matter.

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[13] Running a regression of effort on all scenario indicators and controlling for individual fixed effects, we find that the changes in the two scenarios under the equality in share condition relative to the general equality condition is not statistically significantly different from each other (F-test gives a p-value of 0.7916).

[14] Running a regression of effort on all scenario indicators and controlling for individual fixed effects, we find that the changes in the two scenarios under the equality in flat payment condition relative to the general equality condition is statistically significantly different from each other (F-test gives a p-value of 0.0141).

——————Insert Table 18——————

3.4.2. Individual Level Effort

First, we perform a full-sample regression analysis to test Hypothesis 1 that workers experience domain-contingent inequality aversion regarding equity and salary. We then conduct subsample analysis for the control group and the percentage treatment group to test Hypothesis 2 that domain-contingent inequality aversion is driven by how equity is presented.

Table 19 reports regression results examining how different levels of compensation affect individual effort choice. According to Propositions 1 and 2, the domain-contingent inequality aversion model predicts a negative asymmetric effect of inequality in equity, or in other words, $\gamma_1 < |\gamma_3|$. In contrast, models with non-domain-contingent inequality aversion and no inequality aversion predict a symmetric effect, i.e., $\gamma_1 = |\gamma_3|$. Consistent with the presence of domain-contingent inequality aversion, we find a negative asymmetric effect of inequality in equity. The estimated γ_1 is smaller than the absolute value of the estimated γ_3 (Columns (1)-(3)). In other words, workers respond more to low share than to high share. Such a negative asymmetric effect is statistically significant at the 10% level for the fixed effects specification in Column (3) (p-value of the F-test is 0.0649), and presents evidence for Hypothesis 1 that workers experience domain-contingent inequality aversion. We consider the fixed effects model as the ideal specification since it controls for time-invariant individual heterogeneity arising from inattentiveness, confusion, or shirking by dropping those individuals who do not change effort choices across scenarios.

——————Insert Table 19——————

Result 1. Consistent with the prediction of the domain-contingent inequality aversion model, inequality in equity has a negative asymmetric effect on effort, i.e., effort responds more to low share than to high share.

Furthermore, recall that we hypothesize that the domain-contingency is driven by how equity is presented. In particular, Hypothesis 2 says that domain-contingent inequality aversion is more likely to occur when equity is presented differently from salary. Consequently, $\gamma_1 < |\gamma_3|$ is more likely to be observed for the treatment group when compared to the control group. In Table 19, we see that the negative asymmetric effect of inequality in equity becomes more prominent in the treatment subsample (Column (4)) with a p-value of 0.0593 for the F-test, but turns out to be statistically insignificant in the control subsample (Column (5)) with a p-value of 0.4559 for the F-test. We use the individual fixed effects specification for the subsample analysis to deal with potential inattentiveness of workers. Some workers do not change effort choices across scenarios so the specification using within-person variation is the ideal regression analysis. Hence, the test confirms Hypothesis 2 since the domain-contingency inequality aversion only appears in the treatment group for which equity is in its percentage form.

Result 2. We find that domain-contingent inequality aversion (i.e., more severe inequality aversion in the output share domain than in the flat payment domain) only appears when equity is presented in the percentage format but does not appear when equity is presented in the same format as the flat payment.

We do not believe that worker attentiveness is a challenge to our results with the inclusion of attention checks in our design. Experimental evidence has shown that MTurk participants perform better on online attention checks than do subject pool participants (Hauser and Schwarz, 2016). To further deal with the concern that workers may stop paying attention after passing pre-screening questions, we restrict our main analysis in Table 19 to workers with response time greater than 5 minutes. This drops 8% of the sample, leaving us 713 workers. We find that our fixed effects regression is still robust and the negative asymmetric effect of inequality in equity is even stronger for the treatment subsample but not for the control subsample (p-value for the F-test is 0.0712 for the full sample, 0.0250 for the treatment subsample and 0.7034 for the control subsample).

Table 19 also has implications for the parameter space of the degree of inequality aversion in the two separate domains. First, the effect of inequality in flat payment appears to be positive asymmetric since high flat payment increases effort more than the drop in low flat payment ($\gamma_2 > |\gamma_4|$), though this asymmetric effect is marginally statistically significant at the 10% level ($p-$value from F-test of the null hypothesis that $\gamma_2 + \gamma_4 = 0$ is 0.1082). Second, relative to general equality, low share induces a larger decrease in effort than low flat payment ($|\gamma_3| > |\gamma_4|$) even when the share reduction is at most equal to that of the flat payment reduction.[15] The difference is statistically significant at the 1% level (p-value from F-test of the null hypothesis that $\gamma_3 = \gamma_4$ is 0.0036). Third, we see that effort responds less to an increase in share than to an increase in flat payment ($\gamma_1 < \gamma_2$), though not significantly so (p-value from F-test of the null hypothesis that $\gamma_1 = \gamma_2$ is 0.4222). According to Propositions A.4 and A.5, given the model assumption of domain-contingent inequality aversion, these results imply that $\alpha_x - \beta_x \leq 2\alpha_x\beta_x$.

3.4.3. Group Level Effort

We now consider the group-level outcomes in a test of Hypothesis 3, which predicted that equality in equity is more likely to induce the highest total group effort when equity is shown differently from salary. In other words, offering the same equity but different salaries is more likely the optimal firm compensation strategy when equity is presented in its distinct percentage form.

Figure 16 illustrates the average total group effort across conditions. While average total group effort is the highest under the equality-in-share condition for the treatment group, group effort is lower than the average total group effort under other conditions (general equality and general inequality) for the control group. This finding, though not statistically significant, is consistent with Hypothesis 3 that equality-in-share is more likely the optimal compensation strategy (in the sense of inducing the highest total group effort) when share is shown in percentage form. A regression analysis further supports this conclusion. Table 20 reports regression results examining how total group effort is affected by different group-level conditions. We find that total group effort is higher under the equality-in-share condition relative to the equality-in-flat-payment condition (Column (1)), and more so when we restrict to the percentage treatment subsample (Column (2)). When compared to the other two group conditions (general equality and and general inequality), we do not have enough statistical significance for our estimates, but the signs suggest that the equality-in-share condition likely induces higher total effort than those other two conditions only in the percentage treatment sample (i.e., when share is shown in the percentage form).

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[15] The value of share reduction is at most $(60\% - 50\%) \times 500 = 50$. The value of flat payment reduction is $300 - 250 = 50$.

————————**Insert Figure 16**————————

————————**Insert Table 20**————————

These suggestive findings are consistent with the implications from our experimental results in the previous section. Domain-contingent inequality aversion implies that inequality in output share has a negative asymmetric effect on effort while inequality in flat payment can have a positive asymmetric effect on effort. As a result, the equality-in-share condition (but inequality in flat payment) is more likely to induce the highest total group effort when domain-contingent inequality aversion is more prominent, i.e., in the treatment group when equity is presented in a different percentage form from the control group.

3.5. Conclusion

We propose a behavioral model of domain-contingent inequality aversion and argue that workers dislike inequality in the equity domain more than salary inequality when equity is presented differently from salary. In contrast to other models with non-domain-contingent inequality aversion or no inequality aversion, our model features a negative asymmetric effect of inequality in equity. This negative asymmetric effect, coupled with a possible positive asymmetric effect of inequality in salary, suggests that the *equality-in-equity* compensation strategy could benefit firms. In an experiment, we examine how workers respond to combinations of different distributions of equity and salary. Our findings produce corroborating evidence for the existence of domain-contingent inequality aversion, and further demonstrate that the separation of domains is driven by a presentation effect.

While our findings are suggestive of an important pattern for compensation design, our study has limitations related to external generalizability. The character of workplace interactions can be far more complex than what is presumed in our experimental setting, and consideration of real-effort contribution may not be perfectly proxied by stated effort. This concern is valid, but our experiment intents to shed light on the underlying layers of inequality aversion and the factors that influence behavior under combinations of different incentives.

Furthermore, we consider a number of competing stories about worker preferences in our setting and find evidence that rules them out. While some workers may exhibit pure altruism or risk-seeking behavior to some extent, our observed negative asymmetric effect of inequality in equity characterizing domain-contingent inequality aversion cannot be explained by these two preferences. Moreover, even though risk-averse workers may potentially produce the aforementioned negative asymmetric effect, our summary statistics show that risk-aversion is not a dominant factor as workers tend to choose effort levels above what is predicted by risk-aversion.

Our experimental design enables us to identify a presentation effect that drives the separation of compensation domains. While we do not have a clear answer for why workers are more inequality averse in the equity domain when the separation of domains is triggered, we provide one possible explanation—when equity is presented in its percentage form, it is more likely to be perceived as more scarce than salary. Most firms have a limited amount of equity—a set percentage of the firm in their options pool—to distribute,[16] and employees may then perceive equity rewards as a scarce commodity.[17] A percentage form of equity facilitates the relative comparison of share size between participants (Dieckmann et al., 2009; Waters et al., 2006), and thus driving the salience of the finiteness of the 100% output. A fixed 100% means that there is a limited supply of output to be shared, and consequently increases the perception of scarcity.[18]

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[16] The creation and issuing of additional options beyond the existing options pool are costly to prior employees because the new options dilute their percentage ownership of the firm.

[17] "Equity Compensation in An Era of Scarcity", *Solium Capital*, accessed November 26, 2016.

The design also screens out many alternative mechanisms for why equity is viewed differently from salary, such as a failure to recognize the importance of equity (since most employees do not understand the value of the options they hold),[19] differential bargaining power over equity versus salary, distinct information structures (salary information is likely confidential while equity information is likely public knowledge), and overoptimism about the equity value (Bergman and Jenter, 2007; Oyer and Schaefer, 2005) since both equity and salary are essential, non-negotiable, public, and bounded in our design. Our results, however, do not rule out two other potential mechanisms for why equity and salary occupy separate domains. Perhaps equity differs from salary because of its non-pecuniary benefits, such as a sense of ownership and legitimacy of status (Graham et al., 2002; Hamilton, 2000). Also, equity likely might be viewed as a current asset while cash might just be viewed as current income, in which case cash and equity are in different mental accounts that interact differently with individual inequality aversion (Shefrin and Thaler, 1988). These alternatives would complement the view of domain-contingent inequality aversion.

Human capital is the most critical asset of modern technology and service firms. Compensation structures incentivize performance and facilitate the hiring and retention of skilled employees and managers. The finding that workers respond to inequality differently depending on the compensation domain, and more specifically the framing of the domain, provides implications for compensation package design in organizations.

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[18] Limiting supply is a common intervention to induce perception of scarcity in experiments (Effron and Miller, 2011; Mittone and Savadori, 2009).

[19] Casserly, M. (2013, March 8) Understanding Employee Equity: Every Startup's Secret Weapon. *Forbes*. Retrieved from http://www.forbes.com.

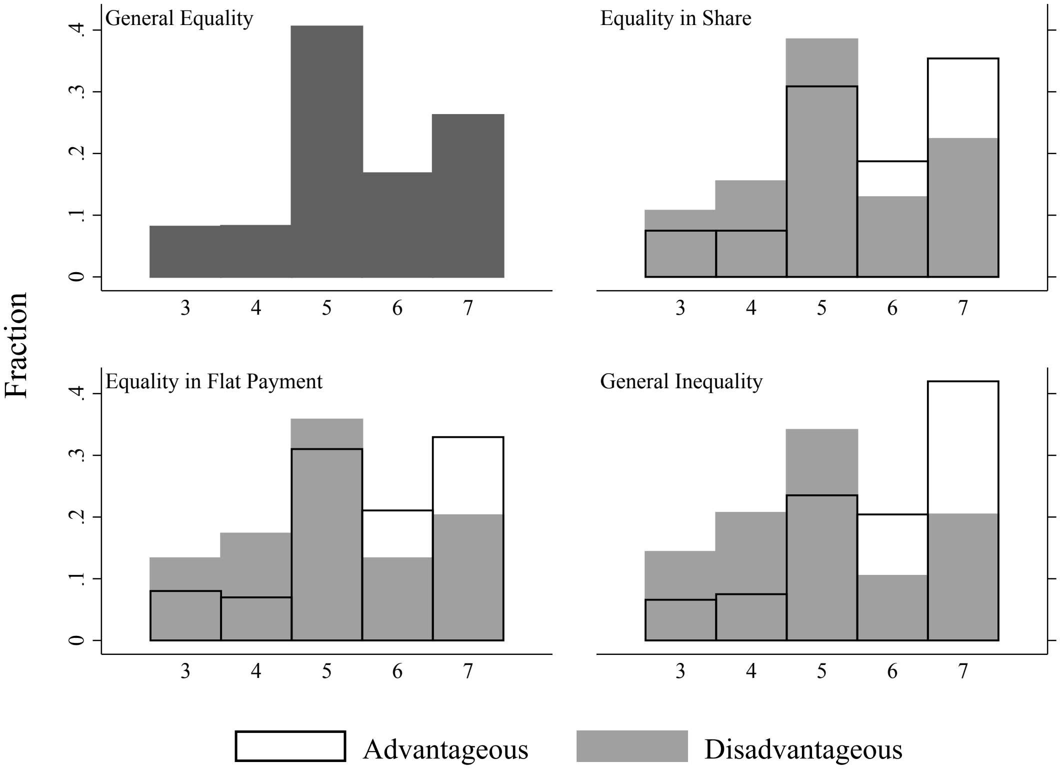


Figure 14: **Distributions of Individual Effort Choice by Scenario.** This figure shows the distribution of individual effort choices under each scenario, pooling the control and the percentage treatment groups. The 7 individual-level scenarios are organized into 4 general group-level conditions in 4 subfigures: general equality (top left), equality in share (top right), equality in flat payment (bottom left), and general inequality (bottom right). The x-axis represents individual effort choice. Note that effort choice is converted from individual contribution to the group and ranges from 3 to 7. The y-axis and the histograms represent the fractions of each effort choice within the condition. In the equality-in-share condition, equality-in-flat-payment condition, and general inequality condition, there are two types of scenarios: advantageous (white bars with black outlines) and disadvantageous (light grey bars). In the equality-in-share condition, advantageous refers to the scenario with high flat payment; disadvantageous denotes the scenario with low flat payment. In the equality-in-flat-payment condition, advantageous scenario signifies the scenario with high output share while disadvantageous scenario refers to the scenario with low output share. In the general inequality condition, advantageous scenario refers to the scenario with both high flat payment and high output share while disadvantageous scenario signifies the scenario with both low flat payment and low output share.

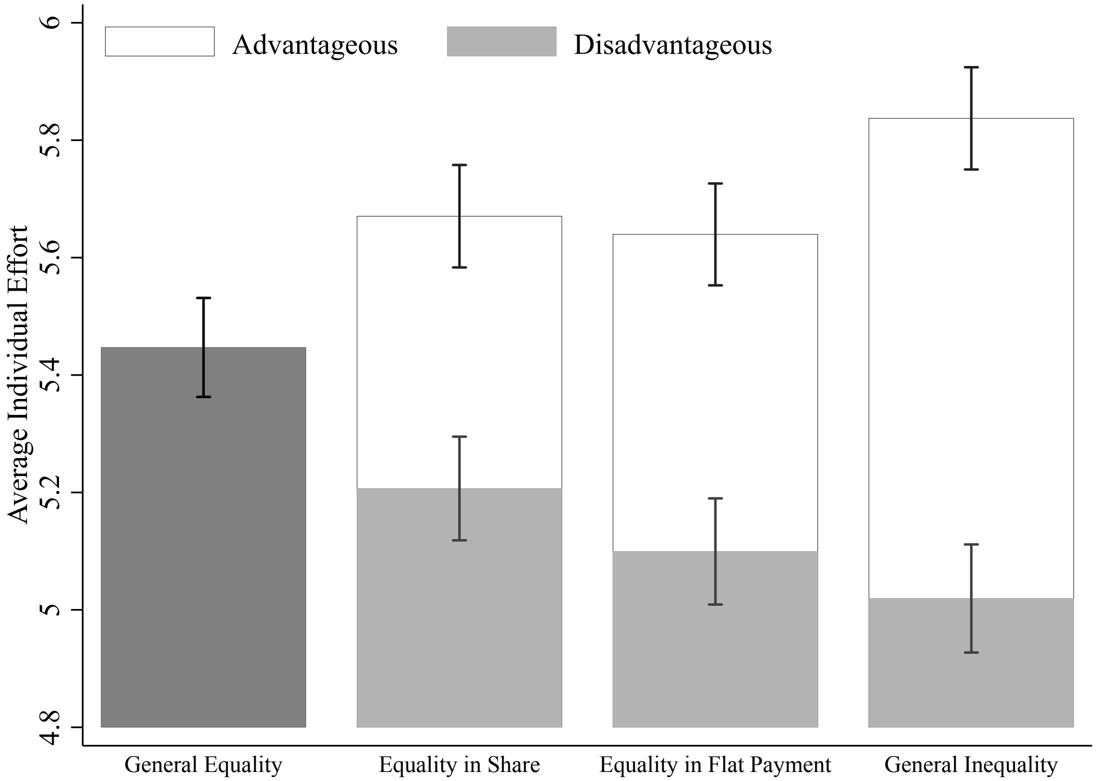


Figure 15: **Average Individual Effort Choice by Scenario.** This figure shows the average individual effort choice by scenarios, pooling the control and the percentage treatment groups. The 7 individual-level scenarios are organized into 4 general group-level conditions in 4 bars: general equality (first bar), equality in share (second bar), equality in flat payment (third bar), and general inequality (fourth bar). The x-axis represents the condition. The y-axis represents the average individual effort. Error bars are displayed in black, representing 95% confidence intervals. In the equality-in-share condition, equality-in-flat-payment condition, and general inequality condition, there are two overlaid bars that represent two types of scenarios: advantageous (white bars with black outlines) and disadvantageous (light grey bars). In the equality-in-share condition, advantageous scenario refers to the scenario with high flat payment while disadvantageous scenario denotes the scenario with low flat payment. In the equality-in-flat-payment condition, advantageous scenario refers to the scenario with high output share while disadvantageous scenario signifies the scenario with low output share. In the general inequality condition, advantageous scenario refers to the scenario with both high flat payment and high output share while disadvantageous scenario denotes the scenario with both low flat payment and low output share.

