An Investigation into the Constructive Role of Task-based Conflict within the Agency Theory

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Thesis Introduction

There are two main ways of making a living:
by production or by conflict.

Hirschleifer 2000

Conflicts emanate and expand wherever there is an encounter of interests. The theoretical approaches of the agency theory often stress on the potential danger that conflict can pose threats and bring about adverse outcomes (Amason and Schweiger, 1994; Jensen and Meckling, 1976; Smith, 2010). Therefore, any conflict between management and the owner inflicts unwanted costs upon the organization, and as a result, leads to unsatisfactory conditions (Mirrlees, 1976). That is why averting conflict is considered as a path leading to optimal results by the general agency theory paradigm. Nevertheless, the findings of the psychological studies and the experiments conducted regarding the organizational behavior indicate that disagreement tends to affect collective performance positively (Jehn, 1995; Rahim, 2002; Shankman, 1999).

Yet, the challenging issue here is to probe into the theoretical and practical influence of conflict between the agent and principal. The agency theory frowns upon conflict and demands that it is bypassed. On the other hand, however, there is a considerable body of evidence to prove the constructive effect of conflict through the organization. That is to say, although the agency theory attempts to avoid and eliminate conflict between the agent and the principal drawing upon the pretext that conflict of any nature wastes the resources (Rahim, 2002; Song et al., 2006). In the meantime, conflict management advocates the idea of the managers embracing diversity rather than thinking alike to bring about innovation. Given the challenge discussed, the present study is an attempt to identify the elements causing the division between theory and practice. One of the factors that contributes to this split is that the agency theory makes strict assumptions on individuals characteristics and thus decreases the role of the agent to a production element working merely to serve the interest of the principal. This study will explore such presumptions on the side of the agency theory that are not in conformity with the agent's choices. It will also argue that this perspective does not offer a comprehensive view of the principal-agent relationship, which contributes to an array of interactions between individuals, and thus fails to reflect the actual decision-making process. In this view, the agency theory considers the agent's operational effort as the input and tries to maximize the payoff and at the same time, set the principal's interest as the primary goal. The agency theory then employs two instruments to realize this goal: first, providing the agent with enough reward and second, defining a proper monitoring setting to control agent's actions (Eisenhardt, 1989).

However, the practice of modeling an individual's behavior is more sophisticated than being solely based on the external incentives. The unrealistic assumptions are discussed which are assumed to be the main reason of the gap between what theory expects and how the agent's behavior turns out in practice. What this premise concludes is that the agent's decreased effort level does not necessarily and solely indicate that they are being opportunistic and egoistic. Rather, it can be caused by the information asymmetry or lack of intrinsic motivation. Once the latter is true, the agent assumes that there is a better way to carry out what they are tasked with, which they are not allowed to employ. This contradicts with the assumption of the agency theory regarding the work-aversion on the side of the agent. On a different scale, the current thesis tries to answer the question whether allowing the disagreements to surface, and dedicating effort to settling a task conflict can promote the innovation index of the teamwork. That is to say, if a new job design which mixes the operational tasks with the conflict clarification ones can act to the benefit of the organization.

The answer will be negative in the light of the agency theory since a job profile of such traits will waste time, and thus lacks efficiency. Furthermore, the agent is seen by the agency theory as egoistic and opportunistic (Perrow et al., 1986; Shankman, 1999), who will shirk whenever the opportunity presents itself. Thus, addition of such an activity to their job-profile will make them neglect their operational tasks. This is the result of the assumption embedded in the agency theory that agent's behavior can be determined and controlled through the incentive and monitoring mechanisms. Consequently, it fails to take into account the agent's preferences as an individual. The danger of such view is that it deprives the corporate of the innovation potential entailed by diversity. In contrast, a job profile that can couple the operational tasks with the conflict clarification ones is favored by conflict management, as it offers higher intrinsic incentives to the agent. A job structured thus indicates that the agent is given the opportunity to voice their thoughts and to contribute to the decision-making process. This is in contrast with the incentive scheme embedded in and employed by the agency theory.

In the past decades growing attention has been directed towards the role of behavioral factors in an organization. However, the earliest studies of such factors date back to the '40s. For instance, in the administrative context, Simon and Millett (1947) believed that every organizational theory should be a function of the psychology of human choice. Two decades later, Cyert and March (1963) founded one of the cornerstones in the Carnegie School to set forth the concept of a behavioral theory of the firm *behavioral theory of the firm* (See Beck et al. (2017)). Later, their theory turned into a source of inspiration for further studies on cognition, performance feedback, attention, learning, and adaptation (Argote and Greve, 2007; Eisenhardt and Bourgeois, 1988; Gavetti et al., 2012).

The supporters of Carnegie school also hold to the belief that the classical rational agent model is unable to result in realistic decision-making anticipation because of its unrealistic assumptions. Given the asymmetry of information and lack of knowledge, the agent might make decisions that are not in line with the maximization postulate of the agency model (Gavetti et al., 2012). This inconsistency has caused the definition of corporate governance to be redefined through resetting new objectives. The older version of the corporate firm assumed that corporate governance's ultimate goal is to maximize the benefits of the investors (Shleifer and Vishny, 1997). On the contrary, the more moderate viewpoint guaranties that the manager (the agent) runs the firm to benefit all stakeholders. In this view, shareholders, suppliers, customers, and employees are all included as stakeholders (Goergen, 2012).

The existing body of literature draws mainly upon the behavioral factors that play a role in the theory of the firm. However, an in-depth examination of conflict clarification activities within the agency setting is missing. Likewise, a model is discussed that takes not only the extrinsic incentives, but also the intrinsic rewards into consideration, which thus more likely reflects the actual process of decision-making. Then, the question: whether in an agency model, putting efforts into resolving conflict can positively impact the corporation output is addressed. This hypothesis is investigated theoretically and practically.

For the theory, a mathematical model applied by the agency theory is used to extract the optimal sharing rule. This model is adopted from Holmstrom (1979)'s work. Next, a conflict index is added into the two initial agency models. Thesis theoretical findings indicate that under the new assumptions, conflict clarification efforts positively influence the total outcome. Also, it suggests that in a company with high innovation potential, the principal's share of the outcome is higher when there is observable conflict clarification activity.

For the practical setting, the relationship between the management board and the shareholders is investigated. There it is examined whether shareholders' activism affects the performance indicators of the firm positively. To this end, the current thesis mainly focuses on the innovation and financial indices. The findings of the empirical work indicate a positive effect of the shareholders' proposals related to executive compensation and corporate governance on innovation. The results suggest that shareholders' proposals can enhance the number of patents between 8% to 11%, depending on the proposal category. Among all types, executive compensation (i.e. 11%) has the highest effect and is robust to the different specifications. Besides, an executive compensation proposal is associated with 13% higher revenue.

In short, the present thesis successfully bridges between the theory and practice of studying the conflict-of-interest in principal-agent relationship. Furthermore, it shows that the effect of conflict resolution can vary depending on the type of controversy, task type, and even the firm's industrial background. Likewise, the study suggests that entitling the conflict and putting effort into resolving it instead of ignoring or surpassing it can have a favorable effect on the financial output. The main argument draws upon the neglected potential of conflict resolution in generating innovation that ultimately leads to higher corporate benefits. In addition to the knowledge transfer, the positive effect of conflict of interests can be examined through two viewpoints: first through observability enhancement and further through providing higher motivation (incentive scheme) for the agent to work harder. These viewpoints form the critical argument of this thesis, which is elaborated on throughout the three papers. A definition of conflict in the organizational context will follow. After that, a brief prelude into the three papers will provide a holistic picture of what is included in the present study.

Conflict of interests

The conflict includes a wide span of concepts. This characteristic makes conflict into an interdisciplinary topic and therefore appealing to a wide range of fields of human studies. In the literature, conflict research covers at least six viewpoints with various approaches depending on the context: the micro-level (psychological), the macro-level (sociological), economic relations, labor market, bargaining, and negotiation, and third-party struggle clarification (Lewicki et al., 1992). In order to investigate the role of the conflict, first, a more accurate definition has to be set forth. The current study limits its investigation to a concrete definition of conflict, adopted originally from Roloff (Roloff, 1987, p.496), and developed by Rahim

(2002). Roloff has defined conflict as following;

> "Organizational conflict occurs when members engage in activities that are incompatible with those of colleagues within their network, members of other collectivities, or unaffiliated individuals who utilize the organization's services or products."

Rahim has widened this definition by conceptualizing conflict as:

> "An interactive process manifested in incompatibility, disagreement, or dissonance within or between social entities (i.e., individual,group, organization, etc.)" (Rahim et al., 2001, p.198).

This definition has several implications. Firstly, the investigation focuses on the activity and therefore targets the task conflicts. Secondly, each individual has some interests which oppose others, and this opposition can emerge in the form of disagreement, dissonance, and incompatibility. Through using this definition, Rahim et al. (2001) introduced a meta-model based on five different forms of conflict: integrating, obliging, dominating, avoiding, and compromising. Integrating underlines a conflict management style based on exchanging information and finding an alternative among all possible ways, which serves the benefits of both parties. Obliging is about shared interests and thereby tries to reduce the differences. As the name testifies, dominating management style is about imposing one's own opinion on the other person. In avoiding, parties are encouraged to ignore the problem in hopes that it will disappear after some time. Finally, in compromising, both parties give up some of their interests and take others in order to meet halfway.

Rahim's model has examined the role of conflict when using each of these conflict management styles, and concluded that only compromising and integrating styles lead to better performance. In the meantime, better performance is interpreted in terms of the financial and non-financial returns for the stakeholders. The most typical manifestation of the positive contribution of conflict within an organization emerges in the form of innovation and efficiency (Song et al., 2006).

The current study will employ a similar argument to focus on the task-based conflict, which is associated with the innovation index enhancement (Jehn and Mannix, 2001). Examining the task conflict is highly intuitive because facing disagreement when defining a task is thought to help parties to gain a better understanding of the task itself. It can be described as disagreements about strategies and implementation, which embeds all disputes and encounters over any arbitrary task rather than personal controversy interactions. This category of disagreement is categorized by focusing on reaching an agreement through negotiation and bargaining, which calls for a degree of compromise on both sides. Thus, both parties' opposite behaviors should be steered towards coming to a middle point, while the weight is placed on cooperative interests rather than the competition. Moreover, coming to a mutual consensus out of controversy is also included in the definition. Likewise, the current thesis excludes formal litigation proceedings and all war game models, in which parties spend their resources on being armed against each other. The latter depicts a zero-sum game situation when one party's loss would lead to the other's gain. Thus, it is supposed to result in a "lose-win" status. Excluding such cases when talking about agency relationships seems to be quite intuitive.

Likewise, within the scholarly realm of behavioral economics, there are shreds of evidence of mutual and opposing interests in any given disagreement. It is even true in international affairs, where two countries are components of a more extensive system that depend on and simultaneously affect each other. In this sense, the situation of perfect opposite interests is an exceptional case (Deutsch, 1973; Schelling, 1960). The third implication of the current definition relates to the fact that conflict can happen at any level in the organization, at the top level between the board manager or a lower level between employees (Evan, 1965). The recent finding is in line with the more moderate definition of corporate governance given in the literature before. The firm belongs to all stakeholders and not only to shareholders. In this sense, the interest of any of the stakeholders is not any less important than that of shareholders.

The current thesis be presented in three papers. A short overview of each one of three papers will follow.

Paper 1: Towards the Incentive Schemes in a General Theory of Agency

Challenging the incentive scheme applied by agency theory, this study will look through the foundations upon which the general agency theory is established. By shedding light on the theoretical definitions of the principal-agent relationship and agency mathematical illustration, this work tries to explain how the agency theory yields the optimal sharing rule. Moreover, it argues those assumptions of the agency theory which do not draw upon the decision-making processes of the real world. Four critical assumptions serve as the target of the proposed critique. First, the belief of external reward being the only instrumental incentive to make the agent work harder is discussed. In this way, it is argued that a higher reward may narrow the agent's view and stop him from creative thinking. The modern view entitles the behavioral economics factors and ascertains that no external incentive can lead to action until the intrinsic motivation is missing. In this sense, intrinsic incentives are more crucial for taking actions than extrinsic ones (Ariely et al., 2009; Glucksberg, 1962; McGraw and McCullers, 1979; Wiseman and Gomez-Mejia, 1998).

Second, assuming that observability enhancement is always beneficial to the principal will be discussed. The behavioral economics findings suggest that however, observability mitigates the moral hazard; it simultaneously gives the agent the impression of distrust and threat and, therefore, can provide the agent with lower motivation to work (Cropper, 1981; Eisenhardt and Bourgeois, 1988; Prat, 2005). First and foremost, the agency model pursues its objective of optimizing the interest of the owner through two major premises (Eisenhardt, 1989). One of them assumes that the outcome is based on the incentive scheme depicted in the contract (Alchian and Demsetz, 1972; Charreaux, 2002; Eisenhardt, 1989; Jensen, 1983). The second one iterates that reducing information asymmetry will mitigate the moral hazard because the agent's action will uphold the principal's interest (Eisenhardt, 1989). In this regard, a combination of the appropriate incentive and proper monitoring tools can ensure the desired results. This view of the staff fails to consider the individuals' complication as a human being and thus, gradually fades away in an organizational psychology field. Furthermore, within the agency paradigm, the principal assumes the agent is risk-averse, and therefore she prevents imposing the agent any risk. Conducted experiments, however, found that the agent's attitude towards risk may change depending on the circumstances (Cyert and March, 2015; March and Shapira, 1987; Sitkin and Pablo, 1992). Finally, the restrictive assumption of the agent being opportunistic, egoistic, and adverse selective will be discussed.

Paper 2: Improving the Sharing Rule in an Agency Model through Clarification of the Task Conflict

Second paper reapplies the agency model used by Holmstrom (1979)and develops a new model by including conflict clarification as a new input. In a complete contract state, Holmstrom showed that each signal from the agent's side will change the distribution of the outcome and therefore can affect the agent's behavior in not deviating from the contract. With a similar strategy, current thesis introduces a Conflict Clarification (CC) model to show that allocating some of the agent's effort to resolving conflicts between agent and principal can lead to a more optimal state. The thought behind this hypothesis is built on three pillars. First, the innovation and revelation associated with each conflict propose a new way of doing the task more efficiently. Nevertheless, innovation is thought to bring about alterations in the production function and has become an indispensable component of the production, but it has been neglected in the general agency theory. Second, the signals that are dispatched during conflict clarification will lessen the moral hazard. The recent argument results from a comparison between two CC models, one with observable conflict resolution activities and one where such activities are hidden from the principal's eyes. Finally, as the distribution of outcome shifts, the agent is provided with higher incentives to work harder. The new setting is tested against the conventional agency model in terms of total outcome, optimal effort, and first and second-best sharing rules. The findings suggest that under mentioned assumptions, the presence of conflict clarification effort will enhance the total outcome no matter if the principal observes or does not observe the conflict effort. Also, in the industries with a high propensity to innovation, the principal's share of the outcome is the highest when there is observable conflict clarification activity. In contrast, the agent will get better off when the principal cannot observe conflict activity.

Paper 3: An Investigation into the Role of Shareholder Activism in Improving Innovation and Financial Performance

The third paper examines the effect of the conflict of interest in an agency relationship empirically. Through using a panel dataset collected over 14 years from S&P 500, this study gives an analysis of the role of shareholder activism on the financial and innovation outcome in corporate governance. For this purpose, the evidence is collected from proposals that stockholders make to the management board in each annual meeting. The relationship of the stockholders with the management board fulfills the requirements of agency theory. Moreover, it happens at the top of the organizational hierarchy, where the general culture and the official policies are issued. In this sense, every revelation generated at this level will be reflected in the organization's overall indices since it will be followed and implemented in the lower levels. The number of proposals that stockholders present to the board of managers in a given year will be used as the conflict index. Also, for analyzing the effect of each type of conflict, proposals are categorized into three different groups, corporate governance, executive compensation, and social policy. For measuring innovation, similar to the innovation literature,the number of patents registered by the company in a given year is used. Also, for measuring the financial outcome, the firm's revenue will be used. Furthermore, to control the effect of high propensity to patenting, two control variables for the RD and the size are added into the model. The aimed examinations are based on using a variety of estimators both to find the best fit for the data and to test the robustness of the findings.

Then the primary hypothesis is tested, while noting that variations in the number of proposals can enhance a company's innovation and financial indicators. Furthermore, a secondary hypothesis speculates that there is a proposal number, for which the effect of conflict on the patent number is maximized.

The findings suggest that whether the conflict has a positive, negative, or unclear effect on the performance depends on the conflict type. Current research suggests a positive and significant effect of executive compensation (10%) and corporate governance (5%) proposals. In contrast, social policy proposals seem to have no clear effect on the patent number. This result is consistent with several pieces of literature, which found no clear effect of shareholder activism on the market value and firm value (Ferri and Göx, 2018; Guercio and Hawkins, 1999). Also, one extra executive compensation proposal is associated with 13% higher revenue.

The findings also confirm the secondary hypothesis and suggest that the effect of the conflict is the highest when the number of the proposals equals four. It implies that a moderate amount of conflict is constructive, however too much conflict can disorder the problem solving and production process.

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Towards the Incentive Schemes in a General Theory of Agency

Review of Theory and Evidence

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Abstract

The current paper tries to shed light on the incentive scheme applied by agency theory. First, the agency assumptions as fundamental to this theory are discussed. Second, by monitoring the agent's action a comprehensive review of the mathematical model of agency introduced by Ross (1973) and adopted by Holmstrom (1979) is presented. General agency theory assumes that the problem of moral hazard can be mitigated through designing tools that; on the one hand, provide the agent with enough incentives to work hard and on the other hand monitor the agent's action precisely.

In the practice, however, these assumptions do not simulate a real decision-making situation until the behavioral factors are neglected. It is argued that external incentives cannot move the agent, whenever he does not have sufficient intrinsic motivation. Furthermore, enhancing observability does not always lead to a more optimal result. However it can mitigate the moral hazard, it can at the same time ruin the trust between parties and therefore, decrease the incentives to work hard. Moreover, the assumptions of agents' risk-aversion besides his opportunistic attitude will be discussed.

Contents

1 Introduction

Agency theory focuses on the agency problem and the way to solve it (Jensen and Meckling, 1976; Ross, 1973). Furthermore, it counts as an age-old problem that exists since the emergence of corporation which was addressed in a wide range of academic fields, from Economics (Jensen and Meckling, 1976; Ross, 1973; Spence and Zeckhauser, 1971) to finance (Fama, 1980) and political science (Adams, 1996). Agency theory, in its classical definition, is built on incentive schemes. In this sense, the principal tries to induce the agent to make a higher effort by providing higher incentives. Hence, when talking about effort, the operational action is what actually and merely counts in the agency paradigm. In this sense, through taking the operational effort as the input, agent tries to maximize his payoff, while assuming the agent as risk-averse (Jensen and Meckling, 1976; Smith, 2010). In a general agency theory setting, because the owner only observes the outcome, whereas the agent who sees his effort, the problem of asymmetry information and consequently the conflict of interests arises. This opposition between both parties' interests leads to agency cost. The agency theory developed by Jensen and Meckling supposes that the corporate outcome will be reduced by the cost of conflict (Jensen and Meckling, 1976).

The current paper's main idea is to investigate the fundamentals upon which the general agency theory is established. By shedding light on the agency theory and its mathematical illustration, this work explains how incentive schemes play a crucial role to derive the optimal sharing rules. Moreover, by criticizing the standard agency theory's restricted assumptions, this paper contributes to the behavioral agency theory. In this sense, the question: why the agency theory fails to come to a realistic model that simulates a decision-making situation is addressed. According to the general agency model, the ultimate and the only objective of the cooperation is to uphold shareholder interests, which seems misguiding. Shankman (1999) believes that such a view can even work detrimental to the firm's interest . Principally, the agency model follows its mission, which is optimizing the owner's interest through two major propositions (Eisenhardt, 1989). One of these propositions assumes that the outcome is based on the incentive scheme depicted in the contract (Alchian and Demsetz, 1972; Charreaux, 2002; Eisenhardt, 1989; Jensen, 1983). Therefore, the agency theory considers the agent a production factor that works based on the contract, whenever he is provided with sufficient incentives, and otherwise will shirk the task. In this sense, agency theory also believes that there is a monotonic relationship between the reward amount and the motivation and effort (Jensen, 1998). The second proposition ascertains that reducing information asymmetry will mitigate the moral hazard because the agent's action will uphold the principal's interest (Eisenhardt, 1989).

Based on the evidence from literature in different fields, the current work shows where these propositions make restrictions to develop a realistic model. The general agency model has attracted large attention so far. However, it also has drawn criticism from other perspectives within the agency theory framework for its limitations. For this reason, behavioral agency theory believes that this model's restrictive assumptions make it incapable of providing a model that reflects reality (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992; Wiseman and Gomez-Mejia, 1998). Wiseman and Gomez-Mejia (1998) suggest that the agency model's premises regarding risk behaviors are too restrictive and straightforward that they cannot simulate real decision-making preferences. This general criticism served as a basis for developing a new model. They combined behavioral factors into the agency model and relaxed the restrictive assumption of the agent's risk-aversion (Wiseman and Gomez-Mejia, 1998).

In the literature, there are several examples of examining the role of behavioral factors in mitigating agency problems (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992). As an instance, Eisenhardt and Bourgeois (1988) found that the observable coalition behavior among managers is associated with poor firm performance. In another study, Simon and Millett (1947) showed that the corporation's poor outcome does not necessarily imply the agent's evil intention but is due to the bounded rationality restricted through asymmetry information. It is taking a sub-optimal choice when the agent being incompetent at processing all information. For this specific case, the general agency theory would probably prescribe to improve the agent's share by providing more incentives to the agent. In contrast, the agent seems to have sufficient incentives but the lack of information.

In a similar work, (Gavetti et al., 2012) showed that due to the asymmetry information and lack of knowledge, the agent might make decisions that are not consistent with the maximization postulate of the agency model. Likewise, Pepper and Gore argue that intrinsic motivation also matters when talking about the agent's action. Therefore, in their work, besides income, they also investigated the role of agency preferences on the agent's risk-taking and effort. By including the behavioral factors besides executive compensation into the agency model, they showed that behavioral agency theory provides a better setting in theorizing executive compensation (Pepper and Gore, 2015). In this way, agency theory with a behavioral approach was a source of inspiration for further studies in cognition, performance feedback, attention, learning, and adaptation (Argote and Greve, 2007; Eisenhardt and Bourgeois, 1988; Gavetti et al., 2012).

The current paper likewise reviews the fundamental assumptions of the general agency theory. It also explains how the optimal sharing rule is derived by shedding light on the agency theory and its mathematical illustration. Furthermore, it provides four streams of the critics of the agency theory. First, the assumption of external reward as being the only instrumental incentive to make the agent work harder. Based on the literature, the high reward may narrow the agent's view, stop him from creative thinking, and therefore acts as counterproductive. Therefore, agency theory's spirit is not consistent with innovation. Second, assuming that observability enhancement is always beneficial to the principal, will be addressed. In this manner; however, observability mitigates the moral hazard, it simultaneously provides the agent with lower motivation to work. In addition, current paper discusses the restrictive assumption of an agent's risk-aversion. Finally, the restrictive assumption of agent being opportunistic, egoistic, and adverse selective will be discussed and criticized.

The second section gives a detailed description of the agency problem, its evolution, and its related terms and concepts. Section three discusses the limitations of the general theory of agency. Section four presents the mathematical model of agency theory introduced by Harris and Raviv (Harris and Raviv, 1979) and developed by Holmstrom (Holmstrom, 1979). Along with the general agency theory assumption, it is demonstrated how the optimal contract is derived. Finally, Section five concludes.

2 Agency Problem

2.1 Evolution

In its general form, the agency model focuses on the relationship between the capital owner (principal) and a party (agent), who works on this capital in return for a share of the payoff. The first scholar who shaped the agency theory in a form known today is Ross (1973), who formulated a mathematical model of the agency problem. This model was mostly developed later by the work of Jensen and Meckling (1976). They built a theory that demonstrates how separate individuals' conflicting goals can be brought to an equilibrium. Their model was a generalized form which is considered a source of inspiration for generating specific agency models (Harris and Raviv, 1979; Holmstrom, 1979; Mirrlees, 1976).

Jensen and Meckling's theory also prompted two distinguished categories of agency model suggested which is explained by Eisenhardt (1989):

1. **Positive agency theory**: discusses the roots of the agency problem and the agency cost attached to it. This agency theory type proposes that the principal can manage information and risk-sharing costs by establishing an appropriate incentive contract. This theory believes in two propositions. First, it assumes that making the proper agent incentive will make the agent put in his highest effort and not deviate from the contract. Second, it believes that providing the principal with more information on the agent's type will confine the agent's action in favor of the principal. The work of Eisenhardt (1989) mostly influences this theory. Based on two assumptions mentioned above, Eisenhardt formalized two propositions to minimize the agency problem: (1) through managing the incentives and setting an outcome-based contract and (2) through monitoring and controlling the manager which also imposes some agency cost to the firm.

2. **General theory of principal-agent:** is also based on the contract scheme between principal and agent. However, it implies a more prescriptive approach to the problem and tries to provide a formal mathematical model to optimize the principal-agent relationship. It assumes that the principal is risk-neutral and tries to maximize her profit, whereas the agent is risk-averse (Harris and Raviv, 1979). Wiseman and Gomez-Mejia call this theory normative agency theory.

Although the agency theory mostly concentrates on the interactions between the agent and the principal, it also covers other relationships within the organization. In this sense, agency theory can be classified into three types. Type one refers to the conflict of interests between management and the ownership (Jensen and Meckling, 1976; Ross, 1973). In type two, governance mechanisms on the conflict between majority and minority shareholders are studied (Gilson and Gordon, 2003; Shleifer and Vishny, 1997). This type of agency problem arises because major owners use their power to make decisions to the detriment of minor shareholders. Finally, the third type arises, when the owner makes risky decisions that threads the creditors (Damodaran, 1997). These three different agency problem types emanate from the division of ownership from decision making role.

In more recent times, scholars found the agency theory's assumptions either not realistic or not necessarily beneficial to the firm. For example, (Cremer, 1995) argues that observability does not make an advantage to the principal under all conditions. This preposition only holds when there is no renegotiation possibility, and the contract is not dynamic. Otherwise, receiving information about agent's type and action, makes the agent decide for non-renegotiation and be less committed to it. In a similar work, Holmstrom (1979) shows that a signal that conveys extra information about the agent's action will better off the principal. However, this is only a valid point when there is no full contracting on observable actions. Around twenty years later, he argued that however information revelation under the mentioned conditions would decrease the moral hazard, yet it will lessen the agent's motivation for exerting high effort (Holmström, 1999). Moreover, Prat believes that in contrast to the agency's assumption of information disclosure, the mutual funds refuse to publish the information on the portfolio. Because it will reveal the information not only to the investors but also to the rivals. In this case, information disclosure is the wrong kind of transparency, which can be detrimental to the firm (Prat, 2005).

2.2 Agency Problem Definition

Any relationship between at least two parties, in which one acts for, or on behalf of, or representative of the other party can be considered agency (Ross, 1973). This definition helps one think beyond a relationship within an organizational context. Based on this definition, the relation between a landlord (conventionally she) and a farmer tenant (conventionally he) also counts as an agency relationship. The landlord owns the land but possesses no skill, time, and physical competence to work on the land. Therefore, she decides to hire a sharecropper to work on her land in return for a fixed wage or a portion of the crop produced. As long as the tenant farmer works on the land, he can affect the landlord's outcome through the effort level he chooses to put forth. Another example for an agency relationship is a venture capitalist who provides capital to an entrepreneur. In this case, the entrepreneur raises funds to implement an idea, in which he is highly skilled. The venture capitalist's single point of information remains the entrepreneur because he is the party who is involved in all stages of the task, while the action being unobservable to the capital owner. Furthermore, the agency relationship holds between a manager and her employees, who work eight hours a day on a project, for which the manager is the responsible person, an agency relationship is maintained. The manager will never know what the employees indeed do unless she perfectly monitors employees' actions which is highly costly.

The last example refers to the stockholders and board members' relationship. The stockholders are the company owners and the external manager who works as CEO and runs the company on behalf of the owners. Each decision from the executive side will have consequences regarding the firm value and can directly affect the shareholders' interest. In this sense, suppose that an individual is willing to work as a manager and earn money in return. However, he possesses no company to run. Furthermore, assume that a capital owner is interested in running a business and making money out of her investment, but she cannot manage a company due to a lack of know-how and skills. It is a widespread scenario in the real world, a workforce with no capital and a capital owner with no expertise. In the context of agency theory, the owner and the worker are called principal and agent, respectively. Rationally, the capital owner concludes a contract with the manager, based on which the manager runs the business in return for some income. Hence, after signing the contract, the principal has the authority and the ownership of the company, while the agent runs this business for her.

However, a perfect contract that guarantees both parties' best utility level does not exist from a practical point of view. On the one hand, the problem arises when the principal cannot condition the contract on the effort level that the agent exerts because the effort is unobservable to her. Consequently, she has to contract upon the outcome because both parties can observe it. On the other hand, the agent will possibly claim that determining the payment based on the result is at his disadvantage because no matter how hard he tries, there are external factors over which he has no control. To better understand the latter situation, assume that the CEO of *"X Airline"* is expected to increase the business revenue at least by three percent during the next quarter, and his earning is set to be conditional to this achievement. Simultaneously, the new federal law restricts the number of travels against a recent virus outbreak. This regulation will affect the airline industry negatively regardless of the CEO strategies and actions. As a result, the attempt of the CEO will not possibly lead to higher revenue. In such cases, the relationship between the outcome and the agent's effort is impaired, and therefore no correct interference about the effort can be made merely based on the result. Hence, the uncertainty issue arises due to the absence of a reliable connection between the agent's action and the outcome. So in case of a good result, the principal cannot infer for sure whether the high return is due to favorable external factors or instead due to the agent's hard work.

Besides, the principal faces further problems due to information asymmetry if she tries to infer about the agent's effort level when observing the outcome. The fact that the principal cannot track the agent's action gives the agent the possibility to act not necessarily in favor of the principal. For example, an entrepreneur in the IT sector might devote most of his energy and effort to an idea with high personal return and increased recognition in the scientific community. Although, by doing so, he postpones the investor's expected payoff or even does not contribute to the overall success of the venture at all.

In summary, when two circumstances, namely uncertainty, and unobservability coincide, the problem of reaching a perfect contract arises. As already mentioned, when an agent acts and makes decisions on behalf of the owner which is unobservable to the principal, he can affect the principal's return and possibly, deprives her of reaching the best possible outcome. In an optimization context, this best possible outcome is called the "first-best solution" and equals the result, which would be realized if the owner and the manager were the same person. Moreover, the agency theory believes that the first best solution is to be reached under the perfect monitoring condition. If the principal can observe all agent's actions, she can make him take the effort level that is the best for the principal.

For example, if a landlord works on her land, she will give her best effort to optimize the crop amount and reach the first-best solution. Now suppose that the landlord decides to hire a sharecropper in return for a specific payment. From an agency theory point of view, the agent will not choose the same level of effort that the landlord herself did, at least, when his actions are hidden from the landlord and under uncertainty. But as soon as one of these conditions disappears, an optimal setting for the sharing rule can be achieved. Hence, only in the presence of uncertainty, inference about the link between effort and the outcome gets impaired. So, in a world of certainty, this relationship could have been perfectly built, and the principal could have made a perfect inference about the action, only through observing the yield. Therefore, uncertainty counts as the first obstacle on the way of an optimal contract. In this regard, agency theory believes that even under uncertainty, if farm tenants' actions are perfectly observable by the landlord, he will choose the optimal level of effort that leads to the first-best solution. Because then the principal will condition the wage to the agent's action and not to the outcome. In doing so, she gives the agent appropriate incentives to choose the highest level of effort.

	x_s	x_m	x_b
a_l	$p_s(a_l)$	$p_m(a_l)$	$p_b(a_l)$
a_m	$p_s(a_m)$	$p_m(a_m)$	$p_b(a_m)$
a_h	$p_s(a_h)$	$p_m(a_h)$	$p_b(a_h)$

Table 1: Discrete probability distribution of the outcome, x_j over three effort levels.

Table (1) gives a better understanding of how uncertainty affects the relationship between action and outcome. The agent chooses an action a from a set of possible actions A, which includes three levels of effort: low, medium, and high effort, $A : \{a_l, a_m, a_h\}$. Also, suppose that x takes only three possible values: small, medium, and big. According to the table, if the agent exerts low effort, a_l, the probability that the small outcome has resulted equals $p_s(a_l)$ with $p_s(a_l) > p_b(a_l)$. After the contract is signed, the agent will choose one of these effort levels to take. The principal is not aware of the agent's choice, and only after realizing the outcome will the principal observe x. So as parameter a is hidden from her, she will not be able to say what effort level the agent has exerted. The agency problem is about finding a way to induce the agent to take a_h against all other effort levels. General agency theory assumes that the agent will exert higher effort when he knows that he will gain a higher outcome. Therefore, monetary incentives are considered the most optimal solution to the problem of moral hazard.

2.3 Moral hazard, Adverse Selection, State of Nature

In the agency literature, the problems regarding uncertainty and unobservability are generally sorted into three groups: moral hazard, adverse selection, and state of nature (Arrow, 1985). The first two types are related to the fact that the principal cannot observe the agent's action, Whereas the last case occurs out of the manager's control. Based on the agency theory assumptions principal proposes a contract to the agent, which the agent may accept or reject. The principal also tries to offer the lowest wage to the agent, but still so high that it gives the agent sufficient motivation to cooperate. In the case of accepting the contract, the agent should choose an effort level to carry out the task. As the effort is not observable to the principal, it is impossible to condition contracts on the action, and therefore the principal can link the payment only to the outcome. In the agency context, this situation, when the unobservable effort of one party imposes some risk or cost to the other party, is called *"moral hazard"*.

