Economic analysis on vicarious liability

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abstract Vicarious liability is usually the absolute liability of employer for misconduct of the agent. They have said that if the agent has limited assets, the vicarious liability leads the employer effectively to monitor the employee and in turn, the employee to take more care. However we can consider another vicarious liability rule under a duty-based standard such negligence. The employer is liable when the employee is proved to be liable from the point of negligence of care and the employer is proved to be negligent for supervising for the employee. So for the employer to be liable for employer responsibility, we must prove the double negligence. Then, we conclude that the target level of care is designed so as to equal to the legal standard level and , in contrast, the actual monitoring level that the employer chooses does not satisfy the legal standard level of monitoring.

1 Introduction

In this paper, we investigate liability rules for tort action of employee between employer and employee. In particular, we consider about how the supervising liability of employer and tort action of employee should be allocated.

Vicarious liability is usually the absolute liability of employer for misconduct of the agent. They have said that if the agent has limited assets, the vicarious liability leads the employer effectively to monitor the employee and in turn, the employee to take more care. However we can consider another vicarious liability rule under a duty-based standard such negligence.

Theoretical research on this issue began from Kornhouser(1982) and Sykes(1981). They insist that vicarious liability is more likely to increase social welfare

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from the point of the insolvency of agents and the limitations on the ability to shift liability. So far many contributions have been made. (Chu and Qian(1995), Polinsky and Shavell(1993), Arlen(1994), Previleggi,Marchese, and Cassone(2002), Bisso, J.C., and A.H. Choi,(2008))

1.1 Tort law in Japan

Employer liability In Japan, it is provided by the Civil Code 715 that a master is responsible for the wrongdoing of a servant in the course of employment. The master's responsibility is under the negligence of supervising for a servant. When the servant is proved to be liable from the point of negligence of care. Although the Japanese legislators of Civil Code accepted this rule from German Civil Code 831,a number of courts have not admitted the exculpation of master. This attitude of courts is influenced from traditional doctrine of respondent superior and the old Civil Code of 1892 that was derived from French Civil Code. This is actually strict liability for the employer. Therefore this trend was considered as vicarious liability under the negligence principle of the agent's tort.

Recently considering that in large companies damages to outsiders become often large and it is pretty difficult to find out the injurer and prove the fault of the injurer, they sometimes say that the company itself should be liable for the damage. This means for the tort action of the agent in a company, the negligence rule of the tort law directly is applied to the company itself.

1.2 The design of enforcement system

In this paper we consider the design problem of enforcement system for controlling the tort action in the employer-employee relation. We describe the following story.

Firstly an employer and an employee make an agreement on the wage-activity system. The employee's activity has the possibility of incurring a damage to outsider. Though the employee can be engaged in a regular activity designated in advance. he can be engaged in a careless activity. More careful activity decreases the possibility of occurrence of damage. Since the damage may give some punishment to the employer under a tort law, he will try to make an incentive to induce the employee to do more careful activity. The employer makes it by designing an adequate wage system and monitoring activity to the employee.

2 The model

2.1 First Best Activity and Strict Liability

Both players are assumed to be risk-neutral. The probability of occurrence of the damage depends of the care level e of the employee. This is represented by a decreasing function $p(e)$, with $p'(e) < 0, p"(e) > 0, and p'(0) = -\infty$. We normalize the care level e to be equal to the cost of care which the employee incurs. And the size of damage is constant regardless of the care level of employee.

First best level When the care level of employee is a perfect information, the most desirable care level can be obtained from the social point of view. This is the level of minimizing the social cost composing of the care cost and the expected damage. That is,

$$\min_e e + p(e)D$$

Therefore, the first best care level satisfies

$$1 + p'(e)D = 0 \tag{1}$$

, showing that at the first best care level the marginal care cost is equal to marginal value of expected decrease of damage. Let us denote the level by$\hat{e}$. We easily obtain $d\hat{e}/dD > 0$.