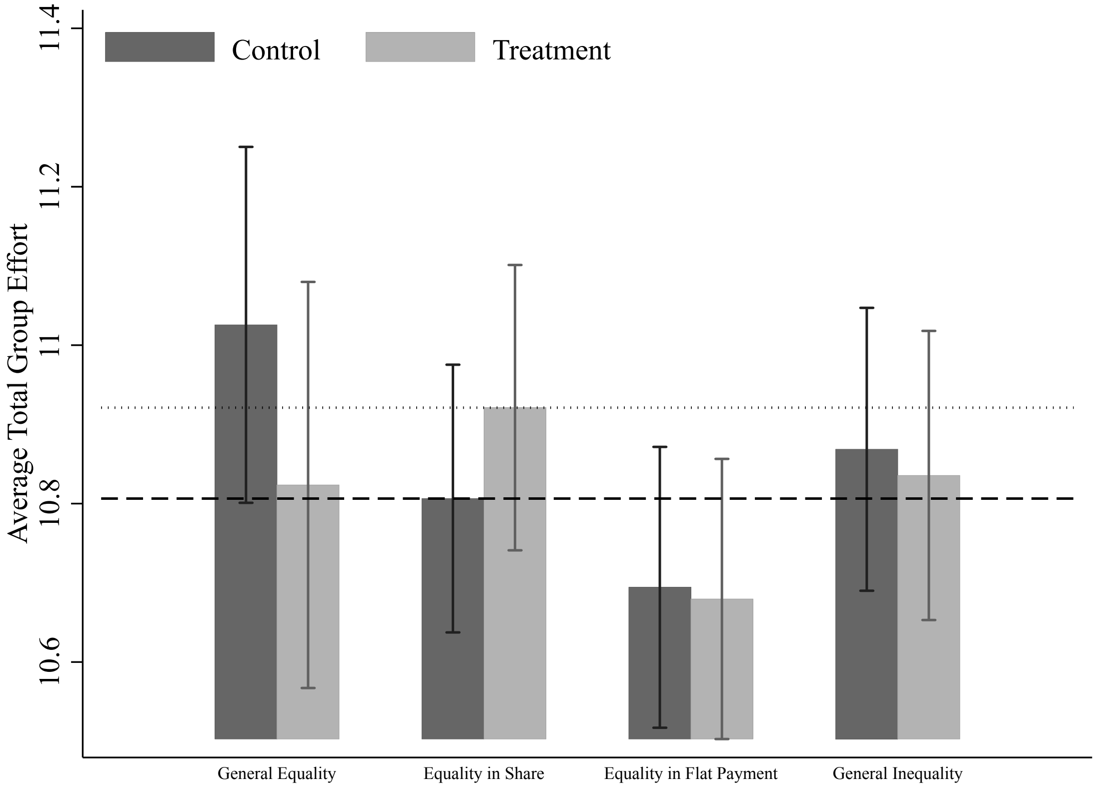


Figure 16: **Average Total Group Effort by Condition.** This figure shows the average total group effort across conditions for the control and percentage treatment groups respectively, in support of Hypothesis 3. There are 4 general group-level conditions: general equality, equality in share, equality in flat payment, and general inequality. The x-axis represents the group-level conditions. The y-axis and the bars represent the average total group effort. The control group averages are in dark grey and the percentage treatment group averages are in light grey. Error bars are displayed, representing 95% confidence intervals. The black dashed horizontal line is added to compare the equality-in-share condition with other conditions for the control group. The grey dotted horizontal line is added to compare the equality-in-share condition with other conditions for the percentage treatment group.

Table 14: **Levels of Compensation.** This table displays the possible levels of flat payment and output share. There are three possible levels for either flat payment or output share: high, medium, and low. Flat payment is shown in experiment points. Output share is presented in different formats depending on the group. In the control group, output share if the project succeeds is shown in experiment points. In the percentage treatment group, output share is shown in percentage. Note that the total group output is 500 points if the project succeeds, so the value of output share is the same in both control and percentage treatment groups.

		Output Share	
Level	**Flat Payment**	Control (Points)	Percentage Treatment (%)
High	300	300	60%
Medium	250	250	50%
Low	200	200	40%

Table 15: **All Individual-Level Scenarios.** This table shows the 7 individual-level scenarios. First column provides the names of scenarios. Each scenario is named first by the group-level condition (general equality, equality in share, equality in flat payment, general inequality) and then named by the advantageous or disadvantageous position. Second and third columns show the amount of flat payment (in experiment points) received by the participant and his partner respectively given the scenario. Fourth and fifth columns show the amount of output share received by the participant and his partner respectively given the scenario. Note that output share is shown in percentage form for the percentage treatment group and is shown in experiment points for the control group.

	Flat Payment		**Output Share**	
Scenario	Participant	His Partner	Participant	His Partner
(a) General Equality	250	250	50% / 250	50% / 250
(b) Equality in Share (Advantageous)	300	200	50% / 250	50% / 250
(c) Equality in Share (Disadvantageous)	200	300	50% / 250	50% / 250
(d) Equality in Flat Payment (Advantageous)	250	250	60% / 300	40% / 200
(e) Equality in Flat Payment (Disadvantageous)	250	250	40% / 200	60% / 300
(f) General Inequality (Advantageous)	300	200	60% / 300	40% / 200
(g) General Inequality (Disadvantageous)	200	300	40% / 200	60% / 300

Table 16: **Cost Schedule for Increasing Probability of Group Project Success.** This table shows the cost schedule for increasing probability of group project success. Probability of success can be increased linearly at a 4% interval. We refer to the number of points sacrificed to increase project success probability as one's contribution. There are 5 possible levels of contribution, increasing quadratically. The square root of this privately stated level of contribution is interpreted as our measure of unobservable effort.

Increased Probability of Success	12%	16%	20%	24%	28%
Cost of Points (Contribution, Seen)	9	16	25	36	49
Effort Choice ($\sqrt{\text{Contribution}}$, Unseen)	3	4	5	6	7

Table 17: **Summary Statistics: Means of Individual Effort Choice by Scenario.** This table reports the summary statistics for individual effort choice by individual-level scenario. The first column lists all the scenarios. The second and third columns report the means of individual effort and standard errors (in parentheses) for the control group and the percentage treatment group respectively. The fourth column shows the full sample averages and standard errors (in parentheses). The last column reports the p-values from two-tailed t-tests between the control group and the treatment group ($^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$).

	Group			p-Value
Scenario	Control	Treatment	Total	(Control vs. Treatment)
(a) General Equality	5.47	5.42	5.45	0.55
	(0.059)	(0.062)	(0.043)	
(b) Equality in Share (Advantageous)	5.64	5.70	5.67	0.54
	(0.060)	(0.066)	(0.044)	
(c) Equality in Share (Disadvantageous)	5.22	5.19	5.21	0.77
	(0.062)	(0.065)	(0.045)	
(d) Equality in Flat Payment (Advantageous)	5.65	5.63	5.64	0.84
	(0.061)	(0.064)	(0.044)	
(e) Equality in Flat Payment (Disadvantageous)	5.10	5.10	5.10	0.93
	(0.063)	(0.067)	(0.046)	
(f) General Inequality (Advantageous)	5.80	5.87	5.84	0.45
	(0.061)	(0.064)	(0.044)	
(g) General Inequality (Disadvantageous)	5.12	4.92	5.02	0.04^{**}
	(0.066)	(0.066)	(0.047)	
Observations	387	387	774	

Table 18: **Summary Statistics: Means of Individual Effort Choice by Compensation Level.** This table reports the summary statistics for individual effort choice by compensation level. In Panel A, each scenario is categorized based on the level of output share (high, medium, low). In Panel B, each scenario is categorized based on the level of flat payment (high, medium, low). Note that for both Panels A and B, there are 774 observations for high and low levels per group (control or treatment), and 1,161 observations for medium levels per group (control or treatment). For both panels, the first column lists the compensation level, the second and third columns report the means of individual effort and standard errors (in parentheses) for the control group and the percentage treatment group respectively, the fourth column shows the full sample averages and standard errors (in parentheses), and the last column reports the p-values from two-tailed t-tests between the control group and the treatment group (*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$).

	Group			p-Value
Level	Control	Treatment	Total	(Control vs. Treatment)
		Panel A: Levels of Output Share		
High	5.73	5.75	5.74	0.70
	(0.043)	(0.046)	(0.031)	
Medium	5.45	5.44	5.44	0.88
	(0.035)	(0.038)	(0.026)	
Low	5.11	5.01	5.06	0.13
	(0.046)	(0.047)	(0.033)	
		Panel B: Levels of Flat Payment		
High	5.72	5.78	5.75	0.33
	(0.043)	(0.046)	(0.031)	
Medium	5.41	5.38	5.40	0.62
	(0.036)	(0.038)	(0.026)	
Low	5.17	5.06	5.11	0.092*
	(0.045)	(0.047)	(0.033)	

Table 19: **Regression Results for Individual Effort.** This table shows the regression results for individual effort, in support of Hypothesis 1 and Hypothesis 2. The dependent variable is individual effort. The independent variables include the indicators for each output share level (high, medium, low) and for each flat payment level (high, medium, low). Medium share and medium flat payment indicators are dropped as reference categories. Columns (1)-(3) report the estimates using the full sample. Column (1) shows the estimates for the main regression specification. Column (2) shows the estimates when additional individual controls are included. The individual controls include gender, education, race, and whether the person has working experience or not. Column (3) shows the estimates when individual fixed effects are added. Column (4) shows the estimates for the percentage treatment group. Column (5) shows the estimates for the control group. Robust standard errors are reported in parentheses, and are clustered at the individual level in the fixed effects regression (Column (3)). p-values from the F-tests on $\gamma_1 = |\gamma_3|$ are reported.
$^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

	Dependent Variable: Individual Effort				
	Full Sample			Subsamples	
	OLS (1)	OLS (2)	FE (3)	Treatment (4)	Control (5)
High Share (γ_1)	0.202***	0.202***	0.202***	0.200***	0.204***
	(0.043)	(0.042)	(0.028)	(0.040)	(0.040)
High Flat Payment (γ_2)	0.233***	0.233***	0.233***	0.267***	0.199***
	(0.043)	(0.042)	(0.027)	(0.039)	(0.037)
Low Share (γ_3)	-0.276***	-0.275***	-0.276***	-0.305***	-0.247***
	(0.044)	(0.044)	(0.027)	(0.037)	(0.040)
Low Flat Payment (γ_4)	-0.169***	-0.170***	-0.169***	-0.207***	-0.131***
	(0.044)	(0.043)	(0.026)	(0.037)	(0.037)
Constant	5.420***	4.231***	5.420***	5.418***	5.423***
	(0.034)	(0.211)	(0.017)	(0.024)	(0.025)
F-test p-value ($\gamma_1 = \|\gamma_3\|$)	0.2815	0.2872	0.0649*	0.0593*	0.4559
Individual Controls	No	Yes	No	No	No
Individual Fixed Effects	No	No	Yes	Yes	Yes
Observations	5,418	5,411	5,418	2,709	2,709

Table 20: **Regression Results for Total Group Effort.** This table shows the regression results for total group effort, in support of Hypothesis 3. The dependent variable is total group effort. The independent variables include the indicators for all group-level conditions: general equality, equality in share, equality in flat payment, and general inequality. The reference condition is equality-in-share (but inequality in flat payment) and is hence dropped. Column (1) reports the estimates using the full sample. Column (2) shows the estimates for the percentage treatment group. Column (3) shows the estimates for the control group. Robust standard errors are reported in parentheses.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

	Dependent Variable: Total Group Effort		
	Full Sample (1)	Treatment (2)	Control (3)
General Equality (δ_1)	0.062	-0.098	0.219
	(0.107)	(0.159)	(0.143)
Equality in Flat Payment (δ_2)	-0.178**	-0.242*	-0.112
	(0.089)	(0.128)	(0.125)
General Inequality (δ_3)	-0.013	-0.086	0.062
	(0.090)	(0.130)	(0.125)
Constant	10.865***	10.921***	10.806***
	(0.063)	(0.092)	(0.086)
Observations	2,696	1,350	1,346

APPENDIX

A.1. Chapter 1 Appendix: Additional Figures and Tables

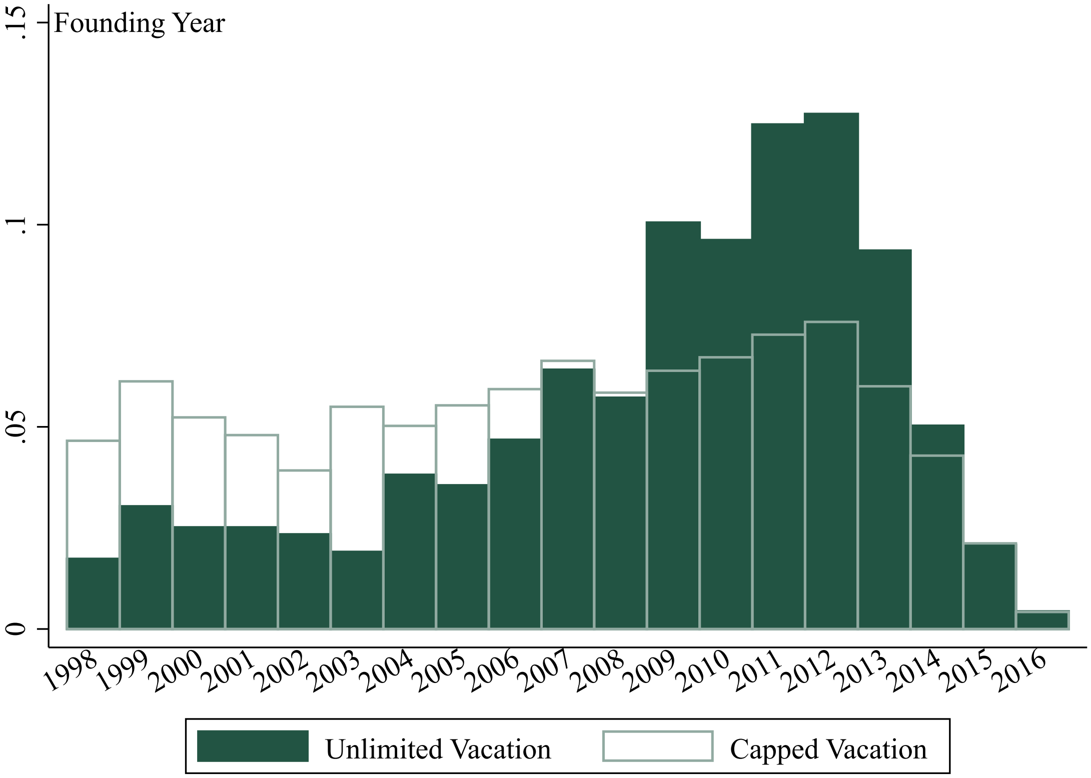


Figure A.1: **Distribution of Firms by Firm Founding Year in Setting 1.** The histograms show the distribution of firms by founding year (restricted to 1998-2018) for firms with and without unlimited vacation respectively in Setting 1.

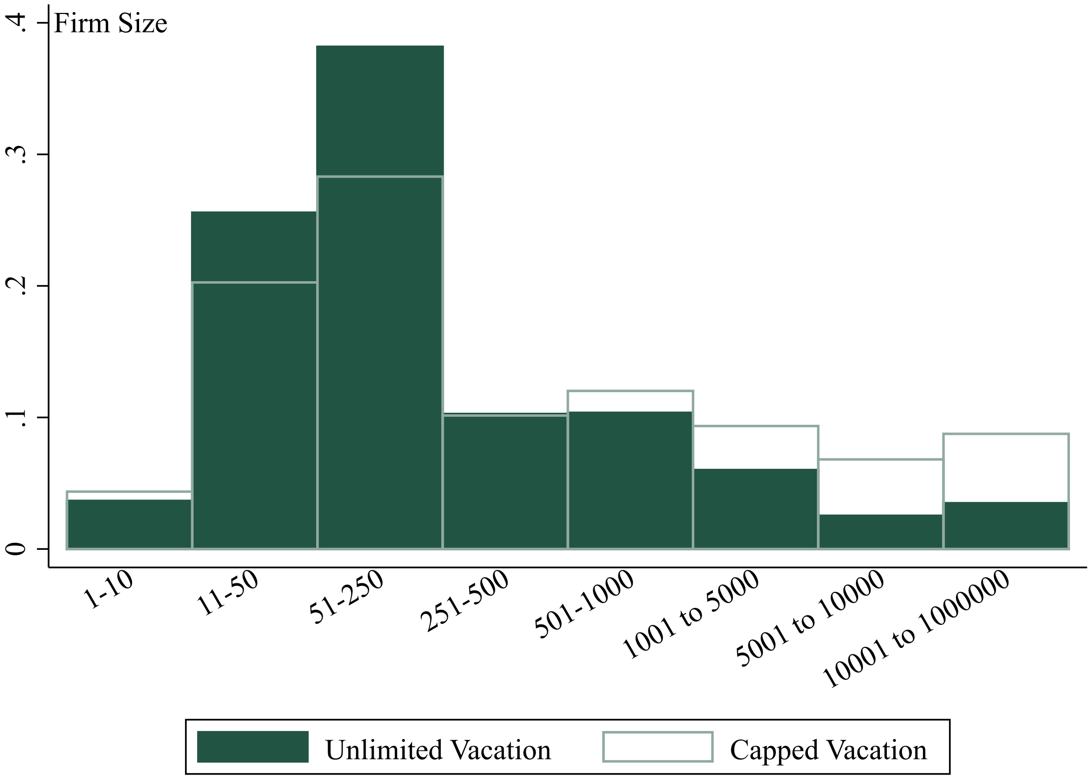


Figure A.2: **Distribution of Firms by Firm Size in Setting 1.** The histograms show the distribution of firms by the number of employees for firms with and without unlimited vacation in Setting 1.

