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Peer Monitoring in the Workplace and the Voluntary Job Separation of Parenting Women*

Hiromi Nosaka†

Abstract

This study examines the effects of the organization type and compensation scheme within a firm on the job separation decisions of working women in the case of childbearing. Under stringent labor legislation that secures employment, the direct dismissal of parenting women is prohibited. Firms, however, deliberately introduce team production in which the workers within a team put peer pressure on parenting women so that these women quit their jobs voluntarily. This threat forces women to abandon the idea of childbearing and leads to social loss. Simple policies are less likely to be effective at turning around the inefficient allocation.

Keywords: team production, peer pressure, fertility, labor legislation.

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1 Introduction

Social norms often influence the job attachment of women in the case of childbearing. Owing to the social pressure that accompanies the role of mothers, women are forced to be fully responsible for child rearing and, as a consequence, are compelled to leave the firm in the case of childbearing. Although the effects of such norms differ across countries, the upsurge in the job separation of women in their 30s may be attributable to the norms in some countries such as Japan and Ireland (Brewster and Rindfuss 2000). In Japan, for example, about 67 percent of women with paid jobs leave their firms within six months of childbirth (CAO 2004). Because women following these norms have to choose either a career without children or job separation to enable child rearing, the decision of childbearing often leads to a significant opportunity cost.

It is noted that social norms, particularly those in workplaces, are not necessarily given exogenously, but rather are often influenced by a firm’s policies on the organization of production and compensation. In order to implement these norms, the specific actions of workers are required such as informal peer monitoring and sanctions against deviators. In this sense, firms may influence the behaviors of their workers and, therefore, the norms of workplaces by altering their organization and compensation schemes. Among various organization types, I argue that the norms in workplaces play a decisive role in the organization of team production. In team production, the compensation of workers is mainly allocated based on team performance and this property thus provides workers with an incentive to monitor each other.

This study describes the roles of workplace norms in relation to organization, particularly team production, in order to draw serious policy implications for family policies. I argue that the firm has an incentive to employ team production in order to deliberately revert the effect of strong family policies that ensure the employment and compensation of parenting women. It is true that firms cannot dismiss parenting women directly under employment protection laws; however, team production gives coworkers an incentive to put peer pressure on such women often forcing them to quit the firm. The present model also predicts that the mere introduction of paid parental leave is ineffective at raising the fertility rate in general, because such leave remains unutilized as long as informal peer pressure continue to forces women to quit their jobs when childbearing.

In order to address the interaction of organization types and workplace norms specifically, I construct a model that narrows the focus of the investi-
gation to two types of organization: team and individual production. In team production, workers within a team collaborate and are able to monitor each other. When compensation is provided on the basis of team performance as a whole, cooperation among workers is considered to be valuable and workers have an incentive to exercise peer sanctions against deviating workers who do not cooperate. In individual production, on the contrary, workers complete their tasks independently and individual performance is observable at a lower cost.

These general properties of the benefits and costs of each organization type apply to the present model, which includes labor legislation for parenting women. The benefits of team production, on the one hand, are obtained by putting peer pressure on parenting women so that they are forced to quit the firm. Under strong employment protection laws, the employer is unable to dismiss parenting women, and individual production involves additional costs because of these laws. However, team production allows the firm to resort to peer pressure in workplaces and hence to avoid these costs. On the other hand, the costs of team production arise owing to the higher level of compensation that the firm pays to enforce the informal activities of workers.

The firm, based on these benefits and costs, chooses between team and individual production. The firm prefers team production when the costs of implementing peer pressure are lower than the benefits from the indirect dismissal of parenting women. This situation occurs particularly when workers possess high discount factors and consequently place great emphasis on future events, because they then take the penalty of peer sanctions seriously.

Owing to both the threat of indirect dismissal and the higher pay, parenting women involved in team production are markedly discouraged from making fertility decisions. First, the threat of indirect dismissal directly raises the opportunity cost of childbearing because fertility decisions are always accompanied by job separation. Second, the higher wage compensation in team production further discourages fertility decisions because the foregone income of childbearing is higher in team production. In team production, despite the existence of strong labor legislation, these two effects result in a strong negative effect on fertility.

The negative effect on fertility leads directly to welfare loss because fertility is socially beneficial. According to the socially optimal allocation in the model, women bear children whenever they have the opportunity to do so because child rearing is beneficial from the social standpoint. The low productivity
of parenting women during child rearing should be compensated for by hiring substitute workers from the outside labor market. In equilibrium, however, team production without substitute workers may be a better strategy for the firm to reduce labor costs because it leads to the job separation of parenting women. Consequently, fertility decisions are greatly discouraged, leading to serious inefficiencies in team production.

The model’s implications provide a new view on recent empirical evidence concerning family policies that aim to raise fertility rates. Although a host of research on fertility affirms the positive effect of parental leave and family benefits on fertility (Del Boca 2002; Morita and Kaneko 1998; Shigeno and Matsuura 2003), empirical evidence reveals that the effects of this labor legislation is less clear and that these effects differ across countries (Gauthier and Hatzius 1997; Shigeno and Ohkusa 1999; Hantrais 1997; Brewster and Rindfuss 2000). Although many factors obscure the effects of family policies on fertility, the social norms pertaining to the role of women in child rearing appear to play a significant role in some countries (Brewster and Rindfuss 2000). The model thus provides a theoretical framework that can account for the effect of these norms on fertility.