Monitoring and strict liability Now let consider the situation where the care level is not observable costlessly. Then suppose that the law of strict liability for the damage is installed. Under this liability rule, the employee is liable to the damage regardless of any care level and any monitoring level, when the damage occurs. However the employee is under the judgment-proof situation. Particularly we assume the employee's asset is zero. In this situation, any adequate care level would be not taken by the employee. So a vicarious liability rule may be introduced. Then it becomes possible to control the care level through any wage incentive system that the employer designs. Suppose the burden ratio of the damage D of the employer is α, with $0 \leq \alpha \leq 1$. Let exclude the case of punitive liability. Anyway the level of the burden ratio α is the matter of legal policy.

Now the employer designs a target care level which the employee must make makes and decide the monitoring level to observe the care level of the employee.

Increasing the level of monitoring increases the possibility of finding out the employee's care level and the proof. That is , the care level can be verifiable by making the monitoring activity. This probability of finding out the true care level is assumed to be the monitoring level a itself. The probability of failing to find the true level is $1 - a$. The cost of monitoring is $C(a)$, with $C'(a) > 0, C(a)" > 0$, and $C'(1) = \infty$.

Then the employer designs the enforcement plan of the target care level and a wage system. Let denote the target care level e_1. If the employer finds out that the employee makes the target level, she is paid w_1, and if he finds out that she makes the care level lower than the target level, she is paid w_0.Here if the employer fails to find out the true care level, the wage is assumed to be equal to w_1.

Then we have to satisfy the incentive compatible condition to induce the employee to make the target care level. This is shown by the following,

$$w_2 - e_1 \geq aw_1 + (1 - a)w_2 - 0 \tag{2}$$

Here the left hand side of this inequality is the expected utility when the target care level is chosen and the right hand side is the expected utility when the deviation is chosen. In the case of the deviation, obviously the employee would choose the minimum care level zero. Needless to say, the employee also has no motivation to choose beyond the target care level.

We have to satisfy the participation constraint for the employee. Assuming the reservation utility for the employee is zero, this participation constraint is satisfied as follows.

$$w_2 - e_1 \geq 0 \tag{3}$$

Meanwhile, the expected cost of the employer for the enforcement plan is obtained by

$$w_2 + C(a) + p(e_1)\alpha D \tag{4}$$

This is the summation of the wage for the employee, the monitoring cost, and the expected damage which the employer bears under the strict liability. In summary, the optimal enforce plan for the employer is to minimize this expected cost subject to the incentive compatible condition and the participation condition.

For a target care level e_1, the above incentive constraint is rewritten as follows.

$$w_2 \geq w_1 + \frac{e}{a} \geq e_1 \tag{5}$$

Therefore, from the point of minimizing the expected cost, $w_2 = \frac{e_1}{a}$ and $w_1 = 0$ are satisfied. Then we decide the target care level e_1 and the monitoring

level a to minimize the expected cost for the employer as following

$$\frac{e_1}{a} + C(a) + p(e_1)\alpha D$$

Then the following two equations are held.

$$\frac{1}{a} + p'(e_1)\alpha D = 0 \tag{6}$$

$$-\frac{e_1}{a^2} + C'(a) = 0 \tag{7}$$

(5) means that the optimal care level is decided so as the marginal wage increase to be equal to the marginal decrease of expected damage burden. (6) means that the optimal monitoring level is decided so as the marginal wage decrease to be equal to the marginal monitoring cost. These optimal levels are denoted $e_1(\alpha)$ and $a_1(\alpha)$.Obviously the optimal care level is smaller than the first best care level, except for the case of the damage burden ratio $\alpha = 1$. Therefore the following lemma is held.

Lemma1 *The care level under the strict liability*

Under the strict liability, the care level is smaller than the first best level. However, if $\alpha = 1$ and $C'(1) < 1$ are held, the care level and the monitoring level equal to first best level.

To investigate the effect of the change of damage burden ratio on the care level and monitoring level, we calculate $de_1/d\alpha$. This is

$$\frac{de_1}{d\alpha} = -\frac{-2e(p'D)^2\alpha + C"(\frac{1}{p'D\alpha^2})}{-((p'\alpha D)^2 - 2ep'p"(\alpha D)^2 + C"(\frac{p"}{\alpha Dp'^2})}$$

Since the sign of denominator is positive for the second order condition of the minimization problem. From this, the above equation is positive. Likewise, we have $da/d\alpha > 0$. Therefore the flowing lemma is held.