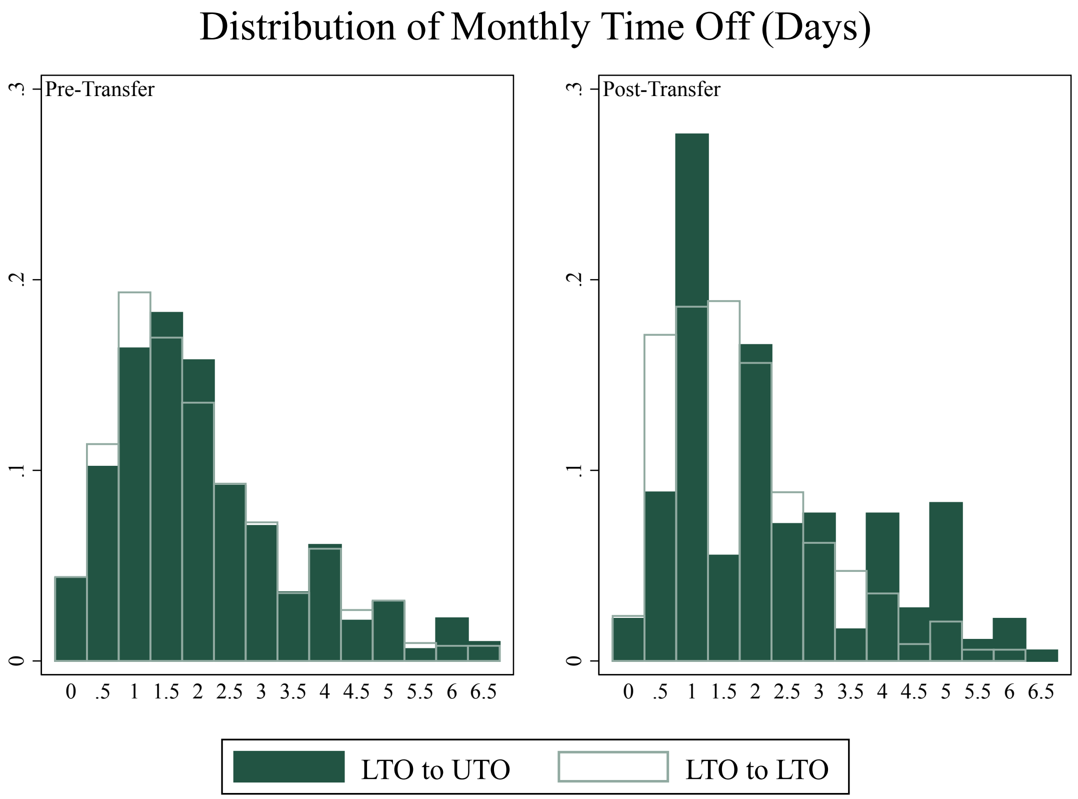
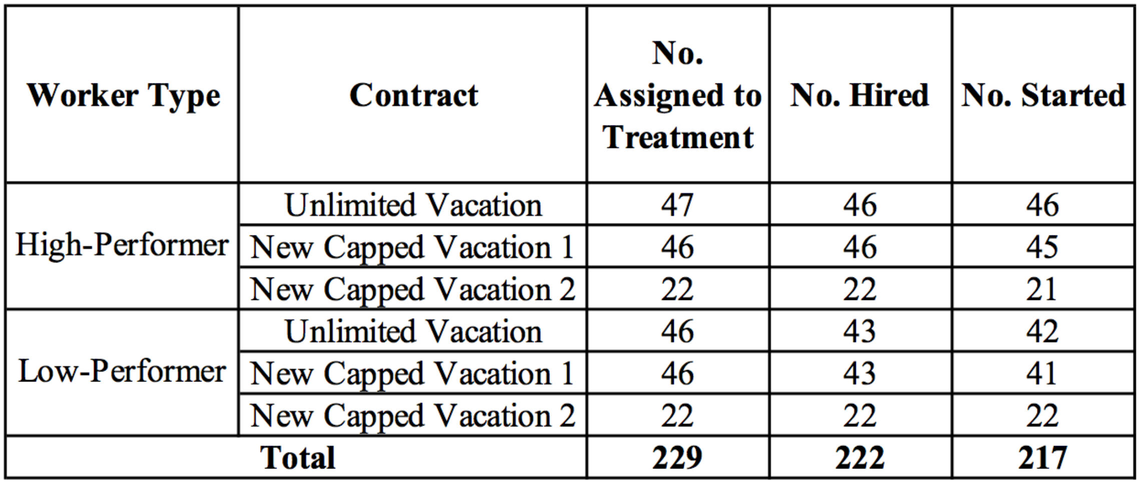


Figure A.3: **Distribution of Monthly Time Off in Setting 2.** This figure shows the distribution of monthly time off in days for the treatment group (LTO to UTO) and the control group (LTO to LTO) pre- vs. post-transfer.



Worker Type	Contract	No. Assigned to Treatment	No. Hired	No. Started
High-Performer	Unlimited Vacation	47	46	46
	New Capped Vacation 1	46	46	45
	New Capped Vacation 2	22	22	21
Low-Performer	Unlimited Vacation	46	43	42
	New Capped Vacation 1	46	43	41
	New Capped Vacation 2	22	22	22
Total		**229**	**222**	**217**

Figure A.4: **Treatments (Experiment 2) in Setting 3.** This table shows treatment assignment based on worker type and contract in Setting 3 (RCT).

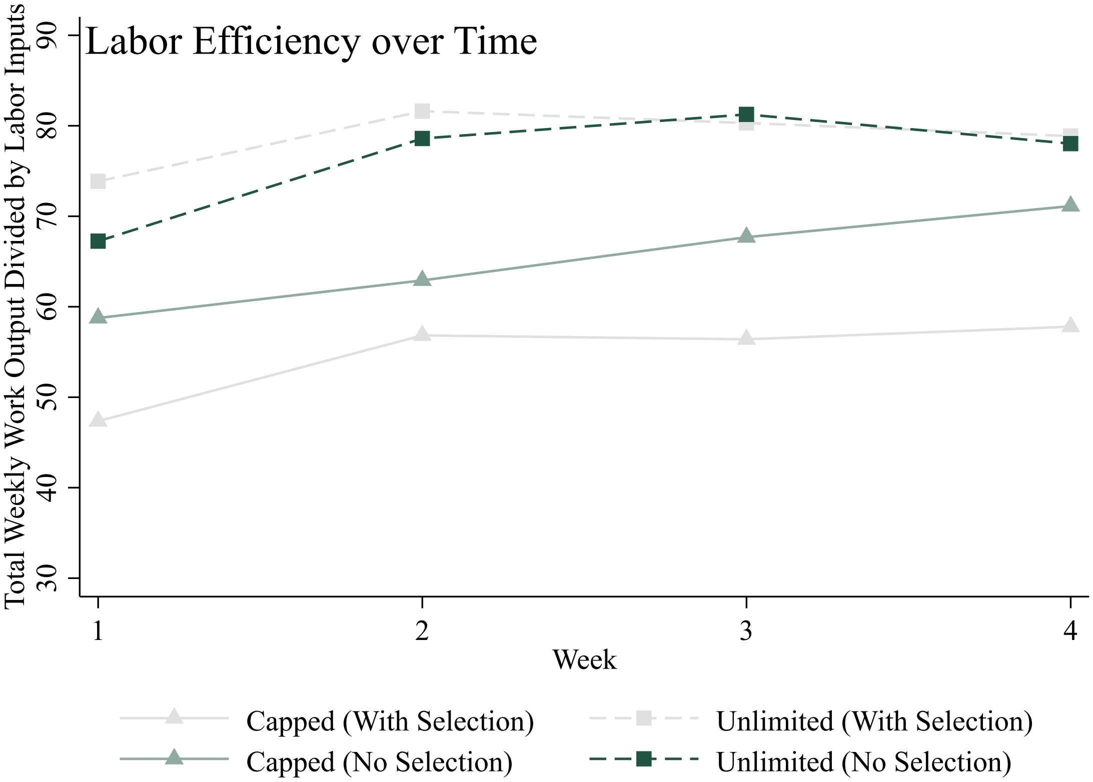


Figure A.5: **Overall Labor Efficiency by Contract and Sorting in Setting 3.** This table shows overall labor efficiency over time by contract and whether there is sorting in Setting 3 (RCT).

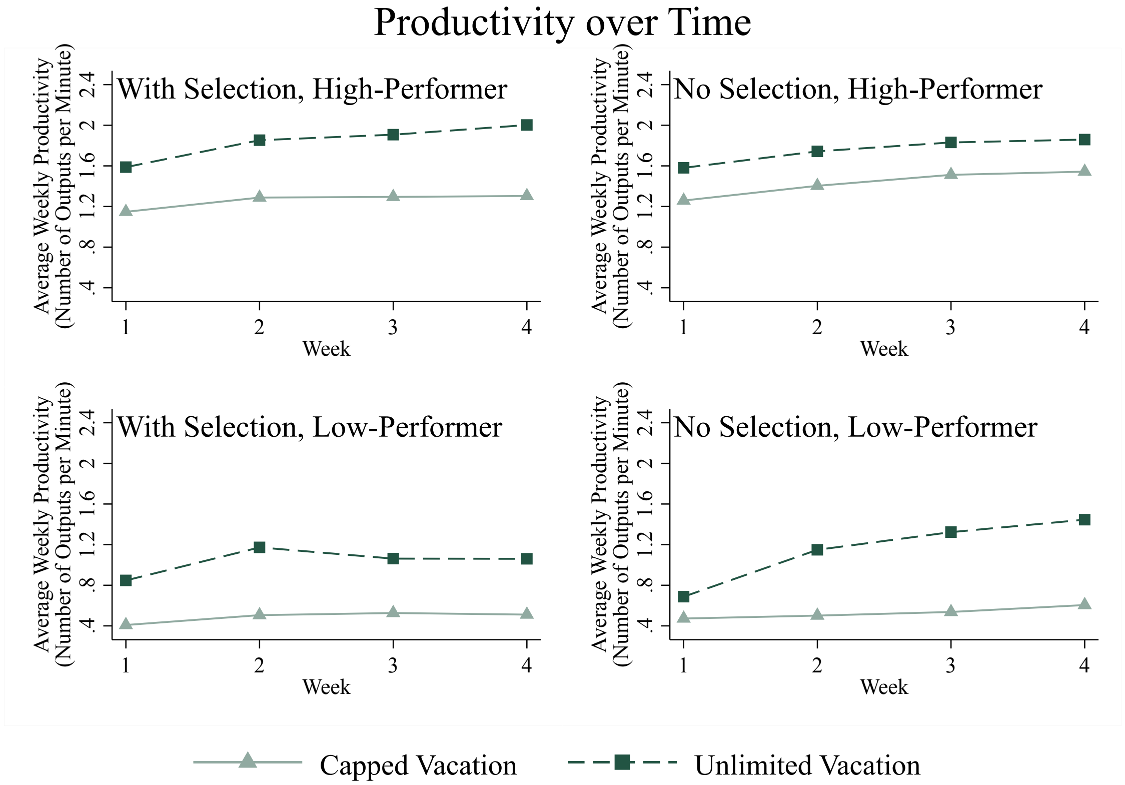


Figure A.6: **Weekly Individual Worker Productivity by Contract over Time Based on Sorting and Worker Type in Setting 3.** This figure shows the average weekly productivity (number of outputs per minute) by vacation contract over time in Setting 3 (RCT), depending on whether workers can choose between two contracts and on worker type. The top left subfigure shows the average weekly productivity over time for high-performers who can choose between two contracts. The top right subfigure shows the average weekly productivity over time for high-performers who are randomly assigned a contract. The bottom left subfigure shows the average weekly productivity over time for low-performers who can choose between two contracts. The bottom right subfigure shows the average weekly productivity over time for low-performers who are randomly assigned a contract. The differences between the means is statistically significant difference at the 5% level for all subfigures at all weeks.

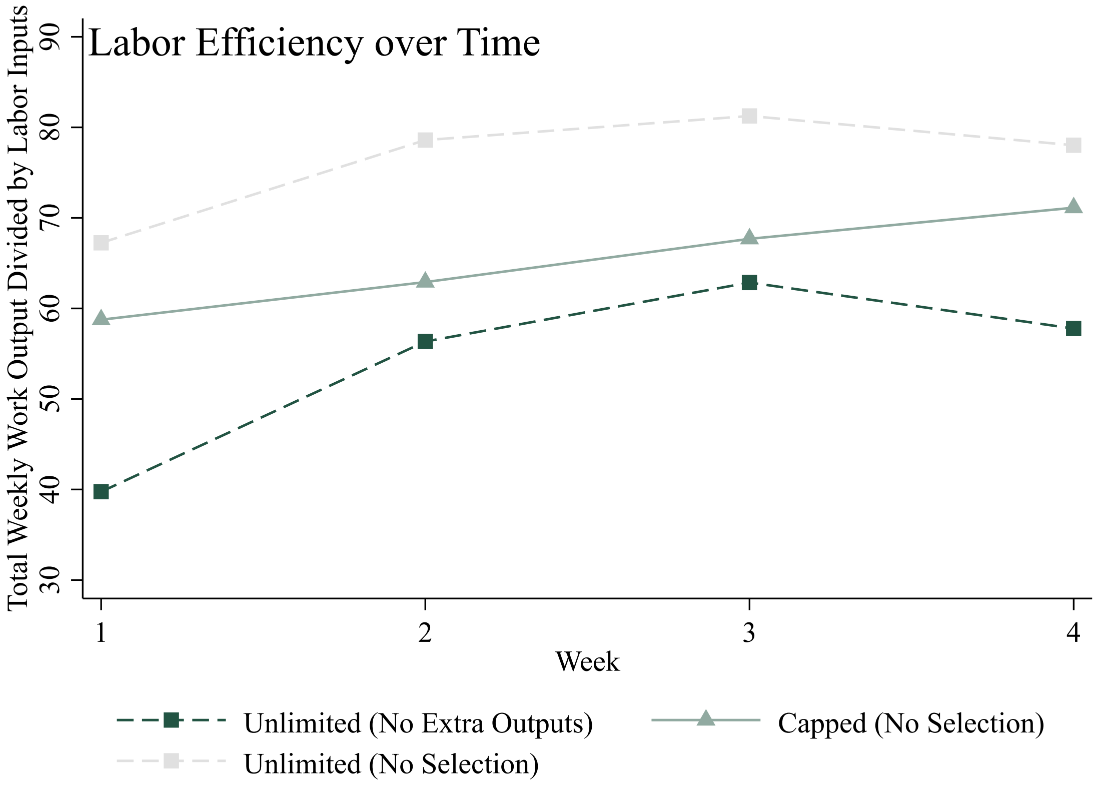


Figure A.7: **Hypothetical Overall Labor Efficiency for Unlimited Vacation in Setting 3.** This table shows the hypothetical overall labor efficiency under unlimited vacation if workers were simply meeting the performance requirement and produced no extra work outputs, and compares it with the actual overall labor efficiency levels under unlimited and capped vacation when there is no sorting.

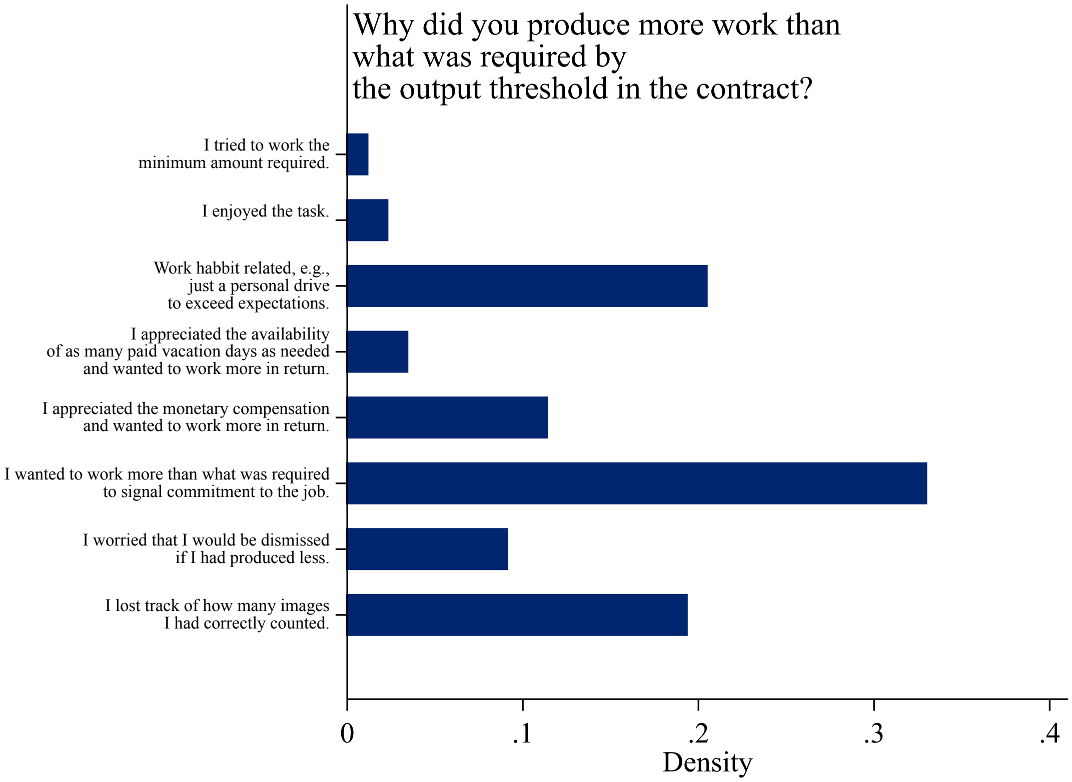


Figure A.8: **Reason for Producing Extra Work in Setting 3.** This figure shows the distribution of why workers under the unlimited vacation produced more than required by their contract based on worker responses in the follow-up survey in Setting 3 (RCT). 88 workers answered this question. The rest of the workers did not answer this question since they did not produce extra work or they did not work under the unlimited vacation contract.