Arrow (1985) names this unobservable effort the ”hidden action” and consequently defines the moral hazard as the covert action taken by the agent.

Some scholars believe that the first discussion around the moral hazard emerged concerning insurance, and this concept was developed along with the insurance industry in the seventeenth centenary (Hale, 2009; Pearson, 2002). However, a long time before that insurance was known as an industry, the moral hazard had been recognized. Furthermore, the rules to mitigate it was thought of as established techniques to control the business risk. For instance, Hart et al. explain about the Chinese merchants in 7000 B.C., who were willing to share the risk of loss in the case of the shipwreck (Hart et al., 1996). Thus, the oldest recorded evidence of controlling risks under uncertainty goes back to the *Hammurabi Code*, which was found in Babylon in 1790 B.C. As reported, the risk due to the state of nature should not have been borne by the labor but by the landlord. For example, law 48 of the Hammurabi Code suggests a solution to reduce the farmers' risk in case of natural disasters.

> ”If a man owes a debt, and the god Adad has flooded his field, or the harvest has been destroyed, or the corn has not grown through lack of water, then in that year he shall not pay corn to his creditor. He shall dip his tablet in water, and the interest of that year he shall not pay.” (Edwards, 1921, p. 20)

The term moral hazard was first used in the late nineteenth, where insurance was first introduced to mitigate the loss under uncertainty (Baker, 1996). Before this time, the cause of good and bad events was perceived only to be God's will. For example, in the Middle Ages, the agent's professional ability was not recognized as a significant factor in profit and loss; in contrast, the state of nature was perceived to be the only factor in charge of the outcome. In this sense, the state of nature was supposed to be divine will, which could not be anticipated and not controlled (Ceccarelli, 2001). For this reason, in the Middle Ages, the church considered insurance to be illicit because it predicted and interfered with the divine will (Ceccarelli, 2001). Through issuing the *decretal Naviganti* in 1234, Pope Gregory announced that buying insurance as prohibited because the insurer was profiting from guaranteeing the safety which can only be provided by God (Ceccarelli, 2001). After this period, the concept of the state of nature has undergone an initial transformation along 700 years, until the religion reformed his view to more modern and suggested that professional skills are not of less importance than the natural phenomena (Rowell and Connelly, 2012).

In the economics literature, moral hazard is mostly considered an *ex-post* event and occurs when an agent shirks his tasks after the contract was signed (Rowell and Connelly, 2012). One example of a moral hazard is a board member who does not exert a sufficient amount of effort to improve the company's revenue, although he is committed to doing so. Nevertheless, there are also pieces of evidence where moral hazard is defined as an *ex-ante* behavior (Winter, 2000). In this sense, before signing the contract, the lack of incentives to reduce the risk is considered to be a moral hazard. In this example, the company owner should try to make appropriate incentives to prevent the agent from deviating from the contract later on. In this sense, the absence of a setting that provides adequate incentive is known as moral hazard. Such a setting is meant to increase the risk of taking a low effort level to the agent. As evident in its modern use, the term moral hazard neither refers to morality nor to hazard, but two words combine and form an idiom, which has a new, independent meaning.

> ”... the problem of moral hazard in insurance has little to do with morality but can be analyzed with orthodox economic tools.” (Pauly, 1968, p. 531)

Based on this methodology, the principal can make agent take the action desirable to her only by setting adequate incentives. Varian defines moral hazard as a lack of incentives to take care of risk (Varian, 2010). In this scenario, building trust among parties has no place, and the agent’s actions can be fully controlled, whether via providing more incentive or monitoring.

The *ex ante* interpretation of moral hazard should be tracked in the concept of insurance (Rowell and Connelly, 2012). The insurance company undertakes the responsibility to compensate specified losses or liabilities in an accident or insolvency within the insurance mechanism. However, the covert action of the insured can increase the probability of loss occurrence. For example, a driver who has taken out insurance for his car drives more carelessly than before because someone else is responsible for the losses. In this example, the moral hazard is a set of behaviors that increase the loss value or the probability of loss’s occurrence. Being challenged by the moral hazard problem, the insurance companies added the deductible article clause to the insurance law to compensate for the missing incentives, which motivates them to take care of the insured property. Adding deductible to the contract can make the insured drive more carefully. Therefore they count as one of the tools that effectively decreases the number of car accidents. Therefore, the question is if the usage of deductibles can be generalized to an agent who works for a principal. In other words, whether in such a relationship, a higher agent’s share of the output serves as significant leverage for inducing the agent to choose higher input. Although the general form of agency theory’s answer to this question is yes, the more modern view challenges this answer’s validity. In the context of experimental psychology, there are shreds of evidence that high payoff can impede the concentration on the task (Ariely et al., 2009; Glucksberg, 1962; McGraw and McCullers, 1979).

Likewise, in the joint venture literature, other studies discuss the agency problem (Bergemann and Hege, 1998; Gompers and Lerner, 2004; Hart et al., 1996; Neher, 1999). At first, the entrepreneur is the party who offers the contract generally to different venture capitalists, until one accepts it (Bergemann and Hege, 1998). The venture capitalist’s payments have to be, at least partially, done upfront and before the project even begins. This fact makes it difficult to contingent the contract on any observable factor. Even investment allocation to the project is hidden from the investor’s eyes, and therefore the moral hazard for investing in this field is relatively high. Bergman believes that in a joint-venture relationship like the general form of agency theory, the unobservable is still effort. Hence, the action can be defined as the attempt that should be put forth to allocate the fund correctly into the project while it bears costs to the entrepreneur.

As an expert in that specific field, the entrepreneur is highly skilled and possesses know-how that the investors are deprived of. This knowledge gap can generate information asymmetry that is particularly risky for investors. In response to this concern, financing for a venture does not naturally happen upfront to prevent the entrepreneur’s opportunistic behaviors. Gompers believes that the staging of capital, known as a characteristic of venture financing, allows investors to withdraw their money any time they observe risky behaviors from the start-up (Gompers, 1995). Moreover, at the early stages, the collateral works as a backup for the later rounds (Neher, 1999). Hart et al. (1996) introduce a dynamic wage model in which the entrepreneur receives the fund in the form of a loan, which should be repaid partly at different stages from the project return. In this sense, the entrepreneur's payoff is determined as the project return minus the loan reimbursement. Although stage financing controls the entrepreneur's opportunistic behaviors in some aspects, like choosing higher production input, the investor faces new moral hazard types. As the project continues to receive funds, the agent controls the capital's allocation and input effort. This control over action and budget allocation is unobservable to the principal, and therefore the agent can also influence the information transfer channels. Bergemann and Hege (1998) explain this situation when the entrepreneur shirks when allocating funds to the project is unobservable to investors. Suppose that both parties have the same belief about the project in terms of its return. Now, assume that the entrepreneur transfers the funds to his private account. As no capital was invested in the project, he expects no return in the first round. However, the investor may interpret failure as "bad news" because she thinks that the entrepreneur worked as promised. Observing the outcome after the first stage will create a deviation between the party's beliefs about the project. This conflict of perceptions leads to two possible scenarios. Either paying the entrepreneur more than determined in the contract for the project, which is defined as inefficiency, or the project would end prematurely due to the contract termination (Bergemann and Hege, 1998). Another form of moral hazard can happen where stage financing allows the entrepreneur to withdraw his human capital before the due time.

Previously, the moral hazard was described through giving some real examples from two industries, agriculture, and the startup market. But as mentioned earlier, besides moral hazard there is a second type of uncertainty, known as *"adverse selection"* related to the information asymmetry between two parties prior to signing the contract (Fama, 1980). In other words, one party (usually agent) has access to the information that helps him evaluate the contract more realistically than the other. In this case, the principal can be disadvantaged as she makes decisions based on an unrealistic assessment of the value and the risk of the outcome. In the farmer tenant example, suppose that the farmer knows that he is ill and cannot work as high as he is expected, notwithstanding he signs the contract. In this case, the expected project's outcome is higher than the real evaluated by the landlord, while the farmer can evaluate the risk more realistically.

Both moral hazard and adverse selection create a correlation between the agent's action and the outcome; however, the direction is opposite. Moral hazard postulates that the agent will invest less effort into the task, whereas adverse selection posits that the agent is a "risky agent". In contrast to moral hazard, which is about covert action, adverse selection is about hidden characteristics (Bigelow, 1990). It is hiring a Farmer who is unwilling to work versus hiring a farmer who is not qualified enough for the task. According to these definitions, these two terms were born and developed in separate contexts. Moral hazard was created along with the fire insurance, while the adverse selection was developed within the life insurance context (Rowell and Connelly, 2012). No one would be willing to exchange one's longevity for financial earning, and therefore moral hazard should not be an issue in the life insurance market. But if an individual takes out life insurance while hiding his illness, he increases the probability of loss's occurrence.

In contrast to the conventional understanding of the moral hazard, which is to be *ex-post*, the adverse selection is an *ex-ante* issue and occurs even before the contract has been signed. In this sense, information asymmetry at the time of contract closure will later cause the principal losing utility. As the insureds are heterogeneous regarding their attitude to loss and lots of their information is hidden, it is not straightforward for the insurer to select only safe-type insureds. This situation gets even more sophisticated as there is no incentive for a high-risk agent to reveal his real risk. Arrow believes that adverse selection causes a redistribution of outcomes from low-risk individuals to high-risk ones (Arrow, 1963). There are shreds of evidence in the life insurance context that more risky which go more often for full coverage form of insurance. As an example, (Kronick et al., 1996) found that patients with severe mental problems spend more generously on health services and suggest this to distinguish high-risk individuals. Hence, by tracing back the spending history of patients, those more risky individuals can be determined. In this sense, the individuals with higher spending on prior-year services can be translated into higher spending in the current year, therefore, it implies that those individuals are more likely to be risky in the future. Besides, this gives a hypothetical pattern that should be taken into account, when selling insurance services. So through setting some restricted rules based on individual history due to using health services, the adverse selection problem can be mitigated to some extent.

The online marketing mechanism is another excellent example of a tool against adverse selection within an organizational context. Klein et al. (2016) showed that a rating mechanism could provide more transparency within the online trading market, which solves the adverse selection to a certain degree. They conducted a natural experiment by tracking the sellers on the eBay platform before and after introducing the new rating mechanism. In 1996, eBay decided to add the rating system to its online platform. In the classic feedback system, in addition to the buyers who could rate the sellers, the sellers could also rate the buyers after seeing their feedback. Moreover, in that system, any user on eBay could give feedback on any seller, no matter if they had purchased and consumed the product of that seller. For this purpose, users had three choices for providing feedback, ”positive”, ”negative” and ”neutral”, which could be accompanied by a text. After several modifications, in May 2007, eBay introduced a new rating mechanism. First, the sellers had to rate the buyer before getting aware of his or her feedback. As a result, a retaliation measurement got implausible, and evaluations turned out to be more realistic and less biased. Second, the sellers could not evaluate the buyers, and only buyers were asked to rate. It was a step towards preserving the principal's utility. Furthermore, the buyer could rate the service quality with one to five stars separately for the following categories: accuracy of the product description, communication, shipping speed, and fees. Without a doubt, this feature could give the buyer more precise accuracy about the product and the seller which led to more ex-ante transparency. Finally, in the new version, buyers could provide feedback anonymously, which motivated them to participate in the survey more than before and leave more honest and accurate feedback without any threat of retaliation.

Klein et al. (2016) found that most sellers improve their efforts when they are aware of a rating system. Furthermore, those sellers who were not able or willing to enhance their services existed from the market. Therefore, such a mechanism can be seen as a remedy for adverse selection, as it provides more transparency to the buyer about the seller type. Even if the buyer decides on more risky sellers, it is plausibly due to the buyer's trade-off between price and risk. Besides, their findings show that such a mechanism will make it costly for exploitative sellers to stay in the market. They also observed this behavior from the risky seller only when this cost did not exceed the cost of changing their behavior. Otherwise, the agent decided in favor of enhancing his product and services. The evidences also show that transparency not only helps the principal in a way to choose a seller based on his type but also it gives more incentives to the agent to select a higher level effort.

In another research, Jin and Leslie (2003) showed that restaurants that had to hang their hygiene certificate on the wall improved their quality. Anderson and Magruder (2012) showed in their paper that an extra half star in the online rating system is associated with a 19% higher sale for a restaurant. Also, another example of mitigating the adverse selection would be the return possibility after purchasing a good. Keeping the product for some time provides the buyer with more information about it, generally followed by a more optimal choice.

Moral hazard and adverse selection are related to the agent, more precisely, the agent's action and the agent's qualification. Besides these two, another source of uncertainty is out of the agent's control and plays a role in determining the outcome. In contrast to moral hazard, the state of nature is used for those situations that affect the outcome but are not under the agent's control, like the effect of a pandemic on an airline turnover. Hence, the first difference between the state of nature and moral hazard and adverse selection is that it is imposed externally. It also differs in this way that can be anticipated by none of parties, and therefore, both parties are equal in their ignorance about it. Remember "X Airline" example. There a situation happening out of the manager's control was depicted where a new federal law restricts the travels. It is an example of real-life related to the outbreak of Coronavirus. In December 2019, the World Health Organization (WHO) office in China announced the first infection to an unknown virus. Within just three months, it turned from a national concern to a global issue worldwide. Thus, as of writing this work, it Unstoppably grows. More restrictive regulations were issued, which prohibited face-to-face connection, and people had to lock-down themselves and stay at home. In such a situation, all industries, including aircraft, faced a recession that needs quite a long time to recover. The occurrence and the magnitude of this incident disrupted the world's economy to such a great extent that S&P 500 index crashed 9.5%, and the Nasdaq index dropped 9.4% lower, which is considered to be the lowest value since Black Friday in 1987. Such circumstances will change the expected outcome of the manager and the owners of an airline. The Coronavirus outbreak holds as a perfect example of the state of nature.

3 Mathematical Model

In this section, an initial form of the agency mathematical model will be presented, which gives a better understanding of the agency problem. Suppose that there is one principal who hires an agent to carry out a specific task. For this purpose, the agent chooses an action $\bar{a}$, among all possible actions $\bar{a} \in A$ that is unobservable to the principal. In a discrete space, the task outcome, $x_n \in \{x_1, ..., x_n\}$ is a function of the level of effort and also the state of nature, $x_n(\bar{a}, P_n(\bar{a}))$, where the state of nature enters into the model as probability form, $P_n(\bar{a}) \in [0,1]$, because it is not certain at the time of contracting. As explained earlier, the agent has no control over the state of nature. However, he is aware of the probability distribution of its occurrence, where the state of nature serves as a random component that connects the effort to the outcome.

	x_1	x_2	...	x_n
a_1	$p_1(a_1)$	$p_2(a_1)$	...	$p_n(a_1)$
a_2	$p_1(a_2)$	$p_2(a_2)$	...	$p_n(a_2)$
...	...	...	...	...
a_m	$p_1(a_m)$	$p_2(a_m)$	...	$p_n(a_m)$

Table 2: Probability distribution of the outcome over the effort level.

Table (2) is an expanded form of Table (1) and gives a representation of the probability of gaining a certain outcome by investing a specific level of effort. Here, there are m effort levels available to the agent, out of which he chooses one action, $\bar{a}$, to carry out the task. The agent's choice on the effort input will define a specific distribution for the outcome, and based on that; the expected output can be calculated. For example, the probability of earning $\bar{x} = x_n$ given $a = \bar{a}$, equals to $p_n(\bar{a})$. In this case, the expected outcome is:

$$x(a = \bar{a}) = \sum_{n=1}^{N} p_n(\bar{a}).x_n;$$

While,

$$\sum_{n=1}^{N} p_n(a_m) = 1, \forall a_m \in A \tag{1}$$

However, the principal is unaware of $\bar{a}$ and agent's choice is hidden to her. So if there is no appropriate incentive provided to the agent, he will shirk his duties. Several scholars like Grossman and Hart (1983); Harris and Raviv (1979); Holmstrom (1979); Mirrlees (1976) have made progress towards understanding and addressing the principal-agent problem. In their scenario, the principal chooses incentive schemes to make the agent choosing a higher effort level. They suppose that the principal determines one risk-sharing design that gets the agent to take the highest possible effort level. In this sense, she will possibly set a contract that maximizes her utility concerning two constraints; (1) the expected utility of the agent should be higher than a level he would get from other projects, and (2) among those possible actions, the agent chooses the action that satisfies his first-order condition. Let's start with a simple model of agency theory, where full monitoring is possible. Under this assumption, the agency theory implies precisely the situation where the agent and the principal is the same person, and therefore, there is no moral hazard.

3.1 Simple Agency Model with Observable Effort

The model introduced here is adopted from Miller (2005). Suppose that a principal suggests a contract to an agent for working on a task. The outcome $x_n \in \{x_1, ..., x_N\}$ will be gained at the end of the project, from which a part $s(x_n)$ will be paid to the agent as remuneration. Therefore, the principal's payoff can be written as: $x_n - s(x_n)$. Here also, realizing x is contingent on the effort level $\bar{a}$ and also π; which is the probability distribution of an stochastic component $p_n \in [0,1]$ over x. This is $\pi(\bar{a}) = Pr(x = \bar{x}|\bar{a})$, where π is not under agent's control. Moreover, the principal's utility is only a function of her wealth $G(x - s(x))$. $G(.)$ is a continuous function which is increasing, differentiable and (weakly) concave with respect to x, i.e., $G' > 0$ and $G'' \leq 0$. The latter condition implies that the principal can be either risk averse, or risk neutral.

In contrast, the Agent's utility function $H(s(x), a) = U(s(x)) - V(a)$ is a function of the received wage (his wealth) besides the cost that a level of effort imposes to him. It is composed of a part showing his utility $U(s(x))$, and differentiable, increasing and strictly concave with respect to $s(x)$, $U' > 0$ and $U'' < 0$ which implies agent's strict risk aversion. The restrictive assumption of risk-aversion has also raised many questions regarding its realistic inherent. If the agent is supposed to be risk-neutral, the moral hazard problem can be avoided.

Also, $V(a)$ depicts the cost-utility function, and the fact that it enters into the utility function with a negative sign suggests that the agent is effort averse. So one can write $V(a_H) > V(a_L)$, which implies that investing higher effort is more costly for the agent. The agent has some reservation utility, meaning that if he does not accept the contract, he will do some other tasks that will give him $\bar{H}$. He will be willing to cooperate only if the utility he gains from the task is higher than his reservation utility. Now, suppose that after signing the contract, the agent has to choose an effort level between two possible actions $\bar{a} \in \{a_H, a_L\}$, to carry out the task. Here a_H shows the high effort, whereas a_L shows the low effort.

In the first scenario, also suppose that the principal can completely observe the agent's action, and therefore the effort level is contractable. In this case, the contract determines the optimal effort level, and the wage that the agents will receive in return of investing $\bar{a}$ level of effort, $(\bar{a}, s(x_1), ..., s(x_2))$. Here, the agent knows that he will receive $s(x)$, only if he exerts $\bar{a}$, and he will have no possibility to shirk. Being aware of this, the agent either accepts or rejects the contract. Thus, the problem can be thought of as an optimal contract that gives the agent his reservation utility with the lowest possible cost. For this purpose, the principal tries to maximize her utility:

$$\max_{s(x)} \sum_{n=1}^{N} G(x_i - s(x_n)).p_n(a^*), \tag{2}$$

subject to;

$$\sum_{n=1}^{N} U(s(x_n)).p_n(a^*) - V(a^*) \geq \bar{H}, \tag{3}$$

where a^* indicates any given effort level at the optimum. The constraint here is known as *Participation Constraint (P)* and ensures that the agent receives such a high utility as to be willing to cooperate. By considering the objective equitation and the constraint jointly, the agency problem tries to find an equilibrium at which the agent is given his reservation utility at the lowest possible cost. Writing down Lagrangian yields;

$$\mathscr{L}: \sum_{n=1}^{N} G(x_n - s(x_n)).p_n(a^*) - \lambda \Big[\sum_{n=1}^{N} U(s(x_n)).p_n(a^*) - V(a^*) - \bar{H} \Big]. \tag{4}$$

The first order condition with respect to $s(x)$ gives [1]:

$$\frac{d\mathscr{L}}{ds(x)} = G'(x_n - s(x_n)) - \lambda U'(s(x_n)) = 0, \tag{5}$$

Equation (5) suggests that the marginal rate of substitution between any two states is equal for both agent and principal at the optimum. This is;

$$\frac{G'(x_n - s^*(x_n))}{U'(s^*(x_n)} = \lambda, \tag{6}$$

while $s^*(x_i)$ indicates the sharing rule at the optimum. Equation (6) is known as the *first best solution* and depicts a situation, where the agent's action is perfectly monitored by principal. This is also the outcome expected to be gained if principal and agent were the same person. Equation (6) holds for every effort level and therefore through determining a^*, the agent can find the optimal sharing rule for the optimal action. Through replacing two possible outcomes x_n and x_i with $x_n > x_i$ into the model at the optimum, the equation takes the following form:

$$\frac{G'(x_n - s^*(x_n))}{G'(x_i - s^*(x_i))} = \frac{U'(s^*(x_n))}{U'(s^*(x_i))} \tag{7}$$

Equation (7) gives a profound understanding about the parties risk-sharing: (a) If the principal is risk-neutral then, $G'' = 0$ implies $G' = C$ for all x, where C is a constant. As a result, the left hand side of Equation (7) will get equal to 1, which makes the right hand side also equals 1, $\frac{U'(s^*(x_n))}{U'(s^*(x_i))} = 1$. However regarding the assumptions the agent is risk-averse, which implies $U'(s^*(x_n)) < U'(s^*(x_i))$, which leads to a contradiction. Therefore, the left hand side equals to 1, only if $s^*(x_n) = s^*(x_i)$. It depicts a situation where the agent receives a fixed wage regardless of the outcome. So if the principal is risk-neutral, she will bear all the risks while the agent is fully insured.

Now, (b) if the agent is risk-neutral and the principal is risk-averse, precisely the opposite situation happens. It means that $U'' = 0$ and, therefore $U' = C$, which makes the agent bear the project's entire risk. You can think of such a situation where an entrepreneur buys the venture in return for paying some fixed amount to the principal. In this case, the principal will receive this amount regardless of how successful the venture is. Finally, (c) suppose that both parties are risk-averse, where they divide the risk between themselves. As mentioned before, this assumption is aligned with the agency theory setting, which assumes that the agent is strictly risk-averse and the principal weakly risk-averse.

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[1] Despite of a discrete outcome space, one can treat x as a continuous variable in order to derive the first order condition and solve the problem.

So far, the optimal sharing rule for a given effort level a^* has been obtained. Therefore, if an effort level that offers the highest utility to the principal among all possible effort levels is found, the optimization problem will be solved. Here, the principal should ask herself which effort level, a_H, or a_L, will give her higher utility. The answer depends on the distribution of outcome over the effort levels. This topic is called the Stochastic Dominance Condition (SDC), which can be expanded into two types of first and second stochastic dominance (FSD) and (SSD). For two given effort level, a_H and a_L with $a_L < a_H$, a_H has first-order stochastic dominance over a_L if and only if for any outcome x, there is a higher probability when choosing a_H over a_L. It cannot be the case here because when choosing high effort, the probability of larger outcome increases, and therefore that of smaller outcome decreases. After all, $\sum_{n=1}^{N} p_n(a) = 1, \forall a \in A$ should be fulfilled. So at least for some x values, the probability of occurrence is lower under high effort. However, the second stochastic dominance holds when the expected outcome under one effort level exceeds that under the other level. Here one should assume the second dominance of the higher effort because otherwise, the agent is not motivated to take higher action against the lower effort. In other words, the higher effort's outcome should be so risky as to worth to be taken. According to Holmstrom (1979), the higher effort is more likely to yield a higher result when x-values are large enough, which is the case at the optimum. So if at the optimum $\pi^*(a) = Pr(x = x^*|a)$ then the following inequality holds:

$$\pi^*(a_L) < \pi^*(a_H) \tag{8}$$

According to the second stochastic dominance, effort level, a_H is more likely to give principal higher utility. This statement suggests that the principal likes the agent to work harder. Despite the second stochastic dominance assumption, two factors can make the agent refuse to choose a_H. First, if the higher outcome cannot compensate for the cost of greater effort. This means when $U(s(x(a_H)) - V(a_H) < U(s(x(a_L)) - V(a_L)$. Second, when the higher expected outcome is riskier. As mentioned before, Holmstrom assumes through choosing a higher level of effort, the probability of realizing lower outcomes decreases. And this implies that gaining a lower outcome is riskier when inserting higher effort.

3.2 Simple Agency Model with Moral Hazard

Now, let's assume that the agent's action is hidden from the principal. In this case, the principal must choose one effort level and then induce the agent to put it forth by providing him appropriate incentives. Making the agent bear too much risk will incline him not to accept the contract, whereas imposing him no risk will make him neglect the task. Therefore the agency problem with moral hazard is about finding an optimal trade-off between risk and incentive. By assuming that the principal is risk-neutral, agency theory supposes the principal as a firm, and the agent as an external manager, where the manager bears a small part of the risk the firm is facing (Grossman and Hart, 1983). Remember that in the previous model where the principal fully monitored the effort, there was no incentive problem, and therefore it was called the first-best solution. In contrast, here, because the agent's action is hidden from the principal, the optimal sharing rule is the second-best solution. Where the second-best answer is Pareto inferior to the first-best one (Holmstrom, 1979). Let's first introduce the assumptions of this model.

Like before, the principal calculates the optimal contract at either level of effort, and then she decides which class of action should be implemented. Here like the previous model, the objective function, besides the participation constraint, remains intact, while an extra constraint enters the model. The second constraint ensures that the agent prefers high effort over low effort. It happens only if the agent gains more utility through choosing a_H against a_L. The second constraint is called *incentive compatibility constraint (IC)* and for the aforementioned example, enters the model as follows:

$$\max_{s(x)} \sum_{n=1}^{N} G(x_i - s(x_n)).p_n(\bar{a}), \tag{9}$$

subject to;

$$\sum_{n=1}^{N} U(s(x_n)).p_n(\bar{a}) - V(\bar{a}) \geq \bar{H}, \tag{P}$$

$$\sum_{n=1}^{N} [U(s(x_n)) - V(a_L)]p_n(a_L) \leq \sum_{n=1}^{N} [U(s(x_n)) - V(a_H)]p_n(a_H). \tag{IC}$$

For now, suppose that there are only two possible outcomes, small x_s, and big x_b. The distribution of effort over outcome can be expressed by Table (3):

	x_s	x_b
a_L	$(1-p_b)(a_L)$	$p_b(a_L)$
a_H	$(1-p_b)(a_H)$	$p_b(a_H)$

Table 3: Probability distribution of the outcome over low and high effort level.

Also, without losing the generality, some numerical assumptions for the agent's cost function are made. Lets assume that $V(a_H) = 1$ and $V(a_L) = 0$. By making these assumptions, one can rewrite the incentive compatibility constraint as:

$$\begin{aligned} &U(s(x_s)).(1-p_b(a_H)) + U(s(x_b)).(p_b(a_H)) - 1 \geq \\ &U(s(x_s)).(1-p_b(a_L)) + U(s(x_b)).(p_b(a_L)). \end{aligned} \tag{10}$$

Rearranging this inequality gives;

$$[U(s(x_b)) - U(s(x_s))](p_b(a_H) - p_b(a_L)) \geq 1, \tag{11}$$

and therefore, to the agent the difference between the utility levels for each outcome is:

$$[U(s(x_b)) - U(s(x_s))] \geq \frac{1}{(p_b(a_H) - p_b(a_L))}. \tag{12}$$

Inequality (12) suggests that incentive compatibility constraint depends on the relative level of payment. In other words, if both wage levels go down, the result remains the same. Being dependent on the relative payment gives the principal the possibility to decrease the agent's share of the outcome, however,by incorporating the participation constraint, an absolute lower bound for the agent's utility will be determined.

The participation constraint (P) given $a = a_H$ takes the form of:

$$U(s(x_b)).p_b(a_H) + U(s(x_s)).(1 - p_b(a_H)) - 1 \geq \bar{H}. \tag{13}$$

If only the absolute level of utility is taken into account and the incentive compatibility constraint is relaxed, the agent's utility will be at stake. In this case, the principal can set $s(x_s)$ and $s(x_b)$ so close that the expected utility remains as before. Even if the big payoff falls, the agent will accept the contract because the expected utility exceeds his reservation utility level. So both constraints are necessary for gaining an optimal contract.

It is known that both constraints bind at the optimum[2], now, let's replace (13) in (11) and solve the equation system for $U(s^*(x_s))$ and $U(s^*(x_b))$:

$$U(s^*(x_s)).(1 - p_b(a_L)) + U(s(x_b)).p_b(a_L) = \bar{H},$$

Which gives:

$$U(s^*(x_s)) = \bar{H} + (p_b(a_L))[U(s(x_b)) - U(s(x_s))], \tag{14}$$

And now (12) is replaced in (14):

$$U(s^*(x_s)) = \bar{H} - \frac{p_b(a_L)}{(p_b(a_H) - p_b(a_L))}. \tag{15}$$

From (12) it is clear that the $[U(s(x_b) - U(s(x_s)] = \frac{1}{(p_b(a_H) - p_b(a_L))}$, and therefore one can derive the value for $U(s^*(x_b))$. Through replacing the value of $U(s^*(x_s))$ into this equation, the following equation is gained:

$$U(s^*(x_b)) = \bar{H} + \frac{(1 - p_b(a_L))}{(p_b(a_H) - p_b(a_L))}, \tag{16}$$

Note that the ratio subtracted from and added to the reservation utility is negative and positive in Equation (15) and (16), respectively. The interpretation is that the agent is expected to gain a utility level under his reservation utility if the outcome is small. In contrast, he earns higher utility than $\bar{H}$ when the result is large. His expected utility, however, should equal or exceed his reserved utility as per participation constraint.

Existing such a setting will impose the agent some risk, which works as an incentive mechanism for working harder. When through increasing the effort level, the probability for the significant outcome does not change considerably, the phrase $\frac{p_b(a_L)}{(p_b(a_H) - p_b(a_L))}$ is large due

[2] See (Grossman and Hart, 1983).

to small denominator. Consequently, the utility of gaining a small outcome decreases.

Having found the agent's optimal wage level, the principal can compare her utility with either group of effort and choose the one giving higher utility. The comparison becomes possible through evaluating the cost of each level of action to the principal. Under the high effort, the principal has to pay the agent's payoff equal to $s(x_s)$:

$$G(x(a_H)) = P_b(a_H)[x_b - s^*(x_b))] + (1 - P_b(a_H))[x_s - s^*(x_s))]. \tag{17}$$

Under low effort she will pay agent only the payoff for which he will get his reservation utility independent of the outcome:

$$G(x(a_L)) = P_b(a_L)x_b + (1 - P_b(a_L))x_s - U^{-1}(\bar{H}), \tag{18}$$

where $U^{-1}(\bar{H})$ depicts the inverse function of agent's utility of $\bar{H}$. Whenever (17) > (18) the principal will choose the high effort.

3.3 Agency Model and Holmstrom's Theory of Contract

In the previous subsection, the agency problem was expanded in more detail for a simple example with two levels of effort and two possible outcomes. Based on the similar assumptions, here a agency model with a continuous outcome space and infinite possible actions is introduced. For this purpose, the agency model applied by Holmstrom (1979) is adopted. As already explained, the agency problem arises due to the separation of the management and the owner (Mirrlees, 1976). The owner has the capital but neither the time nor the competence to do the task by herself. So she hires an agent to carry out the job on her behalf. As the effort is not observable and due to the information asymmetry, the agency theory assumes that the agent will have the opportunity to shirk and not put in his best effort. Because of his opportunistic characteristic, the agent abuses the resources in favor of his personal use. As a rational response to this problem, two mechanisms are applied; formal monitoring and incentive systems (Eisenhardt, 1989; Moe, 1984). Full monitoring imposes a high cost to the firm, and therefore not beneficial from an economic point of view. Regarding the latter mechanism, the well-known economist Bengt Holmstrom has had a fundamental contribution to the contract theory. [3]

He developed the model introduced by Harris and Raviv in 1976, and he added a hidden one-shot action from agent to the classical principal-agent model (Holmstrom, 1979). In searching for the optimal contract, he built a new specification for the principal-agent problem, which suggests that each informative signal beyond the observable outcome can mitigate the moral hazard and improve the sharing rule. This paper will adopt this general form of the agency model and try to build a comprehensive understanding of it.

Assumptions: The new model only differs in the continuity space of the effort and the outcome.

- **Wage:** The principal offers the agent a contract, with a specified wage level contingent on

[3] Jointly with Oliver Hart, he won the 2016 Sveriges Riksbank Prize in Economics in Memory of Alfred Nobel for his contribution to contract theory.

the outcome, $s(x)$. The agent should decide if he accepts or rejects the principal's proposal. If he rejects the contract, he will get his reservation utility, $\bar{H}$.

- **Effort:** If the agent accepts the contract, he will exert a total effort level a among an infinite number of actions, with $a \in A \in \mathbb{R}$, which has an upper bound, and also $a \geq 0$. Here, a refers to the operational effort exerted to carry out the job to produce outcome x. As the action is only observable to the agent and not to the principal, moral hazard arises.