Lemma2 *The change of damage burden ratio and the strict liability*

Under the strict liability, when the damage burden ration of the employer goes up, then the monitoring level increases and the care level of the employee goes up. Then the expected cost of the employer also increases.

Then the social expected cost is written as follows.

$$e_1(\alpha) + C(a(\alpha)) + p(\alpha)D$$

Let us see the effect of the change of damage burden ratio α for the employer on the expected social cost. Since the increase of the damage burden ration increases the care level and the monitoring level, the cost monitoring cost also increases. But the increase of the ratio decreases the probability of occurrence of the damage. Therefore when the damage itself is sufficiently large, the expected social cost can decrease by setting the burden ratio $\alpha = 1$. And when the damage level is sufficiently small, the optimal burden ration is obtained at an interior point in the interval (0,1).

3 Negligence rule and enforcement policy

In this section, under the negligence rule, the optimal enforcement policy for the care level and the monitoring level are investigated. As we mention in the introduction, in Japan, it is provided by the Civil Code 715 that an employer is responsible for the wrongdoing of an employee. This means that the employer is liable when the employee is proved to be liable from the point of negligence of care and the employer is proved to be negligent for supervising for the employee. So for the employer to be liable for employer responsibility, we must prove the double negligence. Moreover, while the proof of the employee's liability has to be done by the victim, the proof of the employer's supervising responsibility only has to be done by the employer. In general, while the proof of the employee's liability is difficult to the victim, the proof of the employer' supervising responsibility is easier to the employer. This is actually strict liability for the employer. Therefore this is also considered as vicarious liability under the negligence principle of the agent's tort. Let us formalize this legal schema under the following time line.

Firstly, the legal authority announces a legal policy of the standard level of care and the standard level of monitoring. Then the employer designs the monitoring level and the target care level for the employee and a wage system. Then the employee chooses a care level. Unfortunately, a damage occurs to a third party. the victim decides if he inquires into the proof of the employee' responsibility or not. When he inquires into the proof and cannot verify the negligence of the employee, the game ends. However when the victim can verify proof of the negligence, the employee is convicted to be negligent. But the employee is under judgment-proof. So the victim goes to the gate of employer.

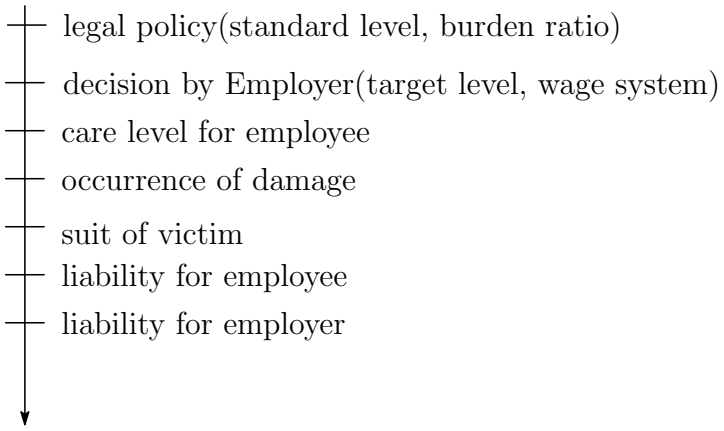

Figure 1: time line

If the employer is appealed by the victim for negligence of the supervising responsibility, the employer himself must do the proof of being innocent. If the employer cannot prove his innocence, he is found to be negligent and has to pay the damage.

3.1 Optimal care level and optimal monitoring level

The authority sets a standard monitoring level a^* for employer and a standard care level e^* for employee. Therefore if the employer and employee choose the levels of care and monitoring smaller than both of these standard levels. The employer responsibility may be imposed. How does the employer choose the target care level and wage system and the monitoring level, facing to the standard level of care and monitoring ? Let us resolve this problem by dividing into four cases

Case 1 $(e \geq e^*, a \geq a^*)$ In this case, the employer chooses the target care level larger than legal standard level and the monitoring level larger than the legal standard level. The target care level is attained by the corresponding wage system. This is satisfied by (5). Then when the damage occurs, the victim investigates the employee 's care level. At this time , the employer can verify the employee's care level with the probability a by the monitoring activity. If the employer succeeds in the monitoring, he can hand the evidence to the victim. We assume the disclosure of the information is obligated. Therefore at this time the employer hand the evidence to the victim. But if the employer

fails in the monitoring, the victim has to seek the evidence of the employee's care level by himself. This search cost is assumed to be $T > 0$.

