INEQUITY AVERSION IN THREE LEVEL HIERARCHIES

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ABSTRACT

INEQUITY AVERSION IN THREE LEVEL HIERARCHIES

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This thesis studies the impacts of wage differences between employees and their immediate superiors in the principal-supervisor-agent framework. It integrates Fehr and Schmidt's (1999) inequity aversion approach into Tirole's (1986) three-level hierarchical model. Due to the inequity averse employees, we observe alterations in the optimal contract parameters as well as the collusion structure. If the supervisor's sensitivity to being behind the principal is higher than the agent's sensitivity to being behind the supervisor, the effort level induced by the principal is lower.

Keywords: Inequity Aversion, Other-Regarding Preferences, Three Level Hierarchies, Optimal Contract Design, Collusive Behavior

ÖZ

ÜÇ KATMANLI HİYERARŞİLERDE EŞİTSİZLİKTEN KAÇINMA

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Bu tez, çalışanlar ve onların birinci dereceden üstleri arasındaki ücret farklılıklarının etkilerini, işveren-denetçi-çalışan çerçevesinde incelemektedir. Fehr ve Schmidt'in (1999) eşitsizlikten kaçınma yaklaşımını, Tirole'ün (1986) üç katmanlı hiyerarşik modeline entegre eder. Eşitsizlikten kaçınan çalışanlar nedeniyle, optimal sözleşme parametrelerinde ve gizli anlaşma yapısında değişiklikler gözlemliyoruz. Eğer denetçinin işverenin gerisinde kalma hassasiyeti, çalışanın denetçinin gerisinde kalma hassasiyetinden yüksekse, işverenenin elde edeceği efor seviyesi daha düşük olacaktır.

Anahtar Kelimeler: Eşitsizlikten Kaçınma, Sosyal Tercihler, Üç Katmanlı Hiyerarşi, Optimal Kontrat Dizaynı, Gizli Anlaşmalar

In memory of my mother, Türkan Tel

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CHAPTER 1

INTRODUCTION

Collusive behavior is a natural phenomenon in organizations. In all types of organizations, individuals might collude with other parties for their own interest to increase their earnings. For instance, a government officer might accept bribes to not prosecute the guilty parties, or alternatively, an employee in a commercial organization might want to earn more while working less. Studies focusing on understanding, analyzing, and solving this problem mostly follow the self-interest approach. This assumption is based on the fact that individuals only consider themselves. They are not concerned with the possessions and situations of others. In this sense, numerous studies are performed to prevent collusion between parties based on the self-interest approach.

Tirole (1986) added the supervisor to the organizational form which was initially constructed as principal-agent network, taking into account the sociological studies in his work, which is one of the reference points for our thesis. Thus, principal-supervisor-agent organization known as three-level hierarchy was born. However, in his seminal framework, although he considered the relationship between the parties, they were only driven by self-interest. Hence, he omitted the effects of interacting parties in his model. Similarly, the standard literature examining the principal-agent framework has also used only the self-interested parties.

Based on the fact that the self-interest approach is lacking the required level of complexity to address real-life problems, some models such as the ones in Itoh (2004) and Giebe and Gürtler (2011) incorporated other-regarding preferences. However, these studies were not inclusive enough to create a theoretical structure. Hence, designing an optimal contract for the three-level hierarchy with the inclusion of other-regarding preferences is a vital concept to be contemplated.

Kucuksenel and Saygili (2019) considered that the self-interest method is not sufficient to represent real-life problems and advanced the analysis by adding other-regarding preferences into a hierarchical model in their work. They upgraded Tirole's (1986) framework with a structure in which an employee does not only think about herself but also considers another employee. Their aim was to examine how other-regarding preferences affect the three-layer hierarchy, namely principal-supervisor-agent, in organizational form. The impacts of this structure on optimal contract design were explored in their study. This thesis is built on their work by covering additional aspects in the three-layer hierarchy. We consider the organization as a whole and examine not only the employees, the supervisor and the agent, but also the owner of the firm, the principal, in our model in terms of the inequity aversion approach.

Campbell and Kamplani (1997) show that an employee does care about the status of her coworker in terms of inequality and is affected by this situation in their empirical study. Taking these into account, Kucuksenel and Saygili (2019) introduce the other-regarding preferences to Tirole's (1986) framework to investigate its effects on the tendency for collusion. When implementing this, the supervisor's and the agent's utilities are constructed by considering other-regarding preferences. Due to its convenience, Fehr and Schmidt's (1999) utility functions are used in their work. In this way, they examine how the wage differences between the supervisor and the agent influence the general structure. That is, the effort level induced by the principal, the supervisor's and the agent's wage are examined in the perspective of designing an optimal contract, therefore, adding additional complexities in comparison to Tirole's (1986) benchmark case.

Eisenkopf and Teyssier (2016) suggest that an agent tends to compare her situation with her superior's in their experimental work. We believe it is compatible with real-life considering that an individual does care not only herself but also her superior's condition in an organization. At this point, the following question comes to mind. How can an organization function properly when subordinates are conflicting with their superiors? In this thesis, we try to find the answer to this question. We believe that this point of view will be beneficial for us in understanding today's problems.

In the light of the Kucuksenel and Saygili's (2019) approach, individuals who care about the others, and Eisenkopf and Teyssier's (2016) vertical other-regarding preferences, the self-

comparison with the superior, this thesis is modeled such that a subordinate has inequity aversion approach towards her immediate superior. Since Tirole's (1986) hierarchical structure has three parties which are the principal, the supervisor, and the agent with a vertical relationship between them, we analyze these other-regarding preferences and their consequences based on Tirole's (1986) work. In other words, we examine a structure in which the agent compares herself with the supervisor as well as the supervisor compares herself with the principal.

Our main addition to the earlier work is introducing a supervisor with inequity aversion tendencies towards her superior, the principal. Kucuksenel and Saygili (2019) do not include the principal in terms of other-regarding preferences in their work. We think that the supervisor's desire to get the same level of wage as the principal is of equal importance to the agent's willingness to get the same level of wage as the supervisor. Therefore, we combine other-regarding preferences in the totality of the three-layer hierarchy.

The introduction of a supervisor comparing her wage with the principal's wage has implications for the amount required for collusion between the agent and the supervisor. Due to the utilities coming from the inequity aversion part, the amount the agent transfers to the supervisor in cases in which the agent is the briber side declines in comparison to the self-interest case. However, it is recognized that the supervisor is more prone to collude. In an opposite case in which the supervisor is the briber side, we observe a similar pattern as in the first case. That is, the supervisor is more reluctant and the agent is more prone to collude in comparison to Tirole's (1986) benchmark case. The components that should be taken into consideration by the principal such as the effort level, the agent's wage, and the supervisor's wage are also altered. However, the rankings of these components in different states have similar characteristics as in the self-interest case. Consequently, the inequity aversion approach matters in the principal-supervisor-agent framework.

Literature is reviewed in the next chapter. Afterward, we construct our main model which is Tirole's (1986) framework employing Fehr and Schmidt's (1999) utility functions. In Chapter 4, we investigate the impact of the supervisor who is inequity averse towards the principal in light of designing an optimal contract. Due to hidden action and information problems, the focus is to solve the principal's problem when she aims to design a coalition-proof contract. Our results are provided and compared with the self-interest case which has no other-regarding

preferences. After briefly discussing the inequity averse agent case, the results regarding the general solution are analyzed. In the condition in which an organization has both inequity averse agent and inequity averse supervisor, the total impact is investigated. Lastly, we summarize key points and refer to possible future studies in Chapter 5. All proofs are gathered in the Appendix.

CHAPTER 2

LITERATURE REVIEW

In the broadest sense, the related literature for our thesis can be sub-categorized into two fields. One of them is the contract theory, which is associated with three level hierarchies and subheadings. The main concern of it is to design an optimal contract and provide necessary incentives to ensure the proper functioning of organizations. Another area is other-regarding preferences which examine the effects of interacting parties. In our work, the focus is on the concept of inequity aversion with a bottom-to-top approach, relating to less paid parties in an organizational structure.

The review of related literature should start with the contract theory. In vertical hierarchies, the first theoretical analyses are done in models consisting of the principal and the agent. Tirole's (1986) seminal study contributes to this field by adding a supervisor with an aim of monitoring the agent and her environment on behalf of the principal. Due to hidden action problem stemming from the fact that the effort level exerted by the agent is not observed by the principal and hidden information problem resulting from that the productivity level is not observed perfectly by the principal as well as the possibility of collusion between the supervisor and the agent, the studies focusing on contract theory become even more important. Adding a supervisor into principal-agent framework induces collusion possibilities between employees, the supervisor and the agent. To prevent this new condition, the incentive mechanisms are expanded in the literature. After this contribution, the significant number of studies followed in his footsteps.

Kofman and Lawarree (1993) argue whether assigning an external supervisor (auditor) is beneficial for the organization or not. In their study, the external supervisor is assumed to not collude. Her goal is to keep an eye on the internal supervisor. Although they are trustworthy,

their knowledge about the progress of the work is not as extensive as the internal supervisor. As a result, they conclude that the effect of using an external supervisor for the organization is ambiguous. They also reveal that assigning random external supervisors for the organization may improve the conditions in the search for designing an optimal contract.

The importance of the role of the supervisor is also analyzed by Strausz (1997). He investigates two cases namely either the principal monitors the agent herself or hires a supervisor for this task. He shows that assigning the task of monitoring the agent to the supervisor is profitable for the principal. Besides, the incentives can be adjusted more appropriately by hiring a supervisor.

Kofman and Lawarree (1996) introduce honest and dishonest supervisors in another work. It is assumed that the principal cannot differentiate these types. Due to these different profiles, the situations of deterring and allowing collusion are costly in different dimensions. In other words, if the principal allows collusion, dishonest supervisors benefit from this situation and it negatively affects the principal. However, if the principal prefers to deter collusion, both honest and dishonest supervisors have to be paid more. They show that if the punishment set by the principal is high enough, the principal always finds it optimal to allow collusion.

Supervision costs and the ex-ante collusion possibility are introduced to Tirole's (1986) benchmark by Bac and Kucuksenel (2006). Unlike the basic model, the supervisor has a cost burden when monitoring the agent. By defining the situation of collusion in the benchmark model as ex-post collusion, ex-ante collusion is described as closing the supervisor's eye by the agent. That is, the supervisor is offered a bribe by the agent at first not to monitor her. They show that when the monitoring cost the supervisor faces is small and the probability of the supervisor's observing the true nature of productivity level is large, ex-ante collusion can be ignored.

When it comes to other-regarding preferences, another related literature, Fehr and Schmidt's (1999) inequity aversion concept is significant in the aspect of adopting the distributional approach. For two actors, the linear utility function is constructed to show their other-regarding preferences. Their mathematical approach can be easily employed in other fields due to its simplicity and tractability.

Itoh's (2004) paper is also a significant one that aims to combine other-regarding preferences with principal-agent relations by fundamentally considering the inequity aversion approach. In the vertical hierarchical perspective, when the agent does care about the principal's well-being, the principal is generally affected badly by this attitude. On the other hand, if the organization has multiple agents who care about each other, this situation is exploited by the principal for her own benefit while designing an optimal contract.

Dur and Glazer (2008) analyze that a worker envying her employer in principal-agent model. The agent is in dilemma since increasing her effort may enrich the principal. The participation constraint of the agent is tightened because of envy. Therefore, either a higher wage or a lower effort level exerted by the agent is induced. They suggest that it is optimal for the principal to share the profit with the agent.

Eisenkopf and Teyssier (2016) show that if the principal is generous to the agents and specifies the strict separation regarding the conditions of the winner and the loser, higher effort levels are exerted by the agents in their experimental work, a tournament with a principal and two agents. More importantly, they illustrate that an agent does not show horizontal other-regarding preferences and vertical other-regarding preferences at the same time. That is, an agent either focuses on the principal or the other agent.

By considering past studies' insights, Kucuksenel and Saygili (2019) employ other-regarding preferences into the three-level hierarchy network in the aspects of the theoretical structure. Their major focus is to investigate the relationship between collusive behavior and optimal contract by examining the inequity aversion theory. The supervisor and the agent are considered as co-workers in their work and their opinions respective to each other are taken into account. They report that collusive behavior is altered by other-regarding preferences. Moreover, higher effort levels can be induced by the principal due to the inequity averse agent. Besides, based on the different statuses of the supervisor, the effort level exerted by the agent may differ.

Lastly, other-regarding preferences might be considered as human-specific motivations. Individuals may think these approaches can only be seen in humans. However, Brosnan and de Waal (2003) demonstrate that it is not unique to humans in their experimental study. When facing an unequal reward distribution, negative responses are given by primates. If a partner

gets a higher reward for equal effort, monkeys react with anger to this situation. In this sense, it can be claimed that concern for another's condition is an important factor for understanding the interacting parties.

CHAPTER 3

THE MODEL

Methodologically a similar approach as Kucuksenel and Saygili's (2019) work was applied in this thesis. Fundamentally, this work is based on Tirole's (1986) principal-supervisor-agent relationship studies. Fehr and Schmidt's (1999) work which provides the inequity aversion concept was also integrated into the model to further investigate the inequity aversion relationship between the agent at the lowest tier of hierarchy and the supervisor at the middle tier as well as the inequity aversion relationship between the supervisor and the principal at the highest tier.

To begin with, we specify Tirole's (1986) organizational form.

To mention the parties, Tirole's (1986) basic model consists of three parties, namely are the agent, the supervisor, and the principal. The principal is the owner of the firm. Therefore, she is at the highest tier of the hierarchy. According to this model, the goal of the principal is getting the maximum effort from the agent. Due to a hidden action problem (will be explained in detail later), the principal assigns a supervisor to monitor the agent with the expectation of maximum performance. However, this action creates the possibility of collusion between the agent and the supervisor. In order to be able to solve this problem, the principal has to adjust the wages of the agent and the supervisor and get the optimal solution with appropriate distribution.

In Tirole's (1986) benchmark, the only productive unit in the hierarchy is the agent. She exerts effort which can be denoted as $e > 0$ in producing units. The environment also adds an additional productivity parameter θ linked to technology that creates a hidden information problem. Therefore, output x is created by adding effort level and the productivity parameter as:

$$x = \theta + e$$

The agent is paid a wage denoted as W by the principal. On the other hand, the agent gets disutility when she exerts effort in the process of production. This disutility in monetary terms can be denoted as:

$$g(e) \; and \; g(0) = g'(0) = 0.$$

where $g(e)$ is strictly convex and strictly increasing.

Another party in this structure is the supervisor. Her main objective is to monitor the agent and the environment. Since the environment determines θ, the principal has to understand its true nature of it. It is important to note that the supervisor performs this job on behalf of the principal. When the supervisor monitors the agent, it is assumed that the supervisor does not exert any effort. Therefore, inspecting the agent does not have any cost burden on the supervisor. In this model, the supervisor gets paid S by the principal.

Output x is taken by the principal. Therefore, it can be considered as her wage. She pays the wages to the agent and the supervisor. We assume that the one who is hierarchically above gets a higher wage than the hierarchically lower ones in all states as in Kucuksenel and Saygili's (2019) work. This assumption is realistic and simple while constructing our model. We also believe this is compatible with real life. Hence, i.e.,

$$\theta + e > S > W$$

While establishing this model, we follow a similar method to Kucuksenel and Saygili's (2019) work. In their study, they examine the other-regarding preferences between the agent and the supervisor based on Tirole's (1986) benchmark. However, we add the principal and additionally analyze the hierarchy with a bottom to top approach in terms of inequity aversion. In our analysis, the agent focuses on her own payoff and the payoff of her interacting superior who is the supervisor. Similarly, in the case of the supervisor, the focus is her own payoff and the payoff of her interacting superior who is the principal. From now on, when the inequity

averse agent or the inequity averse supervisor are mentioned in our study, we refer to these relationships.

The utility of the agent includes her wage minus the cost in her effort (W-g(e)) and the wage comparison with the supervisor as a disutility. That is, (S-W). The utility of the supervisor includes her wage (S) and the wage comparison with the principal as a disutility. That is, $(\theta + e - S)$.