I also derive serious policy implications: the model predicts that the mere introduction of a single policy may be ineffective at raising fertility. For example, the mere introduction of mandated substitute workers during parental leave may not stop peer pressure on parenting women. According to the model, workers have an incentive to use peer pressure as long as the other workers do the same, because any deviation by a single worker can result in a significant utility loss to him- or herself. Therefore, complementary policies are necessary to induce the coordinated change.

The importance of coordinated changes in the behaviors and attitudes of

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1 It is noted that Japanese employers are less likely to provide substitute workers when their female employees are on leave for childcare (ESRI 2005).

2 For example, Brewster and Rindfuss (2000) argued that fertility in Sweden is considerably more stimulated by changes in parental leave and wage compensation policies than in the United States where there was almost no change in fertility in response to the introduction of labor legislation that ensures unpaid leave for childbirth.

3 Hantrais (1997) claimed that a single family policy may lead to a different outcome when combined with other labor legislation. In Germany, for example, maternal leave policy mandates a generous preleave pay; however, the effect of this policy is obscured when combined with the substantial shortage of childcare facilities and German policies that encourage women to stay home for extended periods of time.
workers in workplaces is often cited in empirical studies with regard to effective family policies. Several empirical studies reveal that the attitude and understanding of coworkers and supervisors are crucial for maintaining productivity within a firm when some workers take childcare leave (Staines and Galinsky 1992; Eaton 2003). The present model provides one theoretical foundation for these empirical results.

This study is related to the literature from several fields that unveils the relationship between labor markets and fertility. First, the seminal works of Becker (1991) and Willis (1973) investigated the manner in which the number of children and their education levels are determined by market wages, which constitute a major part of the foregone income of fertility. These studies, however, do not explicitly deal with the effect on fertility decisions of the way that production is organized. Second, job availability affects fertility decisions; Da Rocha and Fuster (2006) explored the effect of job-finding rates on fertility. However, these studies do not explain why parenting women quit their jobs in economies that encourage parental leave.

This study is closely related to the theoretical models of team production (Alchian and Demsetz 1972; Holmstrom 1982; Che and Yoo 2001; Ishida 2009). Che and Yoo (2001), in particular, revealed the manner in which cooperation among team members can be achieved in repeated game settings. My model builds on their work in order to model explicitly the interactions between the workers within a team. In the model of Che and Yoo (2001), however, the decision pertaining to job separation is not a viable option, although it plays a decisive role in this study. Furthermore, the welfare implications are different because my model reveals that team production is socially inefficient in contrast to their models.

Peer pressure and sanctions in workplaces have been studied in various settings. First, peer pressure among workers has been studied as a device for maintaining discipline and eliciting effort in team production (Kandel and Lazear 1992; Rotemberg 1994; Barron and Gjerde 1997). Barron and Gjerde (1997) in particular investigated the optimal compensation scheme when peer monitoring

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4 Refer to Takeishi (2006) for a survey regarding the effects of work-life balance policies on firms’ profitability.

5 The job-finding rate is also related to labor legislation. When labor legislation strongly protects employment, job-finding rates are reduced as job openings are costly in anticipation of future dismissal costs (Blanchard and Portugal 2001).

and sanctions exist in team production, showing that the optimal compensation
is less sensitive to output in order to reduce costly peer monitoring. However,
their model is static, and they do not deal with the way in which peer mon-
investigated the effect of sabotage, which is defined as behavior that disturbs
other workers’ performance in workplaces. Sabotage is naturally an obstacle to
the implementation of relative performance compensation systems as shown in
Lazear; however, these models contrast with my model wherein peer pressure
directly affects the welfare of targets and forces job separation.

Finally, research on norms in repeated game settings and harassment in
workplaces is related to my model. First, several studies have shown that the
norm or cooperation emerges as a result of ostracism (Hirshleifer and Rasmusen
1989) or reputation concern (Okuno-Fujiwara and Postlewaite 1995) in mod-
els of repeated games. These studies, however, do not clarify the interaction
among organization types, compensation schemes, and peer pressure. Second,
harassment behaviors have been studied from various viewpoints. Sexual ha-
arrassment has been investigated, although mainly in relation to laws and crimes
(Basu 2003). Harassment in workplaces is employed by Lindbeck and Snower
(1988, 1990) in order to explain the high wages of incumbent workers in an
insider–outsider model. However, the motivation and policy implications of
their models are clearly different from those of my model.

The remainder of the paper is organized as follows. Section 2 sets up the
model and analyzes the optimal choice of compensation schemes and organiza-
tion types. Section 3 discusses the welfare and policy implications. Section 4
presents some concluding remarks.

2 Model

2.1 Environment

I extend the model of Che and Yoo (2001) to the case in which several workers
can engage in production as a team and put peer pressure on other workers.
It consists of a discrete time model in which time is denoted as $t \ (t = 1, 2, ...)$.
The economy consists of one firm and many workers who are risk neutral and
who share a common discount factor of $\delta$. The firm owns the production tasks

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7In Casas-Arce (2010), the possibility of replacing the opponents is introduced in repeated
games.
for N workers, and it is in the best interest of the firm to employ N workers because the productivity of each task is sufficiently high. Thus, one firm and N workers play a repeated game in which the workers perform certain activities in each period. The workers cannot directly enter side contracts with each other, and negative compensation is not allowed because of their liquidity constraint.