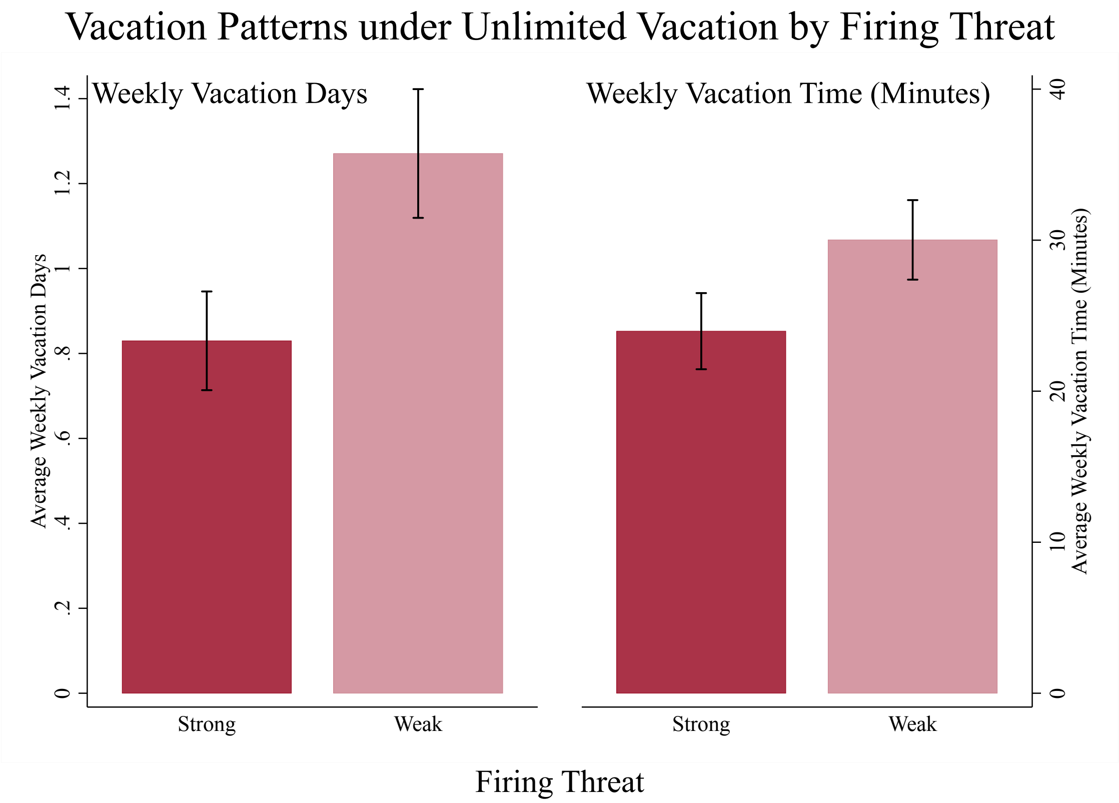


Figure A.9: **Weekly Vacation Patterns under Unlimited Vacation by Firing Threat in Setting 3.** This figure summarizes the weekly vacation patterns for workers under strong vs. weak firing threat separately in Setting 3 (RCT), using workers who work under the unlimited vacation. The left subfigure shows the average weekly vacation days by firing threat treatments, with a statistically significant difference at the 0.1% level. The right subfigure shows the average weekly vacation time in minutes by firing threat treatments, with a statistically significant difference at the 0.1% level.

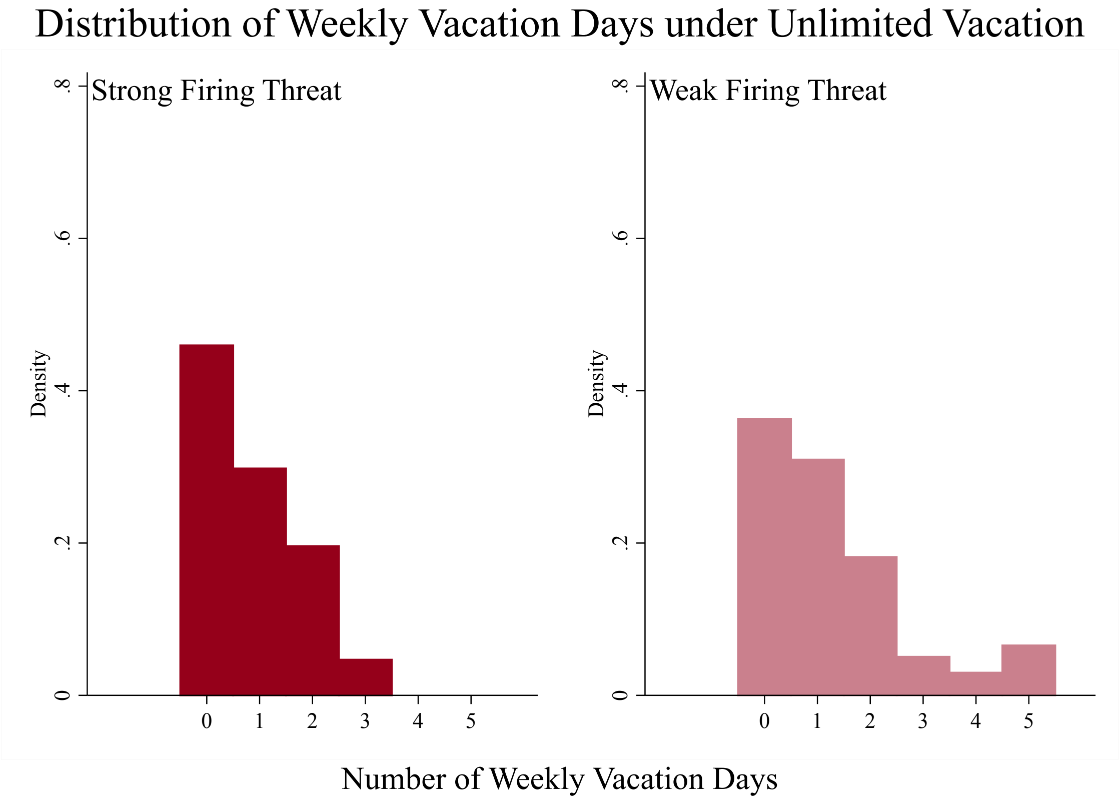


Figure A.10: **Distribution of Weekly Vacation Days under Unlimited Vacation by Firing Threat.** This figure shows the distribution of the weekly vacation days for workers under strong vs. weak firing threat separately, using workers who work under the unlimited vacation.

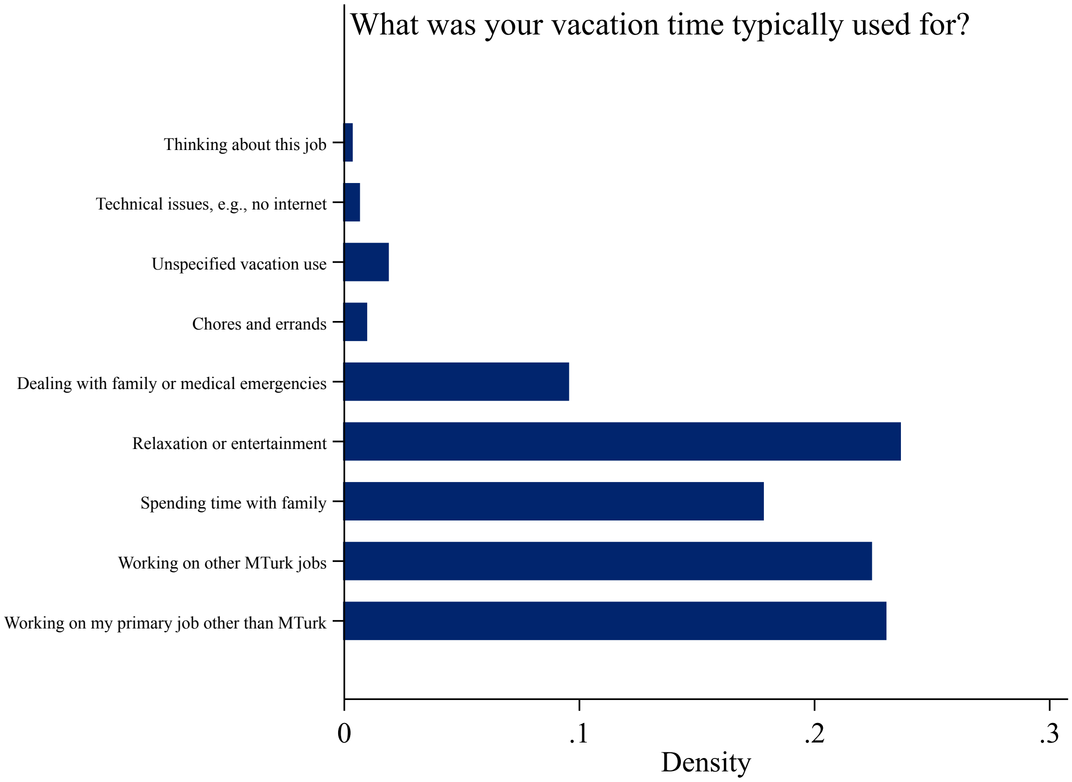


Figure A.11: **Use of Vacation Time in Setting 3.** This figure shows the distribution of how workers typically used their vacation time based on worker responses in the follow-up survey in Setting 3 (RCT). 326 workers answered this question. 68 workers did not answer this question since they did not take any vacation during the job.

Table A.1: **Employee-Level Summary Statistics in Setting 2.** This table shows employee-level summary statistics for the treatment and the control groups in Setting 2.

	Control Group			Treatment Group		
	LTO to LTO			LTO to UTO		
	N=114			N=238		
	Mean	Median	S.D.	Mean	Median	S.D.
Age	30.32	29.00	5.50	30.93	29.00	6.71
Female (%)	0.49		0.50	0.38		0.49
Married (%)	0.13		0.34	0.14		0.35
Job Level before Transfer	1.02	1.00	0.14	1.33	1.00	0.47
Job Tenure (Months) at Transfer	18.14	17.50	8.00	17.84	16.28	9.09

Table A.2: **Weekly Productivity by Worker and Contract Characteristics in Setting 3.** This table shows the regression results for evaluating productivity gain from the unlimited vacation contract in Setting 3 (RCT), including controls on worker and contract characteristics. The dependent variable is weekly productivity (number of outputs per minute). All models use workers who are randomly assigned a contract. Model (4) includes only workers in the capped vacation contract and workers in the unlimited vacation contract with a strong firing threat. Model (5) includes only workers in the capped vacation contract and workers in the unlimited vacation contract with a weak firing threat. All models include week fixed effects. Robust standard errors clustered at the individual level are reported in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$ **** $p < 0.001$.

	Dependent Variable: Weekly Productivity (Number of Outputs per Minute)				
				Firing Threat	
				Strong	Weak
	(1)	(2)	(3)	(4)	(5)
Unlimited Vacation	0.553****	0.574****	0.169	0.782****	0.403****
	(0.086)	(0.087)	(0.195)	(0.102)	(0.098)
High Job Commitment		0.741****	0.448***		
		(0.159)	(0.142)		
Unlimited Vacation × High Job Commitment			0.408*		
			(0.208)		
Constant	0.299***	-0.402**	-0.105	0.092	0.695****
	(0.101)	(0.170)	(0.149)	(0.123)	(0.120)
Observations	695	682	682	454	514

A.2. Chapter 1 Appendix: Theoretical Model Proofs

Workers solve the following utility maximization problem:

$$\max_{l} U(l;R) = w(R) - c(T-l)$$

subject to $l \leq \bar{L}$ when $R = 0$ or $l \leq T$ when $R = 1$. Since the utility function is monotonically increasing in vacation time, workers under capped vacation would choose $L^*(R = 0) = \bar{L}$; workers under unlimited vacation would choose $L^*(R = 1) = L_0 = T - \frac{\underline{Y}}{\eta(1+\tau_1)}$ if not slacking and $L^*(R = 1) = T$ if slacking. Note that L_0 may or may not be positive so it is likely that some workers are not able to choose L_0 when $T - \frac{\underline{Y}}{\eta(1+\tau_1)} < 0$, in which case they would slack for sure and choose $L^*(R = 1) = T$. In particular, firms will only set $\underline{Y}$ such that at least the high ability workers can meet the threshold given time T, or otherwise everyone will be slacking. Therefore, total time T will only be binding for the low ability workers. There are two possible cases: (i) both high ability and low ability workers do not slack at unlimited vacation firms, and (ii) high ability workers do not slack while low ability workers slack at unlimited vacation firms.

Whether a worker slacks depends on whether the worker is paid above his or her non-slacking condition:

$$w(1) \geq \frac{2}{p - pa} c(T - L_0) + \frac{b}{1-a}[w(0) - c(T - \bar{L})] + \frac{(1-a-b)}{1-a} V_u.$$

A.2.1. Proof of Prediction 1

Prediction 1. Sorting. *High-performers are more likely to choose unlimited vacation over capped vacation than low-performers.*

Proof. In Case (i), we have for high-performers, they will choose unlimited vacation if

$$w(1) - c(T - L_0; \eta_H) > w(0) - c(T - \bar{L})$$

and capped vacation otherwise. For low-performers, they will choose unlimited vacation if

$$w(0) - c(T - \bar{L}) > w(1) - c(T - L_0; \eta_L)$$

and capped vacation otherwise. In Case (ii), we have for high-performers, they will choose unlimited vacation if

$$2[w(1) - c(T - L_0; \eta_H)] > 2[w(0) - c(T - \bar{L})]$$

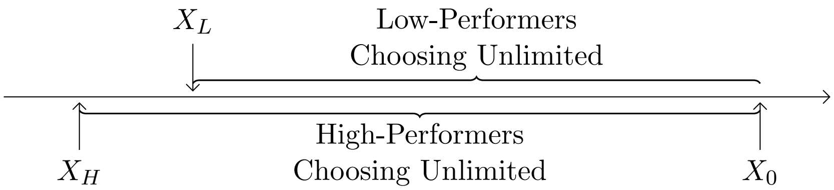
and capped vacation otherwise. For low-performers, they will choose unlimited vacation if

$$2[w(0) - c(T - \bar{L})] > (2 - p)w(1) + pV_f$$

and capped vacation otherwise.

When total time T is binding and low-performers cannot produce $\underline{Y}$ given time T, then as reasoned, they will slack at unlimited vacation firms. Then we will be in Case (ii). Including this additional discussion of the binding case is more complete since the results are no longer sensitive to the choice of $\underline{Y}$.

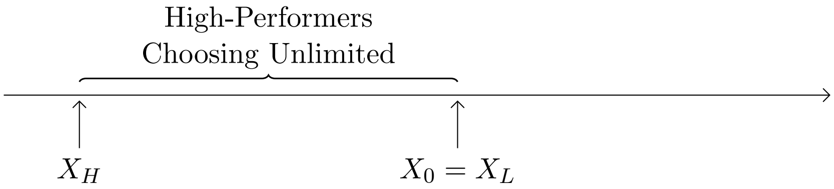
We first consider Case (i). We denote $X_H = w(1) - c(T - L_0; \eta_H)$, $X_L = w(1) - c(T - L_0; \eta_L)$, $X_0 = w(0) - c(T - \bar{L})$. We can show that $X_H > X_L$. There are 4 possible scenarios as detailed below for Case (i):



X_L
Low-Performers Choosing Unlimited
High-Performers Choosing Unlimited
X_H
X_0

[

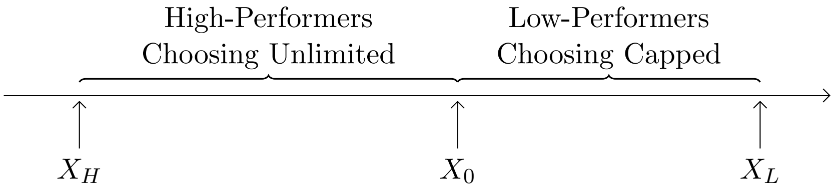
]Case (i) Scenario 1: Pooling Equilibrium (Unlimited)



High-Performers Choosing Unlimited
X_H
$X_0 = X_L$

[

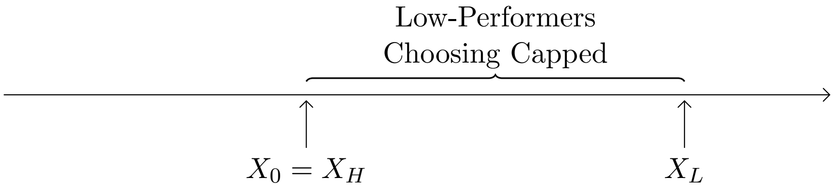
]Case (i) Scenario 2: Hybrid Equilibrium (Low-Performers Randomize)



High-Performers Choosing Unlimited
Low-Performers Choosing Capped
X_H
X_0
X_L

[

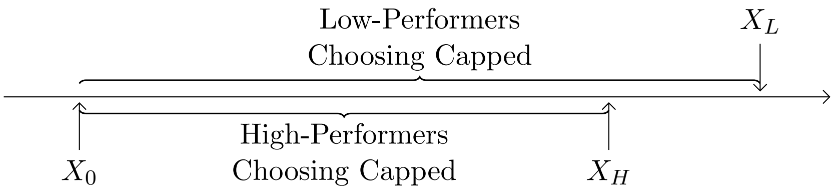
]Case (i) Scenario 3: Separating Equilibrium



Low-Performers Choosing Capped
$X_0 = X_H$
X_L

[

]Case (i) Scenario 4: Hybrid Equilibrium (High-Performers Randomize)



[

]Case (i) Scenario 5: Pooling Equilibrium (Capped)

Across all scenarios, if a low-performer is choosing unlimited vacation, then a high-performer is for sure choosing unlimited vacation. Therefore, in Case (i) where nobody slacks, we have that high-performers are more likely than low-performers to choose unlimited vacation. Reversely, low-performers are more likely than high-performers to choose capped vacation.