From the above discussion, in the case 1,the enforcement policy for the employer can describe as follows.

Firstly, we have

$$w_2 - e \geq 0$$

$$w_2 - e \geq (1-a)w_2 + aw_1 - 0$$

, the employer's expected cost is

$$w_2 + C(a)$$

. Therefore, we can obtain $e = e^*,\ w_2 = e^*/a,\ w_1 = 0$. So, the employer's expected cost is represented by

$$\pi_1 = \frac{e^*}{a} + C(a)$$

. Here let us denote as $a(e^*)$ the monitoring level satisfying the following equation.

$$-\frac{e^*}{a^2} + C'(a) = 0$$

Then for the legal standard level of monitoring $a*$, the actual monitoring level a_1 is shown by

$$a_1 = a(e^*) \quad if \quad a(e^*) \geq a^*$$

$$a_1 = a^* \quad if \quad a(e^*) \leq a^*$$

Therefore, the expected social cost is

$$C(a_1) + p(e^*)D + e^* + p(e^*)(1-a_1)T$$

The second term is the expected damage, which is exposed to the victim since in this case both of the employer and the employee do not bear the burden under this negligence rule. The third term is the expected cost of verification for the victim.

Case 2 $(e > e^*, a < a^*)$ This is the case where the target care level satisfies the legal standard level and the monitoring level does not satisfy the legal standard level. In this case, if the employer has the evidence of the employee's care level, he would not want to reveal the evidence, because if so, his supervising responsibility becomes at issue and since he does not in fact satisfy the legal

standard level of monitoring, he would be liable. Therefore, the victim has to find out the evidence of the employee's care level with a cost T. However, even if the victim finds out the evidence, his investigation ends in vain because the employee satisfies the legal standard level of care.

From the above discussion, we can get the optimal enforcement policy for the employer as follows. Firstly, the incentive system is, as in the case1,

$$w_2 - e \geq 0$$

$$w_2 - e \geq (1-a)w_2 + aw_1 - 0$$

Then 、

$$w_2 = \frac{e^*}{a}, w_1 = 0, e = e^*$$

are obtained. Hence, the expected cost for the employer is

$$\Pi_2 = e^* + C(a)$$

From this, the optimal monitoring level is

$$a_2 = a^* \quad if \quad a(e_* \geq a^*$$

$$a_2 = a(e^*) \quad if \quad a(e_*) \leq a^*$$

Therefore, the expected social cost is

$$C(a_2) + p(e^*)D + e^* + p(e^*)T$$

Here, the third term comes from the fact that the victim always bears the investigation cost when the damage occurs.

Case 3 $(e \leq e^*, a \geq a^*)$ This is the case where the monitoring level satisfies the legal standard level, but the employee's care level does not satisfy the legal standard level. In this case, when the damage occurs, the victim tries to find out the evidence of the employee's care level with a cost T. When the employee takes the low level of care, it is considerably difficult to find out the evidence of the care level. Therefore, in the following, we assume that when the employee does not satisfy the legal standard level, the probability of finding the evidence is t(¡1) even if the victim bears the investigation cost T. Though the employer finds out the evidence of the employee's care level via monitoring with the probability a. The employee's liability would be revealed and the next becomes his turn if he hands the evidence of care level to the court. At

this time , since the employer satisfy the legal standard level of monitoring, he is excused. But since the procedure of trial is costly, we assume that the employer dares not to reveal the evidence of care level. Consequently the employee becomes liable with the probability t. Of course, the employer is not liable in the case.