There are two types of workers: female workers and male workers. Female workers can bear children with probability $\theta$ in each period. In this study, I assume that the firm needs to employ at least one female worker.

**Labor Legislation 1** *The firm is required to employ at least one female worker and assign her to a productive task.*

In this study, the above legislation is interpreted as some form of affirmative action or equal employment law. As clarified later, the best strategy for the firm is to employ just one female worker who has no children in the initial period. The other $N - 1$ workers, referred to as male workers, cannot bear children.

The possibility of job separation plays a decisive role. Regarding this decision, employment protection laws introduce a substantial cost to the firm of dismissing its employees, and this is formalized as the next assumption.

**Labor Legislation 2** *The worker can quit the firm without incurring any costs. However, the firm cannot remove any employed worker from a productive task unless he or she approves of such a shift.*

The above legislation indicates that the currently assigned task is secured under employment protection laws. This assumption is necessary in order to make employment protection effective; otherwise, the firm may assign the worker to an unproductive task, in which his or her productivity may be zero, and this renders the same effect as dismissal when the performance pay scheme is employed. The workers earn a wage rate of zero outside the firm, and many workers whose incomes are zero exist outside the firm. Because the firm pays a positive amount of compensation in equilibrium, there exists competition among unemployed workers to obtain productive tasks.

Each period consists of four stages whose timing is as follows:

1. (Fertility) The female worker makes the fertility decision when the opportunity arises.

2. (Job separation) The workers determine whether to leave or stay in the firm.
3. (Hiring) The firm decides to hire new workers or not.

4. (Production) The workers choose among production effort, peer pressure effort, and no effort.

In the first stage, the female worker can bear a child with probability $\theta$. I assume that the opportunity to bear a child arrives independently in each period and that once the female worker does not have a child in one period, she has to wait for another opportunity, which arrives at probability $\theta$ in the next period. When she has a child, she obtains a positive utility of $a$ in each period because of parenting activities. The childbearing activity is observable to all the agents in the economy.

In the second and third stages, I assume that the firm can hire new workers immediately after workers quit the firm. This assumption implies that the firm does not incur any costs in replacing the workers, because the firm can hire replacements immediately whenever workers leave the firm. This assumption is for tractability, although the introduction of a replacement cost is possible.

In the fourth stage, the male workers select any one of the three actions in each period: production effort, peer pressure effort, or no effort. When they engage in production effort, it raises productivity, although the degree of improvement depends on the ways in which production is organized within the firm. Alternatively, these male workers can put peer pressure on the female worker, which subsequently reduces her utility by $h$. This negative effect is stronger when more male workers put peer pressure on her. Specifically, I assume that her utility decreases by $nh$ when $n$ male workers engage in peer pressure. Each male worker incurs the utility cost of $e$ when he engages in either production effort or peer pressure effort, while the cost is zero when he makes no effort.

The choices available to the female worker in the fourth stage depend on whether she has a child. When she does not have a child, the female worker either engages in production effort or makes no effort in the fourth stage, in which the effort cost for production is $\bar{e}$. However, when she does have a child, the female worker is unable to exert production effort, because her effort cost is considerably high during parenting activities. Therefore, she exerts no effort in this case, although she has the utility of child rearing ($\bar{a}$) in each period.

While the productivity of the parenting female worker in the labor market is low by design, regulations such as childcare leave laws and equal employment laws ensure that she can return to her present job after childbirth. In particular,
I assume that the parenting female worker can maintain the same job and compensation in the following sense.

**Labor Legislation 3** *The compensation level of the parenting female worker is the same as the expected income of the male workers.*

The regulation on compensation is an extreme form of childcare benefit imposed upon the firm, and I consider this extreme case in order to obtain a clear picture of the effect of labor legislation.

The firm arranges the organization type, compensation scheme, and employment policies in order to maximize its profit, and the firm makes all these decisions at the beginning of the initial period. First, the firm decides whether individual production or team production is the best way to organize production. Second, it prepares a compensation schedule that minimizes the labor cost but makes all workers exert production effort. Third, it devises employment policies that determine whether to hire substitute workers when the female worker bears a child. I detail these three components successively next.

The first component that the firm selects is how production is organized: the firm chooses either individual production or team production. In individual production, the outcome of production is realized based on an individual worker, and the individual outcome is either one (success) or zero (failure). Production effort plays a decisive role because it raises the probability of success. In team production, I assume that the firm creates a team of $N$ workers.\(^8\) The firm cannot observe the performance of individual workers; rather, it monitors only the outcome of the team as a whole, which equals either $N$ (success) or $0$ (failure). The production effort of individual workers raises the probability of the success of the team, and I assume that this is a nondecreasing function of the number of workers who make production effort.