- **Outcome:** The outcome $x(a,\theta)$ is a continuous function of the effort a and a random state of nature θ, with $x_a \geq 0$. The outcome here is defined in continuous space with $x \in [0,+\infty)$. Here x is the monetary outcome, which is to be shared optimally between the principal and the agent. Furthermore, both parties will observe the outcome. The parameter θ represents all unexpected circumstances that are not under the agent's control that may favor or impede the production process and links the operational effort to the outcome. Accordingly, given a distribution of θ and, $F(x,a)$ is the expected distribution of x parametrized by efforts, with $F_a(x,a) \leq 0$ with $F_a(x,a) < 0$, for some x values. It is the equivalent formulation of the Stochastic Dominance Condition (SDC) that explained in the previous subsection where the outcome had a discrete distribution. SDC implies that a change in a has a nontrivial impact on the distribution of x. Figure (1) gives a graphical illustration of the SDC. It demonstrates the probability density function of each two given levels of effort, $f(x,a|a=\bar{a})$, the blue curve and $f(x,a|a=\underline{a})$, the red curve with $\bar{a} > \underline{a}$. For all x values with $x < \bar{x}$, the blue curve stands under the red curve. Consequently, the area under the former exceeds that of the latter for $x < \bar{x}$. In other words, the probability of gaining smaller outcomes decreases when the agent exerts a high level of effort. In return, the probability of a higher outcome, $x > \bar{x}$, increases as the effort goes higher. Knowing this, one can suppose that $f_a(x,a) < 0$ at least for some values of x. If $x > \bar{x}$ is called large outcomes, then Figure (1) shows that for large outcomes first stochastic dominance holds.

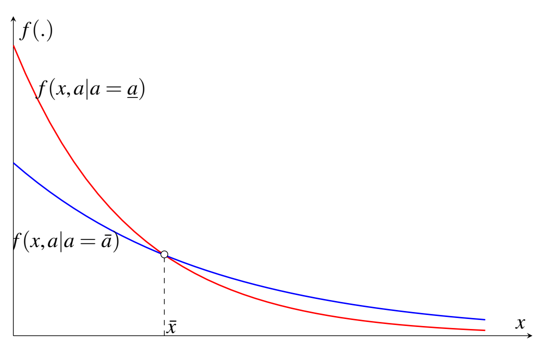

Figure 1: The histogram shows the probability distribution function (pdf) for two arbitrary levels of effort. The red curve is associated with the probability density function of the outcome when the smaller effort level has been chosen by the agent whereas the green line shows the probability of the outcome in case of choosing high effort. As evident, a change in the effort level will shift the pdf to the left.

- **Risk sharing:** Principal's utility is only a function of wealth, $G(x-s(x))$, where $G_x, G_a \geq 0$ and $G'' \leq 0$. However, the utility function of the agent H varies with his share of outcome besides the effort he makes $H(s(x),E) = U(s(x)) - V(a)$, where $V(.)$ is the utility cost function with $V' > 0$. The agent is strictly risk-averse; $U'' < 0$ and also work-averse.

Now the question that agency theory is seeking to address is, how high should the payment be set, such that the agent is still willing to cooperate and exert high effort, while the principal's utility is maximized. Again for finding the optimal sharing rule, one should maximize the principle's utility function subject to the agent's utility function.

$$\max_{s(x),a} E\{G(x - s(x)\}, \tag{19}$$

From the principal perspective, there is some effort level $\tilde{a}$, for which Equation (19) reaches its highest amount. So it tries to induce the agent to take that particular action. To guarantee that the agent will choose $\tilde{a}$, two requirements have to be fulfilled. First, $\tilde{a}$ has to make the agent better off than if he would not have accepted the contract.

$$E\{U(s(x)) - V(\tilde{a})\} \geq \bar{H}. \tag{20}$$

As you remember, this constraint is called the agent's *participation constraint*, reflecting the fact that the agent will accept the contract only if he gains a utility level exceeding his reservation utility. The second constraint, known as *incentive compatibility constraint*, supposes that after signing the contract, the agent will choose a level of effort that maximizes his utility function. Therefore, the effort level that the principal tries to induce the agent to take $\tilde{a}$ should also give the agent enough incentive to be chosen among an infinite number of actions. Putting differently, the difference between the expected outcome and expected cost should be large enough that persuades the agent to select high effort over low effort.

$$\tilde{a} \in argmax E\{U(s(x)) - V(a)\}. \tag{21}$$

Equation (21) implies that the agent will choose a proper level of effort that maximizes his utility, knowing the level of the $s(x)$. This constraint has been incorporated since the principal cannot observe the effort level. If the principal could fully monitor the agent's action, then the second constraint was not needed to be set. In that case, the desired action and its respective payout would be contracted, even when there was no connection between the outcome and the agent's wage. This situation depicts the optimal risk-sharing setting and, as discussed before, is known as *first-best solution*. However, it was assumed that the agent's effort is not observable to the principal, which leads to the *second-best solution*. To proceed with the optimization, (21) should be replaced with its first-order constraint. Also, one have to make sure that an optimum exists, and besides, it is differentiable, which is the case here. Knowing this, the optimization problem takes the form of:

$$\max_{s(x),a} \int G(x - s(x)) f(x,a) dx, \tag{22}$$

subject to two constraints;

$$\int [U(s(x)) - V(a)] f(x,a) dx \geq \bar{H}, \tag{23}$$

$$a \in argmax \int [U(s(x)) - V(a)] f(x,a) dx. \tag{24}$$

According to the approach introduced by Mirrlees (1974, 1976), suppose that given a distribution of the state of the nature θ, $F(x,a)$ is the distribution induced on x via the relationship $x = x(a,\theta)$. The latter term states that outcome is a function of the action and the state of the nature. Suppose F has a density function $f(x,a)$ with f_a and f_{aa} well defined for all (x,a). Furthermore, according to the assumptions, $x_a \geq 0$ which implies $F_a(x,a) \leq 0$ and according to SDC, it is: $F_a(x,a) < 0$ for some a (see Figure (1)). As $V(.)$ and $f(.)$ are continuous in a, the first order condition of the second constraint (Equation (24)) can be calculated:

$$\int U(s(x)) f_a(x,a) dx = V'(a). \tag{25}$$

Equation (25) can be substituted into second constraint (Equation (24)) to give a relaxed Pareto optimization. Doing so, the Lagrangian equation takes the following form:

$$\begin{aligned} \mathscr{L} : \int G(x - s(x)) f(x,a) dx - \lambda \Big\{ \int [U(s(x)) - V(a)] f(x,a) dx - \bar{H} \Big\} - \\ \mu \Big\{ \int U(s(x)) f_a(x,a) dx - V'(a) \Big\} = 0, \end{aligned} \tag{26}$$

calculating the partial derivation of (26) with respect to $s(x)$ is straightforward:

$$\frac{\partial \mathscr{L}}{\partial s(x)} : G'(x - s(x)) f(x,a) - \lambda U'(s(x)) f(x,a) - \mu U'(s(x)) f_a(x,a) = 0. \tag{27}$$

Rearranging (27) suggests that a necessary condition for a and $s(x)$ to solve the first order problem is that there exist parameters λ and μ such that:

$$\frac{G'(x - s^*(x))}{U'(s^*(x))} = \lambda + \mu \frac{f_a(x,a)}{f(x,a)}, \tag{28}$$

Equation (28) will give the optimal payment amount at any given effort level, where $s^*(x)$ represents the optimal sharing rule. To solve the Lagrangian, the partial derivative of Lagrangian equation (Equation (26)) with respect to effort level has to be set equal to zero;

$$\begin{aligned} \frac{\partial \mathscr{L}}{\partial a} : \int G(x - s(x)) f_a(x,a) dx - \lambda \int [U(s(x) - V'(a)] f_a(x,a)] - \\ \mu [\int U(s(x)) f_{aa}(x,a) - v''(a)] = 0. \end{aligned} \tag{29}$$

As already discussed for the simple agency model, now the principal should look for the effort level that gives the agent his highest utility with the lowest cost. Equation (29) implies this statement. To get that, the partial derivative of Equation (26) with respect to Lagrange coefficients is set equal to zero;

$$\frac{\partial \mathscr{L}}{\partial \lambda} : \int [U(s(x)) - V(a)] f(x,a) dx - \bar{H} = 0, \tag{30}$$

and,

$$\frac{\partial \mathscr{L}}{\partial \mu} : \int U(s(x)) f_a(x,a) dx - V'(a) = 0, \tag{31}$$

And now (30) is replaced into (29) and the joint first order condition of the objective function and the second constraint with respect to *a* equal to zero is gained.

$$\int G(x - s(x)) f_a(x,a) dx + \mu . \left\{ \int U(s(x)) f_{aa}(x,a) dx - V''(a) \right\} = 0. \tag{32}$$

Equation (32) is equivalent to the condition Equations (17) and (18), where a simple model with two possible outcomes and effort levels was discussed. Giving this equation, the value for μ can be calculated. According to Borch's work (1962), $s(x) = s^*(x)$ holds only if right hand side in (28) is constant. Because μ and λ are constant parameters, the only requirement remains $f_a(x,a)/f(x,a) = k$. The latter condition contradicts with the fact that for some x values $f_a(x,a) < 0$, and therefore, $\mu = 0$ is derived. In this way, the second constraint will be removed from the model and the setting will resemble a full monitoring scenario. So in the absence of moral hazard,(i.g. when incentive compatibility constraint does not bind), the optimal sharing rule, Equation (28), would look like;

$$\frac{G'(x - s^*(x))}{U'(s^*(x))} = \lambda, \tag{33}$$

which is the *first best solution*. In contrast to the perfect risk sharing (Equation (33)), *second best solution* (Equation (28)) depends on joint distribution of x and a. Also, Holmstrom shows that the condition $\mu > 0$ holds, whenever the first-best solution is not available (see (Holmstrom, 1979)). The Lagrangian multiplier is positive and implies that the principal wants the agent to insert higher effort, given the second-best solution.

Another implication from the optimal sharing rule is that as long as the agent's marginal effort is positive, the agent should work harder to yield a higher income. Positive marginal means that higher effort will lead to a higher outcome. A mathematical expression for this notion would be: $x_+ = \{x | f_a(x,a) < 0\}$. So whenever this is true, for a given x, there will always be a higher wage than his wage, accessible to the agent under full monitoring. In other words, for a given x, $s_\lambda(x) < s(x)$. The proof follows from the fact that firstly, μ is positive and furthermore $G'(x - s^*(x))/U'(s^*(x))$ is increasing in $s(x)$, because $G' = C$ and $U' > 0$. So according to (28), whenever $f_a(x,a) > 0$ then the $s(x)$ will be higher comparing to the first-best solution. The opposite is also true for those x values for which the marginal return to the effort is negative. In this case, the term beginning with μ in Equation (28) will turn negative and therefore, what agent earns is inferior to $s_\lambda(x)$. To provide a better understanding, the numerical example adopted from (Holmstrom, 1979) is used here again.

In this example, the contract is concluded between a repairman and a machine owner. The repairman will choose an effort level $a \in A$ to repair a machine. The machine's lifetime x is exponentially distributed and is a function of effort level, $x \sim exp(1/a)$. The exponential distribution is a continuous distribution of the time between two independent events that occur continuously with an average rate (Kissell and Poserina, 2017). For example, the probability of the next received a call within the next 20 minutes at a service desk, given that every 10 minutes, a customer calls. The probability density function of this distribution is: $\lambda e^{-\lambda x}$, where λ serves as the distribution parameter. Also, for an exponential distribution, the average rate of occurrence equals to $1/\lambda$. In the given example, $\lambda = 1/a$, and therefore, the average time between breakdowns equals a. The higher the effort, the lower the frequency of the breakdown occurs, and that is how the effort is linked to the outcome. Specifically, in the explained example, the probability density function takes the form of $f(x,a) = e^{-x/a}/a$. So for example, the probability that outcome is less or equal to a given amount, say $\bar{x}$, is: $\int_0^{\bar{x}} xf(x,a)dx = 1 - e^{-\frac{\bar{x}}{a}}$. The utility functions of the principal and the agent are given as $G(x) = x$ and $U(s(x)) - V(a) = 2\sqrt{s(x)} - a^2$ respectively. The Pareto-optimal sharing rule, $s(x)$, is calculated through the program:

$$\max_{s(x),a} \int [x - s(x)]f(x,a)dx$$

subject to two constraints;

$$\int [2\sqrt{s(x)}]f(x,a)dx - a^2 \geq \bar{H},$$
$$\int [2\sqrt{s(x)}]f_a(x,a)dx = 2a,$$

The Lagrangian function is;

$$\mathscr{L} : \int [x - s(x)]f(x,a)dx - \lambda \Big\{ \int [2\sqrt{s(x)}]f(x,a)dx - a^2 - H \Big\} - \mu \Big\{ \int [2\sqrt{s(x)}]f_a(x,a)dx - 2a \Big\} = 0. \tag{34}$$

According to Equation (28) one can derive the optimal sharing rule given the second best solution, when knowing that $f_a(x,a) = \frac{e^{-x/a}}{a^2}(-1 + x/a)$;

$$s(x) = \big[\lambda + \mu.\frac{(x-a)}{a^2}\big]^2. \tag{35}$$

For deriving the first best solution [4], $\mu = 0$ is set and consequently $s_\lambda(x) = \lambda^2$. The

[4] For a solution with more detail, see Appendix (1).

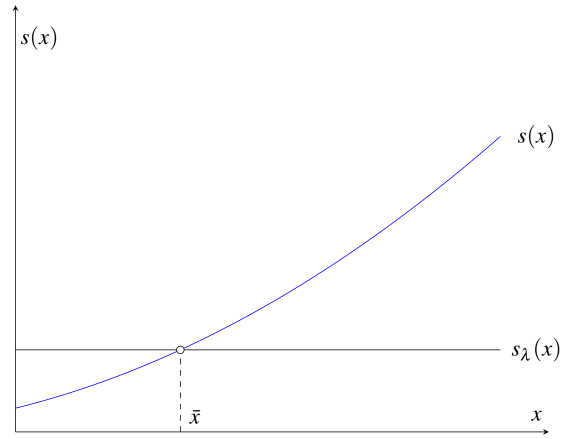

Figure 2: The agent's payoff $s(x)$ varies for different values of k. As it is evident in the graph, the optimal sharing rule converges to the first best solution as k increases.

latter statement implies that under full monitoring, the optimal sharing rule is a fixed amount which is neither a function of effort nor of outcome distribution. Figure (2) illustrates how the first and the second best solutions are related with each other. Here $\mu = a^3$ and therefore μ increases as a increases which implies that inducing the agent to choose higher effort is more costly. The first best solution $s_\lambda = \lambda^2$, $a_\lambda = 1/2\lambda$.

For a numerical solution $\lambda = 1/2$ is set, which gives $a_\lambda = 1$. Also some calculation gives the optimal effort for the second-best solution; $a = 1/2$ and consequently one can write $s(x) = 1/4(x+1/2)^2$, and $s_\lambda = 0.25$. So under the perfect monitoring the agent should take $a = 1$, and in this case, principal's expected wealth will be $x(a_\lambda) - s_\lambda(x) = 1 - 0.25 = 0.75$. While the agent is given a constant wage equal to 0.25. But if the effort is not observable to the principal, the principal wants the agent to take $a^* = 1/2$. If agent takes this effort level then, $x = 1/2$ and based on $s(x) = 1/4(x+1/2)^2$, $s(x) = 0.25$. Therefore, the agent will be compensated by a wage equal to the perfect monitoring case in return for taking half of the effort he invested before. Here, he gets extra remunerated for efforts higher than optimal effort, $a = 1/2$. So if the agent takes the same level of effort to the perfect monitoring situation $a = 1$, he will be paid off by 0.56. And because the total outcome is the same the principal's share decreases to that for the second-best solution $x(\bar{a}) - s(x(\bar{a})) = 1 - 0.56 = 0.43$.

In Equation (28), the term beginning with μ can be interpreted as the division from the optimal sharing rule. Because $\mu > 0$ then for those x values, for which $f_a(x,a) < 0$, left hand side will be smaller in comparison to the first best solution.

Note that $f_a(x,a)/f(x,a)$ is the derivative of log of maximum likelihood procedure, in which an unknown parameter, a can be estimated given the sample observation of x. In other words, this ratio measures how strongly the effort level can be inferred from observing the outcome.

The main finding of the previous example is that the optimal solution under uncertainty is not first-best. So given the same level of the effort, through perfect monitoring the principal's share is higher than that through the second-best solution. Therefore, agency theory believes that observability enhancement improves the optimal sharing rule. Holmstrom argues that any signal that can be observed by both parties and conveys an extra information about agent's effort mitigate the moral hazard and therefore can be used in constructing the sharing rule. Through adding the signal, y, into the density function as a new input and also assuming that still f_a and f_{aa} exist, the new sharing rule, $s(x,y)$,takes the form of;

$$\frac{G'(x-s(x,y))}{U'(s(x,y))} = \lambda + \mu . \frac{f_a(x,y,a)}{f(x,y,a)}. \tag{36}$$

Here again $\lambda > 0$ follows as before and the first-best solution outperforms the second-best one. The interpretation of the $f_a(x,y,a)/f(x,y,a)$ will be equal to that before, however this ratio can now change due to a change of y. Therefore, for the same value of x, this ratio can vary. This means for lower/higher $f_a(x,y,a)$ when the outcome is the same, the principal can infer less/more about the effort, when observing the outcome.

As already mentioned, Holmstrom's conclusion has been criticized by different scholars (Dewatripont et al., 1999; Eisenhardt, 1989; Prat, 2005). As an example, one can think of a sales manager hired by shareholders to increase the company's market share in the IT industry. Based on agency theory assumptions, the manager is expected to carry out the actions prescribed to him by the shareholders as the best practice. He is not authorized to think or propose better actions. Any signal from his side, implying that he deviates from what shareholders expect to be done, will decrease the agent's monetary remuneration. In addition to the company's market share, the shareholders want to see that the manager took the exact efforts they ordered, one by one. Such a signal will enhance observability, but it lessens the manager to a work factor in return. Such a manager cannot use his problem-solving competencies at work. In this way, the innovation potential will be destroyed because the agent is induced to take a particular action to do the job. It assumes that the principal knows the best when it comes to the effort type and level. In contrast, the agent is depicted as the party with no rationality to think or to make decisions. So, not only the agent is assumed not to be loyal enough to carry out that level of effort, he is even not trustworthy enough. In practice, if this assumption were valid, there would be no contract signed at all.

4 Critics of the General Agency Theory

Having explained the assumptions based on which the agency theory has thrived and developed, this section will provide arguments which suggest that agency theory is theoretically limited. In this way, four main assumptions are under critique.

1. **Extrinsic vs. Intrinsic Reward:** As mentioned earlier the agency theory follows its goal of maximizing the principal's wealth via two propositions. In the first proposition, agency theory considers the pecuniary rewards as the only incentive to make the agent working harder. In this sense, the principal tries to make the agent acting royal and trustful by providing an external source. This proposition has two implications. First, it assumes motivation equals action. In this sense, there is a monotonic relationship between reward

and motivation and between motivation and effort (Jensen and Meckling, 1976). Having challenged this proposition, Wiseman and Gomez-Mejia (1998) believe that incentive does not necessarily lead to hard work. In other words, the observed effort can be translated into more motivation; however, the other way around may not be correct.

Secondly, it understates the role of intrinsic incentives. In this sense, the manager's role decreases to a product factor that follows a particular set of rules. Such an incentive mechanism narrows the agent's view in thinking out of the box. Thus, however, this restrictive assumption may work well for the tasks with a specific list of commands, but it fails to give incentives for jobs that demand creativity. In other words, it may bring more efficiency but less innovation. From a capitalistic point of view, which prioritizes efficiency over meaningfulness, such a manager's role is not only ordinary but necessary for a firm's success. There are pieces of evidence in the literature of advocates of the industrial revolution like Adam Smith (Smith, 2010), who promoted this view. Yet among those scholars who criticized capitalism, agency theory's assumptions seem to be inconsistent with human nature.

For example, a well-known experiment designed by Karl Duncker (1945) and later adopted and developed by Glucksberg (1962) is the candle problem or candle task. In this experiment, the participants were given a candle, a box of matches, and a thumbtack box. They were asked to hang the candle on the wall so that the candle wax won't drip onto the table below. The solution was not straightforward because the participants had to use the box of thumbtacks as a platform under the candle and nail the box to the wall. The time that was needed for participants until they come to the solution was recorded. . The result showed that the participants did not directly come to the solution if the thumbtacks were inside the box. However, in case the tacks were piled next to the box, almost everyone solved the problem. In 1962, Glucksberg added a control group to the experiment. The first group was said that their time of solving the solution was recorded for a research purpose. However, the second group was offered a monetary reward for solving the problem, in case they could solve the problem faster than the others. The findings of this experiment were surprising. The second group's average time needed to carry out the task was about three minutes longer than of that of the first group. Glucksberg also repeated the experiment with tacks piled beside the empty box. They observed a positive effect of payment on doing the job. Glucksberg's findings confirmed an interaction between external incentives and the performance only when the task does not demand any out-of-box thinking. But as soon as the assignment required problem-solving skills, the monetary rewards did not work as expected.

These findings conform perfectly to the results of recent studies within the behavioral economics context. Ariel et al. (2005) conducted an experiment for students at MIT University, which involved creativity, cognitive skills, and concentration. They also assigned three levels of payoff to each task from large to low to examine the effect of reward's magnitude on the performance. Their findings show that a higher reward works as a significant incentive when the activity demands only mechanical skill. Nevertheless, as long as the activity begins to need cognitive skills, the higher payoff became associated with worse performance. One argument is that providing large incentives may harm the attention and concentration that play a crucial role in problem-solving tasks (McGraw and McCullers, 1979). In this sense, thinking of the reward disturbs one's brain's productivity and hinders the participants from solving the problem.

Besides, in the organizational context of general agency theory, the fundamental premise of agency can be formulated as higher compensation for the executives leads to a higher effort and consequently better performance of the firm (Eisenhardt, 1989). Therefore, agency theory tries to control the manager's behavior through compensation arrangements, combining different tools, like salary, bonus, and stock options. Thus, designing payment plays a role when trying to mitigate the agency problem. Many scholars draw their attention more to stock options among the literature because it is an outcome-based incentive (Hambrick and Finkelstein, 1995). Due to the risk inherent in the stock options, this form of compensation is prescribed by agency theory because the executive will bear some risk.

In contrast, Sanders and Carptner (2003) argue that a lack of intrinsic motivation causes managers to reduce a part of the risk by launching the stock repurchase program. They showed that using such a plan will typically raise a positive stock market reaction, which increases the stock price and, consequently, the executive's payoff. Therefore it seems that this program aligns the interests of the executives and the shareholders (Jensen and Murphy, 1990). Nevertheless, this is a near-term benefit to the agent, which can put the firm at a disadvantage from a long-term perspective. The stock repurchase program can change the shareholders' perception in case of failure at maximizing their profit. In this sense, the managers can buy time to build long-lasting profit for themselves (Sanders and Carpenter, 2003).

Besides many others, these experiments illustrate the limitation of agency theory's assumption on the external incentive. Because the agency theory is broadly used to design business models, its premises must be enhanced continuously to model the real business situation. These findings, however, show a gap between what science knows and what business does. These experiments recommend managers to encourage employees to participate actively in the problem-solving process by relying on intrinsic reward rather than extrinsic ones(Ariely et al., 2009; Cummings and O'Connell, 1978; Pepper and Gore, 2015).

2. **Information asymmetry:** The second proposition of agency theory ascertains that reducing information asymmetry will mitigate the moral hazard because the action of the agent will be structured in favor of the principal's interest (Eisenhardt, 1989). As an example, Holmstrom discusses that a signal that gives extra information on agents' actions will mitigate the moral hazard and, therefore, lead to a more optimal risk-sharing rule (Holmstrom, 1979). He argues that any information that verifies the agent's behavior makes the agent more incentivized not to deviate from the contract under *complete contracts*. Holmstrom calls this information "informative signal" which improves the risk-sharing rules through enhancing observability. Within behavioral economics, shreds of evidence suggest; however, more transparency mitigates the moral hazard, but it does not necessarily lead to higher effort and better performance (Dewatripont et al., 1999; Prat, 2005).

   Moreover, some findings emphasize the harmful role of information symmetry in the corporation in more extreme behavioral economics positions. For example, Cropper believes that the information revealed the principal will inevitably lead to the third party which can be used by competitors. He argues that the corporations are from a legal system point of view, a private unit, and should be treated as one (Cropper, 1981).

In another work, Prat suggests that transparency on the consequences is beneficial, while information symmetry on action itself can be detrimental. He develops a career concern model and points out that under the full monitoring of the action, the agent can disregard private signals and therefore act only in a way that principal likes to see. This situation will even hide the real agent's type more than before (Prat, 2005). Similarly, Holmström (1999) ascertains in his other work that more information about the agent's action will prevent the agent from exerting high effort to prove his abilities. In another work, Dewatripont et al. (1999) showed that receiving signals about an agent's action leads to a more optimal state; however, a full direct monitoring system possibly leads to an opposite result. This group of literature believes that more transparency is associated with a more precise evaluation of the agent's type. However, it does not provide the agent with an extra incentive for working harder.

3. **Risk-Aversion:** According to the agency theory's assumption, the agent is strictly risk-averse, whereas the principal is assumed to be risk-neutral. This difference in the party's attitude towards risk creates a moral hazard problem. In the context of behavioral economics, however, there are shreds of evidence that contradict the assumption of the agent's risk-aversion. Sitkin and Pablo (1992) argue that perceived risk can change the agent's risk aversion behaviors. In this sense, they suggest that the agent acts more conservatively if he expects a higher payoff. This notion is true because his extreme actions can put his anticipated yield at risk. In contrast, when he anticipates low reward, he will be willing to take a higher risk as there is nothing to lose in case of failure. Wiseman and Gomez-Mejia (1998) show that the agent's risk aversion behavior can vary according to the condition by developing a behavioral agency model. This statement contradicts the agency theory's restricted view, in which the agent is assumed to be risk-averse and the principal risk-neutral. More generally, from a behavior agency theory point of view, the choice of the agent's attitude to the risk is not absolute and can be affected by different factors. For example, in a firm, the manager's previous choices affect her risk-taking behaviors in the future (Cyert and March, 2015; March and Shapira, 1987). In this way, the sunk cost also plays a role in the risk-taking behaviors of manager. Wiseman and Gomez-Mejia (1998) point out that behavioral perspective takes the effect of the historical decisions and the performance followed by them and considers this act as the main difference between traditional versus behavioral view to the agency theory. They also add that the assumption of an agent's risk-aversion should be substituted via the loss-aversion assumption. The risk-averse individual prefers options with lower risk in return for giving up some amount of the return. Whereas, loss avers individual chooses options that contain lower loss. In this way, adding a variable performance-based pay to the base salary would be satisfactory to a loss-averse agent but not attractive to a risk-averse one.

   A very recent experiment by Burchardi et al. (2019) tried to address if a higher share of the output leads to a higher effort and, consequently, higher outcome. In an agricultural context, they designed a field experiment to examine the effect of sharing rule on the agent's effort and, therefore, the outcome. The most prevalent form of contract between the landlord and the tenant farmer is based on the crop output. In this sense, the farmer gives up some portion of an absolute amount of the output to the landlord, and after paying all types of costs and taxes, the remained amount is his share. The primary impulse behind their work was to find an explanation for low agricultural productivity. Therefore, they mainly focused on the sharing rule and tried to determine if a less-than-full residual claim is a significant impediment in reaching the optimal outcome. As of the experiment's time, there were several shreds of evidence showing that contracts with a larger agent's share lead to a higher total output (Ali Shaban, 1987; Bell, 1977; Rao, 1971). Their contribution was that they show how the tenant's share of the crop affects the agent's risk-taking behaviors.

To investigate the effect of the tenant's share on the agriculture outcome, Burchardi et al. (2019) conducted a randomized controlled trial in Uganda. In addition to the income level, they put their focus also on incentives and risk attitudes. They set the experiment in such a manner where one control and two treatment groups were implemented. Before starting the investigation, they trained 304 women in 237 villages as farmer tenants, given a 50% stack in the outcome. After signing the contract, the villages were randomly assigned into those three groups. In the control group (C), the tenants were given their promised 50% sharecrop. In the first treatment group (T1), the research team offered the tenant 75% of the outcome to catch the effect of a higher share in the output on the total product. Furthermore, a second treatment group (T2) was implemented to capture the tenants' heterogeneity in terms of risk-aversion. Tenants in the third group were offered an additional fixed payment besides their promised share in the contract. Moreover, tenants in T2 were assigned into two subgroups, one with a risk-free payoff and the other with a part of their additional payment through a lottery. Both subgroups had an equal expected yield but shared different risk profiles.

The findings of Burchardi et al. suggest that the group with a higher share has, on average, 60% higher output (T1 versus C). However, evidence showing that an extra cash transfer affecting the total outcome is not available (T2 versus C). This result implies that determining a fixed wage makes no additional incentive for the agent to work harder. The group with a greater share invested more on risky input like tools and fertilizer, which means taking a higher risk. They also reported larger output in comparison to the control group. In contrast, the group with a higher fixed wage did not significantly spend more on risky inputs than the control group.

This experiment's findings support the idea that the sharing rule can decrease moral hazard by providing more incentives for working hard. Hence, in this sense, the principal also gets better off as she increases the agent's share in the output. Because the larger product will compensate for the portion of the outcome, which is granted to the agent. Furthermore, the findings suggest that the group with higher risk showed a better performance. So the tenants were willing to take a risk when this risk was linked to a higher payoff. This implication contradicts the critical assumption of the agent's risk-aversion and proposes that the tenant's attitude towards risk is not absolute and can vary under the contract's conditions.

The findings of Burchardi et al. (2019) can also be generalized to other fields. For example, there is evidence highlighting the variable characteristic of the agent's risk-aversion in the venture capital context. In this sense, the results of the farmer tenant experiment support the findings of Stiglitz (1969) and Feldstein (1969). They suggest that levying taxes on entrepreneurial achievement will lessen the start-up's risk-taking behaviors. This proposition has significant implications for governments in setting policies in reducing unemployment.

4. **Agent's egoism and opportunism:** Finally, in the context of general agency theory, the agent is assumed to be an egoist and opportunist who tends to steal, shirk and lie. Therefore, either a mechanism to monitor the agent's action should be designed, or an appropriate incentive setting should be offered so that the agent does not shirk. However, this assumption has raised many questions regarding human decision-making patterns and has been subjected to behavioral economics criticism. For example, Shankman (1999) finds this assumption extreme and believes that, if it were true, no agency relationship could exist at all. He argues that if individuals were egoistic, then both agent and principal were so. This knowledge about the principal makes the agent act against the principal's interest whenever he knows that the principal would also do the same. No cooperation would be formed at all. For this reason, the first step in building cooperation would be relaxing the assumption of egoism. The fact that the principal can also act at a disadvantage to the agent or, more generally, to the firm is not excluded (Perrow et al., 1986).

   Perrow believes that these assumptions are not realistic from the fundamentals, and the employees show loyalty and ethic when being given responsibility. Not establishing sufficient trust within corporate relations makes the path to success and innovation uneven. In its general form, the agency theory assumes individuals as egoistic and then designs appropriate mechanisms to align parties' interests. This strategy imposes considerable agency costs to the firm and seems to contradict the agency theory's ultimate goal, maximizing the owner's net value. Therefore, relaxing such an assumption through hiring honest and loyal agents and trust them later on, is a more optimal choice when following the value-maximizing strategy (Kreps et al., 1982). This notion reminds one of the well-known paradox known in the game theory saying that if any individual wants to earn their opponent's trust, they should first trust them. Regarding what is beneficial in reducing cost, establishing a genuine relationship is the optimal strategy that demands giving trust and good will. Because the factors that define human motives are more than pecuniary rewards, including recognition, achievement, and intrinsic factors like job satisfaction (Donaldson et al., 1994).

5 Conclusion

Current work tried to shed light on the general theory of agency and provided some arguments to show that this model's assumptions do not always reflect the real decision-making scenario. For this purpose, first, the principal-agent problem and its history was explained. Then, the key assumptions based on which the agency theory derives the optimal contract were discussed. Furthermore, the answer to the question question: why the agency theory is incompetent in modeling the behaviors of principal and the agent? was argued.

This work reviewed those controversial assumptions that have aroused several critiques in the literature. Thus, it focused specifically on the assumptions regarding observability, incentive schemes, agent's risk-aversion and agent's egoism.

In general, the agency theory seeks to achieve a contract at the lowest cost while the principal's utility is maximized with respect to all resource limitations. This model tries to set up a scheme of incentive and control mechanisms when it aims to limit the losses caused by a divergence of interests (Fama, 1980; Jensen and Meckling, 1976).

The perfect knowledge assumption suggests that the principal will get better off through more information about the agent's effort. In this sense, if the principal has the same information as the agent owns, the moral hazard decreases, and therefore a more optimal state is gained. Holmstrom model with the informative signal is an example of this assumption (Holmstrom, 1979). He focuses on a signal conveyed to the principal about the agent's action that was not directly observable before. He calls these signals "informative principles" and suggests that any extra information about the agent's performance will alleviate moral hazard. Due to his assumption of *complete contracts*, every single piece of information about the agent's performance will enable the principal to estimate the agent's type and effort. This statement, however, seems not to be always the case. More recent evidence suggests that enhancing the observability does not necessarily make the agent take higher effort (Dewatripont et al., 1999; Holmström, 1999; Prat, 2005). By explaining the mathematical model that Holmstrom developed, limitations of the model assumptions when observing the agent's behaviors were presented. For this purpose, the mathematical agency model is depicted for discrete and continuous outcomes to make the agency problem and its assumptions more comprehensible.