Then we consider Case (ii), which is more complicated. We denote $X'_H = w(1) - c(T - L_0; \eta_H)$, $X'_L = (2-p)w(1) + pV_f$, and $X'_0 = w(0) - c(T - \bar{L})$. We want to compare $2X'_H$ and X'_L. When $2X'_H > X'_L$, then similar to Case (i), we can show that high-performers are more likely than low-performers to choose unlimited vacation. When $2X'_H < X'_L$, however, the reasoning for Case (i) suggests that low-performers are more likely than high-performers to choose unlimited vacation. Now we show that $2X'_H - X'_L > 0$.

$2X'_H - X'_L = pw(1) - 2c(T - L_0; \eta_H) - pV_f$. Recall that in Case (ii), the high-performers do not slack, so the non-slacking condition strictly holds for high-performers and we have $w(1) > \frac{2}{p}c(T - L_0; \eta_H) + b[w(0) - c(T - \bar{L})] + (1-b)V_u = \frac{2}{p}c(T - L_0; \eta_H) + V_f$. Therefore, the NSC for high-performers suggest that $2X'_H - X'_L > 0$. As a result, as in Case (i), high-performers are more likely than low-performers to choose unlimited vacation. In summary, we have established the baseline prediction of sorting.

□

A.2.2. Proof of Prediction 2

Prediction 2. Productivity. *Worker productivity is higher under unlimited vacation than* *under capped vacation, even after controlling for the sorting effect.*

Proof. Productivity is $\eta(1 + \tau_R)$. This prediction is a direct result of the assumption that $\tau_1 > \tau_0 \geq 0$, where the assumption is based on the discussion in Section 1.2.2. $\square$

A.2.3. Proof of Prediction 3

Prediction 3. Slacking and Firing Threat. *Under unlimited vacation, workers are more likely to meet the output threshold, i.e., they are less likely to slack, when firing threat is stronger.*

Proof. When p increases, i.e., when firing threat is stronger, the non-slacking condition becomes easier to satisfy for both high- and low-performers, so there are fewer slackers and workers are more likely to meet the output threshold. $\square$

A.2.4. Implications for Firm Decisions

Now I formally derive the implications for firm-level vacation scheme decision and show that a firm is more likely to be profitable adopting unlimited vacation when the following statements are true:

1. when the firm has greater needs for high-performers (i.e., $v(x)$ is higher for any x)
2. when the firm has a stronger culture of firing conditional on performance (i.e., p is higher)
3. when the firm sees a stronger complementarity gain between unlimited vacation and worker performance (i.e., $\tau_1 - \tau_0$ is higher)

Proof. A firm choosing capped vacation scheme expects profit:

$$\mathbb{E}[\pi; R = 0] = x(0)(T - \bar{L})\eta_H(1 + \tau_0) + \big(1 - x(0)\big)(T - \bar{L})\eta_L(1 + \tau_0) - w(0).$$

A firm choosing unlimited vacation scheme expects profit:

$$\mathbb{E}[\pi; R=1] = \begin{cases} \underline{Y} - w(1) + v\big(x(1)\big), & \text{both high- and low-performers comply, or} \\ x(1)\underline{Y} - w(1) + v\big(x(1)\big), & \text{high-performers comply, low-performers slack} \end{cases}$$

A firm should adopt unlimited vacation if $\mathbb{E}\pi(R=1) > \mathbb{E}\pi(R=0)$. This can only happen when the non-slacking condition (NSC) is being met at least for the high-performers (otherwise, $\mathbb{E}\pi(R=1)=0$). There are two cases we consider: (A) when the firm finds it optimal to set a high NSC wage under unlimited vacation such that no worker slacks, and (B) when the firm finds it optimal to set a low NSC wage under unlimited vacation such that the low-performers slack while high-performers do not slack.

Case (A): The firm finds it optimal to adopt unlimited vacation if

$$\underline{Y} - w(1;\eta_L) + v\big(x(1)\big) > x(0)(T-\bar{L})\eta_H(1+\tau_0) + \big(1-x(0)\big)(T-\bar{L})\eta_L(1+\tau_0) - w(0)$$

Case (B): The firm finds it optimal to adopt unlimited vacation if

$$x(1)\underline{Y} - w(1;\eta_H) + v\big(x(1)\big) > x(0)(T-\bar{L})\eta_H(1+\tau_0) + \big(1-x(0)\big)(T-\bar{L})\eta_L(1+\tau_0) - w(0)$$

For both cases, the profitable condition is more likely to hold when any of the followings is true:

1. $v(x)$ is higher for any x;
2. p is higher; and
3. $\tau_1 - \tau_0$ is higher.

$\square$

A.3. Chapter 3 Appendix: Additional Propositions

All proofs are relegated to Appendix A.5.

A.3.1. Proposition A.1

Proposition A.1. *e_1^* is nondecreasing in x_1 and is nonincreasing in x_2.*

Proposition A.1 says that higher salary cannot reduce a worker's effort, and can only increase it or have no impact. On the other hand, higher salary of one's coworker cannot increase one's effort, and can only decrease it or have not impact. These patterns are hinged on inequality aversion in the salary domain.

A.3.2. Proposition A.2

Proposition A.2. *Let $\Delta y_1 > 0$ be the change in y_1, e_1^* is increasing in y_1 if $\frac{\Delta y_1}{y_1} > \frac{\alpha_x+\beta_x}{(1-\beta_x)(1-\beta_y)}$.*

Increasing a worker's equity may not necessarily increase his effort but is guaranteed to increase his effort when the equity change is large enough. Proposition A.2 gives a sufficient but not necessary condition. It is possible for a sufficiently small increase in equity to decrease effort. Since $\frac{\alpha_x+\beta_x}{(1-\beta_x)(1-\beta_y)}$ is increasing in α_x and β_x, the equity change is more likely to be large enough when the degree of inequality aversion in the salary domain is small.

A.3.3. Proposition A.3

Proposition A.3. *Let $\Delta y_2 > 0$ be the change in y_2, then*

(a) $\exists \delta > 0$ such that e_1^* is decreasing in y_2 if $\Delta y_2 \in (\delta, +\infty)$;

(b) $\exists \delta' > 0$ and $\delta'' > 0$ such that e_1^* is increasing in y_2 if $y_2 < y_1$ and $\Delta y_2 \in (\delta', \delta'')$.

Proposition A.3(a) states that a raise in the coworker's equity reduces the worker's own effort when the raise is big enough. But according to Proposition A.3(b), a raise in the coworker's equity may increase the worker's effort if the worker is in a position with relatively high equity and the coworker's raise is not too big. When a big raise in coworker's equity exacerbates inequality in equity, the worker responds unfavorably due to inequality aversion. On the other hand, if the equity raise in the coworker's pay mitigates inequality in equity, the worker may respond favorably by providing more effort.

A.3.4. Proposition A.4

Proposition A.4. *Let* $x_2 = x_0$*, and let* $e_1^* = e_1^0$ *when* $x_1 = x_2$*. Then,*

(a) $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| \geq \lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|$

(i) if $y_2 > y_1$*; or*

(ii) if $y_2 = y_1$ *and* $\alpha_x - \beta_x \geq 2\alpha_x\beta_x$*.*

(b) $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| \leq \lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|$

(i) if $y_2 < y_1$*; or*

(ii) if $y_2 = y_1$ *and* $\alpha_x - \beta_x \leq 2\alpha_x\beta_x$*.*

The equalities hold when $\lim_{x_1 \uparrow x_0} e_1^* = \lim_{x_1 \downarrow x_0} e_1^* = e_1^0$*.*

Relative to equality in salary ($x_1 = x_2 = x_0$), when a worker's effort responds more to salary raises ($x_1 > x_0$) than to salary cuts ($x_1 < x_0$), we say that inequality in salary has a *positive asymmetric effect* on effort. If the reverse is true, we say that inequality in salary has a *negative asymmetric effect* on effort. The effect is *symmetric* if a worker's effort responds to salary cuts and raises in the same magnitude. Unlike the negative asymmetric effect in the equity domain, Proposition A.4 suggests that the results on the effect of unequal salary are mixed. According to Part (i) of Proposition A.4(a), inequality in salary has either a symmetric or negative asymmetric effect on worker 1's effort when worker 1 has less equity than worker 2. When worker 1 has more equity than worker 2, Part (i) of Proposition A.4(b) says that inequality in salary has either a symmetric or positive asymmetric effect. Part (ii) of Propositions A.4(a) and A.4(b) state that when workers have the same equity, the relationship between advantageous and disadvantageous inequality aversion in the salary domain (α_x, β_x) determines whether there is a positive or negative asymmetric effect. Finally, if e_1^* remains unchanged regardless of equity cuts or raises, then it is trivially true that the effect of inequality in salary is symmetric.

A.3.5. Proposition A.5

Proposition A.5. *Let $x_2 = x_0, y_2 = y_0$, and let $e_1^* = e_1^0$ when $x_1 = x_2$ and $y_1 = y_2$. Then,* $\frac{\lim_{y_1 \uparrow y_0} |e_1^* - e_1^0|}{\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0|} \geq 1 \Leftrightarrow \alpha_x - \beta_x \leq 2\alpha_x\beta_x \Leftrightarrow \frac{\lim_{y_1 \downarrow y_0} |e_1^* - e_1^0|}{\lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|} \leq 1.$

According to Proposition A.5, relative to general equality $(x_1 = x_2 = x_0, y_1 = y_2 = y_0)$, effort responds more to equity cuts $(y_1 < y_0)$ than to salary cuts $(x_1 < x_0)$ if and only if effort responds more to salary raises $(x_1 > x_0)$ than to equity raises $(y_1 > y_0)$.

A.4. Chapter 3 Appendix: Experimental Procedures

Figure A.12 lays out the experimental procedure. Detailed experimental instructions for the control group and the treatment group are available in the Supplementary Appendix, available upon request.

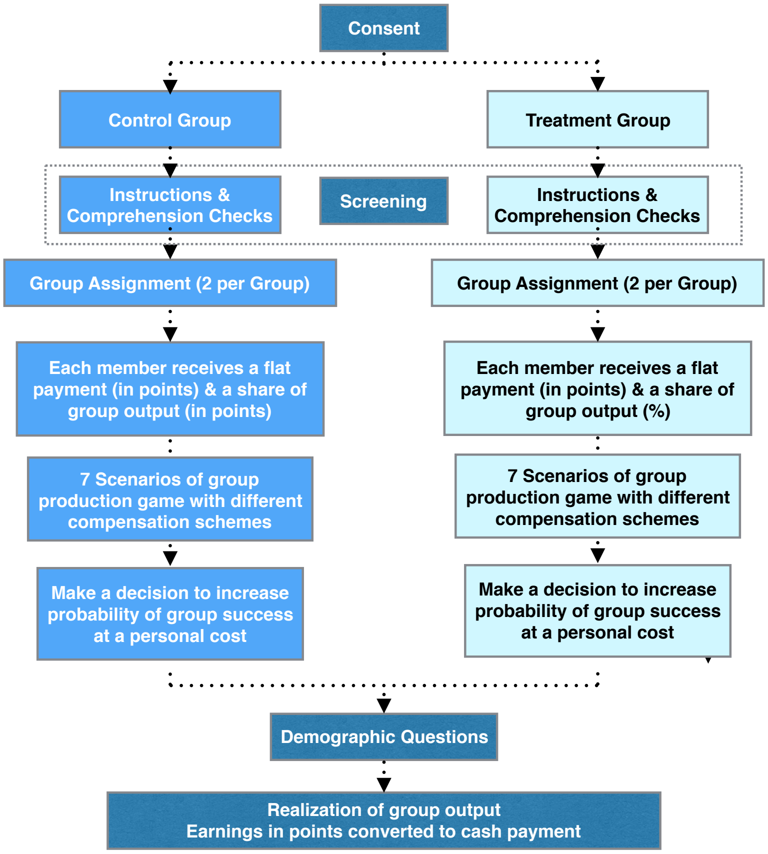

Consent
Control Group
Treatment Group
Instructions & Comprehension Checks
Screening
Instructions & Comprehension Checks
Group Assignment (2 per Group)
Group Assignment (2 per Group)
Each member receives a flat payment (in points) & a share of group output (in points)
Each member receives a flat payment (in points) & a share of group output (%)
7 Scenarios of group production game with different compensation schemes
7 Scenarios of group production game with different compensation schemes
Make a decision to increase probability of group success at a personal cost
Make a decision to increase probability of group success at a personal cost
Demographic Questions
Realization of group output
Earnings in points converted to cash payment

Figure A.12: **Experimental Procedures.**

A.5. Chapter 3 Appendix: Theoretical Model Proofs

A.5.1. Some General Results

The optimization problem faced by worker 1 is

$$\begin{aligned}\max_{e_1} U_1 = \quad & x_1 - C(e_1) + p(e_1+e_2)y_1V \\ & - [\alpha_x \max\{x_2 - C(e_2) - (x_1 - C(e_1)), 0\} + \beta_x \max\{x_1 - C(e_1) - (x_2 - C(e_2)), 0\}] \\ & - p(e_1+e_2)[\alpha_y \max\{(y_2 - y_1)V, 0\} + \beta_y \max\{(y_1 - y_2)V, 0\}] \qquad \text{(A.1)}\end{aligned}$$

and the optimization problem faced by worker 2 is

$$\begin{aligned}\max_{e_2} U_2 = \quad & x_2 - C(e_2) + p(e_1+e_2)y_2V \\ & - [\alpha_x \max\{x_1 - C(e_1) - (x_2 - C(e_2)), 0\} + \beta_x \max\{x_2 - C(e_2) - (x_1 - C(e_1)), 0\}] \\ & - p(e_1+e_2)[\alpha_y \max\{(y_1 - y_2)V, 0\} + \beta_y \max\{(y_2 - y_1)V, 0\}]. \qquad \text{(A.2)}\end{aligned}$$

Since the expected utility functions are not differentiable everywhere, we discuss 6 conditions separately. Since y_1, y_2, x_1, x_2 are exogenously given, equilibrium effort choices e_1^* and e_2^* must satisfy one of the following conditions:

1. $y_2 \geq y_1, x_2 - x_1 > C(e_2^*) - C(e_1^*)$
2. $y_2 \geq y_1, x_2 - x_1 < C(e_2^*) - C(e_1^*)$
3. $y_2 < y_1, x_2 - x_1 > C(e_2^*) - C(e_1^*)$
4. $y_2 < y_1, x_2 - x_1 < C(e_2^*) - C(e_1^*)$
5. $y_2 \geq y_1, x_2 - x_1 = C(e_2^*) - C(e_1^*)$
6. $y_2 < y_1, x_2 - x_1 = C(e_2^*) - C(e_1^*)$

Under each condition, the expected utility functions faced by the two workers are differentiable. Given Condition l, where $l = 1, 2, ..., 6$, we denote the equilibrium effort choices under this condition e_1^l and e_2^l. Given the specifications that $C(e_i) = e_i^2$ and $p = k(e_1 + e_2)$, we derive the equilibrium effort choices under each condition. Under Condition 1, the first order conditions yield

$$e_1^1 = \frac{kV}{2(1+\alpha_x)}[y_1 - \alpha_y(y_2 - y_1)], \quad e_2^1 = \frac{kV}{2(1-\beta_x)}[y_2 - \beta_y(y_2 - y_1)]. \tag{A.3}$$

Similarly, under Condition 2, we have

$$e_1^2 = \frac{kV}{2(1-\beta_x)}[y_1 - \alpha_y(y_2 - y_1)], \quad e_2^2 = \frac{kV}{2(1+\alpha_x)}[y_2 - \beta_y(y_2 - y_1)]. \tag{A.4}$$

Under Condition 3, we have

$$e_1^3 = \frac{kV}{2(1+\alpha_x)}[y_1 - \beta_y(y_1 - y_2)], \quad e_2^3 = \frac{kV}{2(1-\beta_x)}[y_2 - \alpha_y(y_1 - y_2)]. \tag{A.5}$$

Under Condition 4, we have

$$e_1^4 = \frac{kV}{2(1-\beta_x)}[y_1 - \beta_y(y_1 - y_2)], \quad e_2^4 = \frac{kV}{2(1+\alpha_x)}[y_2 - \alpha_y(y_1 - y_2)]. \tag{A.6}$$

Under Condition 5, we have

$$e_1^5 = \frac{kV}{2}[y_1 - \alpha_y(y_2 - y_1)], \quad e_2^5 = \frac{kV}{2}[y_2 - \beta_y(y_2 - y_1)]. \tag{A.7}$$

And finally, under Condition 6, we have

$$e_1^6 = \frac{kV}{2}[y_1 - \beta_y(y_1 - y_2)], \quad e_2^6 = \frac{kV}{2}[y_2 - \alpha_y(y_1 - y_2)]. \tag{A.8}$$

Under Condition 1, $y_2 \geq y_1$. Since $\alpha_y > \beta_y > 0$, $y_2 - \beta_y(y_2 - y_1) \geq y_1 - \alpha_y(y_2 - y_1)$. Since $\alpha_x > \beta_x > 0$, we have $e_2^1 > e_1^1$. Therefore, we have the following result:

Result 1. $x_2 - x_1 > C(e_2^1) - C(e_1^1) > 0$.

Similarly, we have

Result 2. $x_2 - x_1 < C(e_2^4) - C(e_1^4) < 0$.

Result 3. $x_2 - x_1 = C(e_2^5) - C(e_1^5) \geq 0$ *with the equality holds at* $y_1 = y_2$.

Result 4. $x_2 - x_1 = C(e_2^6) - C(e_1^6) < 0$.

We will use these results in proving the propositions. At equilibrium, we must have $e_1^* \in \{e_1^1, e_1^2, e_1^3, e_1^4, e_1^5, e_1^6\}$ and $e_2^* \in \{e_2^1, e_2^2, e_2^3, e_2^4, e_2^5, e_2^6\}$.

A.5.2. Proof of Proposition A.1

Proposition A.1. e_1^* *is nondecreasing in* x_1 *and is nonincreasing in* x_2.