Individual and team production provide different information structures; in particular, I assume that workers can monitor the activities of other workers in team production. In individual production, on the one hand, I assume that the outcome is observable and verifiable to both the firm and the worker, although the effort level is information privy only to the worker who makes the effort.\(^9\) In

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\(^8\)The main results remain unchanged even if the firm changes the size of the team. In such a case, the firm chooses the minimum size of a team that makes peer pressure effective.

\(^9\)This assumption implies that the firm is unable to renge on the initially planned compensation. This contrasts with the relational contracts of Levin (2002) and Kvaløy and Olsen (2006).
team production, on the other hand, only the outcome of the team as a whole (i.e., $N$ or 0) is observable and verifiable. Although the outcomes of individual workers are not observable to the firm, information on these workers’ activities, including their production effort levels, is shared among the workers within a team.

The second policy of the firm is the compensation plan, and this is summarized by the bonus level in the case of success under the assumptions of the model. First, I assume that the productive task is sufficiently profitable. As a result, the firm devises a compensation plan to ensure that all workers make production effort in equilibrium. Second, I assume that the compensation contract is time invariant or memoryless in the sense that compensation is paid based only on the outcome of the corresponding period, as in Che and Yoo (2001). As a result of this assumption, compensation comprises the base salary in the event of failure and a bonus in the event of success in the corresponding period. Third, I assume that the workers face liquidity constraints that make negative compensation infeasible. Because the base salary does not give workers an incentive to exert effort, the optimal base salary is zero under this assumption. Therefore, these assumptions lead to a situation in which the choice variable of the firm is the bonus that is given in the event of success, which is denoted by $w$.

The compensation scheme is prepared in keeping with the labor legislation, which does not allow any discrimination.

**Labor Legislation 4** The workers earn identical levels of compensation when their performances are identical in the current period.

In this sense, the compensation scheme is considered anonymous. This assumption is critical for the female worker whose productivity is low in the case of childbearing by design. I assume that the equal employment law ensures the equal treatment of compensation for both gender subsets. Owing to this assumption, the identical bonus of $w$ is applied to all workers including the female worker.

The third policy of the firm is the employment policy that details the employment decisions of a substitute worker for the female worker after childbirth. First, in the case of job separation, the firm always hires a replacement, because I assume that the productive task is sufficiently profitable. Second, when the female worker has a child, the firm may hire a substitute worker in order to cover her low productivity. However, the firm may not deliberately hire the
substitute worker in team production for strategic reasons. This employment strategy is an important policy variable for the firm.

The choice of organization type thus greatly affects workers’ incentives. In the following two sections, I consider individual and team production more in detail.

2.2 Individual production

In individual production, the firm observes the outcome of individual workers, and this outcome takes the value of either one (success) or zero (failure). The probability of success is denoted by \( q_1 \) and \( q_0 \) when the worker makes production effort and no effort, respectively. I assume that production effort is valuable in the sense that \( 1 > q_1 > q_0 > 0 \).

The firm’s compensation is decided on an individual basis because there is no interaction between workers. The firm maximizes its profit by inducing the effort of all the workers, and the next incentive compatibility condition must thus hold for this purpose:

\[
q_1 w^I - e \geq q_0 w^I,
\]

where \( w^I \) represents the bonus in individual production. The left-hand side provides the value when the workers make production effort and the probability of success is then high, while the right-hand side shows the value when they make no effort and the probability of success is then low. The firm selects the smallest level of bonus that satisfies the above inequality.

\[
w^I = \frac{e}{q_1 - q_0},
\]

where \( w^I \) represents the bonus in individual production. The left-hand side provides the value when the workers make production effort and the probability of success is then high, while the right-hand side shows the value when they make no effort and the probability of success is then low. The firm selects the smallest level of bonus that satisfies the above inequality.

The female worker decides whether to have a child or not when the opportunity arises in the first subperiod. Although her productivity is low, a female worker with a child has no incentive to quit the firm because her income is secured by law (Labor Legislation 3). Thus, the female worker always benefits by bearing a child, as shown below:

\[
w^I q_1 - e < w^I q_1 + \bar{a},
\]

where the values on the right- and left-hand sides represent her decisions to continue working with and without a child, respectively. Thus, the female worker
has a child for any positive level of $\pi$ and continues to work after childbearing. The firm hires one substitute worker to complete the task in equilibrium. Because such an opportunity arises with probability $\theta$, the expected labor cost of the firm, denoted by $C_I^f$, follows the Bellman equation:

$$C_I^f = \theta(N + 1)q_1w^I + (1 - \theta)(Nq_1w^I(1 - \delta) + C_I^f\delta),$$

(2)

where the first term represents the expected total labor cost when the opportunity for childbearing arises and the firm employs $N + 1$ workers, while the second term implies the expected total labor cost in other cases. By rearranging the above equation and (1), we obtain

$$C_I^f = \frac{\theta}{1 - (1 - \theta)\delta} + N)q_1w^I,$$

$$= \frac{\theta}{1 - (1 - \theta)\delta} + N)\frac{q_1}{q_1 - q_0}.$$

(3)

This equation is particularly clear when $\delta$ is one, in which case, $C_I^f = (N + 1)q_1w^I$. In this case, the labor cost increases by the expected bonus of one worker because the firm needs to hire one additional worker regardless, and the same weights are assigned to present and any future events.