Another assumption discussed was that providing higher rewards will give the agent enough incentives to put in a higher effort. In its classical definition, agency theory is built on incentive schemes. When agency theory talks about incentive, always external incentive is meant. It suggests that the principal should induce the agent to take higher effort by providing higher rewards. By taking the operational action as the input agent tries to maximize his payoff. This assumption has aroused several critiques in the field of behavioral economics. Because on the one hand, it takes motivation equal to effort (Wiseman and Gomez-Mejia, 1998), and on the other hand, it understates the intrinsic motivation. The findings show that extrinsic rewards lead to a better performance in manual tasks with a specific set of rules. In contrast, they fail to gain better results when the job demands problem-solving skills. As a result, the agency theory cannot design a real-world decision-making model when coming to innovation and, therefore, should be revised.

Then, the third assumption concerning the risk-taking attitude of the agent was discussed. Agency theory assumes the agent by default risk-averse and work-averse. In this sense, the most optimal contract happens when the agent's wage does not depend on the outcome. Because the effort is not observable, the agent's earning must be linked to the result. Otherwise, he shirks. By assuming the agent as being risk-averse, the principal tries to make the agent's risk as small as possible because otherwise, he won't cooperate. However, pieces of evidence from behavioral economics show that the agent's attitude towards risk is not definite and can change contingent on several factors, including the agent's perception of his payoff and his former decisions regarding risk. So the agent is willing to bear risk in return for a higher share (Cyert and March, 2015; March and Shapira, 1987; Sitkin and Pablo, 1992; Wiseman and Gomez-Mejia, 1998).

Finally, it was argued that the agent's egoism is not always a realistic assumption. Besides designing an incentive setting, a perfect monitoring mechanism is critical for agency theory in reaching the ideal contract. Agency theory has focused on monitoring the agent and has assumed that the agent, by default, tries to shirk and deceive the principal. This is because agency theory assumes the agent to be egoist, work averse, and opportunistic. Therefore, if he receives the same amount of earnings independent of the outcome, he will put no effort. Because the egoism is defined by psychology as acting only in favor of self-interest. This strict assumption counts as a controversial topic within the agency theory because it narrows one's view of human nature. Behavioral economics raises whether individuals are by default egoistic and opportunistic, then why the principal will not act at a disadvantage to the agent? Also, why should the agent trust the principal if he knows that she is not trustworthy from the beginning? Taking such an assumption leads to forming no cooperation because, based on the game theory, both parties will not be the first to trust (Kreps et al., 1982; Perrow et al., 1986; Shankman, 1999).

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Appendices

Appendix.1

Proof. According to the result of Appendix.2. the optimal sharing rule is derived by using Equation (28). So through substituting the numerical values for this example,the following equation is gained:

$$\frac{1}{\sqrt{s^*(x)}} = \lambda + \mu \frac{\frac{e^{-x/a}(x-a)}{a^3}}{\frac{e^{-x/a}}{a}}$$

Which after some simple calculation gives,

$$s^*(x) = \left[\lambda + \mu . \frac{(x-a)}{a^2}\right]^2$$

It is clear that $f(x,a) = e^{-x/a}/a$, $f_a(x,a) = e^{-x/a}(x-a)/a^3$ and $f_{aa}(x,a) = e^{-x/a}(2a^2 - 4ax + x^2)/a^5$. Now let us write the Lagrangian function with all its partial derivatives with respect to $s(x)$, a and also with respect to λ and μ.

$$\mathscr{L} : \int [x - s(x)] f(x,a)dx + \lambda \Big\{ \int [2\sqrt{s(x)}] f(x,a)dx - a^2 - H \Big\} + \mu \Big\{ \int [2\sqrt{s(x)}] f_a(x,a)dx - 2a \Big\} = 0$$

(i) $\quad \frac{\partial \mathscr{L}}{\partial s(x)} : \int -f(x,a)dx + \lambda \int [\frac{1}{\sqrt{s(x)}}] f(x,a)dx + \mu [\int \frac{1}{\sqrt{s(x)}}] f_a(x,a)dx = 0$

$$\Rightarrow \boxed{s^*(x) = [\lambda + \mu . \frac{(x-a)}{a^2}]^2} \tag{A}$$

(ii) $\quad \frac{\partial \mathscr{L}}{\partial a} : \int (x - s(x)) f_a(x,a)dx + \lambda \left[\int [2\sqrt{s(x)}] f_a(x,a)dx - V' \right] + \mu \left[\int [2\sqrt{s(x)}] f_{aa}(x,a)dx - V'' \right] = 0$

$$\Rightarrow \frac{1}{a^3} \int (x - [\lambda + \mu . \frac{(x-a)}{a^2}]^2) e^{-x/a}(x-a)dx + \mu \left[\frac{2}{a^5} \int [\lambda + \mu . \frac{(x-a)}{a^2}] e^{-x/a}(2a^2 - 4ax + x^2)dx - 2 \right] = 0$$

$$\Rightarrow \left[\frac{(\mu^2 x^3 + (2a^2\lambda\mu - a^4)x^2 + (3a^2\mu^2 + a^4\lambda^2 - a^5)x + 2a^3\mu^2 + 2a^4\lambda\mu - a^6)e^{-x/a}}{a^6} + C \right]_{x=0}^{x=\infty}$$

$$+\mu\left[-\frac{2x(\mu x^2+(a^2\lambda-2am)x+2a^2\mu-2a^3\lambda)e^{-x/a}}{a^6}+C\right]_{x=0}^{x=\infty}-2\mu=0$$

$$\text{For second best solution} \Rightarrow \boxed{-2\mu^2-2a\lambda\mu+a^3+0-2\mu a^3=0} \qquad \text{(B)}$$

$$\text{For first best solution} \Rightarrow \boxed{1+0-2a\lambda=0}$$

(iii) $\frac{\partial\mathscr{L}}{\partial\lambda}:\int[U(s(x))-V(a)]f(x,a)dx-H=0$

(iv) $\frac{\partial\mathscr{L}}{\partial\mu}:\int U(s(x))f_a(x,a)dx-V'(a)=0$

$$\Rightarrow\frac{1}{a^3}\int[2\sqrt{s(x)}]e^{-x/a}(x-a)dx-2a=0$$

$$\Rightarrow\frac{2}{a^3}\int[\lambda+\mu.\frac{(x-a)}{a^2}]e^{-x/a}(x-a)dx-2a=0$$

$$\Rightarrow\left[-\frac{2(^2+a^2\lambda\mu+a^2\mu)e^{-x/a}}{a^4}+C\right]_{x=0}^{x=\infty}-2a=0$$

$$\Rightarrow\frac{2\mu}{a^2}-2a=0\Rightarrow\boxed{\mu=a^3} \qquad \text{(C)}$$

replacing (C) in (B) and assuming $\lambda=1/2$ gives: $\bar{a}=1/2$. Now one can write down the $s^*(x)$ as a function of x.

$$\Rightarrow\boxed{s^*(x)=\frac{4x^2+4x+1}{16}}$$

□

Improving the Sharing Rule in an Agency Model Through Clarification of the Task Conflict

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Abstract

This paper theoretically investigates task conflict's role in designing an optimal incentive scheme in an agency relationship. By adding a conflict clarification task into the risk-sharing model, this is possible to show that such input improves the optimal sharing rule. This finding contrasts with the general perception of the conflict, which is deemed destructive and a waste of resources. The Conflict Clarification Model (abb. CC Model) uses the model developed by Holmstrom's as a basis and extends it into a model with multiple inputs. In this sense, the agent invests some of his effort to discuss his ideas about a more efficient way of doing the task. The findings suggest that, in an innovative team, the CC model outperforms the conventional model of agency.

The argument behind this proposition is built on three aspects. First, the innovation and revelation attached to each disagreement suggest a new way of doing the task more efficiently. This innovation has been understated in the general agency theory; however, it can change the production function. Second, the signals that are conveyed during conflict clarification will mitigate the moral hazard. The recent argument results from a comparison between two CC models, one with observable conflict resolution activities and one where such activities are hidden from principal eyes. Finally, as the distribution of outcome shifts, the agent is provided with higher incentives to work harder.

Also the new setting is tested against the conventional agency model in terms of total outcome, optimal effort, and first and second-best sharing rules. The research findings suggest that under CC model assumptions, the presence of conflict clarification effort will improve the total outcome no matter if the principal observes or does not observe the conflict effort. Also, in the industries with a high propensity to innovation, the principal's share of the outcome is the highest when there is observable conflict clarification activity. In contrast, the agent gets better off when the principal cannot observe conflict activity.

Contents

1 Introduction

AGency theory has been initially formed as part of organizational economics and became a decision-making model in the strategic management. Principally, minimizing the agency cost is the main goal of this theory.

At the same time, the conflict of interests embedded in the dyed relationship of agency is a significant source of agency cost. Therefore, the conflict of interest's role is crucial when talking about agency theory. The current paper aims to investigate the role of task conflict in an agency theory. In so doing, the mathematical model of the agency is used as a starting point and a conflict clarification effort is added into the model as the second output. In this way, the agent attempts to discuss his disagreement about the task accomplishment process. Through developing such model, the current paper shows that an agency setting with conflict clarification effort outperforms a conventional agency model.

The review of the studies on corporate governance highlights the an antagonistic view of the conflict, emphasizing its negative, destructive role followed by loss of the resources (Amason and Schweiger, 1994; Jensen and Meckling, 1976; Smith, 2010). There are several reasons responsible for such an orientation. First, on the one hand, the ultimate objective of the agency contract is to create wealth for the capital owner as much as possible. On the other hand, it is generally believed that all costs driven due to the separation of ownership and management impose some agency cost to the firm (Eisenhardt, 1989; Jensen and Meckling, 1976; Smith, 2010). This cost leads the firm to the second-best solution, and therefore should be prevented. These two propositions make the presence of conflict in contrast with the ultimate goal of agency theory, which is maximizing the wealth of the principals (Quinn and Jones, 1995). Such a management model built merely to uphold the capital owner's interest has been criticized for being misleading and even tending towards a counterproductive firm (Shankman, 1999). Because in its assumptions, this theory understates any improvement of the corporation status.

The second controversial presumption of the agency model is the agent's risk-aversion. Therefore, the agent's non-risk-aversion preferences are either considered as exceptional cases (Jensen and Meckling, 1976) or ignored (Arrow, 1971). In this sense, agency theory ignores the agent's preferences and, consequently, surpasses his innovative potential by neglecting his know-how and competence in enduring the risk for a higher outcome. This strict view will possibly lessen the manager's role to a production factor and deprive the firm of reaching a possible better state. Furthermore, in its methodology, agency theory puts its stress more than everything on the operational efforts of the agent (Amason and Schweiger, 1994; Jensen and Meckling, 1976; Smith, 2010). Simultaneously, the manager's facilitator roles like teamwork and mediation, besides his competencies as an individual, are extremely understated (Nilakant and Rao, 1994). This reluctance of the manager's mediator role gets particularly detrimental when the production process is highly complex, as in innovation-based firms (De Dreu, 2012).

In organizational decision-making and conflict management, there are also several pieces of evidence of the constructive role of conflict on the firm's performance measures. For instance, in the scope of conflict management, it is believed that each controversy can be associated with a more effective performance and group outcomes conditional on handling it in a positive manner (Alper et al., 2000; Rahim and Bonoma, 1979). These studies have a more moderate approach and believe in the dual nature prospect of conflict. They argue that the positive effect is merely not derived from the presence of conflict, but from how it is treated (Song et al., 2006; Tjosvold and Chia, 1989). Deutsch (1973) brings attention particularly to the constructive potential embedded in the conflict. In his well-known book, "The Resolution of Conflict: Constructive and Destructive Processes", he considers the conditions under which the disagreement turns to be productive. In his view, the point lies behind the fact that the conflict is the circumstance that should be managed and, if necessary, reformed from competitive interest to the cooperative. Similarly, De Dreu and Weingart (2003) ran a quantitative review and inferred that in contrast to the relationship conflict, task conflict is positively associated with individual satisfaction and team outcome. They also found that the negative impact of the team's dissent gets stronger by adding more complexity to the task. Additionally, controversy in decision-making can be more detrimental to productivity compared to production. In another work, Higashide and Birley (2002) considered the conflict between the entrepreneur and the venture capitalist. Through a survey in the UK, they investigated two types of conflict, cognitive and effective conflicts, and found out that disagreement can benefit venture performance.

Similarly, Jehn conducted a research to find out where the contradiction of the past works are set and how to manage the conflict to have a positive outcome (Jehn, 1995). He ran a multimethod examination consisting of 105 workgroups to address if conflict can affect the team performance. His findings suggest that the answer to this question depends on the group structure, task independence, and conflict type. Within routine tasks, relationship and task-based conflict were negatively correlated with the group satisfaction. However, in teams with non-routine tasks, disagreements about doing the tasks positively affected the group outcome (Jehn, 1995). This finding implies that group pressure toward agreement may bring the team to a superior alternative. Tjosvold and Chia (1989) highlight that open-minded discussion with mutual listening and speaking turns the disagreements into constructive conflict . Through taking a similar approach, Song examined the effect of different conflict-handling strategies on the conflict impact on the organization's outcome. His findings confirm the assumption that accommodating a conflict-handling plan is associated with a more constructive conflict (Song et al., 2006).

Moreover, realizing that there are always common interests in each battle makes one put stress on shared interests while not surpassing the opposite ones. With a similar approach, the current work tries to show that conflict can create productivity and lead to a more optimal state. Based on this hypothesis, clarifying conflict can be defined as reaching an agreement through negotiation and bargaining, which requires compromise behaviors from both parties. Also, in an ex-post contract context, an effort that is put forth to clarify the conflict will be added to the agency model. In this sense, interest heterogeneity will converge towards a middle point and becomes more cooperative. Leonard and Sensiper (1998) believe that an organization acts as a funnel, which converges the ideas that continually come to it into one. This process depicts how knowledge is generated. Based on this definition, current study focuses on the task conflict and exclude all formal litigation proceedings and war game models. In this sense, all zero-sum game situations are excluded, where each party equips themselves against the other party to win a larger share of the payoff. Also, based on the evidence found in behavioral economics and game theory, it is believed that in each disagreement, there are always common

Table 1: Summary of related works

Researcher	Research methodology	Independent variable	Dependent variable	Study Result
(Bourgeois, 1985)	Quantitative	Environmental uncertainty	Economic performance	Positive
(Amason and Schweiger, 1994)	Quantitative	Dialectical inquiry	Strategic decision making	Positive
(Tjosvold and Chia, 1989)	Qualitative	Open minded discussion	Constructive conflict	Positive
(Cosier and Schwenk, 1990)	Quantitative	Structured conflict	Decision making	Positive
(Amason and Schweiger, 1994)	Quantitative	Cognitive conflict	Decision making	Positive
(Jehn, 1995)	Quantitative	Group conflict	Group performance	Up to conflict type
(Leonard and Sensiper, 1998)	Qualitative	Tacit knowledge	Company innovation	Positive
(Alper et al., 2000)	Quantitative	Cooperative conflict	Effective performance	Positive
(Jehn and Chatman, 2000)	Quantitative	Disagree about amounts of conflict present	Group outcome	Negative
(Rahim et al., 2001)	Quantitative	Style of handling conflict	Job performance	Positive
(Rahim, 2002)	Qualitative	Conflict resolution	Organizational learning	Positive
(Higashide and Birley, 2002)	Quantitative	Disagreement	Venture performance	Positive
(Pearson, 2002)	Quantitative	Task conflict	Group outcome	Positive
(De Dreu and Weingart, 2003)	Quantitative	Relationship/task conflict	Team member satisfaction	Negative
(Song et al., 2006)	Quantitative	conflict-handling strategies	Organizational outcome	Positive
(Hülsheger et al., 2009)	Review	Conflict	Group creativity	Different for each study
(Giebels et al., 2016)	Quantitative	Proactive personality	Innovation	Positive as moderate variable

interests (Schelling, 1960). This is because the self-interest parties act rationally, knowing that their interest can only be fulfilled, only if the firm exists (Jensen and Meckling, 1976). This notion is even true in international affairs, where two countries are components of a broader system which depend on and simultaneously affect each other (Deutsch, 1973). In this sense, the situation of entirely opposite interests rarely occurs.

Under agency theory assumptions, the effort is defined concretely. In this sense, the agent has to follow the principal's choice of action and not deviate. Otherwise, he will be punished by earning less. Similarly, the expected outcome, upon which the contract is conducted, is measured based on a probability distribution setting which principal is aware of. As innovation has gained significance in recent decades, the agency theory began to be a less realistic model, as it did not count for the innovation. The principal would like to observe all agent's actions and reach the optimal payoff through controlling them. However, perfect monitoring is highly costly. Holmstrom calls the act of monitoring the routine activities "bureaucracy" and considers it as hostile to the innovation (Holmstrom, 1989). As a result, the spirit of the agency theory does not give much credit to the innovation.

A summary of the above mentioned literature, focusing on the role of conflict management on the firm's outcome, is presented in Table (1). All these studies take an organizational behavior approach, but some research that combines conflict clarification activities with the agency model is missing. With regard to this gap, the current paper tries to fill it. It investigates whether resolving the task-based conflict can improve the sharing rule towards a more optimal state. Current study tries to contribute to the agency theory by adding a new effort input into the agency model. In this sense, the conflict clarification efforts lead to an endogenous innovation factor affecting the corporation's output. Through taking a theoretical approach, a model of bounded rationality which adopts the assumptions of (Jensen and Meckling, 1976) is presented. The model will be an extension to the general agency model applied by Holmstrom (1989). Then it is argued that the model, including conflict resolution activities, provides a more efficient setting for an agency relationship.

Three different types of agency models is tested: a general agency model without conflict; a Conflict Clarification (CC) model with observable conflict activity; and a CC model where the agent takes such action but such effort and its result are only visible to the agent. Then the new setting is tested against the conventional agency model in terms of total outcome, optimal action, principal's, and agent's payoff. Research findings suggest that, in an innovative company, under the CC model's assumptions, the presence of conflict clarification effort improves the total outcome, no matter if the principal observes or does not observe the conflict effort. Also, in the industries with a high propensity to innovation, the principal's share of the outcome is the highest when there is observable conflict clarification activity. In contrast, the agent will get better off when the principal cannot observe conflict activity.

The following section provides a historical investigation by giving a literature review of the agency theory. Section three describes the central proposition, then the arguments that support it will be discussed. Section four presents the mathematical model of the agency problem, and finally, the conclusions are presented in section five.

2 Theory of Agency

Agency problem has been studied by many scholars, from the field of finance (Fama, 1980; Jensen and Meckling, 1976) to economics (Jensen and Meckling, 1976; Ross, 1973; Spence and Zeckhauser, 1971) and also it counts as one of the oldest theories (Wasserman, 2006). The first economist who detected such a problem was Adam Smith. In *The Wealth Nations*, he points out that if the manager is separated from the owner, he would probably work for his benefit and not the owner's. He writes:

> "The directors of such [joint-stock] companies, however, being the managers rather of other people's money than of their own, it cannot well be expected, that they should watch over it with the same anxious vigilance with which the partners in a private copartnery frequently watch over their own. Like the stewards of a rich man, they are apt to consider attention to small matters as not for their master's honour, and very easily give themselves a dispensation from having it. Negligence and profusion, therefore, must always prevail, more or less, in the management of the affairs of such a company." (Smith, 2010), p. 700.

After him, in the finance field, preliminary works focused on the risk-sharing between principal and agent (Arrow, 1971; Wilson, 1968). However, the agency problem's mathematical model was formulated later by Ross (1973) and mostly developed by Jensen and Meckling (1976). They constructed a theory that explains how separate individuals' divergent goals can be brought to an equilibrium (Jensen and Meckling, 1976; Ross, 1973). Their theory was a generalized form that counts as a source of inspiration for creating specific models of agency (Harris and Raviv, 1979; Holmstrom, 1989; Mirrlees, 1976). Genrally speaking, the agency model focuses on the relationship between the capital owner (principal) and a party (agent), which works on this capital in return for a share of the payoff.

The general agency model tries to set up incentive and control mechanisms when it aims to limit the losses caused by a divergence of interests (Fama, 1980; Jensen and Meckling, 1976). On its way, agency theory has tended to focus on monitoring the agent and has assumed that the agent, by default, tries to cheat and deceive the principal. However, the probability that the principal can also act at the agent's disadvantage or, more generally, at the firm's disadvantage is not zero (Perrow et al., 1986). Perrow believes that these assumptions are not basically realistic, and the employees show loyalty when being given responsibility. In this sense, lack of sufficient trust within corporate relations makes the path to success and innovation uneven. The need for a framework that took more realistic input factors into account resulted in the emergence of a new branch of agency theory, the behavioral agency theory (Pepper and Gore, 2015; Sanders and Carpenter, 2003; Wiseman and Gomez-Mejia, 1998). This theory criticizes the positive agency theory as is does not lay sufficient emphasis on intrinsic, realistic factors that affect the agent's action, such as agent preferences (Pepper and Gore, 2015) and his decision making competencies as an individual(Cyert and March, 2015; Simon and Millett, 1947). Also, Holmstrom and Milgrom (1991) believe that standard agency theory cannot explain many aspects of the organizational topics, like job design and authority allocation. Within the firm theory literature, the role of the agency model's behavioral factors had been pointed out many years ago, in the 1960s. Carnegie school's adherence believed that the classical rational agent model could not come to realistic decision-making anticipation due to unrealistic assumptions (Cyert and March, 2015). In summary, this theory differs from the positive agency theory in three main aspects. Firstly, unlike the agency model, which focuses on the relationship between the agent and the principal, the behavioral approach discusses the association between agency cost and the agent's action. Secondly, the standard agency model makes a restrictive assumption on the agent's risk-aversion and assumes the agent as a reward seeker. However, behavioral agency theory supposes that the agent's action results from his trade-off between intrinsic and instrumental incentives (Panda and Leepsa, 2017; Pepper and Gore, 2015; Wiseman and Gomez-Mejia, 1998).

The CC model developed here, in contrast to the standard agency model, which takes one single input, defines multiple tasks for the agent. Evidence within the agency theory context shows that being responsible for more duties motivates the agent for hard work. For example, Holmstrom and Milgrom (1991) believe that through selecting the agent's task portfolio, the principal can affect the agent's incentives (Holmstrom and Milgrom, 1991). There is also evidence suggesting that the agent is willing to take the risk when he receives more authority (Cyert and March, 2015). The current study defines task conflict clarification as the agent's second activity. Therefore, he has to scarify a part of his operational activities to resolve the controversies over how to do the task. Adding conflict resolution activity to the model generates risk in terms of less outcome borne by both parties. In this way, through discussing the task conflict, with some probability, a more efficient method of doing the work may be propounded whose output exceeds the conventional method. For this purpose, the task conflict activity factor will be added into the agency model to creates innovation with some probability. The following research questions will be discussed and tested theoretically:

> **Research Question 1**: In an innovative firm, devoting some of the effort to clarify task conflict is associated with higher total revenue.
>
> **Research Question 2**: In an innovative firm, devoting some of the effort to clarify task conflict is associated with a higher principal's outcome when such attempt and its result are observable to the principal.
>
> **Research Question 3**: In an innovative firm, devoting some of the effort to clarify task conflict is associated with a higher agent's outcome when such effort and its result are not observable to the principal.

3 Innovation of conflict

Recently, the approach to studying conflict has changed to become more pragmatic and contingent. This view focuses mostly on managing conflict and the circumstances under which disagreement can be constructive. In the new paradigm, it is believed that the conflict effect does not merely stem from the conflict itself but also from how the conflict is treated (De Dreu and Weingart, 2003; Rahim et al., 2001). Jehn and Chatman (2000) categorized conflict into three various groups: task conflict, process conflict, and relationship conflict. In an organizational context, task conflict concerns the role alignment in a project. It describes the struggle on the definition and the objective of a task concerning the underlying project.

In contrast, process conflict deals more with reaching the goal and contains all disagreements over the applied procedure. Finally, relationship conflict stems typically from personal and social concerns and therefore does not belong to the work issues. A large number of studies have been conducted to examine each one of these conflict types. For example, Jehn and Chatman (2000) developed the theory of conflict by introducing the factors that can moderate the effect of intra-group conflict on the group's outcome. For this purpose, first, they considered both significant types of conflict, task, and relationship conflict. Their findings suggest that in contrast to relationship conflict, task conflict could be positively correlated to the performance. Evidence from other researches confirms their results (Amason, 1996; Jehn, 1995; Pearson, 2002).

However, other scholars have labeled these dimensions differently; they have a consensus on the meaningful difference of both types of conflict regarding their impact at the workplace. Besides, Jehn and Chatman (2000) provided an index for task types to show whether a conflict is destructive or constructive depends on the task type. They indicated that conflict in the routine functions impedes efficiency because individuals have to solve the task issues how they have been doing it anyway. In contrast, in the non-routine tasks, the conflict seemed to positively contribute to the group's outcome. However, there was a non-linear relationship between the level of controversy and a positive result. In other words, the performance response to conflict increased to a certain level, where it touches its maximum, and after this threshold, the conflict effect turned to be negative. There might be an underlying assumption that the team members gain information along with each conflict, especially when this information is related to their tasks (Jehn and Chatman, 2000). But when team members concentrate so much on conflict clarification activity, they fail to carry out the job. Therefore the efficiency and, consequently, the performance falls.

As already discussed, the conflict clarification effort enables the agent to find a voice against the principal. Once this right is preserved for the agent, the sharing rule can move towards a better point, closer to the first-best solution. The presence of such an effort can affect the outcome through different channels as discribed below:

Knowledge transfer: Firstly, through allocating some effort to resolve conflict, the knowledge transfer occurs. Within a corporation, the management is the party involved in the day-to-day operations and possesses the expertise in that specific industry. Therefore, the owner depends on the manager to get information about the business (Panda and Leepsa, 2017). In this sense, discussing the agent's task processes probably reveals information that can lead to innovation. So even if the manager is not willing to disclose any information, one part of his knowledge is shared with the principal in the form of tacit knowledge (Leonard and Sensiper, 1998). In the conflict management context, transparency in the team is associated with a more efficient effort towards innovation (Zhong, 2018). It also reduces the managerial costs and also improves the efficient allocation of the R&D budget (Zhong, 2018).

The findings of several studies support this claim. Amason believes that conflict role has been understated in the organizational learning (Amason and Schweiger, 1994). Likely, Rahim postulates that organizational learning can improve only through an intervention in the process of conflict while keeping other factors constant. He believes that designing appropriate strategies within conflict management scope enhances the innovative thinking (Rahim et al., 2001). Moreover, in a meta-analysis, Hülscheger et al. investigated 15 different team-level factors affecting group creativity by collecting 104 studies over at least three decades. However, each study seemed to show a different sign for conflict effect on the creativity coefficient. Yet, the authors reported that teams with a higher level of internal and external communication are likely to be more innovative (Hülsheger et al., 2009).

Likewise, in a more recent study conducted in the Netherlands, employees involving more task conflicts are more likely to show creative behaviors when being proactive. In this respect, task conflict is considered as a nexus between proactive personality and innovative actions (Giebels et al., 2016). Also, there are shreds of evidence among the older literature, implying a positive role of conflict in creative thinking. In this regard, empirical research's findings suggests that the presence of conflict can improve the business flow through better decision-making and strategic planning (Bourgeois, 1985; Eisenhardt, 1989). Cummings and O'Connell (1978) believe that proposing a solution to a problem should be separated from evaluating the answers. Along with this speculation, they believe in enforcement of the risk-taking mentality through a free exchange of ideas and legitimizing conflict. They recommend managers to encourage employees to speak up, participate actively in the problem-solving process, and rely on intrinsic reward.

Observability enhancement: By investing a part of the effort on the conflict handle activities, which is observable to both parties, the uncertainty will decrease. In this way, the principal gets aware of the task status quo and collects more knowledge about the agent's type and preferences. Moreover, in the context of agency theory, moral hazard will be mitigated through more transparency (Jensen and Meckling, 1976). In this respect, there are three factors in charge of the outcome uncertainty. First, moral hazard, which means the agent's accountability in exerting optimal effort. Second, adverse selection, i.e., the agent's competence in doing the task, and third state of nature, i.e., the relationship between the agent's action and outcome. The latter source of uncertainty includes all exogenous factors that are not under the agent's control and have been addressed in the literature by designing incomplete contracts. In these types of contracts, there is always a renegotiation possibility after signing the contract (see Baiman (1990)). But the two first issues can be partly addressed through improving observability resulted from conflict settlement. In other words, through social and communication channels, some signals about the agent's type are conveyed, which are characterized by a set of agent's ability, willingness to work hard, his preferences, and his intrinsic motivation. Depending on whether the signal contains good or bad news about the agent's characteristics, the probability distribution can shift respectively to the left or right. This can be considered an informative signal conveyed by the agent and can mitigate the moral hazard leading to a more optimal sharing rule (Holmstrom, 1989). However, there are findings that suggest full monitoring deteriorates the relationship between the agent and the principal (Cropper, 1981; Dewatripont et al., 1999; Prat, 2005).

Furthermore, because the signal delivered to the principal can inform her about the agent's type, the bad type agent is more likely to reject the contract. Therefore, a contract with some space for disputes, negotiations, and dissent is more likely to be refused by a risky type of agent. Because it is hard to shirk when he knows that his payoff depends on the monetary outcome and a conflict clarification activity. Also, it is expected that a good agent will accept such a contract because he knows that it is more likely to be reimbursed proportionately to his effort compared to a conventional contract. Furthermore, through observing some parts of the agent's effort, the principal can estimate the exerted effort more precisely while considering the outcome. It implies that the agent is only responsible for the factors under his control, and accordingly, his remuneration can vary according to his effort more than before. Thus, the fact that it is more likely not to be punished for the bad outcomes resulted from the circumstances out of the agent's control gives him a higher incentive to choose a high effort level. Also, he will not cheat later because he knows that his payoff depends mainly on his effort, not on the exogenous factors. In this sense, conflict resolution activities can be a proper substitute for the agent's monitoring. Even if the conflict seems destructive because it bears some agency cost to the firm, it can simultaneously work as an instrument for reducing such costs by enhancing observability.

More intrinsic incentives: Another reason explaining why an organization with conflict resolution culture outperforms the one without such a culture has to do with providing the agent with an extra incentive not to deviate from the contract after signing it. From a general agency point of view, as the expected outcome increases, the agent becomes more willing to exert higher effort than before. It is quite intuitive because now the agent will gain more with the same effort cost. However, external rewards are not the only factor motivating the agent. Behavioral agency theory supposes that a set of proper intrinsic motivations can improve the agent's incentive more than any external motivation (Pepper and Gore, 2015). Also, discussing the disagreements, instead of surpassing them, is considered as an opportunity for employees who seek a voice (Gorden, 1988). Having a voice gives the employees a sense of belonging and motivate them to work with more enthusiasm. In this way, the employees' inclement towards work changes as they feel involved in the decision-making processes. Other findings suggest that the agent's attitude towards risk can change under this condition (Cyert and March, 2015; March and Shapira, 1987). So, the agent will be willing to bear some risk in return for trying a method of doing the job which he considers to be the most efficient, even if this method seems to be in contrast with the best practice known in the firm. The pieces of evidence suggest that in most cases, the manager seeks a voice to change the accepted strategy of running the business. Gorden (1988) believes that the conventional perception of having a voice in the organization is typically translated into an opportunity to be critical about the organization; however, in his opinion, this definition needs a reconsideration. In this respect, he redefines a voice as discussing problems and suggesting solutions for them (Gorden, 1988). He also points out that parties in an agency relationship do not intend to play a zero-sum game, ending to the firm's dissolution. According to its definition, corporate governance has been formed due to the possibility of conflict of interest in the different relations (Goergen, 2012). Knowing that the agent and the principal are interested in the organizations' survival.

4 Mathematical Models

In this section, the central question of the research is theorized. For this purpose, a mathematical analog of agency theory optimization is developed, while the conflict resolution effort is added into it as an extra input. As discussed in the introduction section, agency theory aims to find the lowest wage level, such that, firstly agent accepts the contract, and second, he is willing to exert high effort. Such a contract will maximize the owner's utility function. The new model is built on Holmstrom's general agency model assumptions (Holmstrom, 1979). In this way, a comprehensive explanation of his model will be given in the first place. Then the premise of CC model will be presented. Two types of CC model will be explained; once the conflict clarification effort is observable to the principal and once where it is hidden to her. Finally, a comparison between the two models will be carried out.

I Assumptions

- **Wage:** The principal (conventionally she) offers the agent (conventionally he) a contract, with a specified wage level contingent on the outcome, $s(x)$. The agent should decide if he accepts or rejects the principal's proposal. If he declines the contract, he will get his reservation utility, $\bar{H}$.

- **Effort:** If the agent accepts the contract, he will choose an effort level a from all possible actions, $a \in A \in \mathbb{R}$ to carry out the task. But the CC model differs in this sense from the conventional model in that it takes two different actions as input. If the agent accepts the contract, he will exert a total effort level, E. He can choose whether to put only operational effort a (then $E = a$) or allocate a proportion of his effort to resolve the task conflict that has been aroused between him and the principal. In this case, the sum of the efforts that agent invest on operational and conflict resolution (e) adds to the total effort (then $E = a + e$), with $E, a, e \geq 0$. Here, operational effort a is exerted into the production task to generate outcome x. In contrast, conflict resolution effort e is considered to be invested in the manager's facilitating tasks that aim to resolve the task conflicts, such as teamwork, brainstorming, and knowledge transfer. The expected outcome for such an effort will be a new technology that changes the economy's scale by developing the production method. The reason to break down the total effort into two parts is the assumption of the different roles that each of these types of effort plays in production processes.