Proof. Given x_1, x_2, y_1, y_2, suppose the equilibrium effort choices e_1^* and e_2^* satisfy Condition l. Consider an increase of x_1 to x_1' or an increase of x_2 to x_2'. Let $e_1^{*\prime}$ be the new equilibrium effort choice for worker 1 after the change. If the equilibrium effort choices still satisfy Condition l, then e_1^* is unchanged since

$$\frac{\partial e_1^l}{\partial x_1} = 0, \quad \frac{\partial e_1^l}{\partial x_2} = 0, \quad \forall l.$$

If the equilibrium effort choices now satisfy Condition m instead of Condition l, $m \neq l$, we need to discuss how the shift affects equilibrium effort choices. First, suppose $y_2 \geq y_1$, then

$$e_1^* = \begin{cases} e_1^1, & \text{if } x_1 < x_2 - (C(e_2^1) - C(e_1^1)) \\ e_1^5, & \text{if } x_1 = x_2 - (C(e_2^5) - C(e_1^5)) \\ e_1^2, & \text{if } x_1 > x_2 - (C(e_2^2) - C(e_1^2)) \end{cases}$$

Given y_1, y_2, and since $1 > \alpha_x, \beta_x > 0$, we have

$$e_1^2 > e_1^5 > e_1^1, \quad e_2^1 > e_2^5 > e_2^2. \tag{A.9}$$

Thus,

$$x_2 - (C(e_2^1) - C(e_1^1)) < x_2 - (C(e_2^5) - C(e_1^5)) < x_2 - (C(e_2^2) - C(e_1^2)).$$

When there is a shift in condition as x_1 increases, it has to be from Condition 1 to Condition 5, or from Condition 5 to Condition 2, or from Condition 1 to Condition 2. As a result, either one of the followings must be true:

1. $e_1^* = e_1^1, \quad e_1^{*\prime} = e_1^5$
2. $e_1^* = e_1^5, \quad e_1^{*\prime} = e_1^2$
3. $e_1^* = e_1^1, \quad e_1^{*\prime} = e_1^2$

By the inequalities in A.9, we have $e_1^{*\prime} > e_1^*$ when there is a shift in condition as x_1 increases. Second, suppose $y_2 < y_1$, then

$$e_1^* = \begin{cases} e_1^3, & \text{if } x_1 < x_2 - (C(e_2^3) - C(e_1^3)) \\ e_1^4, & \text{if } x_1 = x_2 - (C(e_2^6) - C(e_1^6)) \\ e_1^6, & \text{if } x_1 > x_2 - (C(e_2^4) - C(e_1^4)) \end{cases}$$

Given y_1, y_2, we have

$$e_1^4 > e_1^6 > e_1^3, \quad e_2^3 > e_2^6 > e_2^4. \tag{A.10}$$

Thus,

$$x_2 - (C(e_2^3) - C(e_1^3)) < x_2 - (C(e_2^6) - C(e_1^6)) < x_2 - (C(e_2^4) - C(e_1^4)).$$

When there is a shift in condition as x_1 increases, it has to be from Condition 3 to Condition 6, or from Condition 6 to Condition 4, or from Condition 3 to Condition 4. As a result, either one of the followings must be true:

1. $e_1^* = e_1^3, \quad e_1^{*\prime} = e_1^6$
2. $e_1^* = e_1^6, \quad e_1^{*\prime} = e_1^4$

3. $e_1^* = e_1^3, \quad e_1^{*\prime} = e_1^4$

By the inequalities in A.10, we have $e_1^{*\prime} > e_1^*$ when there is a shift in condition as x_1 increases. Hence, e_1^* is nondecreasing in x_1.[1] The proof for the effect of an increase in x_2 on e_1^* is symmetric. □

A.5.3. Proof of Proposition A.2

Proposition A.2. *Let $\Delta y_1 > 0$ be the change in y_1, e_1^* is increasing in y_1 if $\frac{\Delta y_1}{y_1} > \frac{\alpha_x + \beta_x}{(1-\beta_x)(1-\beta_y)}$.*

Proof. Given x_1, x_2, y_1, y_2, suppose the equilibrium effort choices e_1^* and e_2^* satisfy Condition l. Consider an increase of y_1 to y_1'. Let $e_1^{*\prime}$ be the new equilibrium effort choice for worker 1 after the change.

1. If the equilibrium effort choices still satisfy Condition l, then $e_1^{*\prime} > e_1^*$ since the Implicit Function Theorem yields

$$\frac{\partial e_1^*}{\partial y_1} = \begin{cases} \frac{kV(1+\alpha_y)}{2(1+\alpha_x)}, & \text{if } y_2 > y_1, x_2 - x_1 > C(e_2^1) - C(e_1^1) \\ \frac{kV}{2(1+\alpha_x)}, & \text{if } y_2 = y_1, x_2 - x_1 > C(e_2^1) - C(e_1^1) \\ \frac{kV(1-\beta_y)}{2(1+\alpha_x)}, & \text{if } y_2 < y_1, x_2 - x_1 > C(e_2^3) - C(e_1^3) \\ \frac{kV(1+\alpha_y)}{2(1-\beta_x)}, & \text{if } y_2 > y_1, x_2 - x_1 < C(e_2^2) - C(e_1^2) \\ \frac{kV}{2(1-\beta_x)}, & \text{if } y_2 = y_1, x_2 - x_1 < C(e_2^2) - C(e_1^2) \\ \frac{kV(1-\beta_y)}{2(1-\beta_x)}, & \text{if } y_2 < y_1, x_2 - x_1 < C(e_2^4) - C(e_1^4) \\ \frac{kV(1+\alpha_y)}{2}, & \text{if } y_2 > y_1, x_2 - x_1 = C(e_2^5) - C(e_1^5) \\ \frac{kV}{2}, & \text{if } y_2 = y_1, x_2 - x_1 = C(e_2^5) - C(e_1^5) \\ \frac{kV(1-\beta_y)}{2}, & \text{if } y_2 < y_1, x_2 - x_1 = C(e_2^6) - C(e_1^6) \end{cases} \tag{A.11}$$

---

[1] This proposition may not hold in the case of status seeking, i.e., $\beta_x < 0$. When $\beta_x < 0$ and $|\beta_x| < \alpha_x$, we have $e_1^5 > e_1^2 > e_1^1$ and $e_2^5 > e_2^1 > e_2^2$ when $y_2 \geq y_1$. We can show that $x_2 - (C(e_2^5) - C(e_1^5)) < x_2 - (C(e_2^2) - C(e_1^2))$, so increasing x_1 may result in a shift from Condition 5 to Condition 2. Therefore, it is possible that $e_1^* = e_1^5 > e_1^2 = e_1^{*\prime}$.

Since $\beta_x, \beta_y < 1$ and $\alpha_x, \alpha_y > 0$, we have

$$\frac{\partial e_1^*}{\partial y_1} > 0.$$

2. If the equilibrium effort choices now satisfy Condition m instead of Condition l, $m \neq l$, we need to discuss how the shift affects equilibrium effort choices. First, suppose $x_2 > x_1$. Then by Results 1 to 4, we have $l \neq 4, 6$. When y_1 is increased to y_1' while y_2 is fixed, let $\Delta y_1 = y_1' - y_1 > 0$, there are two cases:

   (a) $y_1 \leq y_2, y_1' \leq y_2$: In this case, we must have $e_1^* \in \{e_1^1, e_1^2, e_1^5\}$ and $e_1^{*\prime} \in \{e_1^1, e_1^2, e_1^5\}$. If $e_1^* = e_1^1 = \frac{kV[y_1 - \alpha_y(y_2 - y_1)]}{2(1+\alpha_x)}$ and $e_1^{*\prime} = e_1^2 = \frac{kV[y_1' - \alpha_y(y_2 - y_1')]}{2(1-\beta_x)}$ or $e_1^{*\prime} = e_1^5 = \frac{kV[y_1' - \alpha_y(y_2 - y_1')]}{2}$, then we have $e_1^{*\prime} > e_1^*$ as $\beta_x, \alpha_x > 0$. If $e_1^* = e_1^2 = \frac{kV[y_1 - \alpha_y(y_2 - y_1)]}{2(1-\beta_x)}$ and $e_1^{*\prime} = e_1^1 = \frac{kV[y_1' - \alpha_y(y_2 - y_1')]}{2(1+\alpha_x)}$ or $e_1^{*\prime} = e_1^5 = \frac{kV[y_1' - \alpha_y(y_2 - y_1')]}{2}$, we know that $e_1^1 < e_1^5$, so we have $e_1^{*\prime} > e_1^*$ as long as $e_1^1 > e_1^2$, i.e.,

   $$\frac{y_1' - \alpha_y(y_2 - y_1')}{1 + \alpha_x} > \frac{y_1 - \alpha_y(y_2 - y_1)}{1 - \beta_x}. \tag{A.12}$$

   If $e_1^* = e_1^5 = \frac{kV[y_1 - \alpha_y(y_2 - y_1)]}{2}$, and we have $e_1^{*\prime} = e_1^1 = \frac{kV[y_1' - \alpha_y(y_2 - y_1')]}{2(1+\alpha_x)}$ or $e_1^{*\prime} = e_1^2 = \frac{kV[y_1' - \alpha_y(y_2 - y_1')]}{2(1-\beta_x)}$, we know that $e_1^1 < e_1^2$, so we have $e_1^{*\prime} > e_1^*$ as long as $e_1^1 > e_1^5$, i.e.,

   $$\frac{y_1' - \alpha_y(y_2 - y_1')}{1 + \alpha_x} > y_1 - \alpha_y(y_2 - y_1). \tag{A.13}$$

   Since $1 > \beta_x > 0$, inequality A.12 is a sufficient condition for $e_1^{*\prime} > e_1^*$, which is equivalent to

   $$\begin{aligned} &(1 - \beta_x)[(1 + \alpha_y)(y_1 + \Delta y_1) - \alpha_y y_2)] > (1 + \alpha_x)[(1 + \alpha_y)y_1 - \alpha_y y_2] \\ \Leftrightarrow &(1 - \beta_x)(1 + \alpha_y)\Delta y_1 > (\alpha_x + \beta_x)[(1 + \alpha_y)y_1 - \alpha_y y_2]. \end{aligned} \tag{A.14}$$

   Since $y_2 \geq y_1'$, we have $(1 + \alpha_y)y_1 - \alpha_y y_2 \leq (1 + \alpha_y)y_1 - \alpha_y y_1'$, so a sufficient condition for inequality A.14 is

$$\begin{aligned}&(1-\beta_x)(1+\alpha_y)\Delta y_1 > (\alpha_x+\beta_x)[(1+\alpha_y)y_1 - \alpha_y y_1'] \\ \Leftrightarrow &\frac{\Delta y_1}{y_1} > \frac{\alpha_x+\beta_x}{1-\beta_x+\alpha_y+\alpha_x\alpha_y}.\end{aligned} \tag{A.15}$$

Therefore, under the case $y_1 \leq y_2, y_1' \leq y_2$, $e_1^{*\prime} > e_1^*$ as long as inequality A.15 holds.

(b) $y_1 \leq y_2, y_1' > y_2$: Here we must have $e_1^* \in \{e_1^1, e_1^2, e_1^5\}$ and $e_1^{*\prime} = e_1^3 = \frac{kV[y_1' - \beta_y(y_1'-y_2)]}{2(1+\alpha_x)}$. Since $e_1^1 < e_1^5 < e_1^2$, $e_1^{*\prime} > e_1^*$ as long as $e_1^3 > e_1^2 = \frac{kV[y_1 - \alpha_y(y_2-y_1)]}{2(1-\beta_x)}$, i.e.,

$$\begin{aligned}&(1-\beta_x)[y_1' - \beta_y(y_1'-y_2)] > (1+\alpha_x)[y_1 - \alpha_y(y_2-y_1)] \\ \Leftrightarrow &(1-\beta_y)(1-\beta_x)\Delta y_1 + (1-\beta_x)[(1-\beta_y)y_1 + \beta_y y_2] > (1+\alpha_x)[(1+\alpha_y)y_1 - \alpha_y y_2].\end{aligned} \tag{A.16}$$

Since $y_1 \leq y_2$, the lefthandside of inequality A.16 is larger than or equal to $(1-\beta_y)(1-\beta_x)\Delta y_1 + (1-\beta_x)y_1$ and the righthandside is smaller than or equal to $(1+\alpha_x)y_1$. Therefore, a sufficient condition for inequality A.16 is

$$\begin{aligned}&(1-\beta_y)(1-\beta_x)\Delta y_1 + (1-\beta_x)y_1 > (1+\alpha_x)y_1 \\ \Leftrightarrow &\frac{\Delta y_1}{y_1} > \frac{\alpha_x+\beta_x}{(1-\beta_y)(1-\beta_x)}.\end{aligned} \tag{A.17}$$

Therefore, under the case $y_1 \leq y_2, y_1' > y_2$, $e_1^{*\prime} > e_1^*$ as long as inequality A.17 holds.

Combining the two cases, when $x_2 > x_1$, we have $e_1^{*\prime} > e_1^*$ as long as

$$\frac{\Delta y_1}{y_1} > \frac{\alpha_x+\beta_x}{(1-\beta_y)(1-\beta_x)}. \tag{A.18}$$

Second, suppose $x_2 = x_1$. Then by Results 1 to 4, we have $l \neq 1, 4, 6$. Note that $l \neq 5$

when $y_1 \neq y_2$. There are three cases as y_1 increases:

(a) $y_1 < y_2, y_1' = y_2$: In this case, $e_1^* = e_1^2 = \frac{kV[y_1 - \alpha_y(y_2 - y_1)]}{2(1-\beta_x)}$ and $e_1^{*\prime} = e_1^5 = \frac{kVy_1'}{2}$. For $e_1^{*\prime} > e_1^*$, we must have

$$\begin{aligned} y_1' &> \frac{y_1 - \alpha_y(y_2 - y_1)}{1 - \beta_x} \\ \Leftrightarrow \frac{\Delta y_1}{y_1} &> \frac{\beta_x}{1 - \beta_x + \alpha_y}. \end{aligned} \tag{A.19}$$

(b) $y_1 = y_2, y_1' > y_2$: In this case, $e_1^* = e_1^5 = \frac{kVy_1}{2}$ and $e_1^{*\prime} = e_1^3 = \frac{kV[y_1' - \beta_y(y_1' - y_2)]}{2(1+\alpha_x)}$. For $e_1^{*\prime} > e_1^*$, we must have

$$\begin{aligned} \frac{y_1' - \beta_y(y_1' - y_2)}{1 + \alpha_x} &> y_1 \\ \Leftrightarrow \frac{\Delta y_1}{y_1} &> \frac{\alpha_x}{1 - \beta_y}. \end{aligned} \tag{A.20}$$

(c) $y_1 < y_2, y_1' > y_2$: In this case, $e_1^* = e_1^2$ and $e_1^{*\prime} = e_1^3$. For $e_1^{*\prime} > e_1^*$, we must have

$$\begin{aligned} &\frac{y_1' - \beta_y(y_1' - y_2)}{1 + \alpha_x} > \frac{y_1 - \alpha_y(y_2 - y_1)}{1 - \beta_x} \\ \Leftrightarrow &(1 - \beta_x)(1 - \beta_y)\Delta y_1 + (1 - \beta_x)[(1 - \beta_y)y_1 + \beta_y y_2] > (1 + \alpha_x)[(1 + \alpha_y)y_1 - \alpha_y y_2]. \end{aligned} \tag{A.21}$$

A sufficent condition for the above is

$$\frac{\Delta y_1}{y_1} > \frac{\alpha_x + \beta_x}{(1 - \beta_y)(1 - \beta_x)}. \tag{A.22}$$

Since $0 < \beta_x < \alpha_x < 1$ and $\beta_x < \beta_y$, we have $\frac{\beta_x}{1-\beta_x+\alpha_y} < \frac{\alpha_x}{1-\beta_y} < \frac{\alpha_x+\beta_x}{(1-\beta_y)(1-\beta_x)}$. Combining the three cases, when $x_2 = x_1$, we have $e_1^{*\prime} > e_1^*$ as long as

$$\frac{\Delta y_1}{y_1} > \frac{\alpha_x + \beta_x}{(1 - \beta_y)(1 - \beta_x)}. \tag{A.23}$$

Third, suppose $x_2 < x_1$. Then by Results 1 to 4, we have $l \neq 1, 5$. There are two cases as y_1 increases:

(a) $y_1 \leq y_2, y_1' > y_2$: In this case, $e_1^* = e_1^2 = \frac{kV[y_1 - \alpha_y(y_2 - y_1)]}{2(1-\beta_x)}$ and $e_1^{*\prime} = \{e_1^3, e_1^4, e_1^6\}$. Since $\frac{kV[y_1' - \beta_y(y_1' - y_2)]}{2(1+\alpha_x)} = e_1^3 < e_1^6 < e_1^4$, we have $e_1^{*\prime} > e_1^*$ as long as

$$\frac{kV[y_1' - \beta_y(y_1' - y_2)]}{2(1+\alpha_x)} > \frac{kV[y_1 - \alpha_y(y_2 - y_1)]}{2(1-\beta_x)}. \tag{A.24}$$

A sufficient condition for the above is

$$\frac{\Delta y_1}{y_1} > \frac{\alpha_x + \beta_x}{(1-\beta_y)(1-\beta_x)}. \tag{A.25}$$

(b) $y_1 > y_2, y_1' > y_2$: In this case we have $e_1^* = \{e_1^3, e_1^4, e_1^6\}$ and $e_1^{*\prime} = \{e_1^3, e_1^4, e_1^6\}$. If $e_1^* = e_1^3 = \frac{kV[y_1 - \beta_y(y_1 - y_2)]}{2(1+\alpha_x)}$, and $e_1^{*\prime} = e_1^4 = \frac{kV[y_1' - \beta_y(y_1' - y_2)]}{2(1-\beta_x)}$ or $e_1^{*\prime} = e_1^6 = \frac{kV[y_1' - \beta_y(y_1' - y_2)]}{2}$, then we have $e_1^{*\prime} > e_1^*$ as $y_1' > y_1$. If $e_1^* = e_1^4$, and $e_1^{*\prime} = e_1^3$ or $e_1^{*\prime} = e_1^6$, then $e_1^{*\prime} > e_1^*$ as long as $e_1^3 > e_1^4$, i.e.,

$$\frac{kV[y_1' - \beta_y(y_1' - y_2)]}{2(1+\alpha_x)} > \frac{kV[y_1 - \beta_y(y_1 - y_2)]}{2(1-\beta_x)}. \tag{A.26}$$

If $e_1^* = e_1^6$, and $e_1^{*\prime} = e_1^3$ or $e_1^{*\prime} = e_1^4$, then $e_1^{*\prime} > e_1^*$ as long as $e_1^3 > e_1^6$, i.e.,

$$\frac{kV[y_1' - \beta_y(y_1' - y_2)]}{2(1+\alpha_x)} > \frac{kV[y_1 - \beta_y(y_1 - y_2)]}{2} \tag{A.27}$$

When $y_1 > y_2, y_1' > y_2$, since $1 > \beta_x > 0$, inequality A.26 is a sufficient condition for $e_1^{*\prime} > e_1^*$, which is equivalent to

$$(1-\beta_y)(1-\beta_x)\Delta y_1 > (\alpha_x + \beta_x)[(1-\beta_y)y_1 + \beta_y y_2]. \tag{A.28}$$

A sufficient condition for the above is

$$\frac{\Delta y_1}{y_1} > \frac{\alpha_x + \beta_x}{(1-\beta_y)(1-\beta_x)}. \tag{A.29}$$

Combining the two cases, when $x_2 < x_1$, we have $e_1^{*\prime} > e_1^*$ as long as

$$\frac{\Delta y_1}{y_1} > \frac{\alpha_x + \beta_x}{(1-\beta_y)(1-\beta_x)}. \tag{A.30}$$

Hence, for any given x_1, x_2, y_2, e_1^* is increasing in y_1 if

$$\frac{\Delta y_1}{y_1} > \frac{\alpha_x + \beta_x}{(1-\beta_y)(1-\beta_x)}. \tag{A.31}$$

This is still true when taking into consideration the case when the change in y_1 does not cause a shift from Condition l to Condition m.