### 2.3 Team production

In team production, the firm is unable to observe individual performance and, consequently, the bonus is provided based on team performance, which takes a value of either $N$ (success) or 0 (failure). I denote the probability of success by $p_n$, where $n$ is the number of workers who exert production effort ($n \in \{0, \ldots, N\}$). I make the following assumption for simplicity:

**Assumption 1** $q_1 = p_N > p_{N-1} > p_{N-2} > \ldots > p_1 \geq p_0 = q_0$.

Under this assumption, the expected levels of production are the same for both individual and team production when all workers exert production effort, because $Nq_1 = Np_N$.

I make this assumption primarily in order to clarify the special effect of team production, which is not common in the literature. In the standard model of team production, there is no reason for the firm to choose team production in the present case because there is no gain in productivity, and the free-rider
problem acts as an additional cost. Even in the repeated settings of team production, such as in Che and Yoo (2001), team production is not beneficial when neither synergy ($p_N > q_1$) nor sabotage ($p_0 < q_0$) exists in the firm (Proposition 4 in Che and Yoo (2001)). My model reveals that the firm may choose team production despite this condition.

I further assume supermodularity on $p_n$ and $p_1 = p_0$:

**Assumption 2** $p_{n+2} - p_{n+1} > p_{n+1} - p_n$ (for $n = 1, ..., N - 2$), $p_1 = p_0$.

The first assumption of supermodularity is standard (see Che and Yoo 2001). The second assumption is to guarantee that individual workers have no incentive to work if the others do not exert effort. Although these two conditions are unnecessary to obtain the main results regarding the existence of equilibrium, I impose them to exclude the possibility of collusion in the Discussion section.

Given the technology of team production, I particularly focus on an equilibrium in which the male workers put peer pressure on the parenting female worker. Although many other equilibria exist, this equilibrium is important from the viewpoints of both the firm and the workers. On the one hand, the firm has no incentive to choose team production without peer pressure under the current assumption. Without peer pressure, team production is less efficient than individual production because of the free rider problem in team production. The equilibrium with peer pressure is only valuable among the possible team equilibria from the firm’s perspective. On the other hand, the male workers prefer the equilibrium with peer pressure when the compensation scheme and other policies are appropriately chosen by the firm. As shown in the Discussion section, no allocation improves the welfare of all workers even if they are allowed to collude.

The equilibrium consists of a set of strategies adopted by the firm and the workers. The firm selects the bonus level and the employment policy at the beginning of the initial period. First, the firm chooses the minimum level of bonus, denoted by $w^T$, that induces the workers to exert production effort and to put peer pressure on the female worker whenever she has a child. Second, the firm determines the employment policies. I consider the next strategies on employment in team equilibrium.

**[The employment strategies of the firm]**

1. *When some workers quit the firm, the firm hires the same number of workers for each gender subset.*
2. When the female worker has a child and continues to work, the firm does not hire any substitute workers.

The strategies of the workers include effort choices (production and peer pressure), job separation, and childbearing decisions. Because the workers repeatedly interact with each other within a team, it is necessary to consider explicitly a repeated game of the workers. In team production, the workers can monitor the behaviors of the others within the team; therefore, the strategies of the workers depend on the history of the actions before the decisions are made.

The strategies of the workers in equilibrium comprise the actions in each stage that must satisfy the incentive compatibility constraints. In order to construct the team equilibrium, I first provide the strategies on and off the equilibrium paths and then investigate whether these strategies are indeed the best responses in each subgame. On the equilibrium path, all workers staying in the firms made production effort in the past. It is noted that three stages are relevant for the workers in each period: the first stage in which fertility decisions are made, the second stage in which job separation decisions are made, and the fourth stage in which decisions regarding production and peer pressure are made. I propose the following set of strategies for each stage in team equilibrium with peer pressure:

[1. The strategies of the workers on the equilibrium path]

1-a. The first stage: If the female worker has the opportunity to bear a child, she does so when \( \bar{a} > \bar{a}^c \), where \( \bar{a}^c \equiv p_{NW}^T - \bar{e} \). Otherwise, she abandons the idea of childbearing.

1-b. The second stage: The female worker quits the firm if and only if she bears a child.

1-c. The fourth stage: All workers make production effort.

This set of strategies simply states that all workers make production effort as long as the female worker follows the social norm of working without a child or quitting the firm in the case of childbearing.

Off the equilibrium path in which some workers do not follow the strategies prescribed above, some form of peer sanction does arise in the process. The punishment is conducted in the fourth stage in which the workers select activity types:

[2. The strategies of the workers off the equilibrium path]

2-a. Deviation of the female worker: When the female worker either made
no effort in the past or continues to work after childbearing, all male workers put peer pressure on her.

2-b. Deviation of the male workers: When some male workers are observed not to have followed equilibrium strategies in the past, all workers in the team make no effort.

Given the set of equilibrium strategies of the workers, the firm appropriately chooses a bonus level so that the above actions are the best response for the workers. I show that this is true when the following assumption is imposed on the size of the team (N) and the probability of childbearing opportunity (θ):

Assumption 3  \( \delta h(N - 1) \geq \frac{ep_0}{p_N - p_0}, \quad \theta \leq \frac{p_0}{p_N} \).