  Moreover, two types of CC model is investigated. Once where e is not observable to the principal and once where it is the case. In all models, the operational effort is only visible to the agent. Furthermore, $a \in A \in \mathbb{R}$, whereas there are only two possible levels for e, low effort and high effort; $e \in \{0, \bar{e}\}$. Here, for simplicity, low effort is assumed to be zero, implying that the agent either takes high effort to resolve the conflict or takes no conflict resolution effort at all. After determining e, and according to the upper bound of E, the agent will choose an operational effort level.

- **Outcome:** If the agent exerts no e, then the assumptions of the general agency theory will hold. It means that the outcome $x(a, \theta)$ will be produced, which is a continuous function of the effort a and a random state of nature θ, with $x_a \geq 0$. Here x is the monetary outcome observed by both parties and will be shared optimally between the principal and the agent. The parameter θ represents all unexpected circumstances that are not under the agent's control that may favor or impede the production process and, in this sense, links the operational effort to the outcome.

  Given a distribution of θ, $F(x, a)$ is the expected distribution of x parametrized by efforts, and $F_a(x, a) \leq 0$ with $F_a(x, a) < 0$, for some x values. The latter condition is called the

Stochastic Dominance Condition (SDC) and implies that a change in a has a nontrivial impact on the distribution of x. So under the general agency model, the final outcome x is only a function of operational effort besides the state of nature. In contrast, in the CC model, the final outcome also depends on the conflict clarification activity's production. In this sense, the result of the conflict clarification activity in the form of new technology will be an intermediate product. When $e = \bar{e}$ there is probability p that a new technology (I) will be generated. Also, assume that B depicts the distribution of success in generating innovation when exerting $\bar{e}$. Because there exist only two possible levels for e, therefore I has a Bernoulli distribution $I \sim B(p)$ with two expected outcomes; $I \in \{1,0\}$. Here p is called *innovation probability* and is defined as the probability of success $p = Pr(I = 1)$. The new technology can be defined differently up to the industry. It can emerge as an enlargement of the production scale factor, improvement in product quality, or improvement of an existing process or enhancement in the distribution channel. Therefore, p varies depending on the industry, organization culture characteristics, and propensity to innovation. In the proposed model, p is assumed to be given exogenously. So the outcome of conflict resolution effort is a random variable that can be stated as $I = I(e,B)$. In case of success, the outcome of e is a new technology and enters directly into the production function. After the new technology has been created, the outcome x will be multiplied by $\phi > 1$, which serve as the *innovation quality*.

In case the conflict resolution activity fails in generating innovation, the plant will produce the same amount as before, which is equivalent to $\phi = 1$. It is also the case if the agent would not take any conflict clarification activities. The following expression illustrates the decision prepositions for the agent. If he takes scenario 1), then he will be remunerated based on the general agency model. However, by taking scenario 2), he will possibly bear higher risk, but he will be rewarded based on the CC model.

$$f(kx,a) = \begin{cases} \text{if } 1) e = 0 \Rightarrow E = a_1 & \qquad\qquad f(x,\bar{a}) \\ \text{if } 2) e = \bar{e} \Rightarrow E = a_2 + \bar{e} & \begin{cases} \text{if } I = 1 & f(\phi x, \underline{a}) \\ \text{if } I = 0 & f(x, \underline{a}) \end{cases} \end{cases}$$

Where a_1 and a_2 show the agent's choice of effort in the first and the second model, respectively. Also, $\bar{a}$ and $\underline{a}$ are the optimal effort level for each model with $\bar{a} \leq \underline{a}$. As there is an upper bound for the amount of effort, then $a_1 > a_2$. In contrast, it is expected that the second model's optimal effort level is higher than that in the first model, which means that the principal's expectation of the agent increases as new implemented technology.

- **Risk sharing:** Principal's utility is only a function of wealth, $G(x - s(x))$, where $G_x, G_a \geq 0$ and $G'' \leq 0$. In contrast, the agent's utility function, H varies by his share of outcome, in addition to the effort he makes $H(s(x),E) = U(s(x)) - V(a) - Z(e)$, where $V(a)$ is the utility cost function of agent's operational efforts with $V' > 0$. As per agency theory's presumption, it is also assumed that the agent is strictly risk-averse; $U'' < 0$.

  Also, $Z(e)$ is the cost function of the conflict clarification effort with $Z(0) = 0$. Besides, it is intuitive to assume that $Z(b) < V(b)$ for any given b. Suppose the agent chooses to exert some conflict settlement effort. In that case, there is also a cost-benefit equal to the value of the outcome that has not been produced due to spending some part of the operational effort on clarifying conflict. Both parties will bear this cost in terms of less total outcome. So in a sense, it is assumed that the agent can choose between two pots. First, taking a more certain and conventional outcome by exerting $E = a_1$, or selecting the more risky outcome by devoting some of his effort to discussing different ways of doing the job and therefore taking; $E = a_2 + \bar{e}$.

Next subsection tests the hypotheses theoretically and also shows which conditions the conflict clarification model will give a more optimal contract in terms of the sharing rule. But before that, it is tested which one of two models result in a higher expected total outcome. Therefore, in contrast to the agency theory that only focuses on maximizing the principal's wealth, both models are compared in terms of maximizing the wealth of the firm.

Proposition: In an innovative firm, devoting some of the effort to clarify task conflict is associated with higher total revenue.

One can derive the expected outcome in each of two scenarios: the one where there is no task other than the operational task, $E = a_1$. And second, when the agent divides his effort between two tasks $E = a_2 + \bar{e}$. Here it is assumed that conflict clarification activities are observable to principal. The expected outcome in the first scenario is:

$$\int x.f(x,a|a=\bar{a})dx, \tag{1}$$

and the expected ultimate outcome for a CC model looks like:

$$p.\int x.f(\phi x,a|a=\underline{a})dx+(1-p)\int x.f(x,a|a=\underline{a})dx. \tag{2}$$

So it is only needed to show under which conditions, (2) > (1) holds. Figure (1) demonstrates the distribution function of the outcome for both models. In the second scenario, exerting $\bar{e}$ alters the probability density function (pdf) of the outcome in two ways. First, through a rise in optimal effort $\underline{a} > \bar{a}$, the pdf will shift to the left (moving from red curve to green curve in Figure (1)). The optimal effort increases because the principal observes the conflict clarification activity and also the generated innovation followed by it. Therefore, she expects a higher outcome, because the expected innovation increases the marginal return to the effort. So, in case of generating an innovation $I = 1$, x_a will increase, and now the principal wants the agent to work harder and produce more. After that, an increment in ϕ will happen. It implies that the spread of x will get larger (moving from the green cure to the dashed curve in Figure (1)). The expected probability density function in the conflict resolution activities is highlighted through the dashed curve.

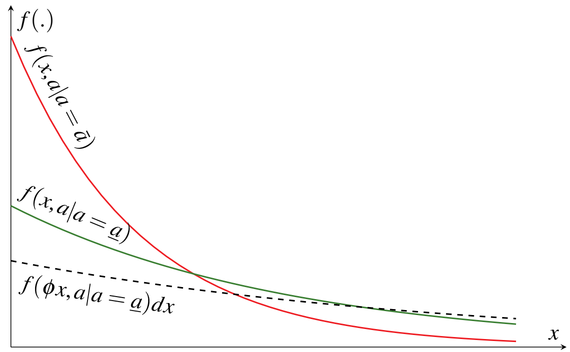

Figure 1: The histogram shows the probability density function (pdf) of both models. The red curve is the outcome's pdf when no conflict clarification activity has been put forth, and the agent only invests effort to produce. The green curve shows the outcome's pdf when conflict resolution activity is taken, but no innovation is generated. The optimal effort increases, and therefore the probability of higher outcomes rises. Finally, the dashed line shows the pdf when the agent takes some conflict resolution activity, which leads to new technology with innovation quality equal to ϕ.

Figure (1) implies that by assuming a and x constant, a change in innovation coefficient has a nontrivial effect on the distribution of x. Given p, the expected probability density function of x for the CC model, would be a weighted average of both probability density functions (see Equation (2)). For more simplicity, k is defined as the expected innovation coefficient;

$$k = p.\phi + (1-p).1, \tag{3}$$

and replace it in (2). In this way, the expected total outcome in the second scenario takes the form of:

$$\int x.f(kx,a|a=\underline{a})dx.$$

Proposition: Based on the assumptions mentioned above, a CC model leads to a higher total outcome, than a general agency model when the following condition holds:

$$k \geq \frac{a_1}{a_2}, \tag{4}$$

where, k is the expected innovation coefficient.

***Proof*.** Without loss of generality, it is assumed that x has an exponential distribution with parameter a, $x \sim exp(1/a)$. In this case, the probability density function is $f(x,a) = \frac{1}{a}.e^{-x/a}$. The proof will be based on two properties of the exponential distribution function. First, the scaling property, which ascertains that if $x \sim exp(1/a)$ then $kx \sim exp(1/ka)$ for $k > 0$. Second, it is known that the expected value of x, when x is exponentially distributed with parameter $1/a$ equals to $E(x) = a$ (See Appendix.1.). So the expected outcome in the first and the second model equal to a_1 and ka_2 respectively. Therefore,

$$k.a_2 \geq a_1,$$

Which is equivalent to (4). ■

This proposition implies that as long as the expected coefficient of innovation compensates that portion of the effort invested in the conflict clarification, the optimal outcome will be high enough to outperform the original agency model. Moreover, k is a function of p and ϕ. Therefore, the higher the propensity to innovate and the quality of the innovation, the more the conflict model outperforms the general agency model in terms of the total outcome. One can infer that discussing the possible methods to do a task is particularly important when the company has a high propensity to innovate. Other implication from Equations (4) is that, manager's job profile plays a role in the effectiveness of the conflict clarification activity. In other words, when the conflict clarification effort is small enough compared to operational effort ($\frac{a_1}{a_2}$ is small), it makes sense to take such an effort.

II Contract without Conflict Resolution Effort

To provide a comparison between the two models in terms of the sharing rule, first the general agency model is considered where there is no conflict resolution activities ($e = 0$). In this case, total effort equals the production effort ($E = a$), which is also in charge of generating the outcome, $x(a,\theta)$). First, a quick explanation of driving the optimal sharing rule through the original model adopted from Holmstrom (1979) is given. Then the conflict model is developed and those conditions are explained under which the optimal sharing rule in the latter model exceeds that of the first model.

To derive the optimal agent's share, the commonly used Lagrangian method is used to find the local maximum value, while the constraints being taken into account. In this method, one function $f(x)$, calling objective function is optimized against some constraints $g(x)$ (Kalman, 2009). By having object function and constraint, the original problem can be reformulated as a **Lagrangian function**. $\mathscr{L}(x,\lambda_i) = f(x) - \sum \lambda_i g_i(x)$.

In the current case, the objective function is the principal's expected utility function, which itself is a function of her wealth.

$$\max_{s(x),a} E\{G(x - s(x)\}. \tag{5}$$

The principal owns two kinds of leverage to maximize her utility. First, the agent's payoff, which should be minimized. Second, the effort that positively affects the final outcome. Here, the agent's action is hidden from the principal, and therefore she tries to induce the agent to take the action that maximizes (5). Viewing from the principal perspective, there is some effort level $\bar{a}$, for which Equation (5) reaches its highest amount. In order to guarantee that the agent will choose $\bar{a}$, two requirements have to be fulfilled. First constraint implies that $\bar{a}$ has to make the agent better off than if he would not have accepted the contract.

$$E\{U(s(x)) - V(\bar{a})\} \geq \bar{H}. \tag{6}$$

This constraint is called the agent's *participation constraint*, reflecting the fact that the agent will accept the contract only if he gains a utility level exceeding his reservation utility ($\bar{H}$). Second constraint, known as *incentive compatibility constraint*, gives agent enough incentive to choose $\bar{a}$ among m different actions. Hence $\bar{a}$ also should bring the agent the highest utility level among all other possible effort levels. In mathematical words, $\bar{a}$ should maximize the agent's utility:

$$\bar{a} \in \text{argmax}_{\bar{a} \in A} E\{U(s(x)) - V(a)\}. \tag{7}$$

Equation (7) implies that the agent will choose a proper level of effort that maximizes his utility, knowing the status of the $s(x)$. This constraint has been incorporated since the principal cannot observe the effort level. The optimization process is best employed by a situation where x and a are distributed as a continuous variable with density function f. In this sense, there is one objective function besides two constraints, which together form a constrained optimization problem, which can be solved by applying Lagrangian method:

$$\max_{s(x),a} \int G(x - s(x)) f(x,a) dx, \tag{8}$$

subject to;

$$\int [U(s(x)) - V(a)] f(x,a) dx \geq \bar{H} \tag{9}$$

$$a \in argmax \int [U(s(x)) - V(a)] f(x,a) dx. \tag{10}$$

According to the approach introduced by Mirrlees(1974, 1976), suppose that given a distribution of the state of the nature θ, $F(x,a)$ is the distribution induced on x via the relationship $x = x(a,\theta)$. Suppose F has a density function $f(x,a)$ with f_a and f_{aa} well defined for all (x,a). Also it is assumed $x_a \geq 0$, which implies $F_a(x,a) \leq 0$, and according to SDC the following inequality holds: $F_a(x,a) < 0$ for some a. This implies that as a goes higher the probability of the lower outcome decreases and vice versa. Therefore, if one write the derivation of the agent's utility and set it equal to zero (first order condition), the optimal effort can be calculated. Therefore, instead of writing Equation (10), one can write the first order condition;

$$\int U(s(x)) f_a(x,a) dx = V'(a). \tag{11}$$

Now the Lagrangian function can be derived based on (8), (9) and (11).

$$\mathscr{L} : \int G(x - s(x)) f(x,a) dx + \lambda \Big\{ \int [U(s(x)) - V(a)] f(x,a) dx - H \Big\} + \mu \Big\{ \int U(s(x)) f_a(x,a) dx - V'(a) \Big\} = 0 \tag{12}$$

A necessary condition for a and $s(x)$ to solve the Lagrangian function is that there exist parameters λ and μ such that (13) and (14) hold (For more detail on driving this result see

Appendix.2.).

$$\frac{G'(x-s^*(x))}{U'(s^*(x))} = \lambda + \mu \frac{f_a(x,a)}{f(x,a)}, \tag{13}$$

Here, $s^*(x)$ represents the optimal sharing rule. Another equation driven through the setting derivation of Lagrangian function with respect to a equal to zero is the adjoint equation (See Appendix.3.),

$$\int [G(x-s(x))f_a(x,a)dx] + \mu . \left[\int [U(s(x))f_{aa}(x,a)dx - V''(a)] \right] = 0. \tag{14}$$

Given this equation the value for μ can be calculated. According to Borch's work (1962). $s(x) = s^*(x)$ holds only if right hand side in (13) is constant. Because μ and λ are constant parameters, the only requirement remaining to be fulfilled is $f_a(x,a)/f(x,a) = c$. The latter condition contradicts with the fact that for some x values $f_a(x,a) < 0$ (contradicting SCD) and therefore $\mu = 0$ is derived. Inferring so, the second constraint will be removed from the model and the new optimization program will resemble a full monitoring scenario. In this case, there will be no moral hazard (i.g. incentive compatibility constraint would not bind), then Equation (13) would look like;

$$\frac{G'(x-s^*(x))}{U'(s^*(x))} = \lambda, \tag{15}$$

which is referred as the *first-best solution*, because the effort is also observed by principal and there is no incentive issue. In contrast to the perfect risk sharing (Equation (15)), *second-best solution* (Equation (13)) depends on the joint distribution of x and a. Holmstrom shows that $\mu > 0$, when first-best solution is not available (see (Holmstrom, 1979)). It means that accepting that the first-best solution is not available, the principal would like to see that the agent has increased his effort. It is immediately to infer that the second-best solution is inferior to a first-best solution in terms of the principal's share.

The term beginning with μ in Equation (13) can be seen as the deviation from the optimal sharing rule. So every time $f_a(x,a)$ is negative the $s(x) < s_\lambda(x)$ and vise versa. Hence, the smaller the $\mu\left|\frac{f_a(x,a)}{f(x,a)}\right|$, the closer the sharing rule to optimal rule. Also, note that $\frac{f_a(x,a)}{f(x,a)}$ is the derivative of log of maximum likelihood procedure, in which an unknown parameter, a can be estimated given the sample observation of x. Put it differently, this ratio measures how strongly the effort level can be inferred through observing the outcome.

III Contract with Observable Conflict Resolution Effort

In the next scenario, the agent devotes some of his effort to discuss the possible ways of doing the task with the principal. In this way, the agent will develop a new, more efficient method for carrying out the job with some probability. Here both parties can observe the result of the conflict resolution activity. However, since there is an upper bound for the agent's effort, devoting some effort to such action will lessen the agent's effort to invest in production.

In doing so, the agent divides his total effort between two different activities; operational and conflict resolution efforts. As mentioned, latter effort can be chosen from the set of $e \in \{0, \bar{e}\}$. So after accepting the contract and before any action, the agent exerts $e = \bar{e}$ in the first stage of the project. According to the value of $\bar{e}$ and the fact that total effort is bounded upward, he decides about the operational effort level in the next stage. Moreover, it was assumed e would result in a technology change (I), with the probability $p = Pr(I = 1)$, where p is given exogenously based on the industry characteristics. If putting effort into e is successful, then the value of the output based on the operational effort will be multiplied by the factor $\phi > 1$, which current study calls innovation quality. In this case, in the presence of e, when $a \neq 0$, the outcome will be determined according to the operational effort a, the innovation probability p, and finally, the innovation quality ϕ. So, assume that k is the expected innovation coefficient and is measured by Equation (4). Also, the expected total outcome in the second scenario takes the form of:

$$\int x.f(kx,a)dx.$$

In order to derive the optimal sharing rule, again the principal tries to maximize her utility with the lowest possible cost, after the agent chose $e = \bar{e}$. Note that changing the level of technology applied in the production will change the relationship between operational effort and the outcome and consequently the agent's payoff (let's call the share of the agent from the CC model's outcome $\underline{s}(x)$). Because principal can also observe k, she will expect a higher outcome and consequently her expected utility $G(.)$ can be maximized by;

$$\max_{\underline{s}(x),a} \int G(x - \underline{s}(x)) f(kx,a)dx, \tag{16}$$

likewise, the participation (17) and incentive compatibility constraint (18) are written:

$$\int [U(\underline{s}(x)) - V(a)] f(kx,a)dx - Z(e) \geq \bar{H}, \tag{17}$$

$$\underline{a} \in \text{argmax} \int [U(\underline{s}(x)) - V(a)] f(kx,a)dx, \tag{18}$$

where $Z(e)$ represents the cost of the conflict clarification activity. Again, optimal $\underline{s}(x)$ and $\underline{a}$ should fulfill (19);

$$\frac{G'(x - \underline{s}(x))}{U(\underline{s}(x))} = \lambda + \underline{\mu} \frac{f_a(kx,\underline{a})}{f(kx,\underline{a})}, \tag{19}$$

where (19) is an extension of (5) (For a detailed solution see Appendix.4.). Also, it should be noted that under the new specification, the optimal effort, $\underline{a}$, will be different from that of the first model ($\bar{a}$). It is because the emergence of new technology has changed the relationship between the effort and the outcome. In this sense, to gain a specific amount of outcome (a given x value), the second model demands a lower effort level $a_2 < a_1$. So due to a productivity enhancement, the principal wants the agent to put more effort as the marginal return of one unit of effort has increased. As k goes higher, the difference between optimal actions in both models diverges. If $k = 1$, both models will have the same optimal action, $\underline{a} = \bar{a}$. By putting Equation (13) and Equation (19) next to each other, one can compare both models in terms of the optimal sharing rule. Under perfect observability, both models suggest an equal first-best solution as the first-best solution does not depend on the outcome distribution. Therefore;

$$s_\lambda(x) = \underline{s}_\lambda(x). \tag{20}$$

However, comparing both models based on their second-best solution depends on the distribution of x. The model, which has a lower deviation from the optimal sharing rule, is the most optimal model. The deviation from the optimal sharing rule is calculated through the term beginning with μ in Equation (13) and Equation (19) for the first and the second model, respectively.

Theorem: Let's $s(x)$ be an optimal sharing rule in an innovative corporate, for which the agent's choice of action is unique and interior in A. Then, in the presence of the observable conflict resolution effort e, there exists a sharing rule $\underline{s}(x)$, which Pareto dominates $s(x)$.

Proof. By holding all other factors constant, if one can show that the new model produces a higher outcome while the agent's share decreases or at least remains constant, the proof is done.

1. As showed in the previous subsection, the expected outcome when taking the same level of effort is higher in the second model if $k > a_1/a_2$. So in an industry with a high propensity to innovate, the second model's expected outcome is higher than that of the first model. A part of this increment comes from the new technology, which increases the economies of scale. The other part is caused by the change in the optimal action. In other words, because the upper-bound for both constraints increases, the agent is willing to exert more effort than in the first model.

$$kx_1 = x_2 \geq x_1, \tag{21}$$

where x_1 and x_2 are the actual outcome in the first and the second model, respectively.

2. The first-best solution for both models are the same and therefore the share of principal in the second model is higher, given the first-best solution. According to (20) and (21):

$$kx_1 - \underline{s}_\lambda(x) \geq x_1 - s_\lambda(x). \tag{22}$$

3. For the second-best solution, it is needed to show that $x - s(x)$ is higher in the CC model. Because $s(x)$ has a direct relationship with $\mu \dfrac{f_a(x,\bar{a})}{f(x,\bar{a})}$, it has to be shown that:

$$\mu \frac{f_a(kx,\underline{a})}{f(kx,\underline{a})} \leq \mu \frac{f_a(x,\bar{a})}{f(x,\bar{a})}. \tag{23}$$

Again if we assume that $f(x,a) = e^{-x/a}/a$ then, $f_a(x,a) = e^{-x/a}(x-a)/a^3$ and $f(kx,\underline{a}) = e^{-x/ka}/ka$ with $f_a(kx,\underline{a}) = e^{-x/ka}(x-ka)/k^2a^3$. By knowing this, one can easily calculate $\frac{f_a(x,\bar{a})}{f(x,\bar{a})} = \frac{(x_1-\bar{a})}{\bar{a}^2}$ and $\frac{f_a(kx,\underline{a})}{f(kx,\underline{a})} = \frac{(kx_1-k\underline{a})}{k\underline{a}^2}$. Therefore, (23) can be rewritten as follows.

$$\underline{\mu}\frac{(kx_1 - k\underline{a})}{k\underline{a}^2} \leq \mu\frac{(x_1 - \bar{a})}{\bar{a}^2}. \tag{24}$$

As Holmstrom shows the value of μ is always positive and implies that the principal would like to see the agent chooses higher effort, given the second-best solution (Holmstrom, 1979). Also because both parties observe k, the μ will be only a function of $\bar{a}$ and not k. So through increasing $\bar{a}$ to $\underline{a}$ the value of μ increases too. Cancelling for k in the left hand side gives:

$$\underline{\mu}\frac{(x_1 - \underline{a})}{\underline{a}^2} \leq \mu\frac{(x_1 - \bar{a})}{\bar{a}^2}. \tag{25}$$

So here because $\underline{a} \leq \bar{a}$ it can be inferred that the left hand side is only smaller when the rise of the μ is compensated with the fall of the ratio next to it.

$$\frac{\underline{\mu}}{\mu} \leq b^2\frac{(x_1 - \bar{a})}{(x_1 - \underline{a})}, \tag{26}$$

Where, b shows the ratio of the optimal effort level in the second model divided by that of the first model, $b = \underline{a}/\bar{a}$, with $b \geq 1$. Therefore, when the Inequality (26) holds, even if the agent is expected to exert higher effort, and the total outcome is larger in the second model, the agent's share is less than that of the second model.

Here it is worth noting that there are also other situations, where the sharing rule is more optimal than merely the situation, where the total income is higher and the agent's share is lower. However, here the most extreme case was proved. So whenever this condition is fulfilled the CC model outperforms a general agency model, however, the other way around could not be true. For example, think of a situation, where the total effort is so high that even a higher agent's share does not deprive the principal of a payoff greater than that of a general agency theory. ■

The inequality (26) also suggests that whether the CC model provides a more optimal sharing rule depends generally on the relation of the optimal effort level in both models. The stronger the principal believes that the new optimal effort is higher, the greater her share of the outcome.

Example: To grasp a better understanding of both models, a numerical example adopted from Holmstrom (1979) is provided. In this example, the contract is concluded between a repairman and a machine owner. Suppose the repairman's effort will determine the expected time before the machine will break down. Also, assume that all that repairman is asked for is to follow the machine owner's machine manual. The monetary return, x, is proportional to the length of time the machine will remain operative, where the proportionality factor has been taken= 1.

Let's first begin with the model, where there is no conflict resolution activity exerted. This implies the situation where the repairman proceeds the instruction one by one; however, he believes that there is a more efficient way to fix the machine. In this example, the utility functions are given as follows: $G(W) = W$, $U(W) = 2\sqrt{W}$, $V(a) = a^2$, $Z(e) = e$ and $x \sim exp(1/a)$. From (13), the optimal sharing rule is (for a detailed solution see Appendix.5.):

$$s(x) = \Big[\lambda + \mu.\frac{(x-a)}{a^2}\Big]^2. \tag{27}$$

Here the $\mu = a^3$ and therefore, μ increases as a increases. This means that inducing the agent to choose higher effort is more costly. The first-best solution $s_\lambda = \lambda^2$, $a_\lambda = 0.5\lambda$. For a numerical solution assume that $\lambda = 0.5$, which gives $a_\lambda = 1$ and $s_\lambda = 0.25$. Also some calculation gives the optimal effort for the second-best solution; $\bar{a} = 0.5$ and consequently one can write $s(x) = 1/4(x+1/2)^2$ and therefore, $s(x) = 0.25$. Under perfect monitoring, the agent should put forth $a = 1$ while he is given a constant wage equal to 0.25. However, if the effort is not observable to the principal, the agent will be compensated by a wage equal to 0.25 in return for putting only half of his effort level of the perfect monitoring situation. Given the second-best solution, he also gets extra remunerated for efforts higher than $\bar{a} = 0.5$. So if the agent takes the same level of effort as of the perfect monitoring situation, he will be paid off by 0.56. On the other hand, the principal's payoff under full observability equals to 0.75, $x(a_\lambda) - s_\lambda(x) = 1 - 0.25 = 0.75$. Her share decreases to $x(\bar{a}) - s(x(\bar{a})) = 1 - 0.56 = 0.44$ when the agent's effort is unobservable and the agent takes the first-best effort level. In this way the welfare measure for the first and the second-best solution is $3/4$ and $9/16$ respectively. In contrast, the agent will be punished for putting effort levels lower than optimal effort level, $a < \bar{a} = 0.5$. For example, for putting $a = 0.25$ the agent's payoff will equal to 0.14 and the principal will earn 0.11.

Now let us suppose that the repairman invests some effort to persuade the owner about trying a new solution that he deems as the most effective. He believes that his action can double the time before the machine breakdown ($k = 2$). After getting the owner's agreement, the agent will choose an operational effort level according to the expected outcome. Therefore;

$$\underline{s}(x) = \Big[\lambda + \underline{\mu}\frac{(x-2a)}{2a^2}\Big]^2, \tag{28}$$

(See Appendix.6.). Here, the optimal sharing rule in the case of perfect monitoring is equal for both models; $s_\lambda(x) = \lambda^2$. This implies that in both models, the absolute level of payment (λ^2) is equal, which is independent of the outcome value. However, the optimal effort under perfect monitoring is multiplied by k, which gives; $a_\lambda = k/2\lambda$. It means that when the principal knows about the innovation, she expects the agent to work harder as it is less costly for him to produce one extra unit of outcome. Taking $\lambda = 0.5$ gives $a_\lambda = k = 2$. Through exerting this effort, the expected total outcome increases to four, $x = 4$, while the agent's share of the outcome remains unchanged, $s_\lambda(x) = \lambda^2 = 0.25$. In contrast, the share of the principal will increase to 3.75. With an equivalent argument, $\underline{\mu} = \underline{a}^3$ follows. As expected, the value of μ does not depend on the innovation factor (for a detailed solution, see Appendix.6.) and only is a function of optimal effort. However, because the second model's optimal effort is higher, it is inferred that $\underline{\mu} \geq \mu$. Also, the optimal level of effort given the second-best solution is calculated through;

$$4\underline{a}^3 + \underline{a} = k,$$

If $k = 1$ then the optimal effort level given the second-best solution will be equal to the optimal effort level in the first model; $\underline{a} = \bar{a} = 0.5$. But for $k = 2$ optimal action will increase to $\underline{a} = 0.6$. Therefore for any given k optimal sharing rule can be written as;

$$\underline{s}(x) = \left[\frac{1}{2} + \frac{a}{k}(x - ka)\right]^2, \tag{29}$$

which gives, $\underline{s}(x) = (0.3x + 0.14)^2$. As k rises, the optimal effort and, therefore, the expected value go up. It also increases the principal's expectation in terms of the agent's action. Therefore, the agent has to exert higher effort than before, while his wage remains unchanged to delight the principal. Again, if agent takes the action equal to the optimal effort given the second-best solution $a = \underline{a} = 0.6$, he will receive a reward which he would get for the optimal state. In this case, the outcome would be $x = 2 \times 0.6 = 1.2$ and therefore $\underline{s}(x) = (0.3(1.2) + 0.14)^2 = 0.25$. In this case, principal's share equals to $x - \underline{s}(x) = 1.2 - 0.25 = 0.95$.

Now let us compare both models for one given effort level. If the agent takes $a = 0.5$, he will be remunerated differently in each of the models. In the first model, he will receive 0.25 out of the total outcome equal to $x = 0.5$. In the second model, however, he will be given only 0.19 out of $x = 1$. In this case, the remuneration is less, because the agent has made a lower effort than the optimal level; therefore, he gets punished by a lower payoff. Also, the principal's share when $a = 0.5$ and $k = 2$ will be 0.81, which is much higher than that of the first model ($0.5 - 0.25 = 0.25$). Also if he puts an effort level greater than the optimal level in the CC model, he will be rewarded. Suppose that the agent puts $a = 1$; therefore $x_1 = 1$ and $x_2 = 2 \times 1 = 2$. In the first model, (Agent's payoff, Principal's payoff) will be (0.56, 0.44), however CC model will give (0.54, 1.45).

Figure (2) illustrates the relationship between outcome and the agent's payoff for different k values. As apparent, $\underline{s}$(x) locates under $\bar{s}(x)$ curve. Also, as k increase $s(x)$ converges to the first-best solution for all $x > \underline{a}$. So even if the total outcome is higher the share of the agent falls. Moreover, for low values of outcome, $x < \underline{a}$, the agent will be punished more severely, as the deviation from $s_\lambda(x)$ increases.

To sum it up, based on the assumptions of the agency theory, the total outcome and the principal's share of the outcome will increase when principal gives the repairman the possibility to try new methods for fixing the machine. Then, the repairman may work more effectively through exerting some of non-operational efforts to discuss the new methods with the principal. In this sense, fewer hours of operational work leads to a larger total outcome, even if the share of the agent decreases or remains unchanged. This is because the ultimate goal of the agency theory is to maximize the wealth of the owner and ignore the preferences of the agent. Current model was developed based on the agency theory assumptions. Yet, to which extend these assumptions reflects the reality stays unanswered here. The evidences from this model showed that the spirit of the agency model is not necessarily consistent with

Repairman example for two models

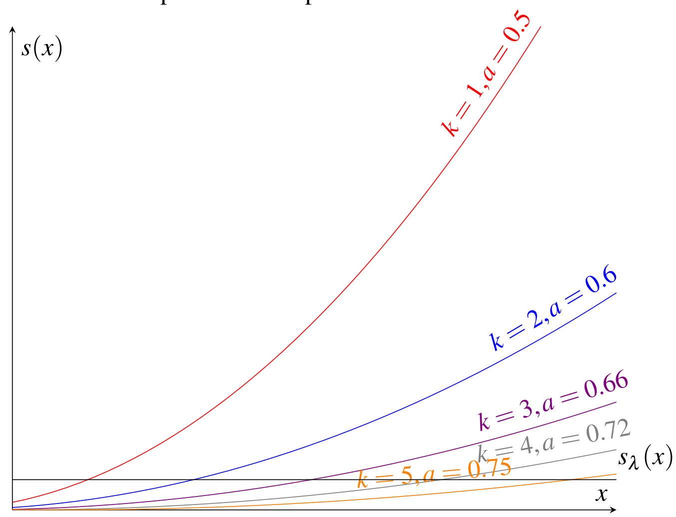

Figure 2: The agent's payoff $s(x)$ varies for different values of k. As it is evident in the graph, the optimal sharing rule converges to the first-best solution as k increases.

the innovation and at the end of the day, only the operational effort of the agent is what counts and gets remunerated.

As you remember, $k = p.\phi + (1-p).1$. So as the probability and the quality of innovation increase, higher ϕ and higher P, the wealth growth will also increase. It is worth noting that the findings are quite intuitive and well compatible with the above mentioned arguments in explaining the innovation of conflict. As was stated earlier, the excellence of the second model comes firstly from knowledge transfer which is emerged through the variations in I and consequently the innovation coefficient k. This will change the production function to a new state, one that generates higher outcome in return for the same level of operational effort. Secondly, changes in the observability level will alter the risk-sharing rule towards an optimal state with a lower moral hazard, which provides the principal with higher outcome. It was mentioned that in the presence of the observibility of the innovation product, this was the case. Finally, giving the agent the chance to innovate provides him more incentive for taking higher level of actions and to work harder. Thereby, on one hand, knowledge transfer serves as a tool to produce larger pie, and on the other hand, observability enhancement is in charge with a more appropriate sharing rule based on the agent's performance.