$\square$

A.5.4. Proof of Proposition A.3

Proposition A.3. *Let $\Delta y_2 > 0$ be the change in y_2, then*

(a) $\exists \delta > 0$ such that e_1^* is decreasing in y_2 if $\Delta y_2 \in (\delta, +\infty)$;

(b) $\exists \delta' > 0$ and $\delta'' > 0$ such that e_1^* is increasing in y_2 if $y_2 < y_1$ and $\Delta y_2 \in (\delta', \delta'')$.

Proof. Given x_1, x_2, y_1, y_2, suppose the equilibrium effort choices e_1^* and e_2^* satisfy Condition l. Consider an increase of y_2 to y_2'. Let $e_1^{*\prime}$ be the new equilibrium effort choice for worker 1 after the change.

1. If the equilibrium effort choices still satisfy Condition l, then we have $e_1^{*\prime} < e_1^*$ if

$y_1 < y_2$, and $e_1^{*\prime} > e_1^*$ if $y_1 > y_2$, as suggested by the Implicit Function Theorem:

$$\frac{\partial e_1^*}{\partial y_2} = \begin{cases} \frac{kV(-\alpha_y)}{2(1+\alpha_x)}, & \text{if } y_2 > y_1, x_2 - x_1 > C(e_2^1) - C(e_1^1) \\ 0, & \text{if } y_2 = y_1, x_2 - x_1 > C(e_2^1) - C(e_1^1) \\ \frac{kV\beta_y}{2(1+\alpha_x)}, & \text{if } y_2 < y_1, x_2 - x_1 > C(e_2^3) - C(e_1^3) \\ \frac{kV(-\alpha_y)}{2(1-\beta_x)}, & \text{if } y_2 > y_1, x_2 - x_1 < C(e_2^2) - C(e_1^2) \\ 0, & \text{if } y_2 = y_1, x_2 - x_1 < C(e_2^2) - C(e_1^2) \\ \frac{kV\beta_y}{2(1-\beta_x)}, & \text{if } y_2 < y_1, x_2 - x_1 < C(e_2^4) - C(e_1^4) \\ \frac{kV(-\alpha_y)}{2}, & \text{if } y_2 > y_1, x_2 - x_1 = C(e_2^5) - C(e_1^5) \\ 0, & \text{if } y_2 = y_1, x_2 - x_1 = C(e_2^5) - C(e_1^5) \\ \frac{kV\beta_y}{2}, & \text{if } y_2 < y_1, x_2 - x_1 = C(e_2^6) - C(e_1^6) \end{cases} \tag{A.32}$$

Since $\alpha_x, \alpha_y > 0$, $0 < \beta_y, \beta_x < 1$, we have

$$\frac{\partial e_1^*}{\partial y_2} \begin{cases} > 0, & \text{if } y_2 < y_1 \\ = 0, & \text{if } y_2 = y_1 \\ < 0, & \text{if } y_2 > y_1. \end{cases} \tag{A.33}$$

2. If the equilibrium effort choices now satisfy Condition m instead of Condition l, $m \neq l$, we need to discuss how the shift affects equilibrium effort choices. First, suppose $x_2 \geq x_1$. Then by Results 1 to 4, we have $l \neq 4, 6$. When y_2 is increased to y_2' while y_1 is fixed, let $\Delta y_2 = y_2' - y_2 > 0$. There are two cases:

   (a) $y_2 < y_1, y_2' \geq y_1$: In this case, $e_1^* = e_1^3 = \frac{kV[y_1 - \beta_y(y_1 - y_2)]}{2(1+\alpha_x)}$ and $e_1^{*\prime} \in \{e_1^1, e_1^2, e_1^5\}$. Since $\frac{kV[y_1 - \alpha_y(y_2' - y_1)]}{2(1+\alpha_x)} = e_1^1 < e_1^5 < e_1^2 = \frac{kV[y_1 - \alpha_y(y_2' - y_1)]}{2(1-\beta_x)}$, then we have $e_1^{*\prime} > e_1^*$ as long as

$$\begin{aligned} &\frac{kV[y_1 - \alpha_y(y_2' - y_1)]}{2(1+\alpha_x)} > \frac{kV[y_1 - \beta_y(y_1 - y_2)]}{2(1+\alpha_x)} \\ &\Rightarrow \Delta y_2 < \frac{\alpha_y + \beta_y}{\alpha_y}(y_1 - y_2) \equiv \delta_1 \end{aligned} \tag{A.34}$$

and $e_1^{*\prime} < e_1^*$ as long as

$$\begin{aligned} &\frac{kV[y_1 - \alpha_y(y_2' - y_1)]}{2(1-\beta_x)} < \frac{kV[y_1 - \beta_y(y_1 - y_2)]}{2(1+\alpha_x)} \\ &\Rightarrow \Delta y_2 > \frac{(\alpha_x + \beta_y)y_1 + (\alpha_y + \beta_y + \alpha_x\alpha_y - \beta_x\beta_y)(y_1 - y_2)}{(1+\alpha_x)\alpha_y} \equiv \delta_2. \end{aligned} \tag{A.35}$$

$\delta_2 = \frac{\alpha_x+\beta_y}{(1+\alpha_x)\alpha_y}y_1 + \left(1+\frac{\beta_y(1-\beta_x)}{\alpha_y(1+\alpha_x)}\right)(y_1-y_2) > \left(\frac{\alpha_x+\beta_y}{(1+\alpha_x)\alpha_y}+1+\frac{\beta_y(1-\beta_x)}{\alpha_y(1+\alpha_x)}\right)(y_1-y_2) > \left(\frac{\alpha_x\beta_y}{(1+\alpha_x)\alpha_y}+\frac{\beta_y\beta_x}{(1+\alpha_x)\alpha_y}+1+\frac{\beta_y(1-\beta_x)}{\alpha_y(1+\alpha_x)}\right)(y_1-y_2) = \left(\frac{\beta_y}{\alpha_y}\cdot\frac{\alpha_x+\beta_x}{1+\alpha_x}+1+\frac{\beta_y}{\alpha_y}\cdot\frac{1-\beta_x}{1+\alpha_x}\right)(y_1-y_2) = \left(\frac{\beta_y}{\alpha_y}+1\right)(y_1-y_2) = \delta_1 > y_1-y_2$. Since $y_2' \geq y_1$ implies that $\Delta y_2 \geq y_1 - y_2$, we have e_1^* is increasing in y_2 if $\Delta y_2 \in [y_1 - y_2, \delta_1)$ and is decreasing in y_2 if $\Delta y_2 \in (\delta_2, +\infty)$.

(b) $y_2 \geq y_1, y_2' \geq y_1$: When there is no shift in condition, we have e_1^* is decreasing in y_2 by the relationship in A.33, so we derive the sufficient condition on Δy_2 for e_1^* to be decreasing in y_2. We have $e_1^{*\prime} < e_1^*$ as long as

$$\begin{aligned} &\frac{kV[y_1 - \alpha_y(y_2 - y_1)]}{2(1+\alpha_x)} > \frac{kV[y_1 - \alpha_y(y_2' - y_1)]}{2(1-\beta_x)} \\ &\Delta y_2 > \frac{\alpha_x + \beta_x}{(1+\alpha_x)\alpha_y}y_1 + \frac{\alpha_x + \beta_x}{1+\alpha_x}(y_1 - y_2) \equiv \delta_3. \end{aligned} \tag{A.36}$$

Note that when $y_2 < y_1$ and $y_2' < y_1$, i.e., $\Delta y_2 < y_1 - y_2$, there is no shift in condition, so by the relationship in A.33, we have e_1^* is increasing in y_2. Hence, when $x_2 \geq x_1$ and $y_2 < y_1$, e_1^* is increasing in y_2 if $\Delta y_2 \in (0, \delta_1)$ and is decreasing in y_2 if $\Delta y_2 \in (\delta_2, +\infty)$. When $x_2 \geq x_1$ and $y_2 \geq y_1$, e_1^* is decreasing in y_2 if $\Delta y_2 \in (\delta_3, +\infty)$.

Second, suppose $x_2 < x_1$. There are two cases:

(a) $y_2 < y_1, y_2' < y_1$: In this case, $e_1^*, e_1^{*\prime} \in \{e_1^3, e_1^4, e_1^6\}$. When there is no shift in condition, we have e_1^* is increasing in y_2, so we derive the sufficient condition on

Δy_2 for e_1^* is increasing in y_2. Since $e_1^4 > e_1^6 > e_1^3$, we have $e_1^{*\prime} > e_1^*$ as long as

$$\frac{kV[y_1 - \beta_y(y_1 - y_2)]}{2(1-\beta_x)} < \frac{kV[y_1 - \beta_y(y_1 - y_2')]}{2(1+\alpha_x)}$$
$$\Rightarrow \Delta y_2 > \frac{\alpha_x + \beta_x}{(1-\beta_x)\beta_y} y_1 + \frac{\alpha_x + \beta_x}{1-\beta_x}(y_2 - y_1) \equiv \delta_4. \tag{A.37}$$

Since $y_2' < y_1$ implies that $\Delta y_2 < y_1 - y_2$, we have e_1^* is increasing in y_2 when $\Delta y_2 \in (\delta_4, y_1 - y_2)$ if $\delta_4 < y_1 - y_2$.

(b) $y_2 < y_1, y_2' \geq y_1$: In this case, $e_1^* \in \{e_1^3, e_1^4, e_1^6\}$ and $e_1^{*\prime} = e_1^2$. We have $e_1^{*\prime} > e_1^*$ as long as $e_1^2 > e_1^4$, i.e.,

$$\frac{kV[y_1 - \alpha_y(y_2 - y_1)]}{2(1-\beta_x)} > \frac{kV[y_1 - \beta_y(y_1 - y_2')]}{2(1-\beta_x)}$$
$$\Rightarrow \Delta y_2 < \frac{\alpha_y + \beta_y}{\beta_y}(y_1 - y_2) \equiv \delta_5. \tag{A.38}$$

We have $e_1^{*\prime} < e_1^*$ as long as $e_1^2 < e_1^3$, i.e.,

$$\frac{kV[y_1 - \alpha_y(y_2' - y_1)]}{2(1-\beta_x)} < \frac{kV[y_1 - \beta_y(y_1 - y_2)]}{2(1+\alpha_x)}$$
$$\Rightarrow \Delta y_2 > \frac{(\alpha_x + \beta_y)y_1 + (\alpha_y + \beta_y + \alpha_x\alpha_y - \beta_x\beta_y)(y_1 - y_2)}{(1+\alpha_x)\alpha_y} \equiv \delta_2. \tag{A.39}$$

$\delta_5 > y_1 - y_2$. Since $y_2' \geq y_1$ implies that $\Delta y_2 \geq y_1 - y_2$, we have e_1^* is increasing in y_2 if $\Delta y_2 \in [y_1 - y_2, \delta_5)$ and is decreasing in y_2 if $\Delta y_2 \in (\delta_2, +\infty)$.

Note that when $y_2 \geq y_1$ and $y_2' \geq y_1$, there is no shift in condition, so by the relationship in A.33, we have e_1^* is decreasing in y_2. Hence, when $x_2 < x_1$ and $y_2 \geq y_1$, e_1^* is decreasing in y_2. When $x_2 < x_1$ and $y_2 < y_1$, e_1^* is increasing in y_2 if $\Delta y_2 \in (\min\{\delta_4, y_1 - y_2\}, \delta_5)$ and is decreasing in y_2 if $\Delta y_2 \in (\delta_2, +\infty)$. In summary,

(a) when $x_2 \geq x_1$ and $y_2 \geq y_1$, e_1^* is decreasing in y_2 if $\Delta y_2 \in (\delta_3, +\infty)$;

(b) when $x_2 \geq x_1$ and $y_2 < y_1$, e_1^* is decreasing in y_2 if $\Delta y_2 \in (\delta_2, +\infty)$ but is increasing in y_2 if $\Delta y_2 \in (0, \delta_1)$;

(c) when $x_2 < x_1$ and $y_2 \geq y_1$, e_1^* is decreasing in y_2;

(d) when $x_2 < x_1$ and $y_2 < y_1$, e_1^* is decreasing in y_2 if $\Delta y_2 \in (\delta_2, +\infty)$ but is increasing in y_2 if $\Delta y_2 \in (\min\{\delta_4, y_1 - y_2\}, \delta_5)$

where $\delta_1 = \frac{\alpha_y+\beta_y}{\alpha_y}(y_1-y_2), \delta_2 = \frac{\alpha_x+\beta_y}{(1+\alpha_x)\alpha_y}y_1 + \left(1+\frac{\beta_y(1-\beta_x)}{\alpha_y(1+\alpha_x)}\right)(y_1-y_2), \delta_3 = \frac{\alpha_x+\beta_x}{(1+\alpha_x)\alpha_y}y_1 + \frac{\alpha_x+\beta_x}{1+\alpha_x}(y_1-y_2), \delta_4 = \frac{\alpha_x+\beta_x}{(1-\beta_x)\beta_y}y_1 + \frac{\alpha_x+\beta_x}{1-\beta_x}(y_2-y_1)$ and $\delta_5 = \frac{\alpha_y+\beta_y}{\beta_y}(y_1-y_2)$. Therefore, e_1^* is decreasing in y_2 if

$$\Delta y_2 \in (\delta, +\infty) \text{ where } \delta = \begin{cases} \delta_3, \text{ if } y_2 \geq y_1 \\ \delta_2, \text{ if } y_2 < y_1 \end{cases} \tag{A.40}$$

and e_1^* is increasing in y_2 if

$$y_2 < y_1, \Delta y_2 \in (\delta', \delta''), \text{ where } \delta' = \begin{cases} 0, \text{ if } x_2 \geq x_1 \\ \min\{\delta_4, y_1 - y_2\}, \text{ if } x_2 < x_1, \end{cases} \quad \delta'' = \begin{cases} \delta_1, \text{ if } x_2 \geq x_1 \\ \delta_5, \text{ if } x_2 < x_1. \end{cases} \tag{A.41}$$

This is still true when taking into consideration the case when the change in y_2 does not cause a shift from Condition l to Condition m.

□

A.5.5. Proof of Proposition A.4

Proposition A.4. *Let $x_2 = x_0$, and let $e_1^* = e_1^0$ when $x_1 = x_2$. Then,*

(a) $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| \geq \lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|$

(i) if $y_2 > y_1$; or

(ii) if $y_2 = y_1$ and $\alpha_x - \beta_x \geq 2\alpha_x\beta_x$.

(b) $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| \leq \lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|$

(i) if $y_2 < y_1$*; or*

(ii) if $y_2 = y_1$ *and* $\alpha_x - \beta_x \leq 2\alpha_x\beta_x$.

The equalities hold when $\lim_{x_1 \uparrow x_0} e_1^* = \lim_{x_1 \downarrow x_0} e_1^* = e_1^0$.

Proof. Let e_1^0 be the equilibrium effort choice of worker 1 under equality in salary, i.e., when $x_1 = x_2 = x_0$. We discuss three cases depending on the relationship between y_1 and y_2 and examine how a change in x_1 affects e_1^* relative to e_1^0.

1. Suppose $y_2 > y_1$. We have $e_1^0 = e_1^2$ when $x_2 - x_1 = 0$. When $x_1 > x_0$, then $x_2 - x_1 < 0$, so $e_1^* = e_1^2$ and $\lim_{x_1 \downarrow x_0} |e_1^* - e_1^0| = |e_1^2 - e_1^2| = 0$. When $x_1 < x_0$, then $x_2 - x_1 > 0$, so $e_1^* \in \{e_1^1, e_1^2, e_1^5\}$ and $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| = |e_1^2 - e_1^2| = 0$ or $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| = |e_1^1 - e_1^2| > 0$ or $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| = |e_1^5 - e_1^2| > 0$. Therefore,

$$\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| \geq \lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|.$$

   The equality holds when $\lim_{x_1 \uparrow x_0} e_1^* = \lim_{x_1 \downarrow x_0} e_1^* = e_1^0$.