We decide to compare the gross wages excluding the effort costs and the wage payments as Kucuksenel and Saygili's (2019) work. As Cato (2013) and Neilson and Stowe (2010) nicely capture, individuals are more prone to compare direct wages instead of taking into account the effort levels or any kind of cost burden. Moreover, the parties may experience difficulties in assessing how much other participants work or whom they pay to. Hence, this information asymmetry may lead to some confusion when setting up the model. Another point is that Tirole's (1986) structure assumes the effort level exerted by the agent cannot be detected by the principal. Given this assumption, it is expected that a low tier employee cannot observe her superior's effort level and any cost she has perfectly. As a result, since we think this is more applicable in comparing wages, we model our thesis in this way with only considering gross wages.

The utility function of the agent who is inequity averse towards the supervisor is represented by employing Fehr and Schmidt's (1999) approach as:

$$U(W - g(e) - \lambda_{AS}(S - W))$$

The utility function of the supervisor who is inequity averse towards the principal is represented by employing Fehr and Schmidt's (1999) approach as:

$$V(S - \lambda_{SP}(\theta + e - S))$$

U and V are Von Neuman Morgenstern utility functions whose attributes are increasing, differentiable and strictly concave including $U'(0) = \infty$ and $V'(0) = \infty$.

λ_{AS} is the inequity aversion parameter between the agent and the supervisor from the point of view of the former. λ_{SP} is the inequity aversion parameter between the supervisor and the principal from the point of view of the former. We will focus on the inequity aversion part in the utilities from the perspective of weighted sum regarding λ_{AS} and λ_{SP} to simplify and satisfy the participation constraints. i.e., $0 < \lambda_{AS} < 1$ and $0 < \lambda_{SP} < 1$. It can be interpreted as the agent does not prefer being behind the supervisor and the supervisor does not prefer being behind the principal. It boils down to that as these parameters increase, the agent and the supervisor get more disutility. That means they are more sensitive to wage differences between their superiors and their own. If λ_{AS} and λ_{SP} decrease, they are less sensitive to wages differences. It is constructive to express that if $\lambda_{AS} = 0$ and $\lambda_{SP} = 0$, our model has the same features as Tirole's (1986).

Due to the possibility of different states (will be explained later) in this environment, it is plausible to use the notion of the expected utilities while constructing all parties' payoffs. The person at the top of the hierarchy, the principal, is risk-neutral. The arrangements are made by her in the organization regarding assigning, taking the output and paying the wages. These functions can be written as:

$$EU(W - g(e) - \lambda_{AS}(S - W)) \quad for\ the\ agent$$

$$EV(S - \lambda_{SP}(\theta + e - S)) \quad for\ the\ supervisor$$

$$E(x - S - W) = E(\theta + e - S - W) \quad for\ the\ principal$$

The agent and the supervisor have reservation wages W_0 and S_0 respectively. These wages correspond to $\overline{U} \equiv U(W_0)$ and $\overline{V} \equiv V(S_0)$. We combine these to get the individual rationality constraints:

$$EU(W - g(e) - \lambda_{AS}(S - W)) \geq \overline{U}$$

$$EV(S - \lambda_{SP}(\theta + e - S)) \geq \overline{V}$$

To specify hidden information problem, the level of exerted effort by the agent cannot be detected by both the principal and the supervisor. i.e., The agent is the only one who knows

her effort level. The effort level is determined by the agent after the productivity level arises. However, the environment determines the productivity levels which can be either low level $\underline{\theta}$ or high level $\overline{\theta}$ where $0 < \underline{\theta} < \overline{\theta}$, and $\Delta\theta = \overline{\theta} - \underline{\theta}$. Since the agent always knows about the productivity level and her effort level, we have four possible states based on the capability of the supervisor witnessing the productivity levels. Briefly;

State 1: $\underline{\theta}$ is observed by both.

State 2: $\underline{\theta}$ is observed by the agent. The supervisor fails to observe it.

State 3: $\overline{\theta}$ is observed by the agent. The supervisor fails to observe it.

State 4: $\overline{\theta}$ is observed by both.

The low productivity level $\underline{\theta}$ and the high productivity level $\overline{\theta}$ are common knowledge as well as their probability of occurrence. Moreover, one of these four possible states ultimately must happen in this environment. Therefore, $\sum_{i=1}^{i=4} p_i = 1$ where p_i is the probability of a state arising.

Finally, the situation in which the supervisor succeeds or fails in observing is known by the agent.

To mention timing, the sequence of events starts with a contract offered by the principal specifying the wages of the agent and the supervisor. They are considered as the functions of observable variables. These variables are x, λ_{AS}, λ_{SP} and the report the supervisor prepares for the principal, r. It is assumed that x, λ_{AS}, λ_{SP} and r are common knowledge for all actors. When the contract is offered by the principal, the agent's and the supervisor's wages are common knowledge as well. It is regarded as the main contract.

After the contract is confirmed by the agent and the supervisor, the possibility of side transfers arises between them. For side transfers to be implemented, it should be Pareto optimal for both. The function of side transfers has similar features to the previous one. Side transfers can be observed by the agent and the supervisor, however, not by the principal.

The supervisor's report can take two values which are either empty $r = \phi$ or $r = \theta$. She can conceal the information from the principal. However, she cannot fabricate it. That is, when θ

is observed by the supervisor successfully, she may prefer not to report it to the principal, or it must be true. When the supervisor reports the productivity level, the principal counts on it. Therefore, it is fair to assume that it is credible for the principal. On the other hand, if she fails while observing, then, it should be empty $r = \phi$. As explained earlier, the effort level is only known by the agent herself. The claims of the agent in terms of the productivity level cannot be thought of as credible.

After accepting the contract, θ is determined by the agent and she decides what her effort level would be. Since θ and e become evident, this situation means that the output x is produced. Then, the supervisor decides on how to report. After that, we observe what the state is.

Finally, we witness the execution of the contract. The wages of the agent and the supervisor are paid by the principal. If possible, we may see side transfers between the agent and the supervisor according to the choices they make.

We will refer Tirole's (1986) result in which the principal knows the true nature of the productivity level and the effort level exerted by the agent. By doing so, it will be used when we clarify our results.

To specify first best solution, at the end of this section, we know it from Tirole's (1986) work which has self-interested parties, that is, $\lambda_{AS} = 0$ and $\lambda_{SP} = 0$, that without hidden action and information problem, the supervisor is not required by the principal. That means the supervisor gets S_0 which is her reservation wage in all states. We can write the principal problem as:

$$\max_{e}\{\theta + e - g(e)\}$$

It can be easily recognized that $g'(e^*) = 1$ for both productivity levels. Besides, the agent wage should be $W = W_0 + g(e^*)$ in all states. When we solve the principal's problem in our model, $g'(e^*) = 1$ will be basically the reference point for our structure.

CHAPTER 4

ANALYSIS OF THE PRINCIPAL'S PROBLEM

We explained the general structure of our model in the previous chapter to comprehend how it works in an organizational form. The main concern of the model is to design an optimal contract for the principal since she is not able to grasp the agent's actual effort level and the productivity parameter the environment determines. Hence, the supervisor is hired by the principal to inspect the agent. However, as the productivity parameter θ may have different values and this circumstance generates a moral hazard problem, the principal needs to rule out the possibility of collusion between the agent and the supervisor. Therefore, having an optimal contract for the principal, the constraints should be introduced to our model.

When the principal intends to have an optimal contract, her goal is to get maximum effort from the agent and pay the lowest possible wages to the agent and the supervisor. Meantime, she should also prevent the possible collusion between the agent and the supervisor. Hence, the participation constrains, the incentive compatibility constraint and the collusion constraints should be added when analyzing the principal's maximization problem. She wants to maximize her utility subject to these constraints.

Up to now, we establish our model based on Tirole's (1986) work employing Fehr and Schmidt's (1999) approach. In Tirole's (1986) benchmark work, the agent and the supervisor are self-interested, i.e., $\lambda_{AS} = 0$ and $\lambda_{SP} = 0$. That can be summarized as their utilities only depend on their wages and the cost of effort levels. They do not care about what the other person has. Kucuksenel and Saygili (2019) expand this model and add the other-regarding preferences between the supervisor and the agent. That is, the agent does care the supervisor's wage and the supervisor does care the agent's wage in terms of the inequity aversion and the status seeking approaches. However, with our model, we additionally approach the situation in a way that

the supervisor cares the inequity aversion relationship towards the principal in her payoff in our structure. After solving the principal's problem in our model, we will compare our results with Tirole's (1986).

Before investigating the general solution of the principal in our model, we believe that it is useful to examine the effects of the inequity aversion parameters separately. Firstly, the agent is the only inequity averse and the supervisor is the self-interested, $\lambda_{AS} \neq 0$ and $\lambda_{SP} = 0$. While the agent compares her wage with the supervisor's wage, the principal's wage is not considered by the supervisor. Secondly, the supervisor is the only inequity averse and the agent is the self-interested, $\lambda_{AS} = 0$ and $\lambda_{SP} \neq 0$. The supervisor does care the difference between her wage and the principal's wage. However, the agent only considers herself. By doing so, we will see the effects of these parameters separately. Moreover, this approach will allow us to look at the model from a broader perspective. Afterward, when examining the model, we will consider how these inequity aversion parameters are related. Since the first case was analyzed by Saygili (2016), we will not repeat it in our study. However, before we solve our model in which the agent and the supervisor both are the inequity averses, Saygili's (2016) results will be mentioned.

4.1 The Inequity Averse Supervisor ($\lambda_{SP} \neq 0$, $\lambda_{AS} = 0$)

As a prerequisite to be able to analyze the optimal contract for the principal, both the agent as well as the supervisor have to accept the contract. We explained that both parties have reservation wages and utilities, W_0, S_0, $\overline{U} \equiv U(W_0)$ and $\overline{V} \equiv V(S_0)$. We may think that both the agent and the supervisor have a certain wage threshold, and their expected payoffs must cross this threshold to enable them to perform their jobs. Hence, they are defined as the individual rationality (participation) constraints in the literature. Since the principal is at a higher tier than the supervisor, naturally her wage should be higher than the supervisor's, $\theta + e > S$. In our framework, considering all Tirole's (1986) benchmark and our approaches, we can define the individual rationality constraints for the agent as:

$$(APC^{IAS}): \quad EU(W - g(e)) = \sum_i p_i U(W_i - g(e_i)) \geq \overline{U} \equiv U(W_0)$$

for the supervisor as:

$$(SPC^{IAS}): \quad EV(S - \lambda_{SP}(\theta + e - S) = \sum_i p_i V(S_i - \lambda_{SP}(\theta_i + e_i - S_i) \geq \overline{V} \equiv V(S_0)$$

These constraints guarantee that the main contract offered by the principal is signed by the agent and the supervisor.

The next constraint called incentive compatibility is related to the relationship between state 2 and state 3 in terms of the agent. However, unless the supervisor gives an empty report to the principal in state 1 and state 4, the principal is aware of the productivity level in these states. Therefore, she can evaluate the output and has an opinion about the effort level exerted by the agent.

As mentioned earlier, the principal has incomplete information about the effort level exerted by the agent in state 2 and state 3 due to an empty report. Therefore, the situation regarding state 2 and state 3 could be more problematic for the principal. To figure out this problem, appropriate adjustments must be made by her.

We know that the agent observes low level $\underline{\theta}$ in state 2 and high level $\overline{\theta}$ in state 3. Since an empty report should be given to the principal by the supervisor in these states, the agent can claim that it is low level $\underline{\theta}$ although it is high level $\overline{\theta}$ when state 3 arises. By doing so, she gets paid more for exerting less effort. That means she can manipulate the productivity levels to increase her payoff. Based on her claim of being in a different state, she can get W_2 with exerting effort $e_2 - \Delta\theta$. Normally, W_2 is paid to the agent when the effort level is e_2 in state 2. Therefore, this situation should be managed by the principal. The wage in state 3 minus disutility coming from the effort should be higher than the wage in state 2 minus disutility coming from the effort $e_2 - \Delta\theta$. Thus, we can define the agent's incentive compatibility constraint as:

$$(AIC^{IAS}): \quad W_3 - g(e_3) \geq W_2 - g(e_2 - \Delta\theta)$$

This constraint ensures that the agent does not decrease her effort level when there is no supervision. That is, when the agent is in state 3 in which she observes high level productivity parameter, she does not falsely claim that it is state 2 in which she observes low level produc-

tivity parameter.

Up to now, we specified the necessary conditions for the agent and the supervisor regarding accepting the contract and behaving truthfully in a singular perspective. However, we need to overcome the challenges that could arise as a result of collusion. The fundamental concern for the principal is to prevent the possibility of bribery between the agent and the supervisor. What she needs to do is to make the agent and the supervisor stick to the agreement with the suitable distribution of their wages with considering their states as well. Likewise, the payoffs of effort cost and inequity aversion relationship should be contemplated.

It is well pointed out that the agent and the supervisor might make side transfers in case of collusion. The first is that the agent is the one who is the briber, and the supervisor is the one who is the bribed. There are two cases that might arise.

The agent might want to hide the low productivity $\underline{\theta}$ in state 1 and make the supervisor report untruthfully. If behaving like in state 2 is more favorable than being in state 1 for the agent, she might attempt to bribe the supervisor. To be able to do this, there is a maximum amount she can give up to in state 2. We call it $t^{IAS}_{max,1}$. Then, her payoff is $W_2 - t^{IAS}_{max,1} - g(e_2)$.

To illustrate, to prevent the possible collusion from the point of view of the principal, the agent should be indifferent between state 1 and state 2 with transferring the maximum payment she is willing to offer. The agent cannot transfer more than $t^{IAS}_{max,1}$ to the supervisor. That is, paying more bribes might increase the likelihood of collusion. However, this transfer cannot be rational for the agent. It is just because the agent takes more utility when the supervisor gives a true report in state 1. Hence, we denote this condition as:

$$W_2 - t^{IAS}_{max,1} - g(e_2) = W_1 - g(e_1)$$

then the maximum amount of transfer is:

$$t^{IAS}_{max,1} = W_2 - g(e_2) - W_1 + g(e_1)$$

On the other hand, a similar path should be followed by the supervisor. There is a minimum amount the supervisor can accept when she decides to collude. It is cited as $t^{IAS}_{min,1}$. Then, her

payoff is $S_2 + t^{IAS}_{min,1} - \lambda_{SP}(\theta_2 + e_2 - S_2 - t^{IAS}_{min,1})$. That is, the supervisor remains silent by accepting this bribe. She gives an empty report to the principal. In terms of the principal, the supervisor should be indifferent between in state 2 and in state 1 with receiving the minimum transfer. The supervisor cannot get less than $t^{IAS}_{min,1}$ from the agent. With accepting less than $t^{IAS}_{min,1}$, the true behavior of the supervisor in state 1 becomes plausible for her. Hence, she avoids collusion. It is denoted by:

$$S_2 + t^{IAS}_{min,1} - \lambda_{SP}(\theta_2 + e_2 - S_2 - t^{IAS}_{min,1}) = S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1)$$

then we have

$$t^{IAS}_{min,1} = \frac{S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1) - S_2 + \lambda_{SP}(\theta_2 + e_2 - S_2)}{1 + \lambda_{SP}}$$

The principal must make necessary adjustments in terms of wages so that this collusion possibility regarding state 1 and state 2 does not happen. In other words, the minimum amount of transfer to the supervisor should be bigger than the maximum amount of transfer from the agent. If the circumstances of possible transfers meet these conditions, the agent and the supervisor will not be able to come to an agreement to collude. Hence, it can be written as:

$$t^{IAS}_{min,1} \geq t^{IAS}_{max,1}$$

It is called as the first collusion constraint. We reform this as:

$$\begin{aligned}(CIC1^{IAS}): \quad & \frac{S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1)}{1 + \lambda_{SP}} + W_1 - g(e_1) \\ & \geq \frac{S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)}{1 + \lambda_{SP}} + W_2 - g(e_2)\end{aligned}$$

Concealing the low productivity $\underline{\theta}$ in state 1 is restrained by the first collusion constraint.