IV Contract with unobservable Conflict Resolution Effort

In this subsection through a very similar setting, an agency theory is modeled, in which the agent decides to take some of his efforts to try what he deems as the best practice. However this time the principal observes neither the conflict clarification effort nor the technology followed by this effort. Therefore, without this kind of effort being mentioned in the contract, the agent will use a part of his effort to test his idea. This is equivalent to the situation, where the innovative agent is forced by the contract to follow the conventional rules in order to carry out the task. In this case, the agent is not provided with effective communication channels to express his ideas. It means that, now parties have different perceptions of the expected outcome. Because the principal does not know about the new technology, so she expects the agent to exert an effort equal to that in the first model. Therefore, the agent will be remunerated based on the formula presented in Equation (13).

$$s(x) = \left[\lambda + \mu . \frac{(x-\bar{a})}{\bar{a}^2}\right]^2,$$

Also, the optimal level of effort will be calculated in the same way as in the first model. However, from the agent's point of view, the expected outcome equals $x = ka$, and based on this information, he will choose an effort level to produce x. For this purpose, he sets the first order of his utility function (Equation (11)) equal to zero.

$$\int U(\underline{s}(x)) f_a(kx, \underline{a}) dx - V'(a) = 0.$$

Returning to the repairman example, the machine owner wants to see the repairman exerting $a = \bar{a} = 0.5$. In this case, observing $x = 0.5$ makes the principal conclude that agent has invested the optimal effort equal to 0.5. These calculations are carried out from the principal's point of view.

From the agent's perspective, different values will be derived. Because the agent is aware of the innovation, the optimal action that maximizes agent's utility is calculated as suggested by CC model (See Appendix.6.). In this way, the agent's optimal effort is calculated by $4\underline{a}^3 + \underline{a} = k$. For $k = 1$, it is equal to 0.5 (like first model) and for $k = 2$, $\underline{a} = 0.6$. Again suppose that $k = 2$, and the agent exerts $a = 0.5$, then the expected outcome will be $x = 1$. Because the principal can only observe the final outcome, she will reward the agent for any outcome higher than $x = 0.5$. Because, the principal pays the agent based on $s(x) = 1/4(x + 1/2)^2 = 0.56$. The principal observes the outcome and deems that higher outcome is due to higher effort level.

In this case, principal's share is only $x - s(x) = 0.44$. To be able to compare all three models, the party's payoff for some other effort levels can be calculated. For $a = 1$ and $a = 0.25$, (Agent's payoff, Principal's payoff) will be (1.65, 0.31) and (0.25, 0.25) respectively, however general agency model resulted in (0.56, 0.44) and (0.14 ,0.11) for these effort levels respectively.

Here the principal gets worse off compared to the case, where she could observe the innovation effort and its result. It implies that trying new methods to carry out the job makes the principal better off, only when she is aware of such effort and also the innovation resulted. This result confirms the findings of Holmstrom showing that in moral hazard problems, more information about the agent is never detrimental to the owner (Holmstrom and Milgrom, 1991). In contrast, for the agent, it is more optimal to implement his idea without informing the principal. In this way, he will bear less risk, while the principal is bearing all the risks of innovation. Also, it is worth noting that the results should be interpreted under the agency theory's restricted assumptions and the limitations of the new model. First, it is discussed that the findings are valid only for innovative companies ($k > 1$). Therefore, contingent on how one unit effort leads to an extra unit of the outcome, the effect of k on the outcome will be defined. Hence, testing if the CC model generates a higher total outcome, is first, a function of the innovation probability p. In this sense, having a high propensity to innovation plays a role in answering the recent question. Secondly, innovation quality, ϕ matters. In this case, the quality of innovation plays a crucial role in such an inference.

In summary, when the conflict clarification remains unobserved by the principal, the agent makes the best benefit out of it. In this sense, when the agent is encouraged not to speak up about his ideas, he will exert such effort but preferably hidden from the principal. This leads one to infer that clarifying the conflict is more beneficial to the principal than to the agent.

5 Conclusion

Challenging the conventional perception of conflict, this paper suggests that conflict resolution is associated with a better state. The conflict is defined as coming to a middle point consistsing of trade-offs between goal dimensions (logrolling) and the discovery of new alternatives, on which both parties agree. The presence of a conflict of interests is perceived to be destructive because it will impose extra agency cost (Amason and Schweiger, 1994; Eisenhardt and Bourgeois, 1988). Therefore, making any effort on conflict seems to contrast with the agency theory's goal, which is maximizing the owner's wealth. In this sense, the agent is considered a work factor that should be hired with the lowest possible cost. An agent with a low wage can guarantee the owner's wealth maximizing speculation.

However, lessening the agent's role to a work factor will deprive the company of the agent's competencies, like team-working, problem-solving and innovative thinking. Based on these assumptions, the current work showed that incorporating the conflict clarification effort as a new input into the rational agency model can improve the corporation's performance. For this purpose, this paper argued that however, the presence of the task conflict can impose agency costs to the organization, yet such an effort can compensate for its cost, and therefore, it can lead to a more optimal state.

Within the agency theory paradigm, the contract is initiated to limit the agent to act in the favor of the principal's interest. Therefore, the existential reason for a contract is the conflict of interest, because otherwise, no contract was needed. However, it should not be neglected that there are also common interests for which the group, team, or organization has been built in each controversy. Therefore, agency theory looks for a contract scheme that limits egoistic behaviors by providing appropriate incentives. In contrast, the introduced model in the current work focused on turning the conflict into common interests, which can be translated as changing destructive conflict into constructive cooperation.

The investigation began with a mathematical agency model, introduced by Ross (1973), mostly developed by the work of Jensen and Meckling (1976), and finally applied by Holmstrom (1976). The current research built a conflict clarification (CC) model, differing from the original model in including a behavioral factor when conducting the contract. In this sense, the agent and the principal agree to invest some effort to clarify their task conflicts. This effort then results in a new technology that enhances the efficiency by parameter k, on average. In this way, three different models were investigated by deriving their optimal efforts and sharing rules: A general model of agency, as Holmstrom used and explained. A CC model, where the agent is aware of the agent's conflict clarification activity and also observes its result, k. And finally, a CC model in which the agent takes some of his time to work on the innovation, of which the principal is not aware.

Then a comparison between these models were run at the firm level by calculating the total outcome. The finding suggests that a company with a high propensity to innovation shows a better outcome when takes the conflict clarification effort as an input. It means a CC agency model outperforms a general agency model in terms of total outcome. In this way, given the optimal effort level for each model, it was shown that whenever $k > 1$, the CC model's optimal outcome outperforms the conventional agency model, no matter whether the principal observes the conflict effort or not. The rise in the outcome is associated with two sources. First, a change in the technology, and second, a jump in the agent's optimal effort level. The latter happens because the marginal return to effort increases and therefore, the principal's expected outcome grows.

Another comparison between the two models was conducted in terms of the optimal sharing rule for the first- and second-best solution. It was also examined if more observability makes the principal better off. A comparison between two CC models with different levels of observability confirmed this proposition. Another finding is that the principal's most optimal return happens in the conflict clarification effort's presence, but only if she can observe such an effort and its result. Because in this case, she can evaluate the operational action through observing x, more precisely than before. If this effort is hidden from her, she will receive a payoff even lower than that of the first model. Therefore, from an agency theory point of view, the conflict model with observable conflict effort outperforms the other models. Moreover, the current work derived the share of the agent under each of these settings. The findings suggest that in contrast to the principal, the agent gains his highest earning in the presence of conflict clarification effort, but when this is hidden from the principal.

Within an organizational context, giving the employees a voice particularly benefits the owners. When the agent is not given such an opportunity, he will implement his idea secretly and enjoy the result mostly, while the principal bears also the risk. It implies that having a voice and speaking up favors the owner even more than the manager. Therefore, the current work encourages the owners to give a voice to the agent before even the agent asks for it. As a summary, research findings show that a conflict model outperforms a conventional agency model, with or without observable innovation effort. This notation is particularly correct for innovative companies or tasks that demand creativity and problem-solving skills. This finding confirms the shreds of evidence from behavioral economics literature, that emphasis on the constructive role of task conflict (Wiseman and Gomez-Mejia, 1998). Under these conditions, in either level of observability, the total outcome will improve, which makes the corporate better off. In this way, if the principal gets better off or the agent is a matter of information asymmetry related to such an effort. It should also be noted that deciding on conflict resolution efforts depends by large on the owner's attitude in terms of risk-taking. Therefore, a comparison between the first and second models is contingent on the agent's risk aversion profile.

The findings of this work are particularly attractive to scholars studying the most optimal contract. Also, it will benefit policymakers in issuing labor laws, based on a more realistic assumption. Corporate owners, particularly venture capitalists, can take advantage of the current work by granting employees a voice, new job designing, or allocating the firm's authority. Entitling the employees a channel to speak up not only because of realizing labor rights but also as a mechanism to reduce the official monitoring costs and increase staff's innovation potential.

Further studies should be conducted to test similar hypotheses, as described here. The current model did not discuss the agent's job design, which can be used as an effective incentive scheme (Holmstrom and Milgrom, 1991). In contrast, it confined the conflict clarification effort to some specific amount, however the effort allocation percentage to each one of the tasks can also change the results.

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Appendices

Appendix

Appendix.1. It has to be proved that if the random variable $X \sim exp(\lambda)$ then, $E[X] = 1/\lambda$, for $x \in [0, +\infty)$ and $\lambda > 0$.

Proof. It is known that $f(x;\lambda) = \lambda.e^{-\lambda.x}$.

$$E[X] = \int_0^\infty x f(x) dx = \int_0^\infty x\lambda e^{-\lambda x} dx.$$

Here the integration by part is used as a technique to solve the integral. The integration by formula is:

$$\int U \frac{dV}{dx} dx = UV - \int V \frac{dU}{dx} dx$$

Wher $U = x$, $dU/dx = 1$, $dV =, e^{-\lambda x} dx$ and $V = \int dV = \int e^{-\lambda x} dx = \frac{e^{-\lambda x}}{-\lambda}$. Therefore;

$$E[X] = \lambda \left[x \frac{e^{-\lambda x}}{-\lambda} - \int_0^\infty \frac{e^{-\lambda x}}{-\lambda} dx \right].$$

After solving the integral the previous equation gets the form of;

$$E[X] = \left[-xe^{-\lambda x} - \frac{e^{-\lambda x}}{-\lambda} \right]_0^\infty$$

Substituting ∞ into the previous equation and subtracting $E[0]$ from it gives:

$$E[X] = -\left[\frac{0}{\lambda} - \frac{1}{\lambda} \right] = 1/\lambda$$

So knowing that $E[X] = 1/\lambda$ and also the fact that if $X \sim exp(\lambda)$ then $kx \sim (\lambda/k)$, this is easy to infer that $E[kX;\lambda] = \lambda/k$. ■

Appendix.2.

Proof. To solve this constrained maximization (Equation (8)-(10)), first Equation (10) is replaced by (11) to get a relaxed Pareto optimization. Then Lagrangian method is applied.

The Lagrangian function takes the form of:

$$\mathscr{L} : \int G(x-s(x))f(x,a)dx+\lambda\left\{\int[U(s(x))-V(a)]f(x,a)dx-H\right\}+ \\ \mu\left\{\int U(s(x))f_a(x,a)dx-V'(a)\right\}=0 \tag{30}$$

Now the first order conditions of the Lagrangian function with respect to $s(x)$, a and also with respect to Lagrangian multipliers should be set equal to zero. calculating the partial derivation of (30) is straightforward:

(i) $$\frac{\partial\mathscr{L}}{\partial s(x)} : \int G'(x-s(x))f(x,a)dx+\lambda\int U'(s(x))f(x,a)dx \\ +\mu\int U'(s(x))f_a(x,a)dx=0$$

(ii) $$\frac{\partial\mathscr{L}}{\partial a} : \int G(x-s(x))f_a(x,a)dx+\lambda\left[\int U(s(x))f_a(x,a)dx-V'\right] \\ +\mu\left[\int U(s(x))f_{aa}(x,a)dx-V''\right]=0$$

(iii) $$\frac{\partial\mathscr{L}}{\partial\lambda} : \int[U(s(x))-V(a)]f(x,a)dx-H=0$$

(iv) $$\frac{\partial\mathscr{L}}{\partial\mu} : \int U(s(x))f_a(x,a)dx-V'(a)=0$$

From (i) one can drive the optimal sharing rule $s^*(x)$ in terms of x. For any definite integral, the "*Fundamental theorem of calculus*" holds:

$$if\int_a^b g(x)dx=\int_a^b h(x)dx\Rightarrow g(x)=h(x)$$

Where $g(x)$ and $h(x)$ are two continuous functions on $\mathbb{R}$. So one can rewrite the (i) as:

$$G'(x-s^*(x))f(x,a)-\lambda U'(s^*(x))f(x,a)=\mu U'(s^*(x))f_a(x,a)$$

and some simple calculations give:

$$\frac{G'(x-s^*(x))}{U'(s^*(x))}=\lambda+\mu\frac{f_a(x,a)}{f(x,a)}$$

■

Appendix.3.

Proof. Based on the derivation of the Lagrangian formulated in Appendix.2. and through replacing (iv) by 0 in Equation (ii), the following statement will be gained.

$$\int G(x-s(x))f_a(x,a)dx+\mu.\left[\int [U(s(x))f_{aa}(x,a)dx-V''(a)]\right]=0.$$

■

Appendix.4.

Proof. With a very similar approach explained in Appendix.2., the Lagrangian function of the second model is set equal to zero. To solve this constrained maximization (Equation (16)-(18)), first the second constraint Equation (18) is substituted by its first order condition to get a relaxed Pareto optimization. Then Lagrangian method is applied. The Lagrangian function takes the form of:

$$\mathscr{L}:\int G(x-\underline{s}(x))f(kx,a)dx+\lambda\Big\{\int [U(\underline{s}(x))-V(a)]f(kx,a)dx-Z(e)-H\Big\}+ \quad (31)$$
$$\mu\Big\{\int U(\underline{s}(x))f_a(kx,a)dx-V'(a)\Big\}=0$$

Now the first order conditions of the Lagrangian function with respect to $\underline{s}(x)$, a and also with respect to Lagrangian multipliers should be set equal to zero. calculating the partial derivation of the above term is straightforward:

(i) $$\frac{\partial\mathscr{L}}{\partial\underline{s}(x)}:\int G'(x-\underline{s}(x))f(kx,a)dx+\lambda\int U'(\underline{s}(x))f(kx,a)dx$$
$$+\mu\int U'(\underline{s}(x))f_a(kx,a)dx=0$$

(ii) $$\frac{\partial\mathscr{L}}{\partial a}:\int G(x-\underline{s}(x))f_a(kx,a)dx+\lambda\left[\int U(\underline{s}(x))f_a(kx,a)dx-V'\right]$$
$$+\mu\left[\int U(\underline{s}(x))f_{aa}(kx,a)dx-V''\right]=0$$

(iii) $$\frac{\partial\mathscr{L}}{\partial\lambda}:\int [U(\underline{s}(x))-V(a)]f(kx,a)dx-H=0$$

(iv) $$\frac{\partial\mathscr{L}}{\partial\mu}:\int U(\underline{s}(x))f_a(kx,a)dx-V'(a)=0$$

From (i) one can drive the optimal sharing rule $\underline{s}^*(x)$ in terms of x. It is known that for any definite integral, the "*Fundamental theorem of calculus*" holds:

$$if\int_a^b g(x)dx=\int_a^b h(x)dx\Rightarrow g(x)=h(x)$$

Where $g(x)$ and $h(x)$ are two continuous functions on $\mathbb{R}$. So the (i) can be rewritten as:

$$G'(x-s*(x))f(kx,a)-\lambda U'(\underline{s}(x)*)f(kx,a)=\mu U'(\underline{s}(x)*)f_a(kx,a)$$

and some simple calculations give:

$$\frac{G'(x-s^*(x))}{U'(\underline{s}^*(x))} = \lambda + \mu \frac{f_a(kx,a)}{f(kx,a)}$$

■

Appendix.5.

Proof. According to the result of Appendix.2. the optimal sharing rule is driven by using Equation (13). So through substituting the numerical values for this example, it gives:

$$\frac{1}{\sqrt{s^*(x)}} = \lambda + \mu \frac{\frac{e^{-x/a}(x-a)}{a^3}}{\frac{e^{-x/a}}{a}}$$

Which after some simple calculation gives,

$$s^*(x) = \left[\lambda + \mu.\frac{(x-a)}{a^2}\right]^2$$

From $f(x,a) = e^{-x/a}/a$,one can derive $f_a(x,a) = e^{-x/a}(x-a)/a^3$ and $f_{aa}(x,a) = e^{-x/a}(2a^2 - 4ax + x^2)/a^5$. Now let us write the Lagrangian function with all its partial derivatives with respect to $s(x)$, a and also with respect to λ and μ.

$$\mathscr{L} : \int [x - s(x)] f(x,a)dx + \lambda \Big\{ \int [2\sqrt{s(x)}] f(x,a)dx - a^2 - H \Big\} + \mu \Big\{ \int [2\sqrt{s(x)}] f_a(x,a)dx - 2a \Big\} = 0$$

(i) $$\frac{\partial \mathscr{L}}{\partial s(x)} : \int -f(x,a)dx + \lambda \int [\frac{1}{\sqrt{s(x)}}] f(x,a)dx + \mu [\int \frac{1}{\sqrt{s(x)}}] f_a(x,a)dx = 0$$

$$\Rightarrow \boxed{s^*(x) = [\lambda + \mu.\frac{(x-a)}{a^2}]^2} \qquad \text{(A)}$$

(ii) $$\frac{\partial \mathscr{L}}{\partial a} : \int (x - s(x)) f_a(x,a)dx + \lambda \left[\int [2\sqrt{s(x)}] f_a(x,a)dx - V' \right] + \mu \left[\int [2\sqrt{s(x)}] f_{aa}(x,a)dx - V'' \right] = 0$$

$$\Rightarrow \frac{1}{a^3} \int (x - [\lambda + \mu.\frac{(x-a)}{a^2}]^2) e^{-x/a}(x-a)dx + \mu \left[\frac{2}{a^5} \int [\lambda + \mu.\frac{(x-a)}{a^2}] e^{-x/a}(2a^2 - 4ax + x^2)dx - 2 \right] = 0$$

$$\Rightarrow \left[\frac{(\mu^2 x^3 + (2a^2\lambda\mu - a^4)x^2 + (3a^2\mu^2 + a^4\lambda^2 - a^5)x + 2a^3\mu^2 + 2a^4\lambda\mu - a^6)e^{-x/a}}{a^6} + C \right]_{x=0}^{x=\infty}$$

$$+\mu\left[-\frac{2x(\mu x^2+(a^2\lambda-2am)x+2a^2\mu-2a^3\lambda)e^{-x/a}}{a^6}+C\right]_{x=0}^{x=\infty}-2\mu=0$$

$$\text{For the second-best solution} \Rightarrow \boxed{-2\mu^2-2a\lambda\mu+a^3+0-2\mu a^3=0} \qquad \text{(B)}$$

$$\text{For the first-best solution} \Rightarrow \boxed{1+0-2a\lambda=0}$$

(iii) $\frac{\partial \mathscr{L}}{\partial \lambda}: \int [U(s(x))-V(a)]f(x,a)dx-H=0$

(iv) $\frac{\partial \mathscr{L}}{\partial \mu}: \int U(s(x))f_a(x,a)dx-V'(a)=0$

$$\Rightarrow \frac{1}{a^3}\int[2\sqrt{s(x)}]e^{-x/a}(x-a)dx-2a=0$$

$$\Rightarrow \frac{2}{a^3}\int[\lambda+\mu.\frac{(x-a)}{a^2}]e^{-x/a}(x-a)dx-2a=0$$

$$\Rightarrow \left[-\frac{2(^2+a^2\lambda\mu+a^2\mu)e^{-x/a}}{a^4}+C\right]_{x=0}^{x=\infty}-2a=0$$

$$\Rightarrow \frac{2\mu}{a^2}-2a=0 \Rightarrow \boxed{\mu=a^3} \qquad \text{(C)}$$

replacing (C) in (B) and assuming $\lambda=1/2$ gives: $\bar{a}=1/2$. Now $s^*(x)$ can be written as a function of x.

$$\Rightarrow \boxed{s^*(x)=\frac{4x^2+4x+1}{16}}$$

Calculating the first-best solution is also straightforward. If the second constraint does not bind then, $\mu=0$. Hence, $s_\lambda=\lambda^2=1/4$. Also Equation (ii) gives; $a_\lambda=1/2\lambda=1$. In the case of the first-best solution, the expected outcome equals 1 from which $1/4$ is the agent's share and $3/4$ is the principal's share. As evident, the amount of agent's share does not depend on the effort level but the parameter λ. It implies that no matter how hard the agent tries, he will be given only λ^2 in case of the full monitoring. However in the second-best solution if the total outcome equals to 1 unit the principal will be given only $9/16$ of it. ■

Appendix.6.

Proof. The only difference in the solution of the second model in comparison to the first model is the probability density function which is equal to $f(kx,\underline{a})=e^{-x/ka}/ka$, $f_a(kx,\underline{a})=e^{-x/ka}(x-ka)/k^2a^3$ and $f_{aa}(kx,\underline{a})=e^{-x/ka}(2k^2a^2-4kax+x^2)/k^3a^5$.

$$\mathscr{L}: \int[x-\underline{s}(x)]f(kx,\underline{a})dx+\lambda\Big\{\int[2\sqrt{\underline{s}(x)}]f(kx,\underline{a})dx-\underline{a}^2-H\Big\}+$$
$$\mu'\Big\{\int[2\sqrt{\underline{s}(x)}]f_a(kx,\underline{a})dx-2\underline{a}\Big\}=0$$

(i) $$\frac{\partial \mathscr{L}}{\partial \underline{s}(x)} : \int -f(kx,\underline{a})dx + \lambda \int [\frac{1}{\sqrt{\underline{s}(x)}}] f(kx,\underline{a})dx + \mu [\int \frac{1}{\sqrt{\underline{s}(x)}}] f_a(kx,\underline{a})dx = 0$$

$$\Rightarrow \boxed{\underline{s}^*(x) = [\lambda + \mu . \frac{(x-ka)}{ka^2}]^2} \tag{A}$$

(ii) $$\frac{\partial \mathscr{L}}{\partial a} : \int (x - \underline{s}(x)) f_a(kx,\underline{a})dx + \lambda \left[\int [2\sqrt{\underline{s}(x)}] f_a(kx,\underline{a})dx - V' \right]$$
$$+ \mu \left[\int [2\sqrt{\underline{s}(x)}] f_{aa}(x,a)dx - V'' \right] = 0$$

$$\Rightarrow \frac{1}{k^3a^3} \int (x - [\lambda + \mu . \frac{(x-ka)}{ka^2}]^2) e^{-x/ka} (x-ka)dx +$$

$$\mu \left[\frac{2}{a^5k^3} \int [\lambda + \mu . \frac{(x-ka)}{ka^2}] e^{-x/ka} (2a^2 - 4ax + x^2)dx - 2 \right] = 0$$

$$\Rightarrow \left[\frac{(\mu^2x^3 + (2a^2k\lambda\mu - a^4k^2)x^2 + (3a^2k^2\mu^2 + a^4k^2\lambda^2 - a^5k^3)x}{a^6k^4} \right.$$

$$\left. + \frac{2a^3k^3\mu^2 + 2a^4k^3\lambda\mu - k^4a^6)e^{-x/ka}}{a^6k^4} + C \right]_{x=0}^{x=\infty}$$

$$+\mu \left[-\frac{2x(\mu x^2 + (a^2k\lambda - 2akm)x + 2a^2\mu - 2a^3k^2\lambda)e^{-x/ka}}{a^6k^3} + C \right]_{x=0}^{x=\infty} - 2\mu = 0$$

For the second-best solution $\Rightarrow \boxed{-2\mu^2 - 2a\lambda\mu + a^3k + 0 - 2\mu ka^3 = 0}$ (B)

For the first-best solution $\Rightarrow \boxed{k + 0 - 2a\lambda = 0}$

(iii) $$\frac{\partial \mathscr{L}}{\partial \lambda} : \int [U(\underline{s}(x)) - V(a)] f(kx,\underline{a})dx - H = 0$$

(iv) $$\frac{\partial \mathscr{L}}{\partial \mu} : \int U(\underline{s}(x)) f_a(kx,\underline{a})dx - V'(a) = 0$$
$$\Rightarrow \frac{1}{a^3k^2} \int [2\sqrt{\underline{s}(x)}] e^{-x/ka} (x-ka)dx - 2a = 0$$
$$\Rightarrow \frac{2}{a^3k^2} \int [\lambda + \mu . \frac{(x-ka)}{ka^2}] e^{-x/ka} (x-ka)dx - 2a = 0$$
$$\Rightarrow \left[-\frac{2(\mu x^2 + a^2k\lambda x + a^2k^2\mu)e^{-x/ka}}{a^4k^2} + C \right]_{x=0}^{x=\infty} - 2a = 0$$
$$\Rightarrow \frac{2\mu}{a^2} - 2a = 0 \Rightarrow \boxed{\mu = a^3} \tag{C}$$

replacing (C) in (B) and assuming $\lambda = 1/2$ gives: $\underline{a}$ as a function of k. If $k = 1$ then then the optimal effort level given the second-best solution will be equal to the optimal effort level in the first model; $\underline{a} = \bar{a} = 1/2$.

$$\Rightarrow \boxed{4\underline{a}^3 + \underline{a} = k} \tag{D}$$

$$\int [G(x - \underline{s}(x)) f_a(kx, \underline{a})] dx + \mu'. \left\{ \int [U(\underline{s}(x)) f_{aa}(kx, \underline{a})] dx] - V''(\underline{a})] \right\} = 0. \tag{32}$$

$$\Rightarrow \boxed{s^*(x) = \left[\frac{1}{2} + \frac{a(x - ka)}{k} \right]^2}$$

■

An Investigation into the Role of Shareholder Activism in Improving Innovation and Financial Performance

With Evidence from S&P 500 between 2002-2015

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Abstract

The current study examines the role of conflict within corporate governance. For this purpose, it uses the data on the shareholder proposals annually presented to the board of directors. In doing so, the effect of conflict between shareholders and the management can be investigated. Also, the role of such disagreement on the company's outcome is tested. Furthermore, by classifying the proposals into three categories, the conditional effect of each type of proposal is measured. These three categories are executive compensation, corporate governance, and social policy.

For measuring the company's outcome, two types of indicators, innovation and financial, are used where financial performance is measured through annual revenue and innovation performance is represented by the number of patents. Moreover, there are two control variables in deriving the final results. Likewise the literature on innovation, the current research controls for R&D investment and company size.

Subsequently, the primary hypothesis is tested, noting that variations in the number of proposals can enhance a company's innovation and financial indicators. Furthermore, the secondary hypothesis speculates a proposal number for which the effect of conflict on the patent number is maximized. In order to run the empirical test, the evidence from S&P 500 for over 14 years is collected. Moreover, several regression models are used and compared to find the best regression model fitting the data and the hypotheses. Among others, a negative binomial estimator provides an unbiased and efficient estimation.

The findings suggest whether the conflict has a positive, negative, or unclear effect on the performance; it depends on the conflict type. Current research suggests a positive and significant effect of executive compensation (i.e. 11%) and corporate governance (i.e. 8%) on proposals. Furthermore, one extra executive compensation proposal is associated with 13% higher revenue. The findings confirm the secondary hypothesis and suggest that the effect of the conflict is the highest when the number of the proposals equals four. It implies that a moderate amount of conflict is constructive; however, too much conflict can disorder the problem-solving and production process.

Contents

1 Introduction

In more recent decades, conflict management has attracted more attention. The reason could be that in the last decades, the organizational structure has changed, from homogeneous to more diverse and from individual-centered to team-centered groups (Rahim, 2002). The organizations are considered the intersection point of many different ideas and interests because individuals share diverse educational, psychological, and cultural backgrounds. Such an environment is highly prone to conflict. Several studies believe that such diversity can enhance the innovation performance indicators at the individual and also at the group level. For example, Deutsch (1973) brought attention to the constructive potential embedded in the conflict and considered the conditions under which the conflict turns productive. In his view, the conflict is a circumstance that should be managed and, if necessary, reformed from competitive interest to the cooperative.

The current paper similarly, tries to shed more light on the constructive role of disagreement. To this effect, it investigates the relationship between the board of directors and shareholders, and test if shareholder's proposals can improve the company's key performance indicators. Besides, the current study tests the effect of different types of conflict on the outcome.

In the literature, there are generally two channels for shareholders to have a role in the board's decision-making process. First, threatening the management by auctioning their shares will drop the stock price (Admati and Pfeiderer 2009). It stimulates a lose-lose game in which both parties will be at stake. Another way for shareholders to express their disagreement on a particular issue is through making a shareholder proposal (Thomas and Cotter, 2007). Observing the number and the type of the shareholder proposal is a known proxy for simulating disagreement between owners and the board of directors.

Thomas and Cotter (2007) believe that the shareholder's voting pattern has changed recently, and along with that, the effectiveness of the proposals increased. This notion implies a more important role of the stockholders' voice in the overall strategies and consequently on the key performance indicators. There are several examples of ambiguous results pertaining to shareholder proposals' effect on the company's performance in the literature. For instance, Gillan and Starks (2000) examined the impact of proposals on the shareholder wealth while focusing on two different proposal sources, institutional sponsors and individual sponsors. Their findings suggest a negative effect of the institutional proposals, whereas the positive impact of non-institutional proposals on the shareholder's return. In a different study, Prevost and Rao (2000) suggest that proposals cannot affect managers' decisions. Their underlying argument is that the proposals are not binding and therefore not an effective tool to involve in the decision-making process (Prevost and Rao, 2000).

In contrast to their claim, there is a literature line that emphasizes the positive effect of the proposals on the firm's outcome. For example, Harris and Raviv (2010) consider shareholder-initiated proxy proposals as effective leverage for monitoring in a corporation. Another empirical study based on the Investor Responsibility Research Center (IRRC) data, collected from 1992 to 2002 by Tkac (2006), suggests that withdrawing the proposals by shareholders can be seen as a signal for conflict resolution. She ascertains that the more successful the firm, the most frequently the firm is targeted to proposals. She shows that 80% of the withdrawn proposals were responded to by the corporation, either in the form of implementing the proposed action or at least as a dialog (Tkac, 2006).

Despite the literature mentioned above, examining the effect of shareholder activism on the various outcomes, a study that addresses the relationship between the disagreement and the innovation outcome is missing. With regard to this gap, the current paper investigates the role of shareholder proposals on the number of the patent filed by the company. The central hypothesis is to address whether there is a relationship between shareholder proposals and the innovation outcome. The main hypotheses will be tested empirically through the evidence on the stockholder proposals collected from S&P 500 for over 14 years. In this way, first, the effect of the conflict on the main variable of interest, innovation will be tested. Moreover, innovation is measured by using the number of patents each company files in a given year. Besides, total revenue will be used to proxy financial performance as the second dependant variable. The analysis in the current study considers: (i) three different types of proposals filed by shareholders; (ii) the number of the proxy proposals in a year; (iii) the type, size, and R&D input of the companies targeted, and (iv) the company's performance in innovation and revenue.

The findings suggest that the magnitude of the proposal's effect varies over different regression models and specifications when proposals are not classified by type. Similar to the results of the literature mentioned above. The current study additionally finds that the effect of corporate governance and social policy proposals is not robust and, therefore, not reliable across different models. Under OLS assumptions, the executive compensation proposal's coefficient is positively correlated with innovation outcome. This result is robust to the fixed-effects OLS model and shows that one more executive compensation proposal will increase the number of patents by 56 units.

The effect of one extra executive compensation proposal equals 11% more patents. This effect decreases to 8% for the corporate governance proposals. Furthermore, it will be discussed that a negative binomial estimator gives the best fit among all other estimators.

Similarly, the effect of proposals on the company's revenue seems to be unclear when using the accumulated form of the proposals. Once proposals are classified into three types, only the executive compensation proposals seem to have a positive, significant, and robust effect on revenue. In this way, the OLS estimator with the fixed-effects control suggests that one extra executive compensation proposal is associated with 13% higher revenue.

The next section explains the process of the shareholder proposal submission. Moreover, the research hypotheses will be presented and discussed how shareholders can play a role in generating innovation. Furthermore, the method of measuring innovation will be presented. Section three describes the data and the research methodology, followed by empirical results. Section four concludes.

2 Innovation of Conflict in Corporate Governance

2.1 Shareholder Activism

In a general agency theory setting, the owner only observes the outcome. In contrast to the principal, the agent sees the effort too. Hence, the problem of asymmetry of information and, consequently, the conflict of interests arises. In this manner, the encounter of interests reduces the performance as it bears some costs to the corporation (Amason, 1996; Jensen and Meckling, 1976; Smith, 2010). One way to reduce this cost is to fully monitor the agent's action, which is highly costly (Hill, 1992). Another way is to grant the shareholders a role to contribute in business decision-making process. Through submitting proposal, shareholder are given a voice to express their opinion on a specific topic. For the first time in 1942, shareholders activism has emerged, however, the rapid development of this concept happened later in 70's (Gillan and Starks, 2000). The phrase "Shareholder activism" refers to how shareholders can use their right to influence corporate management. The activism can be leveraged whenever shareholders believe that the managers are not working in their best interest and not maximizing the firm's value. However, it can also arise when the shareholders are against some specific board's strategy and general policy (Goranova and Ryan, 2014). It also serves as a relatively young field of study that gives scholars the chance to investigate the role of conflict of interests within the corporation.