2. Suppose $y_2 < y_1$. We have $e_1^0 = e_1^3$ when $x_2 - x_1 = 0$. When $x_1 > x_0$, then $x_2 - x_1 < 0$, so $e_1^* \in \{e_1^3, e_1^4, e_1^6\}$ and $\lim_{x_1 \downarrow x_0} |e_1^* - e_1^0| = |e_1^3 - e_1^3| = 0$ or $\lim_{x_1 \downarrow x_0} |e_1^* - e_1^0| = |e_1^4 - e_1^3| > 0$ or $\lim_{x_1 \downarrow x_0} |e_1^* - e_1^0| = |e_1^6 - e_1^3| > 0$. When $x_1 < x_0$, then $x_2 - x_1 > 0$, so $e_1^* = e_1^3$ and $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| = |e_1^3 - e_1^3| = 0$. Therefore,

$$\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| \leq \lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|.$$

   The equality holds when $\lim_{x_1 \uparrow x_0} e_1^* = \lim_{x_1 \downarrow x_0} e_1^* = e_1^0$.

3. Suppose $y_2 = y_1 = y_0$. In this case, we have $e_1^2 > e_2^2$, so $C(e_2^2) - C(e_1^2) < 0$. We also have $C(e_2^5) - C(e_1^5) = 0$. Thus, we have $e_1^0 = e_1^5$ when $x_2 - x_1 = 0$. When $x_1 > x_0$,

then $x_2 - x_1 < 0$, so $e_1^* = e_1^2$ and $\lim_{x_1 \downarrow x_0} |e_1^* - e_1^0| = |e_1^2 - e_1^5| = |\frac{kV}{2(1-\beta_x)} y_0 - \frac{kV}{2} y_0| = \frac{kV}{2} y_0 \frac{\beta_x}{1-\beta_x} > 0$. When $x_1 < x_0$, then $x_2 - x_1 > 0$, so $e_1^* = e_1^1$ and $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| = |e_1^1 - e_1^5| = |\frac{kV}{2(1+\alpha_x)} y_0 - \frac{kV}{2} y_0| = \frac{kV}{2} y_0 \frac{\alpha_x}{1+\alpha_x} > 0$. Therefore,

$$\frac{\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0|}{\lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|} = \frac{\alpha_x}{1+\alpha_x} \cdot \frac{1-\beta_x}{\beta_x}. \tag{A.42}$$

When $\frac{\alpha_x}{1+\alpha_x} \cdot \frac{1-\beta_x}{\beta_x} \geq 1$, i.e.,

$$\alpha_x - \beta_x \geq 2\alpha_x \beta_x, \tag{A.43}$$

we have $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| \geq \lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|$, vice versa.

Hence, combining the three cases, $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| \geq \lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|$ if $y_2 > y_1$ or if $y_2 = y_1$ and $\alpha_x - \beta_x \geq 2\alpha_x \beta_x$. $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| \leq \lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|$ if $y_2 < y_1$ or if $y_2 = y_1$ and $\alpha_x - \beta_x \leq 2\alpha_x \beta_x$. The equalities hold when $\lim_{x_1 \uparrow x_0} e_1^* = \lim_{x_1 \downarrow x_0} e_1^* = e_1^0$. □

A.5.6. Proof of Proposition A.5

Proposition A.5. *Let $x_2 = x_0, y_2 = y_0$, and let $e_1^* = e_1^0$ when $x_1 = x_2$ and $y_1 = y_2$. Then, $\frac{\lim_{y_1 \uparrow y_0} |e_1^* - e_1^0|}{\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0|} \geq 1 \Leftrightarrow \alpha_x - \beta_x \leq 2\alpha_x \beta_x \Leftrightarrow \frac{\lim_{y_1 \downarrow y_0} |e_1^* - e_1^0|}{\lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|} \leq 1$.*

Proof. When $x_1 = x_2 = x_0$ and $y_1 = y_2 = y_0$, we have $e_1^0 = e_1^5$. We examine how e_1^* responds to changes in x_1 and y_1 relative to e_1^0.

1. Fixing $y_1 = y_2$, when $x_1 > x_0$, then $x_2 - x_1 < 0$, so $e_1^* = e_1^2$ and $\lim_{x_1 \downarrow x_0} |e_1^* - e_1^0| = |e_1^2 - e_1^5| = |\frac{kV}{2(1-\beta_x)} y_0 - \frac{kV}{2} y_0| = \frac{kV}{2} y_0 \frac{\beta_x}{1-\beta_x} > 0$. Fixing $x_1 = x_2$, when $y_1 > y_0$, then $y_2 - y_1 < 0$, so $e_1^* = e_1^3$ and $\lim_{y_1 \downarrow y_0} |e_1^* - e_1^0| = \lim_{y_1 \downarrow y_0} |e_1^3 - e_1^5| = \lim_{y_1 \downarrow y_0} |\frac{kV}{2(1+\alpha_x)} [y_1 - \beta_y (y_1 - y_0)] - \frac{kV}{2} y_0| = |\frac{kV}{2(1+\alpha_x)} y_0 - \frac{kV}{2} y_0| = \frac{kV}{2} y_0 \frac{\alpha_x}{1+\alpha_x} > 0$. Therefore,

$$\frac{\lim_{y_1 \downarrow y_0} |e_1^* - e_1^0|}{\lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|} = \frac{\alpha_x}{1+\alpha_x} \cdot \frac{1-\beta_x}{\beta_x}. \tag{A.44}$$

When $\frac{\alpha_x}{1+\alpha_x} \cdot \frac{1-\beta_x}{\beta_x} \geq 1$, i.e.,

$$\alpha_x - \beta_x \geq 2\alpha_x\beta_x, \tag{A.45}$$

we have $\lim_{y_1 \downarrow y_0} |e_1^* - e_1^0| \geq \lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|$, vice versa.

2. Fixing $y_1 = y_2$, when $x_1 < x_0$, then $x_2 - x_1 > 0$, so $e_1^* = e_1^1$ and $\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0| = |e_1^1 - e_1^5| = |\frac{kV}{2(1+\alpha_x)} y_0 - \frac{kV}{2} y_0| = \frac{kV}{2} y_0 \frac{\alpha_x}{1+\alpha_x} > 0$. Fixing $x_1 = x_2$, when $y_1 < y_0$, then $y_2 - y_1 > 0$, so $e_1^* = e_1^2$ and $\lim_{y_1 \uparrow y_0} |e_1^* - e_1^0| = \lim_{y_1 \uparrow y_0} |e_1^2 - e_1^5| = \lim_{y_1 \uparrow y_0} |\frac{kV}{2(1-\beta_x)} [y_1 - \alpha_y(y_0 - y_1)] - \frac{kV}{2} y_0| = \frac{kV}{2} y_0 \frac{\beta_x}{1-\beta_x} > 0$. Therefore,

$$\frac{\lim_{y_1 \uparrow y_0} |e_1^* - e_1^0|}{\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0|} = \frac{1+\alpha_x}{\alpha_x} \cdot \frac{\beta_x}{1-\beta_x}. \tag{A.46}$$

When $\frac{1+\alpha_x}{\alpha_x} \cdot \frac{\beta_x}{1-\beta_x} \geq 1$, i.e.,

$$\alpha_x - \beta_x \leq 2\alpha_x\beta_x, \tag{A.47}$$

we have $\lim_{y_1 \uparrow y_0} |e_1^* - e_1^0| \geq \lim_{x_1 \uparrow x_0} |e_1^* - e_1^0|$, vice versa.

Hence, combining the two cases, we have

$$\frac{\lim_{y_1 \uparrow y_0} |e_1^* - e_1^0|}{\lim_{x_1 \uparrow x_0} |e_1^* - e_1^0|} \geq 1 \Leftrightarrow \frac{\lim_{y_1 \downarrow y_0} |e_1^* - e_1^0|}{\lim_{x_1 \downarrow x_0} |e_1^* - e_1^0|} \leq 1 \Leftrightarrow \alpha_x - \beta_x \leq 2\alpha_x\beta_x. \tag{A.48}$$

□

A.5.7. Proof of Proposition 1

Proposition 1. Optimal Effort Response to Inequality in Equity Under Domain-Contingent Inequality Aversion. *Let* $y_2 = y_0$*, then* $\frac{\lim_{y_1 \uparrow y_0} \frac{\partial e_1^*}{\partial y_1}}{\lim_{y_1 \downarrow y_0} \frac{\partial e_1^*}{\partial y_1}} > 1$. *Relative to equality in equity* ($y_1 = y_2 = y_0$)*, effort responds more to equity cuts* ($y_1 < y_0$) *than to equity raises* ($y_1 > y_0$)*.*

Proof. By equation A.11, when $y_1 < y_0 = y_2$, we have

$$\lim_{y_1 \uparrow y_0} \frac{\partial e_1^*}{\partial y_1} = \begin{cases} \frac{kV(1+\alpha_y)}{2(1+\alpha_x)}, & \text{if } x_2 - x_1 > C(e_2^1) - C(e_1^1) \\ \frac{kV(1+\alpha_y)}{2(1-\beta_x)}, & \text{if } x_2 - x_1 < C(e_2^2) - C(e_1^2) \\ \frac{kV(1+\alpha_y)}{2}, & \text{if } x_2 - x_1 = C(e_2^5) - C(e_1^5) \end{cases}$$

and when $y_1 > y_0 = y_2$, we have

$$\lim_{y_1 \downarrow y_0} \frac{\partial e_1^*}{\partial y_1} = \begin{cases} \frac{kV(1-\beta_y)}{2(1+\alpha_x)}, & \text{if } x_2 - x_1 > C(e_2^3) - C(e_1^3) \\ \frac{kV(1-\beta_y)}{2(1-\beta_x)}, & \text{if } x_2 - x_1 < C(e_2^4) - C(e_1^4) \\ \frac{kV(1-\beta_y)}{2}, & \text{if } x_2 - x_1 = C(e_2^6) - C(e_1^6). \end{cases}$$

Since $\alpha_x, \beta_x, \alpha_y, \beta_y > 0$, we have $\frac{\frac{kV(1+\alpha_y)}{2(1+\alpha_x)}}{\frac{kV(1-\beta_y)}{2(1+\alpha_x)}} = \frac{1+\alpha_y}{1-\beta_y} > 1$, $\frac{\frac{kV(1+\alpha_y)}{2}}{\frac{kV(1-\beta_y)}{2}} = \frac{1+\alpha_y}{1-\beta_y} > 1$, $\frac{\frac{kV(1+\alpha_y)}{2(1-\beta_x)}}{\frac{kV(1-\beta_y)}{2(1-\beta_x)}} = \frac{1+\alpha_y}{1-\beta_y} > 1$, $\frac{\frac{kV(1+\alpha_y)}{2(1-\beta_x)}}{\frac{kV(1-\beta_y)}{2(1+\alpha_x)}} = \frac{1+\alpha_y}{1-\beta_y} \cdot \frac{1+\alpha_x}{1-\beta_x} > 1$, $\frac{\frac{kV(1+\alpha_y)}{2(1-\beta_x)}}{\frac{kV(1-\beta_y)}{2}} = \frac{1+\alpha_y}{1-\beta_y} \cdot \frac{1}{1-\beta_x} > 1$ and $\frac{\frac{kV(1+\alpha_y)}{2}}{\frac{kV(1-\beta_y)}{2(1+\alpha_x)}} = \frac{1+\alpha_y}{1-\beta_y} \cdot (1+\alpha_x) > 1$. Since $\alpha_y > \alpha_x$ and $\beta_y > \beta_x$, we have $\frac{\frac{kV(1+\alpha_y)}{2(1+\alpha_x)}}{\frac{kV(1-\beta_y)}{2(1-\beta_x)}} = \frac{1+\alpha_y}{1+\alpha_x} \cdot \frac{1-\beta_x}{1-\beta_y} > 1$ and $\frac{\frac{kV(1+\alpha_y)}{2}}{\frac{kV(1-\beta_y)}{2(1-\beta_x)}} = (1+\alpha_y) \cdot \frac{1-\beta_x}{1-\beta_y} > 1$. Since $\alpha_y > \alpha_x$ and $\beta_y > 0$, we have $\frac{\frac{kV(1+\alpha_y)}{2(1+\alpha_x)}}{\frac{kV(1-\beta_y)}{2}} = \frac{1+\alpha_y}{1+\alpha_x} \cdot \frac{1}{1-\beta_y} > 1$. Hence, for all the cases, we have

$$\frac{\lim_{y_1 \uparrow y_0} \frac{\partial e_1^*}{\partial y_1}}{\lim_{y_1 \downarrow y_0} \frac{\partial e_1^*}{\partial y_1}} > 1.$$

Moreover, when α_y or β_y is large, the lefthandside is larger, suggesting a larger asymmetric effect. □

A.5.8. Proof of Proposition 2

Proposition 2. Optimal Effort Response to Inequality in Equity Absent Domain-Contingent Inequality Aversion. *Let* $y_2 = y_0$*. Let* $\tilde{e}_1$ *be worker 1's optimal effort choice absent inequality aversion. Let* $\hat{e}_1$ *be worker 1's optimal effort choice under non-domain-contingent inequality aversion. Then* $\frac{\lim_{y_1 \uparrow y_0} \frac{\partial \tilde{e}_1}{\partial y_1}}{\lim_{y_1 \downarrow y_0} \frac{\partial \tilde{e}_1}{\partial y_1}} = 1$ *and* $\frac{\lim_{y_1 \uparrow y_0} \frac{\partial \hat{e}_1}{\partial y_1}}{\lim_{y_1 \downarrow y_0} \frac{\partial \hat{e}_1}{\partial y_1}} = 1$*. Relative to equality in equity* ($y_1 = y_2 = y_0$)*, effort responds symmetrically to equity cuts* ($y_1 < y_0$) *and* *equity raises ($y_1 > y_0$).*

Proof. In a model absent inequality aversion, $u_{\text{Success}} = x_1 + y_1 V - C(e_1)$ and $u_{\text{Failure}} = x_1 - C(e_1)$, so worker 1 faces the problem:

$$\max_{e_1} x_1 - C(e_1) + p(e_1 + e_2) y_1 V. \tag{A.49}$$

We have the specifications that $C(e_i) = e_i^2$ and $p = k(e_1 + e_2)$, $k > 0$. The first order conditions yield the optimal effort choice under a model of no inequality aversion

$$\tilde{e}_1 = \frac{k y_1 V}{2}, \tag{A.50}$$

so we have

$$\frac{\lim_{y_1 \uparrow y_0} \frac{\partial \tilde{e}_1}{\partial y_1}}{\lim_{y_1 \downarrow y_0} \frac{\partial \tilde{e}_1}{\partial y_1}} = 1.$$

Under a model with non-domain-contingent inequality aversion, $u_{\text{Success}} = x_1 + y_1 V - C(e_1) - D_{\text{Success}}$ and $u_{\text{Failure}} = x_1 - C(e_1) - D_{\text{Failure}}$, where

$$\begin{aligned} D_{\text{Success}} =& \alpha\Big(\max\{(x_2 + y_2 V - C(e_2)) - (x_1 + y_1 V - C(e_1)), 0\}\Big) \\ &+ \beta\Big(\max\{(x_1 + y_1 V - C(e_1)) - (x_2 + y_2 V - C(e_2)), 0\}\Big), \qquad (A.51) \\ D_{\text{Failure}} =& \alpha\Big(\max\{(x_2 - C(e_2)) - (x_1 - C(e_1)), 0\}\Big) + \beta\Big(\max\{(x_1 - C(e_1)) - (x_2 - C(e_2)), 0\}\Big). \qquad (A.52) \end{aligned}$$

So worker 1 faces the problem:

$$\begin{aligned} \max_{e_1} \quad & x_1 - C(e_1) + p(e_1 + e_2) y_1 V - \\ & \alpha \max\{\big(x_2 - C(e_2) + p(e_1 + e_2) y_2 V\big) - \big(x_1 - C(e_1) + p(e_1 + e_2) y_1 V\big), 0\} \\ & - \beta \max\{\big(x_1 - C(e_1) + p(e_1 + e_2) y_1 V\big) - \big(x_2 - C(e_2) + p(e_1 + e_2) y_2 V\big), 0\}. \end{aligned} \tag{A.53}$$

Worker 2 faces a symmetric problem. Equilibrium effort choices $\hat{e}_1$ and $\hat{e}_2$ must satisfy one of the following conditions:

1. $x_1 - C(\hat{e}_1) + p(\hat{e}_1 + \hat{e}_2)y_1V > x_2 - C(\hat{e}_2) + p(\hat{e}_1 + \hat{e}_2)y_2V$
2. $x_1 - C(\hat{e}_1) + p(\hat{e}_1 + \hat{e}_2)y_1V = x_2 - C(\hat{e}_2) + p(\hat{e}_1 + \hat{e}_2)y_2V$
3. $x_1 - C(\hat{e}_1) + p(\hat{e}_1 + \hat{e}_2)y_1V < x_2 - C(\hat{e}_2) + p(\hat{e}_1 + \hat{e}_2)y_2V$

Under Condition 1, the first order conditions yield

$$\hat{e}_1^1 = \frac{kV}{2(1-\beta)}[y_1 - \beta(y_1 - y_2)], \hat{e}_2^1 = \frac{kV}{2(1+\alpha)}[y_2 - \alpha(y_1 - y_2)]. \tag{A.54}$$

Under Condition 2, the first order conditions yield

$$\hat{e}_1^2 = \frac{kV}{2}y_1, \hat{e}_2^2 = \frac{kV}{2}y_2. \tag{A.55}$$

Under Condition 3, the first order conditions yield

$$\hat{e}_1^3 = \frac{kV}{2(1+\alpha)}[y_1 - \alpha(y_2 - y_1)], \hat{e}_2^3 = \frac{kV}{2(1-\beta)}[y_2 - \beta(y_2 - y_1)]. \tag{A.56}$$

For all three conditions, we have

$$\frac{\partial \hat{e}_1}{\partial y_1} = \frac{kV}{2}$$

and hence

$$\frac{\lim_{y_1 \uparrow y_0} \frac{\partial \hat{e}_1}{\partial y_1}}{\lim_{y_1 \downarrow y_0} \frac{\partial \hat{e}_1}{\partial y_1}} = 1.$$

□

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