From the above discussion, the optimal enforcement policy becomes as follows. As for the incentive system, we have

$$w_2 - e \geq 0$$

$$w_2 - e \geq (1-a)w_2 + aw_1 - 0$$

Hence, the expected cost of the employer is

$$\frac{e}{a} + C(a)$$

When we denote a monitoring level satisfying the following equation by $a = a(e)$

$$-\frac{e}{a^2} + C'(a) = 0$$

, If $a^* > a(e) > a(e)$,$a = a^*$is held, therefore $e = 0$ is obtained. If$a^* < a(e)$,$a = a(e)$is held. Since the employer's expected cost is an increasing function of e, it is desirable to make e as small as possible. Therefore、$a(e) < a^*$ is satisfied. Consequently $e = 0$ is held. Then the expected social cost is

$$p(0)(T + D) + C(a^*) \tag{8}$$

Case 4 $(e < e^*, a < a^*)$ This is a case where when the damage occurs, the employee is found to be liable with the probability t and the employer's responsibility becomes at issue. In this case, since the employer can not verify his excuse, he becomes liable. With the probability $1 - t$, the employee is not liable. Then even if the employer have the evidence of the employee's care level, he would not reveal the evidence because the employer becomes liable. So in the case the employee is not found to be liable.

From the above discussion, the employer's expected cost is

$$\frac{e}{a} + C(a) + p(e)t\alpha D$$

Then neglecting the case constraint, we have first order conditions for the minimization of this expected cost

$$-\frac{e}{a^2} + C'(a) = 0$$

$$\frac{1}{a} + p'(e)t\alpha D = 0$$

Let us denote a and e satisfying the two equations by $a(t\alpha D)$ and $e(t\alpha D)$ respectively. From the relationship of $(a*, e*)$and $(a(t\alpha D), e(t\alpha D)$, a and e are obtained. Then the expected social cost is

$$SC_4 = e_4 + C(a_4) + p(e_4)(D + T)$$

Here, the target care level minimizing this expected social cost, neglecting the case constraints, is represented as follows.

$$1 + p'(e)(D + T) = 0$$

Note that this target care level is obviously larger than $e(t\alpha D)$.

4 legal standard level of monitoring and care

So far we have examined the optimal enforcement policy for the employee given a pair of legal standard level of care and monitoring, by dividing the legal standard level and the employer' decision level into four possible cases. Here we will investigate the optimal legal policy for legal standard level of monitoring and legal standard level of care. As a way of analysis, we begin by making the comparison between case 1 and case 2 and the comparison between case 3 and case4. Then we will induce the optimal legal policy by the integration of the results of two comparisons

4.1 Comparison between case 1 and case 2

We will make comparison between case 1 and case 2. In case 1, the target care level and monitoring level are chosen so as to observe the two legal standard levels. In case 2, while the target care level satisfies the legal standard level, the monitoring level does not satisfy the legal standard level. So, refining our discussion to these two cases, we investigate which case the employer wants to pick up as more desirable enforcement policy, given a pair of legal standard levels.

Note that the employer's expected cost is same for these two cases as shown in the previous section. Therefore, for the legal standard level of care e^* given, $e = e^*$ is observed in either cases. We can represent the monitoring level minimizing the employer's expected cost, neglecting the legal standard level of care, as a function $a(e^*)$ of e^*.

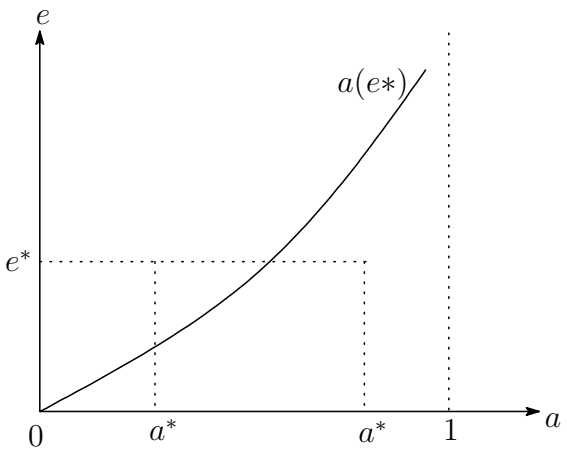

Figure 2:

This function is an increasing one. In figire.2, when a pair of legal standard levels is located on the right side of the curve $a(e^*)$, from (4) an (6), it is easy to show that in case 1, the target level of care is $a = a^*$ and in case 2, it is $a = a^*$. Then since the expected cost for the employer is lower in case 2, he will pick up the case 2. As a result, the expected social cost is

$$C(a(e^*) + p(e^*) + e^* + p(e^*)(1 - a(e^*))T$$

Therefore, the desirable legal standard level of care is obtained by minimizing this expected social cost.