A shareholder proposal is a proxy ballot with shareholders' questions. The proposals are formulated within one of three proposal categories; executive compensation, corporate governance, and social policy. Both manager and the sponsor shareholder have to write their view about the proposal in the corporate proxy statements. Typically, the proposals made by shareholders are opposed by the management board.

The most often examined indicator investigated as a response to shareholder activism is the market reaction. The findings of several studies, show an ambiguous effect of the proposals. However, some scholars report a positive impact (Brav et al., 2008; Cuñat et al., 2012), and negative effect (Karpoff et al., 1996) but most of the researches suggest an insignificant market response (Gillan and Starks, 2000). One possible argument for the latter result could be that an extensive deal of the proposal is withdrawn even before being entered in the proxy statement (Tkac, 2006). This action leads to the most significant proposals to be excluded from the research framework.

Similar to the market reaction, there are equivocal findings on shareholder activism's effect on operating performance. Some report results suggest enhancing the operations (Guercio and Hawkins, 1999), while other scholars find underperformance (Karpoff et al., 1996; Prevost and Rao, 2000). Furthermore, the most investigated type of proposal is "executive compensation". The reason is that this type of proposals depicts the moral hazard issue that is attached to the agency relationship (Guercio and Hawkins, 1999). Ferri and Göx (2018) investigated the effect of the *Say on Pay*. Say to Pay is the right to interfere with the pay compensation structure through voting the designs proposed by the board. They found a positive relationship between such a right and the link between manager's pay and manager's performance. They also identified a conflicting, ambiguous relationship between executive compensation proposals and the firm value. They argue that whether such proposals positively or negatively affect the firm performance depends on what shareholders propose. They stated that no design of a compensation structure can lead to an optimal pay, in which the shareholders also believe (Ferri and Göx, 2018).

Despite the diverse research mentioned above, there is still a gap in supporting the general agency theory assumption. In this sense, a line of research that links the agency theory by considering the proposal as a potential monitoring tool for the management action is missing (Goranova and Ryan, 2014). Such studies will probably concentrate more on firm performance than external indicators. For this reason, the current research examines the role of the shareholder proposals on the innovation and financial outcome of the firms. It tries to find a positive, negative, or even ambiguous role of proposals. In this way, it will differentiate between three types of shareholders' proposals to test if having a voice in any of these three topics can improve the firm's performance indicators.

2.2 Research's Hypotheses

The first pair of hypotheses investigates the role of shareholder activism in generating innovation and higher revenue.

> **Hypothesis 1a**: A company with a higher number of shareholder proposals has a higher number of patents.
>
> **Hypothesis 1b**: A company with a higher number of shareholder proposals is more successful in terms of total revenue.

The second pair of hypotheses focuses on the type of proposal and examines the effect of each of the three proposal types separately.

> **Hypothesis 2a**: In a company, the effect of each type of shareholder proposals (executive compensation, social policy, and corporate governance proposals) on the number of patents is significantly different from zero.
>
> **Hypothesis 2b**: In a company, the effect of each type of shareholder proposals (executive compensation, social policy, and corporate governance proposals) on revenue is significantly different from zero.

According to the literature mentioned (Ferri and Göx, 2018), hypothesis three explores whether executive compensation has the highest effect on the company outcome than other types of proposals.

> **Hypothesis 3a**: In a company, proposals on executive compensation issues have a higher effect on the innovation index than disagreements over social policy and corporate governance.
>
> **Hypothesis 3b**: In a company, proposals on executive compensation issues have a stronger effect on the revenue than disagreements over social policy and corporate governance.

considering the effect of the conflict on the team performance in the literature (Jehn, 1995), the next hypothesis suggests that only a moderate amount of conflict positively affects innovation. The effect turns to become negative as this threshold is overstepped.

> **Hypothesis 4**: In a company with shareholder proposals, there is an optimal number of proposals (CON_i), for which the effect of conflict on the patent number is maximum.

The next group of hypotheses focuses on the moderate effect of proposals on the effect of the R&D expenditure on the patent number. Before that, the effect of R&D on the number of patents is tested.

> **Hypothesis 5a**: In a company, R&D expenditures positively impact the innovation outcome.
>
> **Hypothesis 5b**: In a company, task conflict improves the effect of the R&D expenditures on the number of patents.
>
> **Hypothesis 5c**: In a company, shareholder proposals of year t will improve the R&D effect on the number of patents in year t' where $t' > t$.

2.3 Shareholders' Role in Generating Innovation

The research projects and their outcome on innovation have grown in the latest decades and is highly influenced by the work of Joseph Schumpeter. He believed in innovation as the most decisive factor in business growth. In his opinion, innovation can happen at once due to disruptive practices, also in the form of continuous changes to an existing product or service (Schumpeter, 1934). In the first case, the new technology replaces the old one, while in the second scenario, a current technology develops and improves itself. Based on his definition, innovation may not be mistaken with invention, as innovation contains all changes in doing the tasks in all business lines, from marketing and transportation to design a new product or opening up a new market. Based on the innovation output, Schumpeter (1934) identifies five types of innovation, each of which can result in extra revenue to the company and change the business cycle:

- Product Innovation: where a new product or a new quality is introduced to the market.
- Process Innovation: where a new process of production is invented.
- Market Innovation: where a new market for an existing business is opened up.
- Supply Innovation: where a new source of supplying for raw materials or inputs is developed or secured.
- Organizational Innovation: where communication and interaction among different business functions are subject to change.

The first two classes are related to technological and operational innovation and are tightly aligned with the conventional perception of innovation. In contrast, the last three types do not produce a new product, instead, they ease the running of business by changing corporate relations. Although researchers commonly adopt this innovation classification, it is not the only approach to classify innovation. For example, seeing the innovation as a procedure, with independent interactive input factors, processes, and outputs, gives a very different classification of the innovation type. A very well-known classification of the innovation based on the input elements divides innovations into R&D vs. non-R&D innovations. A considerable amount of studies measure the effect of R&D-based innovation, and all report a strong correlation between these two variables (Cohen and Klepper, 1996; Griliches, 1998; Hall et al., 2001; Pakes and Griliches, 1980). Therefore, the role of R&D expenditure is deniable in generating innovation because this type of expenses is supposed to lead to innovation. For the current thesis similarly, there are several reasons to apply the evidence from R&D sectors besides the data on proposals. First, the academic community has extensively explored the R&D- innovation, and findings show that R&D investment accounts for a large share of innovation variation. Furthermore, evidence to test whether conflict moderates the effect of R&D on innovation is provided.

Regrading the innovation definition given by Schumpeter, generating innovation should not be confined to the R&D department. Similarly, in the last decade, the impact of the non-R&D on innovation has drawn significant attention, and the findings show that non-technological and non-R&D innovations are in charge with a large percent of all innovations (Arundel and Kabla, 1998; Heidenreich, 2009; Lopez-Rodriguez and Martinez-Lopez, 2017). Although the traditional approach to the concept of innovation focuses mostly on the relationship between R&D investments and the index of innovation, on average 50% of all innovations stem from non-R&D activities(Rammer et al., 2009). Rammer et al. (2009) found that mid-sized companies could win similar innovation gain without in-house R&D and rely only on their management and facility capacities. They conducted a study for European countries in a four-year time interval that shows that non-R&D innovation activities are beside R&D activities statically significant and equally crucial for the company's economic growth. The magnitude of the non-R&D coefficient, in this research, was different from country to country. However, the Central European Eastern Countries (CEECs) seemed to believe more in non-R&D activities, as they invest almost 40% more on this type of activities than new member states do (Rammer et al., 2009). Another study by Ritter and Gemünden (2004) suggest that besides R&D, organizational skills for managing innovation, as well as networking competence, are two efficient sources in charge of producing innovation .

The findings of these researchers, besides others, illustrate the critical role of the non-technical channels in leveraging innovation within the organization. Observing innovation as a circumstance that occures along the process rather than as a result of it, has changed the conventional perception of knowledge creation's cycle. In this sense, knowledge is created by team members, maintained, and consequently utilized by them. Similarly, there are shreds of evidence in the literature, claiming that creativity can be born by individuals but should be fostered in the group. For instance, Woodman et al. (1993) considered different sources of the firm creativity and developed a model, which could explain the creativity within an organization. In their opinion, the innovative outcome is a result of individual creativity that is mediated through collective thinking. This finding can also explain the main query of the current work to a large extent.

Current study differs from the literature by focusing only on the conflict clarification through shareholder proposals as a frequently-occurring non-R&D factor, which managers and policymakers have understated. In contrast to the underlying assumption of the agency theory, The finding of the present research shows that top managers' negligence in utilizing the innovative potential of conflict clarification can bear cost and energy to the corporation. In this manner, the organizational culture in behaving conflict may either encourage the stakeholders to participate in the knowledge production process or, in contrast, prevent them from speaking what they really think and consequently deprive the organization of new opportunities. Therefore, the current study assumes that in an organization with a flat hierarchy, where employees are willing to speak up, there is a higher chance that disagreements, new ideas, different alternatives as a solution to the existing situation, and more efficient decisions are taken place. Therefore, an organization with predefined communication channels and a designed free span to make mistakes and learn from them is more likely to generate innovation.

In corporate governance, the stakeholder theory believes that achieving a balance between the interest of all types of stakeholders is the only way to survive (Shankman, 1999). Carroll explains that if the manager plans to stay in her position and create wealth, she must provide other stakeholders enough share not only on the company's profit but also in the decision-making power (Carroll, 1989). Therefore, under the Security and Exchange Commission's (SEC) rules, the board is obliged to give the shareholder the possibility to have a voice. In this way, shareholders can change corporate governance management by making a proposal of a maximum of 500 words.

To get a deeper understanding of how shareholders proposal can affect the innovation index, Figure (1) depicts the service lifecycle in an IT company. The core of this diagram is adopted from *ITIL4* containing all predefined processes, functions, and roles that are considered the best practice (Ahmad et al., 2013). However, ITIL's components are designed to fulfill the IT company requirements, any company that delivers service or products can utilize it by customizing it based on the local business requirements. In ITIL's setting, each service's life begins in the strategy phase, where the general decisions regarding organization goal, investment, and outcome are made. In strategy phase, top managers are the key player. Moreover, the company's overall organizational culture is defined here.

The central added value of the design phase is to improve the existing services and to design new ones. Likewise, in the next phase, service transition, the new services are implemented, which will be operated later in the next stage. Finally, all processes will be continuously affected by a continuous improvement system. All these five phases are in complete alignment with the organizational culture defined previously in the strategy phase. Therefore, if stockholders can have a voice, it will be heard in the strategy because they directly challenge the managers' decisions. In this regard, the potential controversy between the manager's act and shareholders' opinions may lead to a very different way of running the business. The more freely the shareholders' voices, the more opportunity for the new changes in all business lines. So, by affecting the strategy phase, shareholders can make a difference in other service lifecycle phases. Correspondingly, the stockholder has the power to amend the innovation culture within the organization, and equivalently, all different stages of the

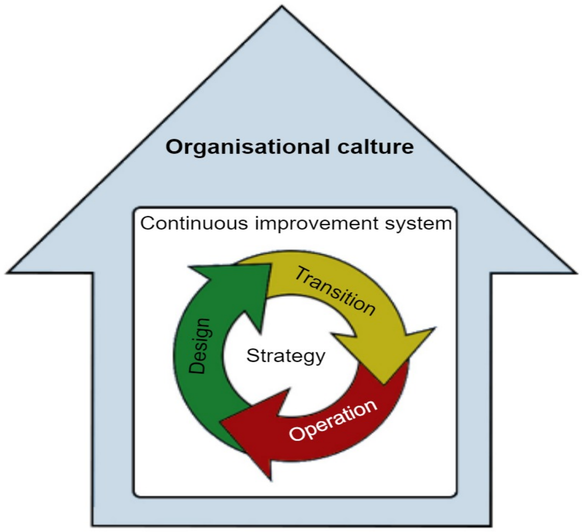

Figure 1: Five phases of the service lifecycle (Ahmad et al., 2013)

service lifecycle are dependent on the outcome of the strategy phase.

For example, the design phase -known as solution design-, should be checked for compliance with all objectives set in the strategy stage. Also, in the transition stage, the organization will be provided with all relevant requirements for merging changes to the existing line of business. Service transition activities enable innovation while controlling the unintended consequences of it. The subgroups of this phase, therefore, are change management and knowledge management. After that, phase operation guarantees that the service is delivered efficiently to the customer. Finally, the services continues improvement will be iterated as long as the service is alive (Ahmad et al., 2013). According to the depicted service lifecycle, innovation is not located only at one stage but more plausibly happens along with all phases.

Figure (1) shows that innovation is not merely the result of a single process delivered by a specific department, but, it flows preferably in all phases of the service lifecycle. For example, automation of a service, seen as an innovation, has to be proposed by the users and not by the research and development team. Possibly the technical part of the automation will be handed over to the developing unit, but at least the request has to be delivered by those who will work with it. Therefore, ITIL stresses that the process doesn't have to fit the tool, but another way around (Ahmad et al., 2013). In this way, the innovation will be generated due to answering an existing request aroused along the process. In the literature, also there is evidence of such an innovating by doing approach towards innovation in the organization. For example, in a study, Edison et al. (2013) tried to define innovation in

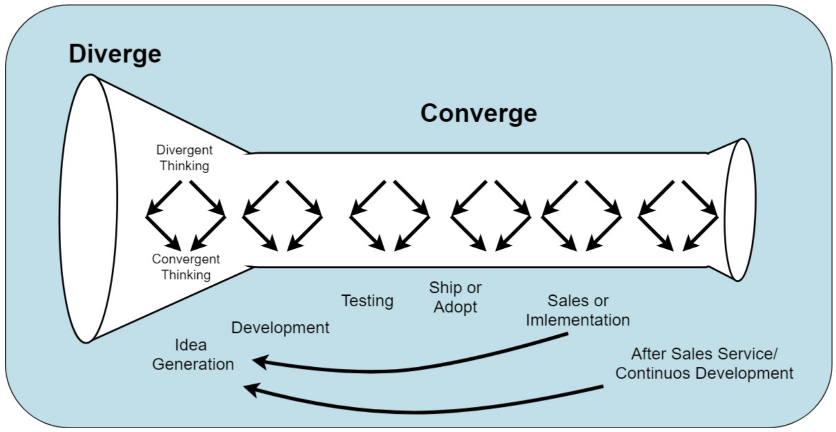

Figure 2: Task Instances Leonard and Sensiper (1998)

the software market through an online questionnaire. For this purpose, they interviewed practitioners and academics. Their findings show that interviewees believe that for measuring innovation, one should measure the innovation climate instead of measuring the innovation itself, because the organization is where the ideas are born. According to this evidence, there are two ways for shareholders to contribute to the innovation index. This nexus can be maintained whether directly, through interfering in the innovation generation process, or can happen indirectly through the organizational culture channel. In the latter case, the proposals from the shareholder side have a decisive role in determining underlying beliefs, assumptions, values, and ways of interacting in the organization. This role of culture creation has also been belonging to the managers' tasks regarding organizational literature. Nilakant and Rao (1994) depict a new role of manager beyond his operational role in producing innovation. Through taking facilitator roles, a manager tries to make more incentives for employees to contribute to innovation more actively (Ritter and Gemünden, 2004). In this sense, disagreement provides a potential for innovation if managed well and directed in the right path. In another work, Leonard and Sensiper (1998) designed an innovation funnel, through which she explains how divergent thinking flows in a cycle and finally comes to convergence with one single idea generated at the end of each cycle (See Figure (2)). With time the cycles get shorter, and consequently, generating ideas gets faster and more efficient.

2.4 Measuring Innovation

In the world of constant and rapid growth of technology, measuring innovation becomes more crucial because it is linked with business performance (Alegre et al., 2006). According to a Boston Consulting Group study, over 70% of the management board are firmly convinced that their company should track and measure the innovation concretely (Andrew et al., 2008). However, some companies perceive innovation as immeasurable, yet the real problem is the absence of appropriate metrics and measurements that cover all dimensions of innovation (Andrew et al., 2008).

There are mostly two essential proxies in the literature to measure innovation, first R&D

expenditures, and second, patent data. By Using R&D as the dependant variable, there is always the thread of overestimation because it also includes the aborted R&D investments (Kleinknecht et al., 2002). Furthermore, as mentioned earlier, all innovations are not the result of R&D investments (Arundel and Kabla, 1998; Heidenreich, 2009; Lopez-Rodriguez and Martinez-Lopez, 2017).

Another widely-used proxy for measuring innovation is the number of patents. There is a large deal of literature, considering the patent's validity for this purpose (Griliches, 1998; Hall et al., 2001; Pakes and Griliches, 1980). However, this methodology aroused several critiques, yet it counts as a reliable common-used proxy for the innovation output. One of these critiques argues that it explains only one dimension of the innovation, affected merely by inventiveness (Griliches, 1998; OECD/Eurostat, 2005).

At its most basic, the U.S. Patent Act (USPA) grants a patent for protecting innovation in one of these fields:

1. A process,
2. A machine,
3. A composition of matter,
4. A manufacturing technique,
5. A useful and new improvement on any of the above[1].

According to the patentable innovations' scope above, the innovation resulting from conflict resolution is also included in this definition. So from a coverage point of view, the patent provides an acceptable proxy, including the desired dimensions for the current work. Therefore, the same proxy will be used to measure the innovation because it covers as many types of innovation as possible and by applying the patent number, there should be no concern regarding the inclusion of all kinds of innovation.

Another criticism relates to the companies' different inclination to patent when they have a different size or come from various industries (Evan, 1965; Kleinknecht et al., 2002). To circumvent this issue, a sector index that controls for propensity to patent is developed. In subsection Data, this will be addressed in more detail.

To sum up, while some scholars find patent inappropriate for measuring innovation, there is a surprising number of examples of using the patent as the innovation indicator in the literature. The absence of a better alternative that can proxy the innovation consistent with the definition of innovation motivated over 18% of all studies in the field of innovation, to use patents number to measure innovation (Becheikh et al., 2006). Organization for Economic Cooperation and Development (OECD) lists these topics (OECD/Eurostat, 2005). Some are also in the same field as the current work, such as; technological emergence, performance, and knowledge diffusion (OECD/Eurostat, 2005).

The first manual for using the patent as a reliable proxy that enhances one's quantitative understanding of science and knowledge (S&T) was issued by OECD at a conference on

[1]See: USPA for more information.

"New science and technology indicators for a knowledge-based economy" in 1994.According to the European Community Innovation Survey, innovation includes all product and process developments that happen internally or through the technology adopted from external sources OECD/Eurostat (2005). This definition has two implications. Firstly, a significant percentage of the innovations have been not necessarily made inside the company but taken externally. This implication causes more inconvenience for measuring innovation, as each new product or process could be counted double (Edison et al., 2013). To prevent data duplication in the current work, only those innovations are considered that were developed at least partly in-house [2]. Secondly, this definition points out the importance of process innovation, which is understated so far. So even though it is more common to patent a new product than a new process, yet a considerable share of the total innovation belongs to the innovations dealing with a process. In a study, Cohen and Klepper measured the patenting rate among new products and compared that to the status of new process patenting in the years between 1991 and 1993. Their findings show that 51% of products and 33% of processes have been patented (Cohen and Klepper, 1996). In another work, Conte and Vivarelli (2014) considered the link between the inputs of innovation (R&D and acquisition of external technology) and the innovation outputs (product and process innovation). They found that R&D is strictly associated with product innovation, while the acquisition of external technology is more correlated with higher process innovation.

3 Empirical Analysis

3.1 Data

Before testing the hypotheses, current subsection gives a holistic view of the data used in this study. By considering the relationship between shareholders and the management board for 134 companies from S&P 500 from 2002 to 2015 the relevant data was collected. This relationship was chosen for different reasons. Firstly, due to a conflict of interest between the stockholders and the manager's board, it is highly prone to conflict. Secondly, finding an appropriate benchmark for measuring the business output is not as complicated as other relationships. Furthermore, the data for such outputs are relatively easily accessible. For this purpose, the data was combined from three different data sources: (i) the data on the patent application available on the united states Patent and Trademark Office (USPTO) database, (ii) the information on the proposals from the proxy monitor, and (iii) data regarding accounting and financial data from Compustat [3].

For measuring the variation of the dependent variable, the company's outcome, two groups of variables are used: one for measuring innovation and another one for financial performance. Regarding the innovation literature, a very common proxy for measuring the innovation outcome is the **number of patents** registered each year by the company (Becheikh et al., 2006). This index is used in two different forms, count data and log. Using log form is a

[2] See USPA for more information.

[3] A comprehensive financial database including data on active an inactive companies, owned by SP Global Market Intelligence

useful way to interpret the regression results, because $100 * \triangle log(y)$ can be approximated as $\% \triangle y$. [4]

According to the literature, there are five primary data sources, known as IP5 (intellectual property offices) for patent data. The five patent offices are the US Patent and Trademark Office (USPTO), the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), and the National Intellectual Property Administration (NIPA). Choosing whether one or several of these data sources depends on the purpose of the study and the level at which the data should be categorized (Kim and Lee, 2015).

The USPTO database, which contains the most information and is easy to use, is regarded as a representative patent database (Archibugi and Pianta, 1996). The data is accessible online via, USPTO homepage. The patent grants exclusive protections and rights to innovation for 20 years. Besides, the International Patent Classification (IPC) is used to categorize the patent into different classes based on their functionalities. According to USPTO, the most frequently applied patent is the utility patent (USPTO, 2015). Based on USPTO's definition, utility patents cover all new products, process and also the methods which bring some "utility" or, in other words, some new "usability". This type of patent is also known as "invention patent". The USPTO database reports only this type of patent. Moreover, a utility patent is the patent type is used in the current study to test the central hypothesis. The reason of such a selection is the fact that, this patent type covers several types of innovation. In this manner, it can be granted for R&D or non-R&D and also for product to process innovation. Additionally, it is appropriately aligned with the definition of innovation provided earlier. Another reason is that other types of innovation (i.e., design, plant, statutory invention registrations, and defensive and publications reissue patents) compose lower than one-third of all applications. For instance, a "design patent" is applied when the idea is novel but only has an aesthetic function for a product. It does not add any new functionality but changes the shape and the form of a current good. According to USPTO fiscal report, out of 618,062 patents filed in 2015, over 73,3% were related to the utility patent (USPTO, 2015).

Regarding the data collection method, this is of great importance to notice that here the data by year of application (the year that application has been filed) is used, not by year of the grant because the application date reflects the date of innovation more correctly (Hall et al., 2001). So it can be the case that some patent applications were filed in the previous year but granted later. However, those patent applications that have never been issued, have been removed from the database (almost 35% of all applications). In other words, for the study, the total number of patent applications across all years equals the number of patent grants while the year of their filing counts. Another remark is related to the multiple assignees for one patent. In this case, the patent will be assigned to the first name-assignee.

Besides innovation, which serves as the initial dependent variable of interest, the effect of conflict between shareholders and the managers on the company's financial indicators is tested. In this way, **total revenue** will measure the variations in the company's financial state for a given company. Revenue is defined as the total amount of income generated by the company to sell its goods or its services before any expenses are subtracted. This data has

[4] To prevent the zero values from being missed from the dataset, the following formula is used $LogPAT = log(PAT+1)$. This rule also holds for revenue in (log), when running the robustness check.

been collected from the financial statement of any respective company, one by one.

For measuring the explanatory variable of interest, conflict, the relationship between the management board and the shareholders is studied. More precisely, all information on the annual proxy statements was investigated to collect the data on the number and scope of the proposals presented from each company's stockholders in a given year. Each proxy statement has a voting card, through which the board of directors solicits the stockholders' vote. There are two various kinds of proposals available. First, the board's proposals, presented at the annual meeting, should be voted by the shareholders. The topics usually put in the vote for this kind of proposal are, for example, voting for the election of a director, voting for ratification of a new accountant, the election of the directors nominated by the board, etc. As expected, the board recommends the shareholders to vote "FOR" these sorts of proposals.

The second group of the proposals is that presented by one or more shareholders to be voted by other shareholders. These types of proposals usually imply a change that shareholders like the board to apply in the company. The shareholders announce their ideas regards governing the company in the form of a proposal prior to the annual meeting. Each proposal received will be discussed in the meeting and subsequently will be put to the vote. This type of proposal requires the affirmative vote of a majority of the shares of common stock represented at the annual meeting. Entitled are all shareholders, owning common stock in the previous fiscal year. After ratification by a majority of the votes, the proposal is binding to be implemented by the board. According to the shareholder proposals' characterization, the management always asks shareholders to vote "against" them. The data on shareholders' proposals is online available on the Proxy Monitor website for a big deal of companies. For those, which have no proxy statement available on this website, the data was collected either through Edgar archive or through the annual report available on the homepage of the respective company.

According to the research query, the second type of proposal will fulfill the expectation of a good indicator. Because the research aim is to proxy the controversy within the company. In this way, current study shows that speaking up and discussing ideas on how to do the task will improve the innovation index, and therefore, the shareholder proposal will be the right choice. Because the number of proposals can be assumed as the frequency of discussions that happened between the parties. The conflict embedded in these types of proposals is specifically then tangible when the board recommends the voter to vote "against" the proposed item, which is always the case. Hence it makes sense to focus only on this type and ignore the board proposals for this study.

Besides, the conflict are categorized into three different groups based on the proposal's scope so that the result can be controlled for various conflict types. The first scope is known as **corporate governance** proposals, which is marked as "CG" in the data set, containing all forms of proposals regarding corporate issues, such as; voting rules, shareholder rights, proxy access, director qualification, and chairman independence. The second group **executive compensation**, "EC", deals with all disagreements on the manager compensation, which is equivalent to the struggling on the amount that the agent earns in the principal-agent model. Finally, **social policy** "SP" conflicts are those proxies registered for expressing disagreements over company policy on human rights, animal rights, environmental issues, charitable giving, health care, political spending, etc. Grouping the data into these three strata enables us to test the initial hypothesis and makes it possible to examine how differently various types of conflict affect the company's performance. The latter issue has always been an appealing topic to scholars in the field of shareholder activism (De Dreu and Weingart, 2003; Giebels et al., 2016). Moreover, besides analyzing each type of proposals a "conflict index" equal to the aggregation of all proposals each year for every firm is used. In addition, a dummy variable is generated based on the shareholder's proposal, called "conflict dummy", taking one when the conflict index is greater than zero. Another type of conflict usage in this research is in lag form when the effect of the proposals in year $t-1$ on the performance of the year t is tested.

Control Variables: Besides the main variable of interest, other factors are controlled, like; R&D expenses, industry segment, and the sector the company is active in, and finally, company size.

In the literature, there is evidence of the positive effect of **company's size** on the innovation index. Two main arguments support this notion. First, the larger the company, the more the resources provided to innovate and also the higher the probability of choosing risky actions in comparison to small and middle-size companies (Damanpour, 1992; Majumdar, 1995; Schumpeter, 1934). Secondly, large companies enjoy large investments in R&D activities, production lines, and marketing (Cohen and Klepper, 1996; Stock et al., 2002). Furthermore, larger companies will report a higher number of proposals in a given year. Therefore, to mitigate the thread of the omitted variable bias, the size will enter the model in the form of the number of employees.

In addition, like over 50% of all studies in the innovation field, the current research will also incorporate the volume of **R&D expenses** into the model. The evidence suggests that almost 80% of all researches found a significant positive relationship between R&D and innovation outcome (Becheikh et al., 2006). In the current work, the R&D expenses and the number of employees have been collected from each company's annual financial statement. They enter into the model in the log-form. Furthermore, this is very common to use the R&D expenses in the lag form, or the sum of R&D expenses over the last n years, because the R&D process is considered a long-term investment (Griliches, 1998; Hall et al., 2001).

Finally, the **industry** to which the company belongs can affect its propensity to innovate (Evangelista and Vezzani, 2010; Kam et al., 2003; Quadros et al., 2001). For example, through using data from 27 firms, Ray et al. (1974) found that about 60 percent of all pharmaceutical companies needed to apply for a patent to protect their products. This number, however, falls under 2% for electronic companies.

Therefore, also an industry index is added to control such tendency. The companies in the dataset have different industries, and consequently, high heterogeneity is expected. For this purpose, all companies are categorized into 14 industry groups and five **sector** groups. Then a number from one to 5 is assigned to the sector index, where industries with the lowest propensity to patent are assigned to group one. This classification is adopted from the work of Mansfield (1986). The empirical study conducted by Mansfield on 96 American manufacturing companies shows that patenting is more important for industries, such as; pharmaceutical, chemical, petroleum, and is less critical for primary metals, electrical equipment, metals, and textile industries (Mansfield, 1986). It implies that there is a higher probability of patenting in the first group when inventing a new product. Therefore, merely by considering the number of patents, one can make no correct inference about the company's innovation index, as the other company might have more innovated and less patented.

3.2 Descriptive Analysis

As mentioned, the data was collected from 134 companies recorded in the S&P 500 for over 14 years. Analog to the other panel datasets, reflecting the real industrial data, this data set contains missed entity-year values. For minimizing the measurement errors an appropriate software is applied that can correctly work with unbalanced datasets. STATA provides several features for data analysis that can prevent data issues. After collecting the data, a comprehensive descriptive analysis of all variables is provided. Table (1) illustrates this analysis. For each variable, Table (1) gives the statistical summary of the variable (overall analysis). It also decomposes each variable into a between and a within component, which would be beneficial when analyzing the panel data. More details on the existing variables is discussed in the following.

The first row of this table gives a statistical summary of the central dependent variable measuring the innovation. Interpreting the number of patents (PAT) registered by a company in a year is, to some extent, complex. That is because of the patent data's unique inherent, which takes only positive integers and includes typically lots of zero values (231 out of all 1567 observations, which serves as 14.7%). It is also expected that patent data has a high variance and a relatively low mean, generating a highly skewed distribution to the left. Figure (3) depicts patent distribution when taking all entity-year observations into a single histogram. This histogram's first characteristic is the long narrow tail, which implies a barely high range of data varying between zero and 7481, with 99% of the total observations lower than 3085. It means that through trimming one upper percentile of the data, the variance will improve by 50 percent. It is worth noting that Figure (3) depicts a cross-sectional view of panel data and only helps to make overall references.

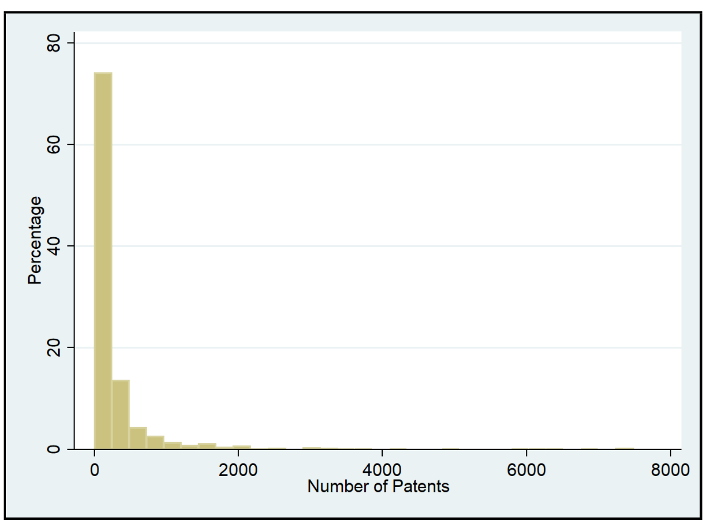

Figure 3: PDF Histogram of number of Patents

Between analysis measures, the average variation of a single individual over time, $\bar{x}_i$s, and afterward calculate the spread measure based on $\bar{x}_i$. In this sense, the standard deviation is defined as the dispersion of group averages, $\bar{x}_i$, around their mean, $\bar{\bar{x}}$.

So this measure gives one the impression of how homogeneous the individuals are relative to each other. For example, for the variable patent, in Table (1), there are 1567 company-year observations with a 270.014 mean, and the standard deviation equals to 593.433. Some companies that had zero patents, at least in one year, and also at least one company has registered 7481 patents in some year. The number of companies equals 130, which is lower than the number of companies in the report. This indicates that for four companies, there is no patent data available for none of fourteen years. If one calculates the mean of the patent data for each of these companies over all years and then, take the standard deviation of these 130 averages, one will come to the between standard deviation (513.817). Moreover, $min\{\bar{x}_i\} = 0$ implies that there exist companies with no patent over 14 years. Likewise, the largest average equals to 4870.214.

Within analysis, in contrast, depicts the dispersion of an individual within its group. On average, all companies have patent data for 11.817 years. This number deviates from the first information about the data, where it was mentioned that the data was collected for 14 years. This difference stems from the fact that the data set is unbalanced. Within variation calculates $x_i' = x_{it} - \bar{x}_i$ and then gets the standard deviation of x_i'. However, if one calculates x_i' for all individual and take the standard deviation, one will not come to the same value reported in Table (1), namely 258.665. That is because STATA adds the overall mean $\bar{\bar{x}}$ to make the result comparable. Also, the same thing happens to the within minimum and maximum. Therefore, the minimum, -1686.636, is the minimum of all x_i's plus the overall mean, 270.014. It is worth noting that, after decomposing the variable into the within and between components, the standard deviation has decreased dramatically. The within standard deviation (258.665) is around one-third of the overall standard deviation. It implies that considering the dispersion of individuals over time gets more accurate as the dispersion within group is taken into account. In other words, the individuals have not been dramatically varied in comparison to their mean value. Also, getting a between standard deviation higher than within standard deviation suggests that the heterogeneity comes from the large difference between companies in generating innovation and not from comparing one individual with its past. By understanding the meaning of the between and within measures, let's go through the next variables. Table (2) gives more detail about the mean (P50) and other percentiles (P25 and P75) for the patent data.