The first condition posits the lower bound on the team size of N, and the large team size clearly ensures this condition. If the size is small, the effect of peer pressure is insufficient and the female worker does not quit the firm even if she receives peer pressure in equilibrium. The second restriction limits the range of the probability of childbearing opportunity, \( \theta \), and the low probability is necessary to support the equilibrium. When the probability is high, the female worker expects to have the opportunity to bear a child in most periods. Hence, for some value of \( \bar{a} \), the female worker has an incentive to make no effort in the anticipation that she can bear a child and quit the firm in the next period before receiving peer pressure. Although this does not happen for most values of \( \bar{a} \), I impose it to ensure that the equilibrium holds for the entire domain of \( \bar{a} \).

The next proposition shows that the above set of strategies constitutes a team equilibrium with peer pressure when the bonus level of \( w^T \) is appropriately chosen.\(^{10}\)

Proposition 1 (Team production) Under Assumptions 1-3, the workers’ strategies constitute a subgame perfect equilibrium in team production, given the bonus level of \( w^T \) that lies in the following range:

\[
\frac{h(N - 1)}{p_0} \geq w^T \geq \frac{\bar{v}}{\delta (p_N - p_0)} (\equiv w^2).
\]

The female worker abandons the idea of childbearing when \( \bar{a} \) is lower than \( a^c \), where \( a^c = p_N w^T - \bar{v} \). Otherwise, she has a child but leaves the firm.

\(^{10}\)All of the omitted proofs are provided in the working paper of this paper (Nosaka 2009).
It is noted that the range of the bonus is not empty because of Assumption 3.

In order to understand why each action is optimal, I consider several typical subgames and investigate whether the incentive compatibility conditions hold in each case.\textsuperscript{11} I first show that the workers have an incentive to engage in production effort on the equilibrium path; second, I consider the question of whether they have an incentive to put peer pressure on the parenting female worker. Finally, I investigate the female worker’s decisions pertaining to optimal fertility and job separation.

First, I present the incentive problem with respect to production effort on the equilibrium path. The next incentive compatibility condition for the male worker is necessary to induce it:\textsuperscript{12}

\begin{equation}
p_N w^T - \bar{e} \geq p_{N-1} w^T (1 - \delta) + p_0 w^T \delta.
\end{equation}

The left-hand side is the expected utility when the male worker makes production effort; this expected utility is no less than that on the right-hand side wherein he makes no effort and obtains $p_{N-1} w^T$ in the current period but the benefit is reduced to $p_0 w^T$ in the subsequent periods because no workers exert effort. By direct calculation, this condition implies that the bonus of $w^T$ must be no less than the following critical value of $\bar{w}^1$:

\begin{equation}
w^T \geq \bar{w}^1 \equiv \frac{\bar{e}}{p_N - (1 - \delta) p_{N-1} - \delta p_0}.
\end{equation}

The bonus of $w^T$ always satisfies this under the condition of the proposition because $\bar{w}^2 > \bar{w}^1$.

Second, I study the punishment stage in which the female worker deviates and continues to work after childbirth. Male workers then put peer pressure on her. The next condition provides them with a sufficient incentive to do this:

\begin{equation}
(p_0 w^T - \bar{e})(1 - \delta) + (p_N w^T - \bar{e}) \delta \geq p_0 w^T.
\end{equation}

The left-hand side denotes the value when the male workers put peer pressure on the parenting female worker. In the peer sanction period, the male workers exert effort for peer pressure; thus, the probability of success is low as reflected

\textsuperscript{11}Here, I do not describe all of the subgames in order to simplify the exposition. Refer to Nosaka (2009) for the complete analysis.

\textsuperscript{12}The situation is slightly different for the female worker; refer to the Appendix in Nosaka (2009) for this issue.
by the first term. Productivity, however, increases in the subsequent periods because the parenting female worker is replaced by a new female worker without a child, and this gain is represented by high productivity in the second term. The value of the left-hand side is no less than that of the right-hand side wherein a male worker deviates and exerts no effort (and no workers provide production effort in the subsequent periods). After some manipulation, this constraint is equivalent to the condition that the bonus of $w^T$ is no less than the critical value of $\bar{w}^2$ in the proposition; this condition obviously holds by assumption.

Moreover, the punishment phase arises as soon as some male workers deviate from the equilibrium strategies. None of the workers then exerts productive effort in the subsequent periods. These strategies are the best response if the strategy leads to a Nash equilibrium of a stage game. The incentive compatibility condition to support it is

$$p_0w^T \geq p_1w^T - \bar{c}.$$  

This is always true under Assumption 2.

Lastly, I investigate the fertility decision of the female worker. This decision determines the critical level of the utility of childcare, denoted by $a^c$, below which the female worker abandons the idea of childbearing in equilibrium.\footnote{I omit the other decisions of the female worker for simple exposition. They are decisions regarding production effort and job separation, and the full analysis is detailed in the Appendix of Nosaka (2009).} Because the female worker quits the firm after she bears a child in equilibrium, she can choose either to quit the firm with a child or to remain in the firm without a child. The female worker quits the firm if $\bar{a} \geq p_N w^T - \bar{c}$; otherwise, she abandons the idea of childbearing. Thus, the critical value of $\bar{a}$ is obtained when this inequality holds with equality, and it is $a^c$ in the proposition.