On the other hand, when the pair of legal standard levels is located on the left side of the curve $a = a(e^*)$,form (4) and (6),it is shown that in case 1, the monitoring level is $a = a(e^*)$ and in case 2, it is $a = a^*$. Since the expected cost for the employer is lower in case 1, case 1 is picked up in the pair location. As a result, the expected social cost is

$$C(a(e^*)) + p(e^*)D + e^* + p(e^*)(1 - a(e^*))T$$

This first order condition of the minimization of this cost with respect to e^* is

$$C'(a(e^*)a'(e^*) + p'(e^*)D + 1 + p'(e^*)T = 0 \tag{9}$$

So when we compare the expected social cost realized in each case by optimal enforcement policy for the employer, given a pair of legal standard levels, case 1 is lower than case 2 because in case 1 the employer positively reveals the evidence of care level. Therefore case 1 is picked up, and hence the target level of care is satisfied by (20).

4.2 Comparison between case 3 and case 4

In case 3, from the previous discussion, the pair of target levels minimizing the expected cost for the employer is $(0, a^*)$ given any pair of legal standard levels (e^*, a^*).

Le us obtain a^* so that the minimum expected cost $C(a^*)$ is equal to the expected cost in case 4

$$\frac{e_4}{a_4} + e(a_4) + p(e_4)t\alpha D$$

This is discussed in two regions $e^* > e_4(t\alpha)$ and $e^* \leq e_4$.Obviously, in region 4 in figure 3, case 4 is picked up by the employer, and in region 3, case 3 is picked up.

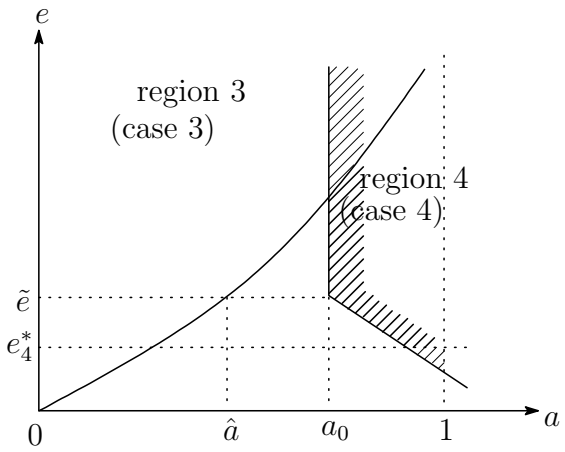

Figure 3:

From this discussion, in the region where case 3 is picked up, the monitoring level minimizing the social cost is given by $a = 0$ and in the region where case 4 is picked up, the social expected cost is

$$e + C(a) + p(e)(D + T)$$

In region 4 , when $e^* > e_4$, the pair of optimal target levels becomes (a_4, e_4)When $e^* < e_4$, the pair of optimal target level is determined by minimizing the expected cost for the employer

$$\frac{e^*}{a} + C(a) + p(e^*)t\alpha D$$

This is obviously on the curve $a = a(e^*$.Therefore, we only have to seek the target care level minimizing the social expected cost in case 4 on this curve. This means that we get e as follows

$$\min e + C(a(e)) + p(e)(D + T)$$

The first order condition for this problem is

$$1 + C'(a(e))a'(e) + p'(e)(D + T) = 0$$

Let us denote this optimal level by e_4^*. It is obvious that the corresponding optimal monitoring level is any level within region 4.

4.3 Optimal legal standard levels

We can obtain the optimal legal standard levels of monitoring and care by integrating the figure 2 and figure 3. Figure 4 is from the integration of two figures.

In region(A), case 1 and case 3 can be picked up by the employer. we see which case is finally picked up. Now for a pair (a^*, e^*) in this region, in case 1, $a(e^*)$ is chosen and in case 2, a^* is chosen, as shown previously. Since $a(e^*) > a^*$in this region,

$$\frac{e^*}{a(e^*) + C(a(e^*))} > C(a^*)$$

is shown. consequently, case 3 is chosen in this region.