Another case is that the agent might prefer to hide the high productivity $\overline{\theta}$ in state 4. For doing this, she should persuade the supervisor to report empty. To achieve this, there is a maximum amount she can give up to in state 3. We call it $t^{IAS}_{max,2}$. Then, her payoff is $W_3 - t^{IAS}_{max,2} - g(e_3)$.

The agent should be indifferent between state 3 and state 4 with transferring the maximum payment she is willing to offer. The agent cannot transfer more than $t^{IAS}_{max,2}$ to the supervisor. A value above this transfer cannot be rational for the agent. It is just because the agent takes more utility when the supervisor gives a true report in state 4. Hence, we denote this condition as:

$$W_3 - t^{IAS}_{max,2} - g(e_3) = W_4 - g(e_4)$$

then the maximum amount of transfer is:

$$t^{IAS}_{max,2} = W_3 - g(e_3) - W_4 + g(e_4)$$

There is a minimum amount the supervisor can accept when she decides to collude for this case. It is cited as $t^{IAS}_{min,2}$. Her payoff is $S_3 + t^{IAS}_{min,2} - \lambda_{SP}(\theta_3 + e_3 - S_3 - t^{IAS}_{min,2})$ with this transfer. That is, the supervisor remains silent by accepting this bribe. She gives an empty report to the principal. She should be indifferent between in state 4 and in state 3 with receiving the minimum transfer. The supervisor cannot get less than $t^{IAS}_{min,2}$ from the agent. With accepting less than $t^{IAS}_{min,2}$, the true behavior of the supervisor in state 4 becomes plausible for her. Hence, she avoids collusion. It is denoted by:

$$S_3 + t^{IAS}_{min,2} - \lambda_{SP}(\theta_3 + e_3 - S_3 - t^{IAS}_{min,2}) = S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)$$

then we have

$$t^{IAS}_{min,2} = \frac{S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4) - S_3 + \lambda_{SP}(\theta_3 + e_3 - S_3)}{1 + \lambda_{SP}}$$

The principal must make necessary adjustments in terms of wages so that this collusion possibility regarding state 3 and state 4 does not happen. In other words, the minimum amount of transfer to the supervisor should be bigger than the maximum amount of transfer from the agent. If the circumstances of possible transfers meet these conditions, the agent and the supervisor do not come to an agreement to collude. Hence, it can be written as:

$$t^{IAS}_{min,2} \geq t^{IAS}_{max,2}$$

It is named as the second collusion constraint. It can be redesigned as:

$$\begin{aligned}(CIC2^{IAS}): \quad & \frac{S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)}{1+\lambda_{SP}} + W_4 - g(e_4) \\ & \geq \frac{S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)}{1+\lambda_{SP}} + W_3 - g(e_3)\end{aligned}$$

This constraint assures the occurrence of high productivity in state 4.

It is critical to mention that paying a side transfer for hiding the environment in state 1 and state 4 decreases the agent's payoff in these possible collusion circumstances. However, obtaining a side transfer from the agent increases the supervisor's payoff in terms of her individual wage. This transfer also decreases the wage differences between the principal and the supervisor. As a result, the supervisor additionally gets more utility. Therefore, when comparing the benchmark case and inequity averse supervisor case, the supervisor might be more comfortable accepting bribes the agent offers.

The second case is that the supervisor is the briber, and the agent is bribed. Although the agent regards the high productivity $\overline{\theta}$ in state 3, the supervisor might want to make her behave as it is in state 2 which results in the low productivity $\underline{\theta}$. Besides, the incentive scheme in state 2 should be marked. In terms of the supervisor, there is a maximum amount the supervisor can give up to in state 2. We call it $t^{IAS}_{max,3}$. Then, her payoff is $S_2 - t^{IAS}_{max,3} - \lambda_{SP}(\theta_2 + e_2 - S_2 + t^{IAS}_{max,3})$. The supervisor should be indifferent between state 2 and state 3 with transferring the maximum payment she is willing to offer. The supervisor cannot transfer more than $t^{IAS}_{max,3}$ to the agent. Hence, this situation can be defined as:

$$S_2 - t^{IAS}_{max,3} - \lambda_{SP}(\theta_2 + e_2 - S_2 + t^{IAS}_{max,3}) = S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)$$

then we have

$$t^{IAS}_{max,3} = \frac{S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2) - S_3 + \lambda_{SP}(\theta_3 + e_3 - S_3)}{1+\lambda_{SP}}$$

The situation the agent faces can be formulated with the same logic. There is a minimum amount the agent can accept when she decides to collude for this case. It can be labeled as $t^{IAS}_{min,3}$. Her payoff is $W_2 + t^{IAS}_{min,3} - g(e_2 - \Delta\theta)$ with this transfer. She should be indifferent between in state 2 and in state 3 with receiving the minimum transfer. The agent cannot get less than $t^{IAS}_{min,3}$ from the supervisor. It can be composed as:

$$W_2 + t^{IAS}_{min,3} - g(e_2 - \Delta\theta) = W_3 - g(e_3)$$

the minimum amount of transfer is:

$$t^{IAS}_{min,3} = W_3 - g(e_3) - W_2 + g(e_2 - \Delta\theta)$$

As formulated in $(CIC1^{IAS})$ and $(CIC2^{IAS})$, from the principal's point of view, she can prevent this possible collusion case by specifying wages that leads to minimum transfer is bigger than the maximum transfer.

$$t^{IAS}_{min,3} \geq t^{IAS}_{max,3}$$

These circumstances can be addressed as the third collusion constraint. We can rewrite this as:

$$\begin{aligned}(CIC3^{IAS}): \quad & \frac{S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)}{1 + \lambda_{SP}} + W_3 - g(e_3) \\ & \geq \frac{S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)}{1 + \lambda_{SP}} + W_2 - g(e_2 - \Delta\theta)\end{aligned}$$

Acting as a low productivity agent with affirming the incentive scheme of state 2 is blocked by the $(CIC3^{IAS})$.

The agent's payoff increases with this possible transfer. However, when the supervisor pays a side transfer to the agent, her payoff is reduced in terms of her wage. Besides, since the wage difference between the principal and the supervisor rises, this induces that the supervisor feels also worse. Since the supervisor is inequity averse, this divergence decreases her utility.

Therefore, the amount the supervisor is willing to offer to the agent for collusion is decreased in comparison to Tirole's (1986) benchmark. As a result, the supervisor may be more reluctant to bribe the agent.

With all these constraints, namely the individual rationality, the incentive compatibility, and the collusion, the aim is the functioning of the organization and the coalition-proof contract. Now, the maximization problem should be solved by the principal subject to these constraints by choosing S_i, W_i, e_i. It is designed as:

$$\underset{(S_i,\, W_i,\, e_i)}{max} \sum_i p_i(\theta_i + e_i - S_i - W_i)$$

$$subject\ to$$

$$(APC^{IAS}),\ (SPC^{IAS}),\ (AIC^{IAS}),\ (CIC1^{IAS}),\ (CIC2^{IAS}),\ and\ (CIC3^{IAS})$$

We will set up the structure as follows: First, Tirole's (1986) findings are presented and then we state ours. The results we find (propositions) and Tirole's (1986) benchmark (theorems) will be subsequently compared to examine their characteristics. To clarify, when λ_{AS} and $\lambda_{SP}$are zero, our model is the same with Tirole's (1986).

4.1.1 Solutions For Benchmark Case

The solution for Tirole's (1986) self-interested parties has the following properties.

a) $S_4^{BC} > S_1^{BC} > S_2^{BC} = S_3^{BC}$

b) $W_3^{BC} - g(e_3^{BC}) > W_4^{BC} - g(e_4^{BC}) > W_1^{BC} - g(e_1^{BC}) > W_2^{BC} - g(e_2^{BC})$ *and* $W_3^{BC} > W_4^{BC} > W_1^{BC} > W_2^{BC}$

c) $S_4^{BC} + W_4^{BC} = S_3^{BC} + W_3^{BC}$

d) $e_1^{BC} = e_3^{BC} = e_4^{BC} = e^* > e_2^{BC}$

e) All the constraints in the benchmark problem, except $(CIC1^{BC})$*, are binding.*[1]

[1] The superscript BC denotes the benchmark values for our problem.

4.1.2 Effort Levels

Effort levels for the inequity averse supervisor have the following properties.

a) $e_1^{IAS} = e_3^{IAS} = e_4^{IAS} = \frac{1}{1+\lambda_{SP}} > e_2^{IAS}$

b) $\frac{\partial e_1^{IAS}}{\partial \lambda_{SP}} = \frac{\partial e_2^{IAS}}{\partial \lambda_{SP}} = \frac{\partial e_3^{IAS}}{\partial \lambda_{SP}} = \frac{\partial e_4^{IAS}}{\partial \lambda_{SP}} < 0$

c) $e_2^{IAS} < e_1^{IAS} = e_3^{IAS} = e_4^{IAS} < e^*$ and $e_2^{IAS} < e_2^{BC}$

First of all, we have the same ranking as Tirole's (1986). The exerted effort level in state 2 is lower than state 1, state 3 and state 4. Besides, effort levels in state 1 and state 3 and state 4 are the same. This result is not unexpected. The low productivity parameter and failed observation from the supervisor are seen in state 2. It is not related to preventing the collusion between the agent and the supervisor, the principal makes state 3 more preferable than state 2 for the agent with the agent incentive constraint. Besides, due to the lower effort level induced by the principal in state 2, the principal can pay a lower wage to the agent in state 2. Hence, we see this type of relationship between states in terms of the effort levels exerted by the agent.

In our model, we find the effort levels depending on the inequity aversion parameter λ_{SP}. That is, in this type of structure, if the supervisor pays attention to her superior's wage, this influences the total organization.

Although the supervisor has no role in producing, she can affect the effort level with her approach to wage inequality. The supervisor dislikes being behind her superior. Since the principal's wage depends on the effort level exerted by the agent, when the supervisor's inequity aversion parameter increases, the effort level induced by the principal should be decreased to satisfy the supervisor's participation constraint. The principal can achieve this by decreasing the agent's wage. The agent responds to this wage reduction by decreasing her effort level. When the parameter decreases, it is the other way around. Hence, it can be identified that there is a negative correlation between the supervisor's inequity aversion parameter and the effort level.

Proposition 4.1.2.c. precisely stems from Proposition 4.1.2.b. The difference between the principal wage and the supervisor wage induces the supervisor to decline her utility owing to

her inequity aversion approach. Knowing this fact and since λ_{SP} is now a value greater than zero, the principal must cancel out this effect to satisfy the supervisor's participation constraint. Hence, the agent's wage should be decreased by the principal. In addition to the new situation, the agent also declines her effort level. In this way, the supervisor's participation constraint condition is met with an inequity aversion parameter. As a result, we have lower effort levels induced by the principal than Tirole's (1986) benchmark cases.

4.1.3 Constraints

All of the constraints, except the first collusion constraint $(CIC1^{IAS})$, are binding.

This result has the same characteristics as Tirole's (1986). It is worth mentioning again that the first collusion constraint is related to state 1 and state 2. $(CIC1^{IAS})$ prevents the possible collusion between the agent and the supervisor in state 1 and state 2. The reason why the first collusion constraint is not binding stems from the fact that when the agent produces low output with the low-level productivity parameter, she uses this low parameter as an excuse. However, when we combine that $(CIC2^{IAS})$ is binding and $(CIC1^{IAS})$ is not, we come to the conclusion that since the supervisor reports truthfully, she can be considered as an advocate for the agent.

4.1.4 Wages

Wages for the inequity averse supervisor have the following properties

a) $S_4^{IAS} - \lambda_{SP}(\theta_4^{IAS} + e_4^{IAS} - S_4^{IAS}) > S_1^{IAS} - \lambda_{SP}(\theta_1^{IAS} + e_1^{IAS} - S_1^{IAS}) > S_2^{IAS} - \lambda_{SP}(\theta_2^{IAS} + e_2^{IAS} - S_2^{IAS}) = S_3^{IAS} - \lambda_{SP}(\theta_3^{IAS} + e_3^{IAS} - S_3^{IAS})$

b) $W_3^{IAS} - g(e_3^{IAS}) > W_4^{IAS} - g(e_4^{IAS}) > W_1^{IAS} - g(e_1^{IAS}) > W_2^{IAS} - g(e_2^{IAS})$

c) $\frac{S_4^{IAS} - \lambda_{SP}(\theta_4^{IAS} + e_4^{IAS} - S_4^{IAS})}{1 + \lambda_{SP}} + W_4^{IAS} = \frac{S_3^{IAS} - \lambda_{SP}(\theta_3^{IAS} + e_3^{IAS} - S_3^{IAS})}{1 + \lambda_{SP}} + W_3^{IAS}$

Our model has the same ranking in terms of wages as Tirole's (1986) results. In Tirole's (1986) benchmark, the wages of the agent and the supervisor are sufficient to show their utilities. However, in our structure with an inequity averse supervisor, the principal should consider the part coming from the supervisor's inequity aversion parameter and wage differences in these rankings.

When we examine Proposition 4.1.4.c., the first thing that should be recalled is the effort level equality between state 3 and state 4, $e_3^{IAS} = e_4^{IAS}$. We have seen it in Proposition 4.1.2.a. It is also critical to note that the second collusion constraint $(CIC2^{IAS})$ which restricts the possible collusion between state 3 and state 4 is binding. When these facts are combined, it can be concluded that the total utilities of the agent and the supervisor in state 3 are equal to the total utilities of the agent and the supervisor in state 4. However, their individual wages can vary between these states.

In essence, when the supervisor cannot observe the productivity level, lower wages should be paid to her as she fails to do her duty. It refers to state 2 and state 3. This is a quite natural result on our basis. Hence, the supervisor's wage in state 1 and state 4 should be higher than state 2 and state 3.

Recall that the second collusion constraint prevents the agent's possible concealing high productivity nature in state 4. Therefore, the principal should keep $S_4^{IAS} - \lambda_{SP}(\theta_4^{IAS} + e_4^{IAS} - S_4^{IAS})$ higher than $S_3^{IAS} - \lambda_{SP}(\theta_3^{IAS} + e_3^{IAS} - S_3^{IAS})$ to reduce the possibility of bribery between the agent and supervisor with improving the supervisor's condition in state 4. However, if $S_3^{IAS} - \lambda_{SP}(\theta_3^{IAS} + e_3^{IAS} - S_3^{IAS})$ is too low, that concerns the relationship between state 2 and state 3, the supervisor who fails to observe the true nature might convince the high productivity agent to behave like low productivity one. Hence, to prevent this type of collusion, $S_2^{IAS} - \lambda_{SP}(\theta_2^{IAS} + e_2^{IAS} - S_2^{IAS}) = S_3^{IAS} - \lambda_{SP}(\theta_3^{IAS} + e_3^{IAS} - S_3^{IAS})$ should be set by the principal.

When comparing the supervisor's utilities between state 1 and state 2, it is obvious that the supervisor who are successful in observing the productivity environment should be paid more. Hence, $S_1^{IAS} - \lambda_{SP}(\theta_1^{IAS} + e_1^{IAS} - S_1^{IAS}) > S_2^{IAS} - \lambda_{SP}(\theta_2^{IAS} + e_2^{IAS} - S_2^{IAS})$. As mentioned above, since the utilities in state 2 and state 3 in terms of the supervisor are the same and the principal needs to satisfy the supervisor's participation constraint, we have $S_1^{IAS} -$

$\lambda_{SP}(\theta_1^{IAS} + e_1^{IAS} - S_1^{IAS}) > S_2^{IAS} - \lambda_{SP}(\theta_2^{IAS} + e_2^{IAS} - S_2^{IAS}) = S_3^{IAS} - \lambda_{SP}(\theta_3^{IAS} + e_3^{IAS} - S_3^{IAS})$.