Given the equilibrium strategies of workers that support peer sanctions against deviators, the firm selects the level of bonus that minimizes the labor cost. The optimal level is clearly the minimum level of $\bar{w}^2$ if peer pressure is preferable to the firm, and I focus on such a case.\footnote{In order to locate the optimal level of bonus, the firm needs to know the consequences when it proposes a bonus below $\bar{w}^2$. In order to make this choice less attractive, I assume that no workers engage in production effort if the firm makes such an offer. This strategy clearly constitutes a Nash equilibrium of the stage game and thus a subgame perfect Nash equilibrium. Because the profit is clearly lower in this case than in the equilibrium one, the firm provides a bonus of at least $\bar{w}^2$.} As a consequence, the
optimal bonus is
\[ w^T = w^2 = \frac{\bar{c}}{\delta(p_N - p_0)}. \] (7)

It is noted that peer pressure—a determinant of \( w^2 \)—requires a cost in addition to the implementation cost for production effort that dictates \( w^1 \), because \( w^1 < w^2 \). In standard repeated settings such as Che and Yoo (2001), the relevant constraint is only on production effort, and the constraint on peer pressure is absent. In this sense, team production with peer pressure requires a higher wage than team production without it.

The expected total labor cost is the expected level of bonus multiplied by the employment size of \( N \) in team equilibrium. In team production, the firm employs only \( N \) workers because the female worker quits the firm in the case of childbearing and the firm need not employ a substitute worker. As a consequence, the total labor cost is
\[ N p_N w^T = \frac{N p_N \bar{c}}{\delta(p_N - p_0)}. \] (8)

### 2.4 Optimal organization

The firm chooses the type of organization that provides the lowest total labor cost. The next proposition reveals that this trade-off is affected by the discount factor of \( \delta \).

**Proposition 2** The firm chooses team production if the following condition holds:
\[ N < \delta \left( \frac{\theta}{1-\delta(1-\theta)} + N \right). \]

Otherwise, the firm adopts individual production.

**Proof.** According to the definitions of the labor cost in (3) and (8), the labor cost of team production is lower if:
\[ \frac{N p_N \bar{c}}{\delta(p_N - p_0)} < \left( \frac{\theta}{1-(1-\theta)\delta} + N \right) \frac{q_1}{q_1 - q_0} \bar{c}. \] (9)

Because \( p_N = q_1 \) and \( p_0 = q_0 \), this condition is identical to the inequality in the proposition. Q.E.D.
The discount factor dictates the optimal organization within a firm. The right-hand side of the inequality in the proposition is an increasing function of the discount factor, and team production is always better when \( \delta = 1 \). For a high level of the discount factor, the firm can induce workers to make production effort and exert peer pressure at a low cost because the workers place more emphasis on the future payoff and the future peer sanction works more effectively. Team production is thus less costly for a high value of the discount factor, and this fact leads to a cost advantage of team production over individual production as formalized in the proposition.

3 Discussion

3.1 Properties of compensation

The equilibrium with peer pressure in the last section is one of the many possible equilibria in team production, but it has a special property: all male workers cannot improve their welfare over the equilibrium payoff through collusion when no monetary transfer is allowed among the workers.\(^{15}\) Thus, the male workers have no incentive to coordinate their behaviors in the equilibrium. The next proposition summarizes the main result.\(^{16}\)

**Proposition 3** Suppose that team production with peer pressure is employed in equilibrium. Then, some male workers are worse off in any other allocation compared with the equilibrium one, given the equilibrium strategy of the firm.

This result is in some sense an extension of Che and Yoo (2001) to the case of \( N \) workers; however, the result differs because I introduce an additional agent, the female worker. It is clear that she prefers to stay in the firm and thus has an incentive to make a side contract with the male workers to stop any peer pressure. The side contract, however, does not provide the male workers with

\(^{15}\)When monetary transfers are possible, the female worker who gains from childbearing can offer such transfers to the male workers in order to continue to work after childbearing. I exclude the possibility of a transfer in this section for two reasons. First, child rearing provides nonpecuniary benefits, and such benefits cannot be directly transferred. Second, monetary transfers are limited under the liquidity constraint. Moreover, collusion is unable to improve the equilibrium payoff when the benefit of childbearing, \( \pi \), is low even if the utility is transferable.

\(^{16}\)The proof is available in Nosaka (2009).
sufficient benefit to turn around their equilibrium behaviors when a monetary transfer among workers is not available.

The firm’s policy regarding no substitute workers in the case of childbearing plays a decisive role in this collusion proofness. In order to address why this strategy is critical, I assume, contrary to the equilibrium, that the firm employs a substitute worker after the female worker bears a child. Then, the payoffs of the male workers are unchanged even if the parenting female worker continues to work because her low productivity is compensated for by the substitute worker. On the contrary, the female worker gains greatly if she can stay in the firm after having a child. As a consequence, when the substitute worker is available, there exists a side contract that raises the welfare of the female worker, keeping that of the other workers unchanged.

3.2 Welfare

The present model reveals the possibility of a significant welfare loss in team production. In team production, the firm devises a compensation scheme such that the female worker can abandon the idea of childbearing in order to save the labor cost. In individual production, on the contrary, no such effects exist in equilibrium. As a result, individual production provides a higher level of welfare because of the benefit of child rearing.