In region (B), case 2 and case 3 is picked up. Which case is finally picked up? Here, note that the pair (a^*, e^*) satisfying

$$\frac{e^*}{a(e^*)} + C(a(e^*)) = C(a^*)$$

is represented by an increasing curve (M) in figure 5. In figure 5, region(B) is divided into region (B_1) and (B_2), and in region (B_1), case 3 is picked up and in region (B_2), case 2 is picked up.

Next, considering that case 4 and case 2 are picked up in region (C), we investigate which case is chosen. To do so, we obtain the target level of care e^* satisfying the following equation.

$$\frac{e_4^*}{a(e_4^*)} + C(a(e_4^*)) + p(e_4^*)t\alpha D = \frac{e^*}{a(e^*)} + C(a(e^*))$$

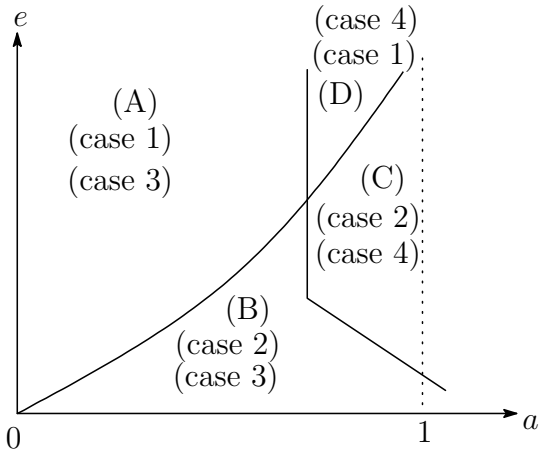

Figure 4:

From this consideration, region (C) is divided into region (C_1) and (C_2), and in region (C_1), case 2 is picked up and in region (C_2), case 4 is picked up.

Finally, in region D, case 1 and case 4 are picked up. However the expected cost for the employer in case 1 is obviously larger than in case 4. Therefore, case 4 is chosen in the region.

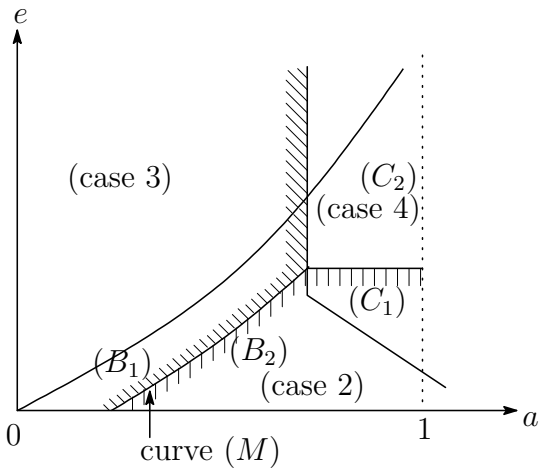

Figure 5:

From the above discussion, we obtain the following proposition.

Proposition 1 *Case 1 is not adopted for any legal standard level of moni-*

toring and care. This means that over-compliance is not realized.

Then we have to obtain the optimal legal policy, that is, the optimal standard levels of monitoring and care. In figure 5, we can get it by making the comparison between the minimum social costs in the case finally picked up in each region.

In the region where case 3 is picked up, it is shown that $a^* = 0, e^* = 0$. In the region where case 2 is picked up, the expected social cost is minimized by e_4^*. In the region where case 4 is picked up, a pair $(\tilde{a}_4, \tilde{e}_4)$ minimizes the expected cost. By comparing these cases, case 4 is optimal for expected social cost and then $(e_4^*), a(e_4^*)$ satisfying the following minimizing problem

$$\min e + C(a(e)) + p(e)(D + T)$$

is the actual target levels of monitoring and care. Therefore, the following proposition is held.

Proposition 2 When the victim bears the proof of liability of employee's tort and the employer bears the proof of his excuse for monitoring, the legal standard level is designed so as to equal to the target level of care that the employer choose, while the legal standard level of monitoring is designed so that the actual monitoring level that the employer chooses does not satisfy it.