When it comes to the comparison between state 1 and state 4, the approach we used above applies here as well. The supervisor can observe the true nature of the productivity in both state 1 and state 4. However, the low productivity parameter is seen in state 1. On the other hand, the high productivity parameter is seen in state 4. It is expected that in a state in which the high productivity parameter occurs, the supervisor's wage should be higher. Hence, the principal keeps $S_4^{IAS} - \lambda_{SP}(\theta_4^{IAS} + e_4^{IAS} - S_4^{IAS}) > S_1^{IAS} - \lambda_{SP}(\theta_1^{IAS} + e_1^{IAS} - S_1^{IAS})$. To sum up, we reach Proposition 4.1.4.a.

Proposition 4.1.4.b presents the relationship between the agent's wages in terms of states. Recall that the inequity parameter of the agent is zero. Therefore, we don't see the wage comparison between the agent and the supervisor in the agent's utilities. When viewed from this angle, it is quite natural that we have the same results as the benchmark case in terms of the agent's wage.

Firstly, since the effort level exerted by the agent in state 2 is lower than the other states, the agent's wage in state 2 should be obviously lower than the wages in other states. It can be claimed that $W_1^{IAS} - g(e_1^{IAS}) > W_2^{IAS} - g(e_2^{IAS})$. Besides, when the agent observes the high productivity parameter which corresponds to state 3 and state 4, her wages also should be higher than in states which are state 1 and state 2 in which the low productivity parameters occur. That is, $W_4^{IAS} - g(e_4^{IAS}) > W_1^{IAS} - g(e_1^{IAS}) > W_2^{IAS} - g(e_2)^{IAS}$ and $W_3^{IAS} - g(e_3^{IAS}) > W_1^{IAS} - g(e_1^{IAS}) > W_2^{IAS} - g(e_2^{IAS})$. The reason why the agent's utility in state 3 is higher than state 2 is that since the supervisor does not observe the high productivity parameter in state 3, the agent might declare that it is a low productivity environment. Therefore, the principal induces the agent not to do it by giving her a higher wage in state 3.

Finally, we have known from Proposition 4.1.4.c. that total utilities in state 3 and state 4 are the same. Besides, the supervisor's payoff in state 4 is higher than in state 3. To achieve equality in Proposition 4.1.4.c., we can deduce that the agent's payoff in state 3 should be higher than the payoff in state 4, $W_3^{IAS} - g(e_3^{IAS}) > W_4^{IAS} - g(e_4^{IAS})$. Besides, it can be suggested that when the agent observes the high productivity parameter without any monitoring from

the supervisor, in order to prevent the collusion between the agent and the supervisor between state 3 and state 4, the agent must be paid more in state 3 by the principal. However, this result has a complication. By having a higher wage in state 3, the agent has an option for potential collusion with the supervisor. Thus, to rule out this, the supervisor's payoff should be higher in state 4 than in state 3. We have reached Proposition 4.1.4.c. again from another direction.

The wage differences of the agent and the supervisor in state 3 and state 4 can be considered as a cost for the principal in terms of requesting the true nature of the productivity environment.

Up to the present, it is shown that our model with inequity averse supervisor and the self-interested agent has similar characteristics to Tirole's benchmark model in terms of the ranking of payoffs and utilities. It is observed that the effort level induced by the principal and the utilities depend on the supervisor's inequity aversion parameter and the wage comparison between the principal and the supervisor.

When adjusting the employees' wages, the principal should focus parts coming from the inequity aversion.

We come to the conclusion that having an inequity averse supervisor is detrimental for the principal, the owner of the firm. We see the wage contractions due to the inequity aversion approach when comparing the benchmark case. To prevent bribery, the principal should also focus on the consequences of the inequity aversion concepts.

4.2 The Inequity Averse Agent ($\lambda_{AS} \neq 0$, $\lambda_{SP} = 0$)

We have interpreted conditions where we have the inequity averse supervisor and the self-interested agent in our model in the previous chapter, $\lambda_{SP} \neq 0$ and $\lambda_{AS} = 0$. Before solving the principal's general problem $\lambda_{SP} \neq 0$ and $\lambda_{AS} \neq 0$, we believe that it is constructive to examine the inequity averse agent and the self-interested supervisor, $\lambda_{AS} \neq 0$ and $\lambda_{SP} = 0$.

Considering Saygili (2016) analyzed this case in his work which clarifies other-regarding preferences between the supervisor and the agent, we decided not to repeat the same analysis in our work. However, we believe Saygili's (2016) results in terms of the effort level induced by the principal should be introduced to get an effective perspective and understand the separate

effect of the inequity averse agent.

4.2.1 Effort Levels

Effort levels for Saygili's (2016) inequity averse agent have the following properties.

a) $e_1^{IAA} = e_3^{IAA} = e_4^{IAA} = 1 + \lambda_{AS} > e_2^{IAA}$

b) $\frac{\partial e_1^{IAA}}{\partial \lambda_{AS}} = \frac{\partial e_2^{IAA}}{\partial \lambda_{AS}} = \frac{\partial e_3^{IAA}}{\partial \lambda_{AS}} = \frac{\partial e_4^{IAA}}{\partial \lambda_{AS}} > 0$

c) $e_1^{IAA} = e_3^{IAA} = e_4^{IAA} > e^*$ *and* $e_2^{IAA} > e_2^{BC}$ [2]

The effort levels are the same in state 1, state 3 and state 4. They depend on the agent's inequity aversion parameter. Since the agent observes the low productivity parameter and the supervisor fails to observe it, the effort level in state 2 is lower than in all other states. This is caused by the agent's incentive constraint. Since the agent is inequity averse, she compares her own wage with the supervisor's. As the inequity aversion parameter increases, that is, she is more sensitive to the wage inequality between herself and her superior, the principal induces more effort level exerted by the agent in every state.

The reason why the effort level is higher than the benchmark case in all states is the inequity aversion parameter. The agent wants to increase her effort level to reduce the wage inequality between herself and the supervisor. The principal might exploit this fact and her choice when employing an agent is an individual who cares her superior wage in terms of inequity aversion relationship.

4.3 The General Solution ($\lambda_{AS} \neq 0$, $\lambda_{SP} \neq 0$)

In previous sections, the inequity averse agent and the inequity averse supervisor cases were analyzed separately. We have shown that the inequity averse agent is beneficial for the principal. On the other hand, having an inequity averse supervisor has negative consequences regarding the effort level exerted by the agent for the firm.

[2] The superscript IAA denotes the inequity averse agent values for our problem.

While considering the totality of the organization, the focus is now to specify how these two inequity averse employees affect the general structure. That means, we need to find out the overall impact when the principal hires an agent and a supervisor who have inequity averse tendencies towards their superiors. Therefore, the positive effect created by the agent and the negative effect the supervisor induces will be compared when examining the total structure as a whole.

At this point, we will solve the principal problem when the agent and the supervisor are both inequity averse. That is, $\lambda_{AS} \neq 0$ and $\lambda_{SP} \neq 0$. The results regarding the effort level, the relationship between wages and the inequity aversion parameters will be correlated with Tirole's (1986) benchmark case.

The major focus of the principal is to design an optimal contract for the organization. She wants to get maximum effort exerted by the agent as much as possible. Yet, she has to pay the wages of her workers to employ them in the firm.

Recall that we assume the principal's wage is always higher than the supervisor's wage. The supervisor's wage is always higher than the agent's wage as well. This applies to any state. That is,

$$\theta_i + e_i > S_i > W_i$$

Now, we will characterize the participation, agent incentive and collusion constraints.

We can compose the participation (individual rationality) constraints just as we did in the case of the inequity averse supervisor. Note that since the inequity aversion parameter of the agent is no longer zero, that is, $\lambda_{AS} \neq 0$, it should be included in the participation constraint. Therefore, it can be formulated for the agent as:

$$\begin{aligned}(APC): \quad & EU(W - g(e) - \lambda_{AS}(S - W)) = \sum_i p_i U(W_i - g(e_i) - \lambda_{AS}(S_i - W_i) \\ & \geq \overline{U} \equiv U(W_0)\end{aligned}$$

for the supervisor as:

$$(SPC): \quad EV(S - \lambda_{SP}(\theta + e - S) = \sum_i p_i V(S_i - \lambda_{SP}(\theta_i + e_i - S_i) \geq \overline{V} \equiv V(S_0)$$

Accepting and signing the contract are ensured by the participation constraints. With these constraints, it can be declared that the agent and the supervisor admit that they will work for the principal.

Adding the inequity aversion part for the agent does not alter the general structure. The principal still needs to solve the problems the environment causes. The first one is between state 2 and state 3 regarding the agent. Since there is no observation by the supervisor in these states, the agent still might claim that it is state 2 even if it is state 3. By doing so, with exerting effort less than e_2, she can get paid W_2. Hence, the principal has to provide necessary incentives regarding state 2 and state 3 taking into account this condition. Therefore, the agent incentive compatibility constraint can be written as:

$$(AIC): \quad W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3) \geq W_2 - g(e_2 - \Delta\theta) - \lambda_{AS}(S_2 - W_2)$$

After the agent and the supervisor agree to work for the organization, the principal's fundamental concern is to prevent the collusion between them. If she does not resolve this, it leads to uncertainty and decreases her utility she might take. Therefore, the principal must arrange the payoffs so that the maximum amount the briber side can pay should be less than the minimum amount the bribed side can accept. They are denoted by t_{max} and t_{min} respectively. In terms of the principal, the parties demanding collusion should be indifferent between her true state and the alternative case regardless of whether the briber or the bribed. The principal prevents the collusion by providing these conditions.

We have already explained the general dynamics of our model in the previous section. Hence, when we construct the collusion constraints, detailed explanations will not be provided again.

The low productivity parameter is seen in state 1. The agent might want to hide it to get more utility by exerting less effort in case of a possible coalition. For doing this, there is a maximum amount she can give to the supervisor. Since state 2 has the low productivity parameter, there

is a correlation between state 1 and state 2 regarding the maximum amount of the transfer. Unlike the first section, we have the inequity averse agent. Hence, its effects should be noted. We denote it as:

$$W_2 - t_{max,1} - g(e_2) - \lambda_{AS}(S_2 + t_{max,1} - W_2 + t_{max,1}) = W_1 - g(e_1) - \lambda_{AS}(S_1 - W_1)$$

then we have

$$t_{max,1} = \frac{W_2 - g(e_2) - \lambda_{AS}(S_2 - W_2) - W_1 + g(e_1) + \lambda_{AS}(S_1 - W_1)}{1 + 2\lambda_{AS}}$$

For the first collusion constraint, the supervisor also should be indifferent between state 1 and state 2 with the minimum amount of the transfer she is willing to accept. It is denoted by:

$$S_2 + t_{min,1} - \lambda_{SP}(\theta_2 + e_2 - S_2 - t_{min,1}) = S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1)$$

then we have

$$t_{min,1} = \frac{S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1) - S_2 + \lambda_{SP}(\theta_2 + e_2 - S_2)}{1 + \lambda_{SP}}$$

In terms of the principal, if the minimum amount of transfer the supervisor can accept is more than the maximum amount of transfer the agent can offer, the possible coalition between the agent and the supervisor is prevented regarding the relationship between state 1 and state 2.

$$t_{min,1} \geq t_{max,1}$$

The first collusion constraint can be rewritten as:

$$\begin{aligned} \text{(CIC1):} \quad & \frac{S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1)}{1 + \lambda_{SP}} + \frac{W_1 - g(e_1) - \lambda_{AS}(S_1 - W_1)}{1 + 2\lambda_{AS}} \\ \geq & \frac{S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)}{1 + \lambda_{SP}} + \frac{W_2 - g(e_2) - \lambda_{AS}(S_2 - W_2)}{1 + 2\lambda_{AS}} \end{aligned}$$

The second coalition possibility regarding concealing the high productivity in state 4 can be designed like the first collusion constraint. This condition is related to state 3. Note that the part coming from inequity aversion for the agent should be added. In this situation, the agent offers at most $t_{max,2}$ satisfying below:

$$W_3 - t_{max,2} - g(e_3) - \lambda_{AS}(S_3 + t_{max,2} - W_3 + t_{max,2}) = W_4 - g(e_4) - \lambda_{AS}(S_4 - W_4)$$

then we have

$$t_{max,2} = \frac{W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3) - W_4 + g(e_4) + \lambda_{AS}(S_4 - W_4)}{1 + 2\lambda_{AS}}$$

For the supervisor, the minimum side transfer offered by the agent must satisfy below:

$$S_3 + t_{min,2} - \lambda_{SP}(\theta_3 + e_3 - S_3 - t_{min,2}) = S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)$$

$$t_{min,2} = \frac{S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4) - S_3 + \lambda_{SP}(\theta_3 + e_3 - S_3)}{1 + \lambda_{SP}}$$

Same as in the first case, the principal must arrange payoffs such that:

$$t_{min,2} \geq t_{max,2}$$

We can rewrite the second collusion constraint as:

$$\begin{aligned} \text{(CIC2):} \quad & \frac{S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)}{1 + \lambda_{SP}} + \frac{W_4 - g(e_4) - \lambda_{AS}(S_4 - W_4)}{1 + 2\lambda_{AS}} \\ \geq & \frac{S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)}{1 + \lambda_{SP}} + \frac{W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3)}{1 + 2\lambda_{AS}} \end{aligned}$$

When considering the possible coalitions between the agent and the supervisor in state 4 and state 1, the agent's payoff decreases when she transfers wage to the supervisor. At the same time, this relocation broadens the wage inequality between them by increasing the supervisor's wage and decreasing the agent's wage. As a result, the agent feels worse due to this wage

gap. These two negative effects consequently cause the possible transfer from the agent to supervisor declines. Therefore, it becomes difficult for the agent to persuade the supervisor to cooperate in comparison to Tirole's (1986) benchmark case.

The supervisor is more prone to collude in these cases. Getting a side transfer from the agent increases the supervisor's payoff. Besides, this gain reduces the wage inequality between the principal and the supervisor and makes the supervisor feel relatively better due to the supervisor's tendency of inequity aversion.

Another possible collusion is related to that the supervisor may want to bribe the agent in state 3. With considering the incentive scheme of state 2, the minimum side transfer the agent can accept should satisfy this condition:

$$W_2 + t_{min,3} - g(e_2 - \Delta\theta) - \lambda_{AS}(S_2 - t_{min,3} - W_2 - t_{min,3}) = W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3)$$

$$t_{min,3} = \frac{W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3) - W_2 + g(e_2 - \Delta\theta) + \lambda_{AS}(S_2 - W_2)}{1 + 2\lambda_{AS}}$$

In a similar vein, we can write the maximum side transfer the supervisor can offer as:

$$S_2 - t_{max,3} - \lambda_{SP}(\theta_2 + e_2 - S_2 + t_{max,3}) = S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)$$

$$t_{max,3} = \frac{S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2) - S_3 + \lambda_{SP}(\theta_3 + e_3 - S_3)}{1 + \lambda_{SP}}$$

To prevent collusion that stems from the supervisor bribing the agent, the main contract must be arranged by the principal such that:

$$t_{min,3} \geq t_{max,3}$$

When considering this possible collusion possibility, the third collusion constraint can be stated as:

$$\text{(CIC3):} \quad \frac{S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)}{1 + \lambda_{SP}} + \frac{W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3)}{1 + 2\lambda_{AS}}$$
$$\geq \frac{S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)}{1 + \lambda_{SP}} + \frac{W_2 - g(e_2 - \Delta\theta) - \lambda_{AS}(S_2 - W_2)}{1 + 2\lambda_{AS}}$$

In terms of the supervisor, we have mentioned that in the previous section the supervisor is worse off regarding the payoff and the inequity aversion relationship with this transfer. When it comes to the agent, this transfer affects the agent positively in both ways. That is, her payoff increases as well as the wage inequality between the supervisor and the agent reduces. Therefore, the agent is more prone to collusion in comparison to the benchmark case.