This welfare result is formalized by the following proposition.\(^\text{17}\)

**Proposition 4 (Welfare)** Equilibrium is efficient in individual production. Equilibrium in team production is efficient if \(\bar{\alpha} \geq \alpha^c\) and inefficient if \(\bar{\alpha} < \alpha^c\).

It is noted that the team equilibrium is less efficient only if \(\bar{\alpha} < \alpha^c\), where women abandon the idea of childbearing.

The literature has examined both the benefits and the costs of team production or joint performance compensation, and this study presents the additional negative aspects of team production. The free rider problem is a typical negative aspect of team production (Holmstrom 1982); however, subsequent studies have investigated many positive aspects of team production, especially focusing on coordination, peer monitoring, and synergy among workers within a team (Che and Yoo 2001). My model thus presents a negative aspect of team production that is attributable to peer monitoring.

\(^{17}\)The proof is available in Nosaka (2009).
3.3 Policy implications

In this subsection, I investigate the robustness of the main results and the effects of labor legislation. I in particular focus upon the three assumptions of the model: the high level of compensation for parenting women, introduction of substitute workers, and availability of other labor contracts.\textsuperscript{18}

I start with the discussion of the effects of compensation for parenting women. In the basic model, the compensation of a parenting female worker is the same as that of her coworkers even after childbearing. The compensation levels, however, are in general lower after childbirth. In order to address this issue, I introduce modified labor legislation under which the legally mandated compensation of the parenting female worker, denoted by $b_m$, is lower than that of her male counterparts.\textsuperscript{19}

When compensation reduces, the firm may prefer individual to team production for the following two reasons. First, the firm directly saves the labor cost for the parenting female worker in individual production. Second, even in individual production, the female worker may choose her job over childbearing in order to avoid low compensation. However, even in the cases of low compensation during parenting periods, team production may still be a better option for firms when $b_m$ has some positive lower bound. This is particularly true when the discount factor ($\delta$) is high.\textsuperscript{20}

I then consider the role of substitute workers in the model. Since the introduction of substitute workers makes team production less attractive, I am able to consider the new requirement that mandates a substitute worker to support the female worker who bears a child. However, the introduction of a substitute worker itself does not alter the equilibrium strategy of the workers in team production. Each worker engages in peer pressure activities because it is his or her best response to the condition that the other workers do the same. The optimal strategies are unchanged even if a new substitute worker is introduced. Because the source of equilibrium lies in coordination among the workers, all of them have to coordinate and alter their behaviors. Coordinated changes in the workers’ behaviors are thus required to alter the equilibrium.

This model’s prediction is therefore consistent with recent empirical evi-\textsuperscript{18}The detailed discussion is provided in Nosaka (2009).
\textsuperscript{19}This implies that $b_m < q_1 w$, where $w$ is the bonus paid when performance is successful and depends on the way in which production is organized within the firm.
\textsuperscript{20}In Nosaka (2009), I discussed the detailed conditions on the profitability of team production in this case.
idence that family policies that aim to raise fertility are more effective when combined with other remedies that alter the attitude and coordinated behaviors of all the workers within a firm as stated in the Introduction (Staines and Galinsky 1992). My model also indicates that the team leader is crucial to successful policy reform because he or she occupies a position capable of affecting coordination among workers within the team.

As the last topic for discussion, I consider the availability of other labor contracts in the model. The firm and female worker may make binding contracts that may be contingent on their choices. For example, the female worker may accept a low bonus before and after childbearing or pay any entrance fee in exchange for the introduction of individual production or any arrangements that eliminate peer pressure.

I argue that these arrangements are less likely to be feasible from several viewpoints. First, labor legislation or legal constraints such as the minimum wage law and equal employment law prevent such arrangements. Although some bilateral contracts are possible, these agreements are not enforceable because no third party would implement these illegal agreements. Second, there exist many informational and financial constraints that make the contract difficult. For example, workers are unable to pay the entrance fee when hired because of the liquidity constraint. Third, it is costly to negotiate over how production is organized when the firm hires female workers.21

4 Conclusion

This study investigates the effect of organization and norms within a firm on the job separation decisions of working women. When labor legislation ensures the employment and wage compensation of the parenting female worker during child rearing, the firm has an incentive to introduce team production in order to gain the benefit from peer monitoring. In team production, it is in the best interests of workers to put peer pressure on parenting female workers so that these women quit their jobs voluntarily. This threat of indirect dismissal forces the female worker to choose between job separation with a child and working without a child, which leads to a high opportunity cost of childbearing. Moreover, the allocation can be inefficient in team production from the social standpoint because the firm maximizes profit without taking into account the

21These costs include those of negotiation with male workers.
social benefit of child rearing. With regard to policy implications, I argue that simple policies aimed at raising fertility may be ineffective because it is optimal for workers to put peer pressure on the parenting female worker as long as the other workers do the same. The coordinated change in behaviors, in addition to the reform of legislation, is critical to break the equilibrium with peer pressure. While the model is too simple to include the complex aspects of labor legislation and institutions, I believe that social norms are more or less created endogenously by the optimal decisions of economic agents.

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References