5 The effect of employee's liability

So far, the wage system that the employer offers to the employee is confined by the incentive compatibility condition and participation condition. In this paper, the employee does not consider the possibility that she may bear the damage when she picks up the care level. Since we assume the judgment-proof for the employee, this consideration is not necessary to the employee. However if the employee has to bear some burden of the damage, the employee will choose the care level under this consideration.

Suppose that the employee has to bear a part of the damage when she is liable. The damage burden is δ. Let us consider this problem in case 1. When she chooses a care level smaller than the target level and the damage occurs, the victim verifies the her liability with probability t. Therefore in the case, she has to bear δ Here, let us denote the level obtained by the following problem by e^0

$$\min e + p(e)t\delta$$

Then we define

$$\hat{e}_0 = e^0 + p(e^0)t\delta$$

Suppose that for the legal standard level of care, $e^* > e^0$ is held. In case 1, since $e^1 > e^*$, the incentive compatible condition is

$$w_2 - e_1 \geq aw_1 + (1-a)w_0 - e \quad (\text{if} \quad e^1 > e > e^*)$$

$$w_2 - e_1 \geq aw_1 + (1-a)w_0 - e - p(e)t\delta \quad (\text{if} \quad e < e^*)$$

From these two equations ,

$$w_2 - e_1 \geq aw_1 + (1-a)w_2 - \min\{e^*, e^0\}$$

Therefore, the incentive compatible condition is

$$a(w_2 - w_1) \leq e_1 - \min\{e^*, e^0 + p(e^0)\}$$

Therfore, we have

$$w_2 \geq e_1 + w_1 + \frac{e_1(1-a) - \min\{e^*, \hat{e}_0\}}{a}$$

Considering the participation condition

$$w_2 - e_1 \geq 0$$

,if $e_1(1-a) - \min\{e^*, \hat{e}_0\} \geq 0$, we obtain

$$w_2 = e_1 + \frac{e_1(1-a) - \min\{e^*, \hat{e}_0\}}{a}$$

and if $e_1(1-a) - \min\{e^*, \hat{e}_0\} \leq 0$, we obtain $w_2 = e_1$.If $e^* \geq \hat{e}_0$, that is, $e_1(1-a) - \hat{e}_0 \geq 0$, the expected cost for the employer is

$$w_2 + C(a) = e_1 + \frac{e_1(1-a) - \hat{e}_0}{a} + C(a)$$

Therefore $e_1 = e^*$ is held. Then, since this expected cost is

$$\frac{e^* - \hat{e}_0}{a} + C(a)$$

, we have $a = a(e^* - \hat{e}_0)$ from the minimum cost problem. Therefore, the optimal monitoring level is $a = a(e^* - \hat{e}_0)$. This means that if the employee has to bear the damage burden, the optimal monitoring level decreases.

Then the expected cost for the employer is

$$\frac{e^* - \hat{e}_0}{a(e^* - \hat{e}_0)} + C(a(e^* - \hat{e}_0))$$

Therefore, if the employee has to bear the damage burden, this expected cost decreases. Finally, if $e_1(1-a) - \min\{e^*, \hat{e}_0\} \leq 0$, the expected cost for the employer $e^* + C(a^*)$ decreases since $e_2 = e_1$.

From this discussion, considering that the employee may bear the damage when it occurs by the care level that she picked up. Since we assume the judgment-proof for the employee, the further investigation will be necessary in the framework of employer-employee.

Concluding remark Vicarious liability is usually the absolute liability of employer for misconduct of the agent. They have said that if the agent has limited assets, the vicarious liability leads the employer effectively to monitor the employee and in turn, the employee to take more care. However we can consider another vicarious liability rule under a duty-based standard such negligence. The employer is liable when the employee is proved to be liable from the point of negligence of care and the employer is proved to be negligent for supervising for the employee. So for the employer to be liable for employer responsibility, we must prove the double negligence. Then, we conclude that the target level of care is designed so as to equal to the legal standard level and , in contrast, the actual monitoring level that the employer chooses does not satisfy the legal standard level of monitoring.

Considering that the employee may bear the damage when it occurs by the care level that she picked up . Since we assume the judgment-proof for the employee, the further investigation will be necessary in the framework of employer-employee.

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