Now, we have to solve the principal's problem arising from the inequity averse agent and the inequity averse supervisor by considering all the constraints which are introduced. The aim for the principal is to maximize her utility subject to these constraints. We address this problem as:

$$\underset{(S_i,\, W_i,\, e_i)}{max} \sum_i p_i(\theta_i + e_i - S_i - W_i)$$

$$subject\ to$$

$$(APC),\ (SPC),\ (AIC),\ (CIC1),\ (CIC2),\ and\ (CIC3)$$

4.3.1 Effort Levels

Effort levels for inequity averse parties have the following properties.

a) $e_1 = e_3 = e_4 = \frac{1+\lambda_{AS}-\lambda_{AS}\lambda_{SP}}{1+\lambda_{SP}} > e_2$

b) $\frac{\partial e_1}{\partial \lambda_{AS}} = \frac{\partial e_2}{\partial \lambda_{AS}} = \frac{\partial e_3}{\partial \lambda_{AS}} = \frac{\partial e_4}{\partial \lambda_{AS}} > 0$

$\frac{\partial e_1}{\partial \lambda_{SP}} = \frac{\partial e_2}{\partial \lambda_{SP}} = \frac{\partial e_3}{\partial \lambda_{SP}} = \frac{\partial e_4}{\partial \lambda_{SP}} < 0$

c) If $\lambda_{SP} > \lambda_{AS}$, then $e_2 < e_1 = e_3 = e_4 < e^*$ and $e_2 < e_2^{BC}$

Proposition 4.3.1.a. expresses that the effort levels in all other states are higher than state 2 considering both the conditions of the agent observing the low productivity parameter as well as the supervisor providing the empty report are determined in this state. Therefore,

the aim is not to prevent the collusive behavior between the supervisor and the agent. The principal prevents that the high productivity agent mimics the low productivity one. The agent is directed to state 3 by the principal with inducing lower effort in state 2. In this way, the principal can decrease the wage of the agent in state 2.

Proposition 4.3.1.a. also states that the effort levels in all states depend on both inequity aversion parameters. In other words, λ_{SP} and λ_{AS} can determine the level of effort induced by the principal.

There is a positive correlation between the agent's inequity aversion parameter and the effort level. Proposition 4.3.1.b. implies this situation. The agent dislikes it when the supervisor's wage is higher than hers. She gets more disutility with a higher inequity aversion parameter. Hence, she increases her effort level to earn more wage by aiming to equalize her wage with the supervisor's wage. Therefore, preferring an inequity averse agent is favorable for the principal.

There is a negative correlation between the supervisor's inequity aversion parameter and the effort level. It is known that the supervisor compares her wage with the principal's wage which is output consisting of the productivity parameter and effort level. The difference between the output and the supervisor's wage gives negative utility to the supervisor. As the inequity aversion parameter increases, the supervisor is worse off since she dislikes being behind the principal. To compensate for this negative effect and convince the supervisor to participate, the principal decreases the agent's wage. Earning less wage declines the agent's effort level as anticipated. Hence, the output taken by the principal is automatically reduced. Considering the consequences of these actions, employing a supervisor who is inequity averse is detrimental for the principal. Although the supervisor is not a productive unit, however, her ability to reduce the output is a significant phenomenon.

In terms of the principal, we see a positive response from the inequity averse agent and a negative response from the inequity averse supervisor. When it is considered as a single structure, there can be two directions. That is, the effort level might be higher than the benchmark case or lower.

In Proposition 4.3.1.c., our main result asserts that if the inequity aversion parameter of the supervisor is bigger than the inequity aversion parameter of the agent, the effort levels induced by the principal in all states are always lower than the finding of Tirole's (1986) e^*. At the same time, the effort level in state 2 is lower than the effort level in state 2 in the benchmark case. That is, if the negative effect the inequity averse supervisor induces dominates the positive effect the inequity averse agent causes, the principal faces lower efforts exerted by the agent in comparison to the benchmark case. In other words, if the supervisor's sensitivity to being behind the principal is higher than the agent's sensitivity to being behind the supervisor, the effort level the principal induces is lower. It is worth mentioning that the non-productive unit's sensitivity has more influence than the productive unit's sensitivity on the effort levels.

4.3.2 Constraints

All of the constraints, except the first collusion constraint (CIC1), are binding.

The agent does not want to be thought that the reason for low output is her effort level. The cause should be the low productivity environment according to her. The agent is supported by the supervisor in this situation.

4.3.3 Wages

Wages for inequity averse parties have the following properties.

a) $S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4) > S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1) > S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2) = S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)$

b) $W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3) > W_4 - g(e_4) - \lambda_{AS}(S_4 - W_4) > W_1 - g(e_1) - \lambda_{AS}(S_1 - W_1) > W_2 - g(e_2) - \lambda_{AS}(S_2 - W_2)$

c) $$\frac{S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)}{1 + \lambda_{SP}} + \frac{W_4 - \lambda_{AS}(S_4 - W_4)}{1 + 2\lambda_{AS}} = \frac{S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)}{1 + \lambda_{SP}} + \frac{W_3 - \lambda_{AS}(S_3 - W_3)}{1 + 2\lambda_{AS}}$$

We find similar results with Kucuksenel and Saygili (2019). Inequity aversion relationship between a subordinate and her superior matters in our model based on Tirole's (1986) organizational hierarchy benchmark. However, it is seen that the rankings are the same regarding the agent's and the supervisor's wages.

When the principal sets the wages of the agent and the supervisor, she should regard the negative utilities coming from the inequity aversion relationship. For the starting point, we know from Proposition 4.3.1.a. that effort levels in state 3 and state 4 are the same. This equality and the second collusion constraint guarantee that the total utilities of the agent and the supervisor in state 3 are the same as the total utilities of the agent and the supervisor in state 4. The principal ensures this balance by giving different wages to the agent and the supervisor while considering the inequity aversion parameters according to her preferences. In order to specify the wages of the agent and the supervisor separately, the supervisor wages in state 3 and state 4 should be compared.

Since the supervisor can observe the high productivity parameter in state 4, the principal keeps $S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4) > S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)$ so that the supervisor is not bribed by the agent who might want to make the supervisor report untruthfully. By giving this incentive, the supervisor cannot act as it is state 3. That is, she cannot misreport state 4. When it comes to the situations in which the supervisor fails in observing, that is state 2 and state 3, unless the principal sets $S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3) = S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)$, the supervisor might bribe the agent to behave like in state 2 although it is state 3.

Given the low productivity parameter in state 1 and state 2, $S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1) > S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)$ is kept by the principal since the supervisor is able to detect the low productivity environment in state 1. Hence, the supervisor should obtain a higher wage in state 1 for performing her duty.

The case of equality in terms of total utilities in state 3 and state 4 is shown in Proposition 4.3.3.c. Besides, we reveal the supervisor's wage in state 4 is higher than in state 3. These two conditions imply $W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3) > W_4 - g(e_4) - \lambda_{AS}(S_4 - W_4)$. This is because the agent should be encouraged with a higher wage in case of a high productivity environment and failed observation. When there is no observation by the supervisor, the agent has an option to tell it is the low productivity environment although it is high. Therefore,

the principal should set the agent's wages in state 2 and in state 3 to avoid this approach as $W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3) > W_2 - g(e_2) - \lambda_{AS}(S_2 - W_2)$.

To sum up, we observe similar rankings in terms of utilities with the benchmark case. However, the principal must regard the effects caused by the inequity aversion relationships. That is, the concepts regarding the participation of employees, the incentives provided to them, and the measures taken to prevent collusion should be examined by the principal by considering the degree of inequity aversion the agent and the supervisor have.

CHAPTER 5

CONCLUSION

In this thesis, considering that the concept of self-interest in organizational form is problematic, we decide to apply an approach that cares about others within organizational hierarchies to design an optimal contract similar to Kucuksenel and Saygili (2019). In order to be able to achieve this, we employ Fehr and Schmidt's (1999) inequity aversion approach into Tirole's (1986) main model.

Considering the vital role of the supervisor in an organization, we initially examine the inequity aversion relationship between the supervisor and her superior, the principal. Afterward, the principal's problem in which both the agent and the supervisor are inequity averses towards their immediate superiors is explored. In other words, we construct a structure in which the agent compares her wage with the supervisor's wage as well as the supervisor compares her wage with the principal's wage. These comparisons have negative impacts on the agent and the supervisor.

We show that other-regarding preferences which relate to the immediate superiors affect the nature of collusive behavior. The agent's and the supervisor's tendencies regarding collusive behavior are altered. In possible collusion cases, regardless of being the agent or the supervisor, the briber side is more reluctant, however, the bribed side is more prone to collude in comparison to the self-interest framework. The principal must consider these tendencies when adjusting the employee's wages to design an optimal contract.

In this structure, the most noticeable effect is on effort levels. The inequity averse supervisor induces lower effort levels in comparison to Tirole's (1986) case. We report that having an inequity averse supervisor is not preferable for the principal. Considering the inequity averse agent who affects effort levels positively, our main result illustrates that if the supervisor's

sensitivity to being behind the principal is higher than the agent's sensitivity to being behind the supervisor, the total effect on effort levels is negative.

We show that the rankings of utilities are the same as Tirole's (1986) benchmark case. However, due to the effects of the inequity aversion, the dispersion between wages differs from Tirole's (1986) main model.

For future studies, the inequity aversion approach from bottom to top can be implemented in other types of hierarchies. Besides, as in Bac and Kucuksenel (2006), the supervisor cost and ex-ante collusion possibility can be added to increase the complexity of the model. To better capture the real-world impact, a model with multiple supervisors and agents can be built. Adding Kofman and Lawarree's (1993) external supervisor and Kofman and Lawarree's (1996) honest and dishonest supervisors to our model can offer different perspectives. Lastly, uncertain or changeable inequity aversion parameters can incorporate a game-theoretical approach to existing literature. We firmly believe that there is room for studies concerning other-regarding preferences and organizational hierarchies.

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APPENDICES

A. PROOFS

A.1 Solution for the Problem with Inequity Averse Supervisor

Lagrangian for the problem with inequity averse supervisor is:

$L = \sum_i p_i(\theta_i + e_i - W_i - S_i) + \mu^1(\sum_i p_i V(S_i - \lambda_{SP}(\theta_i + e_i - S_i) - \overline{V}))$

$+\mu^2(\sum_i p_i U(W_i - g(e_i)) - \overline{U})$

$+\mu^3(W_3 - g(e_3) - W_2 + g(e_2 - \Delta\theta))$

$+\mu^4(S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4) + (W_4 - g(e_4))(1 + \lambda_{SP}) - (S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)) - (W_3 - g(e_3))(1 + \lambda_{SP}))$

$+\mu^5(S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3) + (W_3 - g(e_3))(1 + \lambda_{SP}) - (S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)) - (W_2 - g(e_2 - \Delta\theta))(1 + \lambda_{SP}))$

$(CIC1^{IAS})$ is ignored since it will be later shown that $(CIC1^{IAS})$ is satisfied.

We take the derivatives with respect to S_i, W_i, e_i.

$$\mu^1 V'(S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1)) = \frac{1}{1 + \lambda_{SP}} \tag{A.1}$$

$$\mu^1 V'(S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)) = \frac{1}{1 + \lambda_{SP}} + \frac{\mu^5}{p_2} \tag{A.2}$$

$$\mu^1 V'(S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)) = \frac{1}{1 + \lambda_{SP}} + \frac{\mu^4}{p_3} - \frac{\mu^5}{p_3} \tag{A.3}$$

$$\mu^1 V'(S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)) = \frac{1}{1+\lambda_{SP}} - \frac{\mu^4}{p_4} \tag{A.4}$$

$$\mu^2 U'(W_1 - g(e_1)) = 1 \tag{A.5}$$

$$\mu^2 U'(W_2 - g(e_2)) = 1 + \frac{\mu^3}{p_2} + \frac{\mu^5(1+\lambda_{SP})}{p_2} \tag{A.6}$$

$$\mu^2 U'(W_3 - g(e_3)) = 1 - \frac{\mu^3}{p_3} + \frac{(\mu^4 - \mu^5)(1+\lambda_{SP})}{p_3} \tag{A.7}$$

$$\mu^2 U'(W_4 - g(e_4)) = 1 - \frac{\mu^4(1+\lambda_{SP})}{p_4} \tag{A.8}$$

$$\mu^2 U'(W_1 - g(e_1))g'(e_1) = 1 - \mu^1 \lambda_{SP} V'(S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1)) \tag{A.9}$$

$$\begin{aligned} \mu^2 U'(W_2 - g(e_2))g'(e_2) = 1 &- \mu^1 \lambda_{SP} V'(S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)) \\ &+ \frac{\mu^5 \lambda_{SP}}{p_2} + \frac{(\mu^3 + \mu^5(1+\lambda_{SP}))g'(e_2 - \Delta\theta)}{p_2} \end{aligned} \tag{A.10}$$

$$\begin{aligned} \mu^2 U'(W_3 - g(e_3))g'(e_3) = 1 &- \mu^1 \lambda_{SP} V'(S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)) \\ &+ \frac{(\mu^4 - \mu^5)\lambda_{SP}}{p_3} + \frac{((\mu^4 - \mu^5)(1+\lambda_{SP}) - \mu^3)g'(e_3)}{p_3} \end{aligned} \tag{A.11}$$

$$\begin{aligned} \mu^2 U'(W_4 - g(e_4))g'(e_4) = 1 &- \mu^1 \lambda_{SP} V'(S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)) \\ &- \frac{\mu^4 \lambda_{SP}}{p_4} - \frac{\mu^4(1+\lambda_{SP})}{p_4} g'(e_4) \end{aligned} \tag{A.12}$$

Proof of Proposition 4.1.2: Substituting 1, 2, 3, 4 and 5, 6, 7, 8 into 9, 10, 11, 12 gives that:

$g'(e_1^{IAS}) = g'(e_3^{IAS}) = g'(e_4^{IAS}) = \frac{1}{1+\lambda_{SP}}$ and $g'(e_2^{IAS}) < \frac{1}{1+\lambda_{SP}}$

Since $g'(e_2^{IAS}) < g'(e_1^{IAS}) = g'(e_3^{IAS}) = g'(e_4^{IAS}) < 1$, we have $e^* > e_1^{IAS} = e_3^{IAS} = e_4^{IAS} > e_2^{IAS}$. Upper boundary of $g'(e_2^{IAS})$ goes to $\frac{1}{1+\lambda_{SP}}$. $g'(e_2^{IAS}) = \frac{1}{1+\lambda_{SP}} - \varepsilon$ where $\varepsilon > 0$ is set by the principal to get maximum output. Since $g'(e_2^{IAS}) = \frac{1}{1+\lambda_{SP}} - \varepsilon < g'(e_2^{BC}) = 1 - \varepsilon$, then we have $e_2^{IAS} < e_2^{BC}$

Proof of Proposition 4.1.3: Suppose $\mu^3 = 0$. Combining 2, 3 and 6, 7, we have

$$\frac{V'(S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2))}{V'(S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3))} = \frac{U'(W_2 - g(e_2))}{U'(W_3 - g(e_3))} \tag{A.13}$$

However, (AIC^{IAS}) implies

$$W_3 - g(e_3) \geq W_2 - g(e_2 - \Delta\theta) > W_2 - g(e_2) \tag{A.14}$$

From 13 and 14, we get

$$S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3) > S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2) \tag{A.15}$$

Equations 14 and 15 give us $S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3) + W_3 - g(e_3) > S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2) + W_2 - g(e_2 - \Delta\theta)$. This shows $(CIC3^{IAS})$ is not binding. Hence, $\mu^5 = 0$ is implied. From 6 and 7, we see

$$W_2 - g(e_2) \geq W_3 - g(e_3) \tag{A.16}$$

Considering equations 14 and 16, a contradiction is seen. Hence, $\mu^3 > 0$. That means (AIC^{IAS}) is binding.

Next, suppose $\mu^4 = 0$. Equations 7, 8 imply

$$W_3 - g(e_3) > W_4 - g(e_4). \tag{A.17}$$

Equations 3 and 4 imply

$$\frac{S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)}{1 + \lambda_{SP}} \geq \frac{S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)}{1 + \lambda_{SP}} \tag{A.18}$$

Combining equations 17 and 18 violates $(CIC2^{IAS})$. Hence, $\mu^4 > 0$. This means $(CIC2^{IAS})$ is binding.

Suppose $\mu^5 = 0$. Equations 2 and 3 imply that $S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2) > S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)$. Since (AIC^{IAS}) is binding, we see $S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3) \geq S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)$ from $(CIC3^{IAS})$. This contradiction says that $\mu^5 > 0$ and $(CIC3^{IAS})$ is binding.

The situation that $(CIC1^{IAS})$ is not binding will be shown with the following proof.

Proof of Proposition 4.1.4: Since (AIC^{IAS}) and $(CIC3^{IAS})$ are binding, we get $S_2 - \lambda_{SP}(\theta_2+e_2-S_2) = S_3-\lambda_{SP}(\theta_3+e_3-S_3)$. From equations 1, 2, 4, we see that $S_4-\lambda_{SP}(\theta_4+e_4-S_4) > S_1-\lambda_{SP}(\theta_1+e_1-S_1) > S_2-\lambda_{SP}(\theta_2+e_2-S_2) = S_3-\lambda_{SP}(\theta_3+e_3-S_3)$

Equations 5, 6, 8 imply that

$$W_4 - g(e_4) > W_1 - g(e_1) > W_2 - g(e_2) \tag{A.19}$$

Since $g(e_3) = g(e_4)$ and $(CIC2^{IAS})$ is binding, we have

$$\frac{S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)}{1+\lambda_{SP}} + W_4 = \frac{S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)}{1+\lambda_{SP}} + W_3$$

Since $S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4) > S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)$, this implies that $W_3 - g(e_3) > W_4 - g(e_4) > W_1 - g(e_1) > W_2 - g(e_2)$. Meanwhile, $(CIC1^{IAS})$ is not binding since $W_1 - g(e_1) > W_2 - g(e_2)$ and $S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1) > S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)$.

A.2 Solution for the Principal's General Problem

Lagrangian for the principal's general problem is:

$L = \sum_i p_i(\theta_i + e_i - W_i - S_i) + \mu^1(\sum_i p_i V(S_i - \lambda_{SP}(\theta_i + e_i - S_i) - \overline{V}))$

$+\mu^2(\sum_i p_i U(W_i - g(e_i) - \lambda_{AS}(S_i - W_i) - \overline{U})$

$+\mu^3(W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3) - W_2 + g(e_2 - \Delta\theta) + \lambda_{AS}(S_2 - W_2))$

$+\mu^4((S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4))(1 + 2\lambda_{AS}) + (W_4 - g(e_4) - \lambda_{AS}(S_4 - W_4))(1 + \lambda_{SP}) - (S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3))(1 + 2\lambda_{AS}) - (W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3))(1 + \lambda_{SP}))$

$+\mu^5((S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3))(1 + 2\lambda_{AS}) + (W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3))(1 + \lambda_{SP}) - (S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2))(1 + 2\lambda_{AS}) - (W_2 - g(e_2 - \Delta\theta) - \lambda_{AS}(S_2 - W_2))(1 + \lambda_{SP}))$

$(CIC1)$ is ignored since it will be later shown that $(CIC1)$ is satisfied.

We take the derivatives with respect to S_i, W_i, e_i.

$$\mu^1 V'(S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1)) = \frac{1}{1+\lambda_{SP}} + \mu^2 \frac{\lambda_{AS}}{1+\lambda_{SP}} U'(W_1 - g(e_1) - \lambda_{AS}(S_1 - W_1)) \tag{A.20}$$

$$\begin{aligned}\mu^1 V'(S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)) = \frac{1}{1+\lambda_{SP}} + \mu^2 \frac{\lambda_{AS}}{1+\lambda_{SP}} U'(W_2 - g(e_2) - \lambda_{AS}(S_2 - W_2)) \\ - \frac{\mu^3 \lambda_{AS}}{p_2(1+\lambda_{SP})} + \frac{\mu^5(1+\lambda_{AS})}{p_2}\end{aligned} \tag{A.21}$$

$$\begin{aligned}\mu^1 V'(S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)) = \frac{1}{1+\lambda_{SP}} + \mu^2 \frac{\lambda_{AS}}{1+\lambda_{SP}} U'(W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3)) \\ + \frac{\mu^3 \lambda_{AS}}{p_3(1+\lambda_{SP})} + \frac{(\mu^4 - \mu^5)(1+\lambda_{AS})}{p_3}\end{aligned} \tag{A.22}$$

$$\begin{aligned}\mu^1 V'(S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)) = \frac{1}{1+\lambda_{SP}} + \mu^2 \frac{\lambda_{AS}}{1+\lambda_{SP}} U'(W_4 - g(e_4) - \lambda_{AS}(S_4 - W_4)) \\ - \frac{\mu^4(1+\lambda_{AS})}{p_4}\end{aligned} \tag{A.23}$$

$$\mu^2 U'(W_1 - g(e_1) - \lambda_{AS}(S_1 - W_1)) = \frac{1}{1+\lambda_{AS}} \tag{A.24}$$

$$\mu^2 U'(W_2 - g(e_2) - \lambda_{AS}(S_2 - W_2)) = \frac{1}{1+\lambda_{AS}} + \frac{\mu^3}{p_2} + \frac{\mu^5(1+\lambda_{SP})}{p_2} \tag{A.25}$$

$$\mu^2 U'(W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3)) = \frac{1}{1+\lambda_{AS}} - \frac{\mu^3}{p_3} + \frac{(\mu^4 - \mu^5)(1+\lambda_{SP})}{p_3} \tag{A.26}$$

$$\mu^2 U'(W_4 - g(e_4) - \lambda_{AS}(S_4 - W_4)) = \frac{1}{1+\lambda_{AS}} - \frac{\mu^4(1+\lambda_{SP})}{p_4} \tag{A.27}$$

$$\mu^2 U'(W_1 - g(e_1) - \lambda_{AS}(S_1 - W_1)) g'(e_1) = 1 - \mu^1 \lambda_{SP} V'(S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1)) \tag{A.28}$$

$$\begin{aligned}\mu^2 U'(W_2 - g(e_2) - \lambda_{AS}(S_2 - W_2)) g'(e_2) = 1 - \mu^1 \lambda_{SP} V'(S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)) \\ + \frac{\mu^5 \lambda_{SP}(1 + 2\lambda_{AS})}{p_2} + \frac{(\mu^3 + \mu^5(1+\lambda_{SP})) g'(e_2 - \Delta\theta)}{p_2}\end{aligned} \tag{A.29}$$

$$\mu^2 U'(W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3))g'(e_3) = 1 - \mu^1\lambda_{SP}V'(S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)) + \frac{(\mu^4 - \mu^5)(1 + 2\lambda_{AS})\lambda_{SP}}{p_3} + \frac{((\mu^4 - \mu^5)(1 + \lambda_{SP}) - \mu^3)g'(e_3)}{p_3} \tag{A.30}$$

$$\mu^2 U'(W_4 - g(e_4) - \lambda_{AS}(S_4 - W_4))g'(e_4) = 1 - \mu^1\lambda_{SP}V'(S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)) - \frac{\mu^4(1 + 2\lambda_{AS})\lambda_{SP}}{p_4} - \frac{\mu^4(1 + \lambda_{SP})}{p_4}g'(e_4) \tag{A.31}$$

Substituting 24, 25, 26, 27 into 20, 21, 22, 23, we get:

$$\mu^1 V'(S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1)) = \frac{1 + 2\lambda_{AS}}{(1 + \lambda_{SP})(1 + \lambda_{AS})} \tag{A.32}$$

$$\mu^1 V'(S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)) = \frac{1 + 2\lambda_{AS}}{(1 + \lambda_{SP})(1 + \lambda_{AS})} + \frac{\mu^5(1 + 2\lambda_{AS})}{p_2} \tag{A.33}$$

$$\mu^1 V'(S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)) = \frac{1 + 2\lambda_{AS}}{(1 + \lambda_{SP})(1 + \lambda_{AS})} + \frac{(\mu^4 - \mu^5)(1 + 2\lambda_{AS})}{p_3} \tag{A.34}$$

$$\mu^1 V'(S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)) = \frac{1 + 2\lambda_{AS}}{(1 + \lambda_{SP})(1 + \lambda_{AS})} - \frac{\mu^4(1 + 2\lambda_{AS})}{p_4} \tag{A.35}$$

Proof of Proposition 4.3.1: Substituting 24, 25, 26, 27 and 32, 33, 34, 35 into 28, 29, 30, 31 gives that:

$g'(e_1) = g'(e_3) = g'(e_4) = \frac{1+\lambda_{AS}-\lambda_{AS}\lambda_{SP}}{1+\lambda_{SP}}$ and $g'(e_2) < \frac{1+\lambda_{AS}-\lambda_{AS}\lambda_{SP}}{1+\lambda_{SP}}$

Suppose $\lambda_{SP} > \lambda_{AS}$. Then $g'(e_2) < g'(e_1) = g'(e_3) = g'(e_4) < 1$, we have $e^* > e_1 = e_3 = e_4 > e_2$. Upper boundary of $g'(e_2)$ goes to $\frac{1+\lambda_{AS}-\lambda_{AS}\lambda_{SP}}{1+\lambda_{SP}}$. $g'(e_2) = \frac{1+\lambda_{AS}-\lambda_{AS}\lambda_{SP}}{1+\lambda_{SP}} - \varepsilon$ where $\varepsilon > 0$ is set by the principal to get maximum output. Since $g'(e_2) = \frac{1+\lambda_{AS}-\lambda_{AS}\lambda_{SP}}{1+\lambda_{SP}} - \varepsilon < g'(e_2^{BC}) = 1 - \varepsilon$, then we have $e_2 < e_2^{BC}$

Proof of Proposition 4.3.2: Suppose $\mu^3 = 0$. Combining 25, 26 and 33, 34, we have

$$\frac{V'(S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2))}{V'(S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3))} = \frac{U'(W_2 - g(e_2) - \lambda_{AS}(S_2 - W_2))}{U'(W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3))} \tag{A.36}$$

However, (AIC) implies

$$W_3-g(e_3)-\lambda_{AS}(S_3-W_3)) \geq W_2-g(e_2-\Delta\theta)-\lambda_{AS}(S_2-W_2) > W_2-g(e_2)-\lambda_{AS}(S_2-W_2) \tag{A.37}$$

From 36 and 37, we get

$$S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3) > S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2) \tag{A.38}$$

Equations 37 and 38 give us $S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3) + W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3) > S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2) + W_2 - g(e_2 - \Delta\theta) - \lambda_{AS}(S_2 - W_2)$. This shows $(CIC3)$ is not binding. Hence, $\mu^5 = 0$ is implied. From 25 and 26, we see

$$W_2 - g(e_2) - \lambda_{AS}(S_2 - W_2) \geq W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3) \tag{A.39}$$

Considering 37 and 39, a contradiction is seen. Hence, $\mu^3 > 0$. That means (AIC) is binding.

Next, suppose $\mu^4 = 0$. From equations 26, 27, we get

$$\frac{W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3)}{1 + 2\lambda_{AS}} > \frac{W_4 - g(e_4) - \lambda_{AS}(S_4 - W_4)}{1 + 2\lambda_{AS}}. \tag{A.40}$$

Equations 34 and 35 imply

$$\frac{S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)}{1 + \lambda_{SP}} \geq \frac{S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)}{1 + \lambda_{SP}} \tag{A.41}$$

Combining equations 40 and 41 violates $(CIC2)$. Hence, $\mu^4 > 0$. This means $(CIC2)$ is binding.

Suppose $\mu^5 = 0$. Equations 33 and 34 imply that $S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2) > S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)$. Since (AIC) is binding, we see $S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3) \geq S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)$ from $(CIC3)$. This contradiction says that $\mu^5 > 0$ and $(CIC3)$ is binding.

The situation that $(CIC1)$ is not binding will be shown with the following proof.

Proof of Proposition 4.3.3: Since (AIC) and $(CIC3)$ are binding, we get $S_2-\lambda_{SP}(\theta_2+e_2-S_2) = S_3-\lambda_{SP}(\theta_3+e_3-S_3)$. From equations 32, 33, 35, we see that $S_4-\lambda_{SP}(\theta_4+e_4-S_4) > S_1-\lambda_{SP}(\theta_1+e_1-S_1) > S_2-\lambda_{SP}(\theta_2+e_2-S_2) = S_3-\lambda_{SP}(\theta_3+e_3-S_3)$

Equations 24, 25, 27 imply that

$$W_4-g(e_4)-\lambda_{AS}(S_4-W_4) > W_1-g(e_1)-\lambda_{AS}(S_1-W_1) > W_2-g(e_2)-\lambda_{AS}(S_2-W_2) \tag{A.42}$$

Since $g(e_3) = g(e_4)$ and $(CIC2)$ is binding, we have

$$\begin{aligned} &\frac{S_4-\lambda_{SP}(\theta_4+e_4-S_4)}{1+\lambda_{SP}} + \frac{W_4-\lambda_{AS}(S_4-W_4)}{1+2\lambda_{AS}} \\ &= \frac{S_3-\lambda_{SP}(\theta_3+e_3-S_3)}{1+\lambda_{SP}} + \frac{W_3-\lambda_{AS}(S_3-W_3)}{1+2\lambda_{AS}} \end{aligned}$$

Since $S_4-\lambda_{SP}(\theta_4+e_4-S_4) > S_3-\lambda_{SP}(\theta_3+e_3-S_3)$, this implies that $W_3-g(e_3)-\lambda_{AS}(S_3-W_3) > W_4-g(e_4)-\lambda_{AS}(S_4-W_4) > W_1-g(e_1)-\lambda_{AS}(S_1-W_1) > W_2-g(e_2)-\lambda_{AS}(S_2-W_2))$. Meanwhile, $(CIC1)$ is not binding since $W_1-g(e_1)-\lambda_{AS}(S_1-W_1) > W_2-g(e_2)-\lambda_{AS}(S_2-W_2)$ and $S_1-\lambda_{SP}(\theta_1+e_1-S_1) > S_2-\lambda_{SP}(\theta_2+e_2-S_2)$.

B. TURKISH SUMMARY / TÜRKÇE ÖZET

Bu tez, Küçükşenel ve Saygılı'nın (2019) çalışmasıyla benzer bir metot izlemektedir. Temel olarak Tirole'ün (1986) makalesi baz alınarak, Fehr ve Schmidt'in (1999) eşitsizlikten kaçınma yaklaşımı entegre edilmiştir. Küçükşenel ve Saygılı'nın (2019) makalesinde olduğu gibi, bir organizasyonda sadece kendini düşünen bireylerin olmasının, günümüz dünyasının problemlerini açıklamakta yetersiz kaldığını düşünmekteyiz. Bir bireyin karar alma noktasında, diğer kişilerin durumları ve sahip oldukları şeyleri de hesaba kattığı önemli bir faktördür. Bu tezde, bir yönüyle, bu bakış açısını incelemeye çalıştık.

Tirole'ün (1986) çalışması, standart İşveren-Çalışan ilişkisine denetçiyi de ekleyerek, Kontrat Teorisi literatürüne çok önemli bir katkı yapmıştır. Üçüncü bir partinin modele eklenmesiyle beraber, gizli aksiyon ve gizli bilgi problemleri de dikkate alınarak, işveren için optimal kontrat hangi şartlarda olmalıdır sorusuna cevap aranmıştır. Çünkü denetçinin, işveren adına bu görevi üstlenmesiyle beraber, denetçi ve çalışan arasında rüşvet ihtimali ortaya çıkmıştır. Tirole (1986) makalesinde, tüm bu durumları dikkate alarak, optimal kontratı etkileyen parametrelerin nasıl olması gerektiğinin cevabını aramıştır.

Küçükşenel ve Saygılı (2019), Tirole'ün (1986) İşveren-Denetçi-Çalışan modeline Fehr ve Schmidt'in (1999) eşitsizlikten kaçınma prensibini eklemleyerek, denetçi ve çalışanın birbirlerinin kazançlarını önemsedikleri bir modelle, Kontrat Teorisi ile Sosyal Tercih modellerini entegre etmişlerdir. Daha sonra ise denetçinin ve çalışanın bu yaklaşımlarının, genel model parametrelerini ve sonuçlarını nasıl etkiledikleri karşılaştırılmıştır.

Kofman ve Lawarree (1993) çalışmalarında, firma içerisinde bulunmayan, firma dışı bir denetçinin organizasyonu nasıl etkilediğinin cevabını bulmaya çalışmışlardır. Firma dışı denetçinin görevi, firmada bulunan denetçiyi incelemektir. Firma dışı denetçinin rüşvet alışverişine girmediği farz edilir. Sonuç olarak ise, firma dışı denetçinin etkisinin durumlara göre değişiklik gösterdiğine ulaşmışlardır. Strausz (1997), çalışanın, işverenin kendisi tarafından ya da bu görevi yapması için bir denetçiyi yetkilendirmesi durumunu analiz etmiştir. Bu

görevlendirmenin, işveren açısından daha tercih edilir olduğunu ve teşvikleri daha iyi bir şekilde ayarladığı sonucunu bulmuştur. Bir diğer çalışmalarında ise Kofman ve Lawarree (1996) dürüst ve dürüst olmayan denetçileri kullanmışlardır. Bu denetçilerle, bazı açılardan yolsuzluğu engelleme, bazı açılardan ise yolsuzluğa izin verme daha maliyetlidir. Sonuç olarak, eğer işveren, yeterince yüksek bir ceza uygularsa, yolsuzluğa izin vermeyi her zaman daha optimal bulmuşlardır. Baç ve Küçükşenel (2006) ise literatüre, denetçinin görevi sırasında bir maliyetle karşılaşmasını ve çalışanın denetçiyi önceden ikna ederek, onu gözlemlememe ihtimalini eklemişlerdir. Sonuç olarak, eğer denetçinin gözlem maliyeti düşükse ve ayrıca denetçinin verimlilik düzeyinin ne olduğunu tespit edebilme ihtimali fazla ise, denetçi ve çalışan arasında önceden gerçekleşebilecek bir yolsuzluk ihtimali ihmal edilebilir. Fehr ve Schmidt'in (1999) eşitsizlikten kaçınma yaklaşımı ise Sosyal Tercih modeli açısından, literatüre önemli bir katkıdır. İki kişilik bir yapıda, matematiksel olarak inceledikleri doğrusal fayda fonksiyonu, kişilerin sosyal tercihlerini göstermesi açısından önemlidir. Sadeliği ve birçok alana rahat uygulanabilir olmasından dolayı, oluşturdukları bu yapı, diğer birçok ekonomi alanına rahatlıkla entegre edilebilir. Itoh'un (2004) çalışması ise İşveren-Çalışan modelinde, çalışanın, işverene karşı eşitsizlikten kaçınma yaklaşımını dikkate alarak, bu ilişkileri inceler. Çalışanın böyle bir yönelimde olmasının, işvereni genel olarak kötü etkilediği sonucunu bulmuştur.

Eisenkopf ve Teyssier (2016), çalışanın, ya kendinden üst basamaktaki kişinin kazancını önemsediğini ya da kendisiyle aynı seviyedeki başka bir çalışanın kazancını önemsediğini deneysel olarak göstermiştir. Bir başka şekilde ifade edecek olursak, bir çalışan diğer bir kişinin sahip olduğu durumu önemserken ya dikey bir yaklaşım ya da yatay bir yaklaşım göstermektedir. Çalışan bu iki yaklaşımı bir arada gösteremez. Biz ise Küçükşenel ve Saygılı'nın (2019) izlediği yöntemi dikkate alarak, Eisenkopf ve Teyssier'in (2016) dikey hiyerarşi sonuçlarını da hesaba katarak, çalışanın denetçinin kazancını, denetçinin ise işverenin kazancını önemsediği bir model kurduk. Bunun, gerçek hayat problemlerini anlama ve çözmede uygun bir bakış açısı olduğuna inanmaktayız. Bu şekilde, bu yapıyla bulduğumuz sonuçları, Tirole'ün (1986) sonuçları ile karşılaştırarak, hiyerarşik olarak alttan yukarıya doğru eşitsizlikten kaçınma prensibinin, genel yapıyı nasıl etkilediğini anlamaya çalıştık.

Tirole'ün (1986) modelinde üretim yapan tek kişi çalışandır. Bunu yaparken efor, $e > 0$, sarf etmektedir. Ayrıca modelde, teknoloji kaynaklı bir üretim parametresi θ bulunmaktadır. Çalışanın eforu ve üretim parametresinin toplamı, oluşan ürünü (kazancı) vermektedir. Oluş-

turulan ürün, işveren tarafından alınmaktadır. Bu yüzden, bu ürünü işverenin maaşı olarak kabul ediyoruz.

$$x = \theta + e$$

Çalışan efor sarf ederken, $g(e)$ kadar fayda fonksiyonunda bir eksilme yaşar. $g(e)$ fonksiyonu, tam olarak efor değeri arttıkça artan aynı zamanda konveks bir fonksiyondur. Bu süreçte, işveren çalışana W kadar bir maaş ödemektedir.

Diğer bir parti denetçidir. Denetçinin görevi, çalışanı ve çalışanın karşılaştığı üretim parametresini gözlemleyerek, bunu işverene raporlamaktır. Bu görev karşılığında, işveren tarafından S kadar bir maaş denetçiye ödenmektedir. Çalışanın aksine, denetçi görevini yaparken herhangi bir maliyetle karşılaşmaz.

İşveren-Denetçi-Çalışan yapısında, dikey bir hiyerarşi olduğundan dolayı, işverenin maaşının denetçiden, denetçinin maaşının ise çalışandan fazla olduğunu farz ediyoruz, $\theta + e > S > W$. Bu bakış açısıyla, çalışanın ve denetçinin fayda fonksiyonlarını kurarken, denetçinin kendi maaşı ile işverenin maaşını karşılaştırdığı, çalışanın ise kendi maaşı ile denetçinin maaşını karşılaştırdığı dikkate alınmalıdır. Bu bilgiler ışığında, denetçinin fayda fonksiyonu

$$V(S - \lambda_{SP}(\theta + e - S))$$

çalışanın fayda fonksiyonu ise

$$U(W - g(e) - \lambda_{AS}(S - W))$$

şeklinde oluşturulur. U ve V özellikleri tam olarak artan, konkav ve her yerde türevi alınabilen, Von Neumann Morgenstern fayda fonksiyonlarıdır.

λ_{AS}, çalışanın denetçiyi dikkate alarak, sahip olduğu eşitsizlikten kaçınma parametresidir. Denetçinin maaşının, kendi maaşından fazla olmasına karşı sahip olduğu hassasiyeti göstermektedir. Aynı şekilde, λ_{SP}, denetçinin işvereni dikkate alarak, sahip olduğu eşitsizlikten kaçınma parametresidir. İşverenin maaşının, kendi maaşından fazla olmasına karşı sahip olduğu hassasiyeti göstermektedir. Katılım kısıtlarını sağlaması ve fayda fonksiyonu netleştirmek adına bu parametreleri 0 ile 1 arasında farz ettik, $0 < \lambda_{AS} < 1$ ve $0 < \lambda_{SP} < 1$.

Bu değerlerin ve maaş farklarının pozitif olmasından dolayı, çalışan ve denetçi, bu karşılaştırmalardan eğer maaşlar eşit değilse negatif etkilenmektedir. Bu noktada, eğer bu parametreler 0 olursa, $\lambda_{SP} = 0$ ve $\lambda_{AS} = 0$, bu yapının Tirole'ün (1986) çalışmasıyla aynı özellikleri taşıdığını gözlemleyebiliriz.

Son olarak, bir diğer parti ise firmanın sahibi işverendir. İşverenin görevi, denetçiye ve çalışana kontrat önermek ve maaş ayarlamalarını yapmaktır. Firmanın üretimini ise kendisine maaş olarak alır. Ayrıca, işveren riske karşı nötr bir tavır sergilemektedir.

Daha sonra açıklanacağı üzere, bu modelde dört farklı durum gözlendiğinden dolayı, beklenen fayda fonksiyonlarını kullandığımızı belirtelim. Bu bilgiler ışığında, partiler için beklenen fayda fonksiyonları aşağıdaki gibidir.

$$EU(W - g(e) - \lambda_{AS}(S - W))$$

$$EV(S - \lambda_{SP}(\theta + e - S))$$

$$E(x - S - W) = E(\theta + e - S - W)$$

Çalışan, minimum kabul edeceği maaş W_0 ve bununla bağlantılı olarak $\overline{U} \equiv U(W_0)$ fayda fonksiyonuna sahiptir. Benzer şekilde, denetçi minimum kabul edeceği maaş S_0 ve bununla bağlantılı olarak $\overline{V} \equiv V(S_0)$ fayda fonksiyonuna sahiptir. Beklenen fayda fonksiyonları ve minimum fayda fonksiyonları birlikte değerlendirildiğinde

$$EU(W - g(e) - \lambda_{AS}(S - W)) \geq \overline{U}$$

$$EV(S - \lambda_{SP}(\theta + e - S)) \geq \overline{V}$$

katılım kısıtları yukarıdaki gibi oluşturulur.

Çalışanın sarf ettiği eforu sadece kendisi bilmektedir. Bunun yanında, bu yapıda, yüksek $\overline{\theta}$ ve düşük $\underline{\theta}$ verimlilik düzeyleri bulunmaktadır. Verimlilik düzeyleri arasındaki ilişki $0 < \underline{\theta} < \overline{\theta}$, ve $\Delta\theta = \overline{\theta} - \underline{\theta}$ şeklindedir. İşveren, verimlilik düzeyinin ne olduğunu denetçi vasıtasıyla öğrenebilir. Çalışan ise verimlilik düzeyinin ne olduğunu her zaman bilmektedir. Ancak denetçi verimlilik düzeyini gözlemlerken, her zaman başarılı olmayabilir. Bu bilgiler ışığında

dört tane durum ile karşılaşmaktayız.

Durum 1: $\underline{\theta}$ hem çalışan hem de denetçi tarafından öğrenilir.

Durum 2: $\underline{\theta}$ çalışan tarafından öğrenilir. Denetçi ise görevinde başarısız olur.

Durum 3: $\overline{\theta}$ çalışan tarafından öğrenilir. Denetçi ise görevinde başarısız olur.

Durum 4: $\overline{\theta}$ hem çalışan hem de denetçi tarafından öğrenilir.

Bu dört durumdan biri kesinlikle gerçekleşmelidir. Bu yüzden, $\sum_{i=1}^{i=4} p_i = 1$ kabul edilmektedir. p_i her bir durumun gerçekleşme ihtimalidir.

Olayların hangi sırayla gerçekleştiğine gelirsek, öncelikle işveren, denetçi ve çalışanın maaşlarının ne olduğunu belirten bir ana kontrat önermektedir. Bu maaşlar ürün, x, denetçinin raporu, r, çalışan ve denetçinin eşitsizlikten kaçınma parametrelerine, λ_{AS} ve λ_{SP}, bağlı fonksiyonlardır. Bu değerler herkes için ortak bilgi olarak kabul edilmektedir. Kontrat, denetçi ve çalışan tarafından kabul edildikten sonra, rüşvet ihtimali ortaya çıkar. Eğer denetçi ve çalışan kendileri için pareto optimal bir noktada anlaşabilirlerse, yan ödeme yapılır. Bu yan ödeme fonksiyonu ana kontrat ile aynı özellikleri taşımaktadır.

Denetçi raporunu işverene sunarken, eğer verimlilik düzeyini gözlemlemede başarısız olmuşsa, işverene kesinlikle boş rapor vermektedir. Ancak, eğer verimlilik düzeyinin ne olduğunu öğrenmişse, işverene vereceği rapor ya doğru olmak zorundadır ya da bu bilgiyi işverenle paylaşmamayı tercih edebilir.

Kontratlar kabul edildikten sonra, verimlilik düzeyi çalışan tarafından öğrenilir ve çalışan eforunun ne olacağını belirler. Bu şekilde ürün ortaya çıkmış olur. Denetçi ise verimlilik düzeyini öğrenir veya öğrenmez ve raporunu işverene sunar.

Son olarak, kontrat partiler arasında uygulanır. İşveren, çalışan ve denetçiye maaşlarını öder. Eğer çalışan ve denetçi yan bir ödeme için anlaşmışlarsa, bu rüşvet alışverişi de gerçekleştirilir.

Tüm bu durumlar dikkate alınarak, işverenin kendi fayda fonksiyonunu maksimize etmek için optimal bir kontrat hazırlaması gerekmektedir. Bunun için ise, ilk olarak önerdiği kontratın denetçi ve çalışan tarafından kabul edilmesi gerekmektedir. Denetçi ve çalışanın katılım kısıt-

ları, aşağıdaki gibi tanımlanır.

$$(APC): \quad EU(W - g(e) - \lambda_{AS}(S - W)) = \sum_i p_i U(W_i - g(e_i) - \lambda_{AS}(S_i - W_i)$$
$$\geq \overline{U} \equiv U(W_0)$$

$$(SPC): \quad EV(S - \lambda_{SP}(\theta + e - S) = \sum_i p_i V(S_i - \lambda_{SP}(\theta_i + e_i - S_i) \geq \overline{V} \equiv V(S_0)$$

Durum 2 ve Durum 3'te, denetçi işverene boş rapor sunduğundan dolayı, işveren verimlilik bilgisine sahip değildir. Bu yüzden çalışanın hangi miktarda efor sarf ettiğini belirleyemez. Çalışan, Durum 2 ve Durum 3'teki farklı verimlilik düzeylerini, işverenin öğrenememesinden dolayı, bu durumu kendi çıkarına kullanabilir. İşveren, bu problemi çözmek adına, bu iki durum ile bağlantılı olarak, maaş ayarlamaları ile çalışanı, doğru davranması adına teşvik etmesi gerekmektedir. Çalışanın teşvik kısıtı aşağıdaki gibi yazılabilir.

$$(AIC): \quad W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3) \geq W_2 - g(e_2 - \Delta\theta) - \lambda_{AS}(S_2 - W_2)$$

İşveren, katılım kısıtları ile denetçi ve çalışanın kontratı kabul etmesini, teşvik kısıtı ile de çalışanın farklı bir durumdaymışçasına davranmamasını sağlamıştır. Daha önce belirttiğimiz gibi, işverenin verimlilik düzeyini bilmemesinden dolayı, denetçi ve çalışan arasında rüşvet ilişkisi oluşabilir. Çalışan, Durum 1'deki düşük verimlilik düzeyini ve Durum 4'teki yüksek verimlilik düzeyini gizleyerek bu durumdan fayda sağlamak isteyebilir. Bunu yaparken, denetçinin kabul edebileceği miktarda rüşvet vermesi gerekmektedir. Diğer bir durumda ise, denetçi Durum 2 ve Durum 3 ile bağlantılı olarak, çalışanı yolsuzluk yapmaya ikna etmek isteyebilir.

İşveren, denetçi ve çalışan arasındaki rüşvet alışverişini engelleyebilmek adına, rüşvet alacak tarafın kabul edebileceği minimum miktarın, rüşvet verecek tarafın ödeyebileceği maksimum miktardan büyük olmasını sağlamak zorundadır. Bu durumu sağlamak için, eşitsizlikten kaçınma parametrelerini de dikkate alarak, çalışan ve denetçiye vereceği maaşları bu duruma

uygun olacak şekilde ayarlamalıdır. Bu bağlamda, gizli anlaşma kısıtları aşağıdaki gibi yazılır.

$$\text{(CIC1):}\quad \frac{S_1 - \lambda_{SP}(\theta_1 + e_1 - S_1)}{1+\lambda_{SP}} + \frac{W_1 - g(e_1) - \lambda_{AS}(S_1 - W_1)}{1+2\lambda_{AS}} \geq \frac{S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)}{1+\lambda_{SP}} + \frac{W_2 - g(e_2) - \lambda_{AS}(S_2 - W_2)}{1+2\lambda_{AS}}$$

$$\text{(CIC2):}\quad \frac{S_4 - \lambda_{SP}(\theta_4 + e_4 - S_4)}{1+\lambda_{SP}} + \frac{W_4 - g(e_4) - \lambda_{AS}(S_4 - W_4)}{1+2\lambda_{AS}} \geq \frac{S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)}{1+\lambda_{SP}} + \frac{W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3)}{1+2\lambda_{AS}}$$

$$\text{(CIC3):}\quad \frac{S_3 - \lambda_{SP}(\theta_3 + e_3 - S_3)}{1+\lambda_{SP}} + \frac{W_3 - g(e_3) - \lambda_{AS}(S_3 - W_3)}{1+2\lambda_{AS}} \geq \frac{S_2 - \lambda_{SP}(\theta_2 + e_2 - S_2)}{1+\lambda_{SP}} + \frac{W_2 - g(e_2 - \Delta\theta) - \lambda_{AS}(S_2 - W_2)}{1+2\lambda_{AS}}$$

Birinci ve ikinci gizli anlaşma kısıtlarını inceleyecek olursak, çalışanın yolsuzluk için denetçiye yapacağı ödeme, sadece onun maaşını düşürmekle kalmayacak, ayrıca denetçinin maaşını arttırıp, kendi maaşını azaltarak, eşitsizlikten kaçınma ile bağlantılı olarak, çalışanın daha kötü hissetmesini sağlayacaktır. Bu açıdan bakıldığında, çalışanın ödeyebileceği maksimum rüşvet miktarı, temel modele kıyasla daha az olacaktır. Denetçi için ise, alacağı ödeme hem maaşını arttırıp hem de işveren ile arasındaki maaş farkını azaltacağından dolayı, kendisini daha iyi hissedecektir. Bu açıdan, denetçi temel modele kıyasla, rüşvet almaya daha meyilli olacaktır. Üçüncü gizli anlaşma kısıtına gelecek olursak, burada denetçi rüşvet öneren taraf, çalışan ise rüşvet alan taraftır. Çalışan bu ödeme ile hem maaşının artmasından dolayı hem de denetçi ile aralarında olan maaş farkının azalmasından dolayı, daha iyi bir noktaya gelmektedir. Bu yüzden, sadece kendini düşünen bir çalışana kıyasla, daha az bir miktarda rüşvet önerisi, çalışanı iş birliğine ikna edebilir. Diğer taraftan, çalışana vereceği rüşvet ile birlikte, denetçinin maaşı azalacaktır. Bununla birlikte, işveren ile arasındaki maaş farkı artacağından dolayı, bu durum denetçiyi iki açıdan da kötü etkilemektedir. Sonuç olarak, denetçinin çalışana önerebileceği maksimum rüşvet miktarı, Tirole'ün (1986) temel modelindeki benzer duruma kıyasla, daha düşük bir seviyeye gelecektir.

Bu kısıtları göz önünde bulundurarak, işveren gerekli ayarlamalarla kendi problemini, optimal sonuç elde etmek için çözmesi gerekmektedir. Bulduğumuz sonuçları ise, Tirole'ün (1986) temel makalesindeki sonuçlar ile karşılaştıracağız. Bu şekilde, hiyerarşik olarak alttan yukarıya doğru eşitsizlikten kaçınma prensibinin, optimal sonuçları nasıl etkilediğini gözlemlemiş olacağız.

$$\underset{(S_i,\, W_i,\, e_i)}{max} \sum_i p_i(\theta_i + e_i - S_i - W_i)$$

$$s.\, t$$

$$(APC),\ (SPC),\ (AIC),\ (CIC1),\ (CIC2),\ and\ (CIC3)$$

Bu problemi çözerek, bulduğumuz sonuçlara gelecek olursak, ilk olarak çalışanın sarf ettiği efordan bahsetmek gerekir. Durumlardaki efor seviyelerini, sıralama olarak Tirole'ün (1986) modeliyle benzer bulduk. En az sarf edilen efor ise Durum 2'de gözlendi. Bunun nedeni, Durum 2'deki düşük verimlilik düzeyi ve denetçinin bu durum için işverene boş rapor vermesinden kaynaklanmaktadır. Ayrıca bu sonuç, denetçi ve çalışan arasındaki yolsuzluğu önlemekten kaynaklanmamaktadır. İşveren, Durum 3'teki yüksek verimlilik düzeyini ve Durum 2'deki düşük verimlilik düzeyini dikkate alarak, çalışan için Durum 3'ü, çalışanın teşvik kısıtı ile daha tercih edilir hale getirmiştir. İşveren, Durum 2'deki düşük efor seviyesinden dolayı, Durum 2'deki çalışana vereceği maaşı da bu şekilde düşük tutar. Bu bağlamda, çalışanın, yüksek verimlilik düzeyine sahipken, düşük verimlilik düzeyi varmışçasına hareket etmesi engellenmiştir. Diğer bir husus, efor seviyelerini çalışan ve denetçinin eşitsizlikten kaçınma parametrelerine bağlı olarak bulduk. Bir başka deyişle, işveren tarafından elde edilen efor seviyesi bu parametrelerden etkilenmektedir. Çalışanın eşitsizlikten kaçınma parametresi ile işveren tarafından elde edilen efor seviyesi arasında pozitif bir ilişki vardır. Denetçi ile maaşını kıyaslayan çalışan, daha büyük bir parametre ile, fayda fonksiyonunda daha negatif bu durumla karşılaşmaktadır. Kendisi için bu negatif durumu ortadan kaldırabilmek adına sarf ettiği eforu arttırmayı tercih eder. Bu bağlamda, işveren için, kendi maaşı ile denetçinin maaşını karşılaştıran çalışan, sadece kendini düşünen bir çalışana göre daha tercih edilir bir seçenektir. Denetçinin eşitsizlikten kaçınma parametresi ile işveren tarafından elde edilen efor seviyesi arasında negatif bir ilişki vardır. İşveren ile maaşını kıyaslayan denetçi, daha büyük bir parametre ile, fayda fonksiyonunda daha negatif bir durumla karşılaşmaktadır. İşveren, bu negatif durumu telafi edebilmek ve denetçinin katılım kısıtını sağlayabilmek adına,

çalışanın maaşını düşürür. Maaşı düşen çalışan ise daha az efor sarf etmektedir. Bu şekilde işverenin maaşı da azalmış olur. İşveren için, kendi maaşı ile işverenin maaşını karşılaştıran denetçi, sadece kendini düşünen bir denetçiye göre daha tercih edilir bir seçenek değildir. Efor seviyesi ile alakalı olarak son ve en önemli bulgumuz, eğer denetçinin eşitsizlikten kaçınma parametresi çalışanın eşitsizlik parametresinden büyükse, tüm durumlardaki efor seviyesi, Tirole'ün (1986) temel modelinde ifade ettiği efor seviyelerinden küçüktür. Ayrıca, bizim modelimizdeki Durum 2'deki efor seviyesi, temel modeldeki Durum 2'deki efor seviyesinden de düşüktür. Özetle, eğer eşitsizlikten kaçınan denetçinin efor seviyesi açısından neden olduğu negatif etki, eşitsizlikten kaçınan çalışanın efor seviyesi açısından neden olduğu pozitif etkiden büyükse, efor seviyeleri temel modeldeki efor seviyelerinden küçüktür.

Diğer bir sonucumuzda ise, Durum 1 ile Durum 2 arasındaki gizli anlaşma kısıtı $(CIC1)$ dışındaki tüm gizli anlaşma kısıtları bağlayıcıdır. Bu sonuç Tirole'ün (1986) modelindeki sonuçla birebir benzerdir. Çalışan, Durum 2'deki düşük ürün nedeninin, kendisinin düşük eforu değil de düşük verimlilik düzeyi olarak bilinmesini ister. İlk gizli anlaşma kısıtının bağlayıcı olmaması ve ikinci gizli anlaşma kısıtının ise bağlayıcı olması, denetçinin çalışanı desteklemesi şeklinde yorumlanır.

Çalışanın ve denetçinin maaşlarına gelecek olursak, temel model ile aynı sıralamaya sahip sonuçlar bulduk. Temel modelde, denetçinin ve çalışanın maaşları, fayda fonksiyonlarını ifade etmek için yeterlidir. Ancak, bizim modelimizde, eşitsizlikten kaçınan denetçi ve eşitsizlikten kaçınan çalışan olduğundan dolayı, işveren bu maaş ayarlamalarında, eşitsizlikten kaçınma parametrelerini de göz önünde bulundurmak zorundadır. Durum 3 ve Durum 4'teki efor seviyelerinin aynı olduğunu ifade etmiştik. Bununla birlikte, Durum 3 ile Durum 4 ile bağlantılı olabilecek yolsuzluk ilişkisini engelleyen ikinci gizli anlaşma kısıtı $(CIC2)$ birlikte değerlendirildiğinde, denetçi ve çalışanın eşitsizlik parametreleri de dikkate alınarak, denetçi ve çalışanın Durum 3'teki toplam faydalarının toplamı, Durum 4'teki toplam faydaları ile aynıdır. Ancak, denetçinin ve çalışanın bireysel maaşları bu eşitliği sağlayacak şekilde farklılık gösterebilir.

Denetçinin maaş sıralamasını inceleyecek olursak, Durum 2 ve Durum 3'te, denetçi verimlilik düzeyini gözlemlemede başarısızdır. Durum 1 ve Durum 4'te ise verimlilik düzeyinin ne olduğu bilgisine sahiptir. Bu bilgiler ışığında, işveren Durum 1 ve Durum 4'te, Durum 2 ve

Durum 3'e göre, denetçinin faydasını daha yüksek belirlemesi gerekmektedir. İşveren, Durum 4'teki denetçinin durumunu daha iyi hale getirerek, Durum 3 ve Durum 4 arasında oluşabilecek yolsuzluk ihtimalini azaltmak için, denetçinin Durum 4'teki faydasını, Durum 3'teki faydasına göre daha yüksek olarak ayarlar. Ancak, denetçinin Durum 3'teki faydası çok düşük olursa, Durum 2 ve Durum 3 ile bağlantılı olarak, denetçi, düşük verimlilik düzeyine sahip çalışanı, yüksek verimlilik düzeyine sahipmiş gibi davranması noktasında ikna edebilir. Bu yüzden, işveren, denetçinin Durum 2 ve Durum 3'teki faydalarını eşit olarak ayarlamak zorundadır. Durum 1 ve Durum 2 ile alakalı olarak, denetçi Durum 2'de görevinde başarısız, Durum 1'de ise başarılı olmaktadır. Bu yüzden Durum 1'deki faydası, Durum 2'deki faydasından yüksek olmalıdır. Son olarak, Durum 1 ve Durum 4'te denetçinin faydalarını karşılaştıracak olursak, denetçi, bu iki durumda da verimlilik düzeyinin ne olduğu bilgisine sahiptir. Ancak Durum 4'te yüksek verimlilik düzeyini gözlemler. Bu açıdan, işveren, denetçinin Durum 4'teki faydasını Durum 1'deki faydasından yüksek yapmalıdır. Tüm bu açıklamalar ışığında, denetçinin Durum 4'teki faydasının Durum 1'deki faydasından fazla, Durum 1'deki faydasının Durum 2'dekinden fazla ve Durum 2'deki ve Durum 3'teki faydalarının ise eşit olduğunu açıkladık.

Çalışanın fayda karşılaştırmalarına gelecek olursak, Durum 2'deki efor seviyesinin, diğer durumlardaki efor seviyesinden düşük olduğunu belirtmiştik. Bu yüzden, işveren tarafından ayarlanan çalışanın Durum 2'deki fayda miktarı, diğer durumlardaki fayda miktarından düşük olmak zorundadır. Bu yüzden, çalışanın Durum 1'deki fayda miktarı, Durum 2'dekinden büyük denebilir. Bu noktada, çalışan Durum 3 ve Durum 4'te yüksek verimlilik düzeyine sahip olduğundan dolayı, bu durumlarda daha yüksek faydaya sahip olması gerekmektedir. Durum 3 ve Durum 4'teki fayda miktarları, Durum 1 ve Durum 2'dekilerden büyük olmalıdır. Son olarak ise, Durum 3 ve Durum 4'teki durumları karşılaştırma noktasında, Durum 3'te yüksek verimlilik düzeyi ve denetçinin boş raporu olduğunu bilmekteyiz. İşveren, çalışan ve denetçi arasında, bu iki durumla bağlantılı olarak, bir yolsuzluk ilişkisi kurulmaması için, çalışana Durum 3'te, Durum 4'e göre daha fazla maaş vererek, onu rüşvet alışverişine girmemesi konusunda teşvik eder. Bundan dolayı, çalışan en yüksek faydaya Durum 3'te sahip olmaktadır. Diğer bir açıdan bu sonuca yine ulaşabiliriz. Denetçinin, Durum 4'te en yüksek faydaya sahip olduğunu ifade etmiştik. Ayrıca denetçi ve çalışanın Durum 3 ve Durum 4'teki toplam faydalarının da eşit olduğunu biliyoruz. Bu iki durumun sağlanması için, çalışanın Durum 3'te daha fazla faydaya sahip olması gerekmektedir. Denetçi ve çalışanın, Durum 3 ve Durum

4'teki maaş farkları, işverenin verimlilik düzeyinin ne olduğunu öğrenebilmesi için ödediği bedel olarak ifade edilebilir.

Çalışmamızı noktalarken, bu çalışmadaki önemli noktaları vurgulayarak ve modelimizin hangi açılardan geliştirilebileceğine dair görüşlerimizi ifade edeceğiz.

En temel olarak, ekonomiye dair yapılan çalışmalarda, sadece kendini düşünen birey yaklaşımının yeterli olmadığını ve bu alanda önemli bir teori eksikliği olduğunu düşündük. Küçükşenel ve Saygılı'nın (2019) izlediği metodolojiye benzer olarak, Sosyal Tercih Modeli ile Kontrat Teorisi arasında bir bağlantı kurmaya çalıştık. Bunu yaparken Tirole'ün (1986) ve Fehr ve Schmidt'in (1999) çalışmalarından faydalandık.

Çalışanın, kendisi ile denetçiyi, denetçinin ise kendisi ile işvereni karşılaştırdığı çalışmamızla, bu yaklaşımların, yolsuzluk ve rüşvet alışveriş dinamiklerini etkilediğini gördük. İşveren için, eşitsizlikten kaçınan bir çalışanın, sadece kendini düşünen çalışana göre daha tercih edilebilir olduğunu, eşitsizlikten kaçınan bir denetçinin ise sadece kendini düşünen denetçiye göre işveren için zararlı olduğunu gösterdik. Denetçinin eşitsizlikten kaçınma parametresinin, çalışanınkinden büyük olduğunda ise, işveren açısından, negatif etkinin pozitif etkiyi domine ettiğini gözlemledik.

Daha sonraki çalışmalar için ise, aşağıdan yukarıya doğru izlediğimiz eşitsizlikten kaçınma prensibi, diğer tip hiyerarşiler için de oluşturulabilir.

Baç ve Küçükşenel'in (2006) temel modele eklediği, denetçinin görevini yaparken bir maliyetle karşılaşması ve çalışan ve denetçi arasındaki yolsuzluk ilişkisinin zamansal olarak daha önce kurulması, modelimiz içerisinde incelenebilir.

Birden fazla denetçinin veya birden fazla çalışanın olduğu bir yapıyı incelemek ilginç bir alan olabilir.

Kofman ve Lawarree'nin (1993) firmayı incelemesi için önerdiği dışardan gelen denetçi, ayrıca Kofman ve Lawarree'nin (1996) literatüre kazandırdığı dürüst ve dürüst olmayan denetçi de yine eşitsizlikten kaçınma prensibi ile birlikte incelenebilir. Son olarak ise, oyun teorisi konsepti ile bilinmeyen veya değişken eşitsizlikten kaçınma parametreleri ile modelimiz geliştirilebilir.

Eşitsizlikten kaçınma ve hiyerarşiye sahip organizasyonların birlikte incelenebileceği, birçok alan olduğuna inanmaktayız.

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