Next variable in Table (1) is the log value of the patent data. As a robustness check, the patent is applied in the log form. Also the formula $log(PAT) = log(PAT+1)$ is used, so that the companies with zero number of the patent are not excluded from the analysis. Therefore the minimum remains zero as for patent measure. As expected, the standard deviation in the log form decreases drastically.

The next response variable, total revenue, is expressed in million dollars and tracks the company's financial success. This data is normally accessible to the public through the company's homepage. Through looking at the descriptive statistics for the revenue, one can conclude a heterogeneous sample from the populations, with a variance three times greater than the mean. For those companies that had no reported revenue, the annual sales amount

Table 1: Model Variables: Descriptive Statistics (Part A)

Symbol	Name	Measurement/description		Obs.	Mean	Std. dev.	min	max
PAT	Patent	Number of patents registered by the firm	overall	1567	270.014	593.433	0	7481
			between	130		513.817	0	4870.214
			within	11.871		258.665	-1686.636	2853.364
logPAT	log(PAT)	Logarithm of patent number	overall	1567	4.302	2.043	0	8.920
			between	130		1.539	0	8.442
			within	11.871		1.345	-1.669	6.548
REV	Revenue	The total revenue (in million dollars)	overall	1350	29327.28	47678.55	11.071	482229
			between	113		51511.85	23.622	441292.1
			within	11.94		14974.68	-83784.54	186594.7
logREV	log(REV)	Logarithm of the revenue	overall	1350	9.259927	1.686166	2.404329	13.08617
			between	113		1.622	3.041	12.99498
			within	11.946		0.4805	3.138	11.263
CON	Conflict index	Total number of shareholders' proposals	overall	982	2.16	2.091	0	17
			between	128		1.710	0	9.375
			within	7.664		1.184	-2.211	9.788
dumCON	Conflict dummy	presence of each type of shareholders' proposals	overall	981	0.776	0.416	0	1
			between	128		0.351	0	1
			within	7.664		0.267	-.151	1.633
CG	Corporate governance	Number of the proposals regarding corporate governance	overall	982	0.714	1.015	0	7
			between	129		0.818	0	4.166
			within	7.612		0.713	-1.785	5.561
EC	Executive compensation	Number of the proposals regarding manager's compensation	overall	981	0.836	0.903	0	5
			between	128		0.629	0	2.375
			within	7.664		0.660	-1.163	3.711
SP	Social Policy	Number of the proposals regarding social issues	overall	981	0.612	1.190	0	10
			between	128		0.955	0	6
			within	7.664		0.722	-2.887	4.612

Table 1: Model Variables: Descriptive Statistics (Part B)

Symbol	Name	Measurement/description		*Obs.*	*Mean*	*Std. dev.*	min	max
RD	Research and Development	R&D expenses (in million dollars)	overall	908	915.516	1496.916	1.28	9483
			between	89		1601.069	4.111	8204
			within	10.139		512.065	-3247.824	6693.088
logRD	log(RD)	Logarithm of R&D Expenditure	overall	908	6.013	1.332	0.246	9.157
			between	86		1.380	1.413	9.007
			within	10.069		0.530	1.322	11.090
SumRD		Sum of R&D 5 previous years	overall	463	4710.795	7193.511	70.921	49549
			between	67		8712.419	70.92	49374
			within	6.910		1236	-2724	320015.205
SIZE	Firm size	Number of the employees for the current year	overall	1183	63641.63	72493.06	98	434246
			between	109		70394.97	138	379260.3
			within	10.908		22441.61	-110396.5	222534.1
LogSI	log(SIZE)	Logarithm of variable SIZE	overall	1183	10.347	1.435	4.580	12.981
			between	108		1.471	4.902	12.839
			within	10.953		0.480	3.138	11.263
SILE	Size level	It groups the observation of SIZE in 5 categories	overall	1183	1.338	0.753	1	5
			between	108		0.713	4.710	12.839
			within	10.9537		0.293	-0.732	3.338
IND	Industry in which the firm is active	String variable indicating 14 different industries		1803				
SECIN	Sector index	It assign 14 groups of variable IND into 5 groups	overall	1803	2.776	1.556	1	5
			between	132		1.567	1	5
			within	13.659		0	2.775	2.775
L_n.X		n^{th} lagged of the variable X						

was used. Also, the original data extracted from the financial report sometimes was reported in other currencies, which was converted to US dollars. For example, the company BAE Systems Electronic Systems' annual financial reports use Pound to announce the revenue volume. For this company, the amount was adjusted by applying a pound-dollar exchange rate for the respective year. By investigating all 134 companies' financial statements over 14 years, the research could come to a dataset that has data for 113 companies (number of between observations). Moreover, the dataset has the revenue data for 12 years (number of within observations). The value of revenue varies from 11 million to over 482 billion dollars, with an average of almost 29 billion dollars. One can interpret this broad data range of volatility as a high heterogeneity in terms of size and turnover volume. The revenue amount is also used in log form.

Table 2: Descriptive Analysis of the Number of Patents

Variable	Obs.	min.	P25	P50	P75	max.
PAT	1567	0	50	102	249	7481

In the next row, the leading independent variable of interest, conflict index (CON), reports the summation of the number of all types of proposals that have been submitted to the board in the annual meeting. The yearly number of conflicts that shareholders expressed to the board varies between zero and 17 overall 14 years. Only 12 companies reported zero proposals, whereas "ExxonMobil Research and Engineering Company" reported 17 proposals in the year 2008, 10 of which deal with the social policy, which is usual for a petroleum company. Besides, the number of between observations, (128), shows that several companies reported no data for this index. It is expected that depending on the industry the company is active in, the number, also the type of the proposals vary. The average number of proposals for each company varies between 0 and 9.375. Also, "the number of proposals within" fluctuates between -2.211 and 9.788, which does not mean that any company reported a negative number of conflicts. The within amount implies the deviation from each company's average, and naturally, some of those deviations are negative. In addition to the number of proposals, a dummy, the so called dummy conflict, enters to catch only the presence of conflict rather than its magnitude. According to the table, the overall mean exceeds the standard deviation for both variables, CON and dumCON, which shows a homogeneity in generating disagreements. The amount of standard deviation falls even more for between measures, which can be interpreted as a fixed culture at treating conflict that remains almost constant over time. The next three rows break down the variable, conflict index into three different types of proposals, corporate governance (CG), executive compensation (EC), and finally, social policy (SP). Among all different kinds, executive compensation has a higher mean and a lower variance, which implies more homogeneity in this type of conflict across all companies. One company could theoretically report one, two, or all three types of proposals. A quick comparison shows that executive compensation has the highest frequency of proposals, whereas social policy proposals with the lowest mean. The next variable measures the variations in the R&D expenditure. Two following variables show the R&D amount in log and also the R&D

aggregation spending in the last five years. The inclusion of R&D in lagged form is quite intuitively, as the amount a company invests on R&D in year zero will cause the return in year one or later. Incorporating lag form is also because of the high auto-correlation between the R&D expenses among sequential years (Hall et al., 2001). On average, companies invest 915 million dollars in R&D, and this number varies dramatically from one company to another. The company with the lowest investment in R&D has spent 1.28 million, while the company with the largest R&D sector allocated around 9.5 billion dollars. This implies high heterogeneity among the companies in terms of R&D investment. As expected the volatility of the R&D profile decreases as R&D expenses is used in the log form. Also, a part of the data is lost, as sum of five previous years of the R&D expenses is generated.

The next variables are included in the model to control the companies' general characteristics that may affect the relationship between the number of proposals and the innovation outcome. Therefore, to give an unbiased estimation, one has to control for potential confounding factors. The variables described above, namely the size and the sector, could be correlated with explanatory and dependent variables. For example, the larger the company, on the one hand, the higher the number of patents due to the possibility of the economies of scope, and on the other hand, the greater the number of shareholders and, consequently, the more the proposal's number. In this sense, small businesses versus large businesses are less likely to patent their new achievements, possibly due to the high cost and long time that the patenting process demands (Kleinknecht et al., 2002; Ray et al., 1974). Next row provides the size information for 1183 company-year entities. The smallest company has 98 employees. The largest company, in contrast, is a concern in which 434246 people work. Only 31 companies have less than 1000 employees, and this makes the mean showing a relatively high number (i.e. 63641). The standard deviation (SD) of variable size equals 72493 and gives a standard deviation-mean ratio equal to 1.1, which is not especially large. It implies that the sample data are not a very heterogeneous sample in terms of the size.

The frequency table (Table (3)) provides a better understanding of the size distribution. As evident in Table (3), the first two groups cover over 93% of all observations, and only 7% of all companies have more than 174000 employees. Moreover, more than three-fourths of all companies have less than 90000 employees. By defining a new variable, size level (SILE), the observations are grouped into five equally-sized categories, one to five, with five for the largest companies (Table (3)). Furthermore, according to Table (1), the variable size level has a very low mean (1.338), which is translated to be skewed more to the left, with a standard deviation approximately equal to its mean. The variable "size" will enter the model in the form of absolute value, log value, and size level.

Based on the argument about the patenting propensity according to the company's industrial background, sector variations are controlled (Hall et al., 2001; Kim and Lee, 2015). The next variable listed in Table (1) controls for propensity to patent. In the literature, there are shreds of evidence of different sources of inclination to patenting in various industries, which should be controlled when measuring the effect of the conflict on the innovation outcome. There are other factors, besides inventiveness, affecting the number of the patent; such as industry sector and organization size (Fontana et al., 2013). The string variable IND shows the industry name in which the company operates. Existing companies share 14 different industrial backgrounds. Through using the OECD report (OECD/Eurostat, 2005), industrial

Table 3: Grouping Variable Size in Five Categories

Group midpoint	Size level	**Freq.**	**Percent**	**Cum.**	**min**	**max**
87000	1	918	77.60	77.60	98	86400
174000	2	185	15.64	93.24	87100	171700
261000	3	35	2.96	96.20	174400	256420
348000	4	34	2.87	99.07	266590	341000
435000	5	11	0.93	100.00	351000	434246
Total		1183	100			

sectors are categorized into five different groups from the least patentable (group 1) to the most patentable (group 5) (Mansfield, 1986), and assigned it to a new variable, sector index (SECIN).

Table 4: Industrial Sector's Ranking for Propensity to Patenting

Sector Index	**Freq.**	**Percent**	Sectors
1	502	27.84	Banking, Insurance, Electronics,Food Entertainment, Heavy Equipment, Retail
2	476	26.40	Chemicals, Petroleum, Transportation
3	196	10.87	Bio-tech, Medical, Pharmaceutical
4	182	10.09	Semiconductors
5	447	24.79	IT, Telecommunication
Total	1083	100	

Table (4) illustrates the distribution of sector indices based on the industry. According to the sector index's value in this table, a more heterogeneous distribution is to see, compared to the variable size. So, having companies that are differently inclined towards patenting can generate heterogeneity at the industry level. According to Table (4), sector "IT and Telecommunication" has the highest propensity to the patent, followed by semiconductors, biotech, medical and pharmaceutical industry. The lowest index, in contrast, belongs to group (1) containing Banking, Electronics, and food industries. It also forms the largest part of the whole data.

Another objective that is reached through Table 4 is using the industry/sector index to control for the effect of the time-invariant characteristics. Such an unobserved heterogeneity that does not change over time is a source of bias. As evident, the within variation of variable sector index equals zero (see Table (1)), which implies that this variable remains unchanged over 14 years.

3.3 Empirical Design

In this research several types of models are introduced and tested through the data. This empirical methodology enables one to understand the data identity better and, at the same time, to run a robustness check through comparing the results of different regression models. In total, three models are used, all appropriate for the panel data:

- Ordinary Least Square Model (OLS),
- Poisson Regression, and
- Negative Binomial Model.

In an ideal world, one would choose random conflict data to and measure how the patent number varies in response to a variation of conflict index. However, there are three common threads on this way for finding an unbiased estimator: measurement error, omitted variable bias, and reverse causality. Alternatively, these concerns are mitigated through (1) adding control variables, (2) using fixed-effect controls, and (3) performing other robustness checks related to the model specification.

3.3.1 Ordinary Least Square Model for Panel Data

The investigation begins by running OLS for company-year panel data. The basic model can be written as:

$$LogPAT_{it} = \alpha + \beta . CON_{it} + \varepsilon_{it} \tag{1}$$

Here, i proxies each company, whereas t shows the year. Also, ε_{it} is the error term that reflects the difference of the patent number estimated through this model and that given by real observations. The first column in Table (5) shows the result of this regression. As the left-hand-side variable is reported in the log form, the conflict coefficient (i.e. 0.042) implies that one more proposal in a year possibly leads to a 4% higher patent number. Additionally, according to the high chi^2 test result (i.e. 0.026), the coefficients cannot perfectly explain relationship between conflict and innovation. Likewise, the next column regresses the log of patents number on each conflict type. Here, the effect of three types of conflict is jointly, statically significant. However, only the executive compensation proposal has a significant coefficient, when breaking down the proposals to three groups. The result suggests that one unit increase in the executive compensation proposal possibly leads to a 13% rise of the patent number. Moreover, one extra corporate governance proposal leads to 4% more patents. In contrast, facing disagreements over social policy topics falls the number of patents by 1%. The third column examines only the impact of at least one of these proposal sorts on the innovation outcome. The result shows a highly significant correlation between the presence of conflict and the patent number. In this sense, changing the conflict index status from no proposal to one proposal is associated with a 28% increase in the patent count. In all three first regressions, the value of R^2 is relatively low, which implies that the explanatory variables fail in explaining the variation of the dependent variable. Moreover, these regressions probably suffer from the omitted variable bias which makes the estimation unreliable. To mitigate this issue, variable size and R&D expenses are added into the model in the next regression.

$$LogPAT_{it} = \beta_0 + \beta_1.dumCON_{it} + \beta_2.LogRD_{it} + \beta_3.LogSI_{it} + \varepsilon_{it} \tag{2}$$

Column (4) reports the result of this regression model. After adding the control variables, the conflict dummy's coefficient turns to be insignificant. It means either the proposal and the number of patents have no correlation, or the current specification does not provide the best fit for such a relationship. Moreover, the value of R^2 improved considerably. Also, a one-percent change in the company size leads to a 0.4 % change in the patent number. In the same way, the elasticity of the R&D expenditure, according to the patent, equals 0.2. This column implies that the size and R&D expenses can explain at least one part of the patent number variations, as the R^2 increases after adding these variables to the model.

In the next two columns, the revenue as another performance indicator is used as a dependent variable. By comparing column (3) and column (5), one infers a similar effect of conflict on both variables, and here again, having conflict in a year leads to 20% higher revenue. Only the value of R^2 for the conflict-revenue regression exceeds the one for other regressions. Here, similar to the proposal-patent relationship, adding control variables to conflict-revenue regression alters the coefficient and improves the goodness-of-fit slightly. Interestingly, the effect of the conflict, size, and R&D are very similar for both dependent variables, patent, and revenue. According to the P-values reported in Table (5), the effect of conflict on both dependent variables seems to be significantly different from zero when no other explanatory variables are included. But after adding R&D and size index, the conflict coefficient becomes insignificant, while, the joint P-value remains significant. One explanation can be that variation in patent number has a non-linear relation with the conflict index. Figure (4) displays the scatter plot of the patent on the conflict index. As expected, the plot resembles a concave curve. It implies that on the one hand, the patent has a correlation with CON^2, and on the other hand, there exists some number of proposals for which the patent number is maximized. First, to get an optimal value for the proposal numbers, the number of patents are regressed on the quadratic form of proposals number. The last regression of Table (5) reports the result of this regression. The coefficient of CON^2 is significantly negative, and the R^2 has improved after adding CON^2 into the model. Here also, adding conflict in quadratic form does not change the coefficients of the control variables dramatically.

$$PAT_{it} = \beta_0 + \beta_1.CON_{it} + \beta_2.LogRD_{it} + \beta_3.LogSI_{it} + \beta_4.CON_{it}^2 + \varepsilon_{it}. \tag{3}$$

Through replacing the estimators' coefficients into the previous regression model, one can get the proposal number for which the innovation is maximized:

$$PAT_{it} = -1383 + 8 \times CON_{it} + 43 \times LogRD_{it} + 134 \times LogSI_{it} - 1 \times CON_{it}^2.$$

Through setting the first order condition equal to zero, one gets

$$\frac{\partial PAT_{it}}{CON} = 8 - 2 \times CON_{it} = 0,$$

$$\boxed{CON^* = 4}$$

Table 5: OLS Panel-Data Regression

Variable	(1) OLS($y = LogPAT$)	(2) OLS($y = LogPAT$)	(3) OLS($y = LogPAT$)	(4) OLS($y = LogPAT$)	(5) OLS($y = LogREV$)	(6) OLS($y = LogREV$)	(7) OLS($y = PAT$)
Conflict index	0.046**						7.999
	(0.020)						(11.724)
Corporate governance		0.042					
		(0.0179)					
Executive compensation		0.135 ***					
		(0.019)					
Social policy		-0.009					
		(0.034)					
Conflict dummy			0.282***	0.126	0.199***	0.073*	
			(0.062)	(0.125)	(0.061)	(0.039)	
Size (in log)				0.394***		0.845***	133.838***
				(0.087)		(0.044)	(20.461)
R&D (in log)				0.197***		0.103***	43.177***
				(0.028)		(0.022)	(11.438)
Conflict index^2							-1.232*
							(1.031)
Constant	4.709***	4.670***	4.590***	-0.544***	9.193***	-0.197***	-1382.510***
	(0.089)	(0.118)	(0.325)	(0.158)	(1.111)	(1.021)	(114.050)
N	952	952	952	431	832	419	431
Prob > chi^2	0.026	0.004	0.002	0.000	0.001	0.000	0.000
R^2	0.020	0.026	0.043	0.251	0.221	0.635	0.136

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

This optimization suggests that the innovation outcome trend is increasing for a low number of proposals in a year. Still, for the number of proposals higher than 4, the number of patents begins to fall. This finding confirms the hypothesis of organizational learning through conflict. Rahim and Bonoma (1979) believe that a low amount of conflict can be beneficial for team performance, however, many conflicts are hostile to innovation. An argument for this is that the team members, by and large, gain information through each conflict, especially when this information is related to their tasks (Jehn, 1995). Still, a lot of conflict amounts can disturb the process of doing the job. A study by Jehn (1995) suggests that a moderate amount of conflict which stimulates discussion and debate can enable the team to deliver higher performance. In this way, groups with no task conflict are deprived of new ways to enhance their performance. However, teams with very high task conflict levels report lower performance because much of the controversy can disturb the concentration which the problem-solving demands.

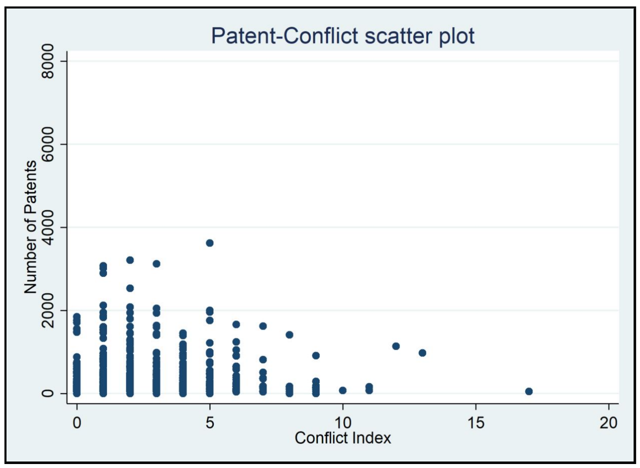

Figure 4: PDF Histogram of number of Patents

3.3.2 Fixed-Effects Vs. Random-Effects

To mitigate the omitted variable bias, those characteristics should be controlled which belong to each specific company and do not change over time. For this purpose, two techniques are presented and compared: random-effects (RE) model and fixed-effects (FE) model, to check which fits the data more properly (Hall et al., 2001).

In the RE model, the individual-specific effect is a random variable uncorrelated with the explanatory variables. This is a strict assumption that cannot be excluded in many data-sets. When group-level effects are correlated with the independent variable, RE estimation turns to be biased. In this case, applying a FE model helps control such heterogeneity by omitting them from the model. Unlike the RE, the FE model assumes that there is an omitted variable that is correlated with other independent variables. So, the impact of the time-constant factors is dedicated and omitted from the model.

$$PAT_{it} = \beta_1.CON_{it} + \beta_2.LogRD_{it} + \beta_3.LogSI_{it} + \alpha_i + \varepsilon_{it}. \tag{4}$$

Where α_i shows all individual unobserved heterogeneity, which is independent of the time. If α_i is correlated with explanatory variable (x_{it}) the OLS estimator becomes biased. The FE model corrects for bias by recognizing α_i and remove it from the model. To grasp a better understanding, think of those characteristics that do not vary over time, such as; industrial sector, organizational culture, etc. These characteristics are specific for each company and can affect the conflict index. In this sense, some industrial sectors are more prone to generate one or more types of proposals. For example, the companies that run their businesses in the petroleum sector face a higher number of social policy proposals because they imply a higher potential threat to the environment. Therefore, there is probably an unobserved heterogeneity that is correlated with the number of proposals. If α_i is not correlated with x_{it}, then the assumption of the RE model is fulfilled, and one may use this model to estimate the coefficients.

The first column in Table (6) shows the original OLS, which regresses the number of patents on the conflict index using an RE model. All4 regressions are run once with an RE and once with a FE models. In all columns of Table (6), the explanatory variables are regressed on the patent number, and for this purpose, the OLS for the panel data is used. The first pair of regressions use the conflict as the sum of all proposal types. The next pair of regressions run both RE and FE models for three types of conflict. And finally, the third pair takes the proposals of the previous year as the explanatory variable. The last regression is run for revenue in the last two columns.

In the first two columns, the conflict index coefficient does not seem to be significantly different from zero in none of the models. However, the joint p-value is statically significant. Both estimators give a very similar results, while the risk of an omitted variable bias in the RE model is high. Also, the coefficients for the control variables and the constant value are quite close. Basically, the constant in a FE model implies the mean average value for the unobserved FE.

In the next regression, the number of proposals are broken down by their types. Both models are only jointly statistically significant, while corporate governance is negative. In this sense, one extra proposal regarding corporate governance leads to 9 units less patent for the company's RE model. Changing the size by one level (around 87000 more employees) averagely results in 178 more patents in the RE model, whereas 193 more patents in the FE model. Increasing the R&D investment by one percent brings between 70 to 72 more patents for the firm. The RE model seems to be a more efficient estimator because of the lower standard error. However, it is expected that the FE model gives an unbiased estimator.

The next column shows the result of regressing the number of patents of the current year on all three types of proposals in the previous year. Similarly, columns (5) and (6) give very close results, while this time, the coefficients for executive compensation and social policy are highly significant and with positive sign. In contrast, corporate governance remains insignificant, with a negative effect. The result implies that each proposal regarding the manager's compensation leads to a 38 unit increase of patent number in the year through

Table 6: Random vs. Fixed-Effects Regression

Variable	OLS ($y = PAT$)		OLS ($y = PAT$)		OLS ($y = PAT$)		OLS ($y = logREV$)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	RE	FE	RE	FE	RE	FE	RE	FE
Conflict index	1.729	2.947						
	(6.754)	(7.690)						
Corporate governance			-8.955	-8.685			-.014	-0.015
			(11.692)	(12.560)			(0.023)	(0.022)
Executive compensation			9.845	7.540			0.139***	0.132***
			(14.036)	(14.645)			(0.044)	(0.027)
Social policy			6.735	11.307			0.030	0.029
			(11.103)	(12.790)			(0.379)	(0.231)
L_1.Corporate governance					-5.090	-3.995		
					(11.843)	(12.662)		
L_1.Executive compensation					38.240***	37.098**		
					(14.107)	(14.711)		
L_1.Social policy					33.722***	42.074***		
					(12.833)	(14.764)		
Size level	178.574***	192.813***	178.232***	193.182***	189.544***	207.704***	0.368***	0.080**
	(39.090)	(43.252)	(38.857)	(43.101)	(189.549)	(47.469)	(0.129)	(0.129)
R&D (in log)	72.912***	74.6391***	70520***	72.221***	68.282***	72.727***	0.261***	0.253***
	(11.213)	(12.631)	(12.691)	(14.896)	(12.965)	(15.387)	(0.037)	(0.037)
Constant	-427.621***	-437.770***	-414.353***	-447.038***	-447.687	-479.396***	6.840***	7.080***
	(77.549)	(88.253)	(80.934)	(98.633)	(88.647)	(104.991)	(0.233)	(0.183)
N	431	431	431	431	401	401	419	419
Prob > chi^2 (F)	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
R^2	0.184	0.183	0.186	0.183	0.205	0.201	0.350	0.344
Hausman Test (P-Value)	0.843		0.843		0.677		0.000	

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

an RE model specification. For a FE model, this number falls down to 37 patents in a year. Moreover, in these two regressions, using the number of proposals in the lag form has increased the value of R^2.

Columns (7) and (8) illustrates the magnitude of the conflict effect on the financial outcome while breaking down the proposals for different types of disagreement. For both models, only executive compensation seems to affect the revenue significantly, and one more proposal of this type is associated with 1.4% higher income. For the FE estimator, this value equals to 1.5%.

The results reported in Table (6) suggest that impact of each proposal type is different from the other one. Across all regression models, executive compensation seems to have a robust positive effect on the patent number and also on the revenue. In contrast, corporate governance estimator reports no clear or reliable coefficient. Its value becomes even negative when control variables are included into the model. The effect of social policy proposals on innovation seems to be positive but insignificant. These results are also consistent with the findings of Table (5). Also these findings are in alignment with several literature, which found no clear effect of proposals on market and firm values (Ferri and Göx, 2018; Guercio and Hawkins, 1999). According to Table (6), both models give very similar conflict coefficients, while the RE estimator is more efficient, and the FE model provides an unbiased estimation. There, a Hausman test checks which model fits the data more appropriately. The last row reports the P-value of a (Durbin-Wu-) Hausman test examining the H_0, which claims that both models lead into the "similar" result. In contrast, H_1 assumes that these two models differ significantly, while a FE estimation is more suitable. Having said that, the Hausman H_0 cannot be rejected with for all patent-conflict regressions. It implies that none of the estimators outperforms the other one in modeling this relationship. For revenue-conflict relationship, however, an FE model fits the data more appropriately [5]. Intuitively,it is expected that time-invariant factors would bias the OLS estimator and therefore, an FE setting will be applied in all next regressions.

Furthermore, R^2 values are slightly higher for the RE model in all three pairs of regressions. This observation suggests that the explanatory variables in an RE model can explain the variations in the dependent variable more probably. The reason is that the FE model omits the time-invariant characteristics. Through this omission, a part of the data, which could plausibly explain the latent variable's variation gets lost. The latter notation is a notable disadvantage of the FE estimator. Assuming the homogeneity in the data by having no significant difference in companies at generating conflict, an RE model would be even an unbiased and more consistent estimator. Such a model could estimate the effect magnitude of the omitted characteristics with an acceptable level of precision. Therefore, by using an FE model, the exact effect size of such invariant variables cannot be measured, the heterogeneity can be controlled in return. In this regard, deciding between an RE or an FE model is necessarily the trade-off between unbiased estimation versus precise estimation. Therefore, one can infer that an FE model is a safer method when one fails to assume that the predictor is uncorrelated with the error terms. It is an underlying assumption of the RE model, however, it holds seldom in practice.

[5] If the Hausmann test P-value < 0.05, then H_0 is rejected, and FE estimation is used because it is consistent and efficient.

3.3.3 Conflict as a Moderator Variable

It is now examined if variation in the conflict index may moderate the effect of R&D on the patent number. In this sense, the fifth group of the research hypothesis can be tested. A very close setting has been developed by Evan (1965), where he examined what type of conflict can be beneficial for the performance of R&D. In the literature, the relationship between patent and R&D expenditure has been widely considered among scholars (Hall et al., 2001; Hausman et al., 2008; Pakes and Griliches, 1980). Each of these works applied different types of models and specifications, and consequently, they came in different results. A very common setting is to use the R&D expenditures in form of lag or sum of the lag R&D values (Hall et al., 2001). Also, the current work uses the same specification for conflict index. It is quite intuitive to think that the conflict index in year t affects the innovation outcome in year t' where $t' > t$.

The investigation is carried out by applying an FE panel model at the firm level and run the patent on the Log of R&D. The first column in Table (7) stating that R&D expenditure has a positive effect on the innovation index as expected. Also, it suggests that averagely, a one-percent change in the R&D investment leads to 0.72 more patents in the year, which is trivial. By incorporating the conflict variable, it is examined if conflict can play a moderate role in the R&D-patent relationship. This regression is reported in column (2). It indicates that by taking the conflict variations into account the goodness-of-fit measure (R^2) is improved. Furthermore, one extra proposal results in 10 more patents, while one percent higher R&D investment produces only 0.82 of a patent. In this way, adding stockholder proposal numbers into the model makes the R&D factor more efficient in generating innovation. Next column adds the conflict in the first lag form.

Table 7: Conflict Index as Moderator in R&D-Patent Relationship

Variable	(1) OLS($y = Patent$)	(2) OLS($y = Patent$)	(3) OLS($y = Patent$)	(4) OLS($y = Patent$)
Conflict index		10.278		
		(6.401)		
L_1.Conflict			27.352***	19.044**
			(7.153)	(8.611)
R&D (in log)	72.771***	82.450***	84.297***	
	(8.365)	(11.310)	(13.053)	
SUM R&D (in log)				397.140***
				(8.168)
Constant	-248.280***	-285.361**	-332.556***	-3011.644***
	(57.190)	(71.873)	(78.911)	(306.234)
N	870	526	485	238
FE	✓	✓	✓	✓
Prob > F	0.000	0.000	0.0000	0.000
R^2	0.132	0.167	0.164	0.187

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Here, it is expected that the task-based conflict takes some time to emerge as a change in the operations and influence the performance indicators. Reported results in column(3) also confirms this hypothesis statically and suggests that one proposal in the previous year is associated with 27 more patents in the current year. Moreover, replacing the conflict index of the current year by that of the previous year has enhanced the R&D effect slightly. This specification is particularly common for measuring R&D investments because the return of such an investment is more likely to happen in a long-term setting. So in column (4), the sum of log(R&D) of the last five years is included. The variations in the number of conflict of the previous annual year plus the variations in the past five years of R&D explains almost 20% of the variation in the innovation index ($R^2 = 0.187$). So one percent higher investment on R&D over the last five years leads to around four more patents in the current year, while the marginal effect of the previous year proposals is 19 patents. As demonstrated in this column, the number of observations decreases as a lagged variable is added to the regression. Therefore, although the lagged variable can improve the goodness-of-fit of the estimation, the potential problem of truncated data may arise.

3.3.4 Poisson Regression

Several regression models have been conducted so far, all using an OLS model. Measuring the effect of R&D on the patent count has always been controversial due to the patent data nature. The patent number gets only non-negative values with high frequency for zero. One of the distributions developed for estimating count variables is Poisson distribution, which is also used often in the context of the R&D-patent relationship. (Hausman et al., 2008).

In fact, this model can be used for all observations that take only "integer" and are "independent and random" distributed such as the number of phone calls received in the customer service of a company in an hour. Independence and randomness are fundamental assumptions for the Poisson distribution. Also in the case of this work, by looking at the probability distribution of the patent data (Figure (3)), one can infer that the data can be represented by a Poisson distribution. The parameter of the Poisson distribution is donated as λ, while $log\lambda_{it} = \beta_i X_{it}$. In this application, λ can be estimated through a maximum likelihood algorithm while the basic Poisson probability specification is:

$$pr(y_{it}) = f(y_{it}) = \frac{\lambda_{it}^{y_{it}}.e^{-\lambda_{it}}}{y_{it}!}.$$

Also the residuals are estimated by $u_{it} = y_{it} - \lambda_{it}$. A restricted assumption of the Poisson model is equal conditional mean and conditional variance:

$$Var[y|x] = E[y|x]$$

The interpretation of the coefficients is also straightforward and can be calculated through:

$$\%\Delta E(y|x) \approx (100\beta_j)\Delta x_j.$$

Here because the estimator is based on the log-likelihood, the Poisson coefficient's interpretation is similar to the log-regression coefficient. Therefore, if x is a log variable,

Table 8: Poisson and Negative Binomial Regression

Variable	(1) Poisson	(2) Poisson	(3) Poisson	(4) Poisson (Robust SE)	(5) Poisson (Robust SE)	(6) N-Binomial	(7) N-Binomial
	$y = Patent$	$y = Patent$	$y = Patent$	$y = Patent$	$y = Patent$	$y = Patent$	$y = Patent$
Conflict Index		0.027***	0.012***	-0.001		-0.001	
		(0.002)	(0.003)	(0.053)		(0.014)	
L_1.Conflict			0.055***				
			(0.003)				
Corporate governance					-0.009		0.084***
					(0.058)		(0.029)
Executive compensation					0.105		0.113***
					(0.066)		(0.041)
Social policy					-0.042		-0.087***
					(0.097)		(0.027)
Size level			0.327***	0.311***	0.284***	0.393***	0.365***
			(0.015)	(0.164)	(0.149)	(0.073)	(0.073)
R&D (in log)	0.311***	0.248***	0.218***	0.562***	0.552***	0.491***	0.489***
	(0.004)	(0.005)	(0.005)	(0.059)	(0.049)	(0.031)	(0.031)
Constant						-3.043***	-0.454
						(0.193)	(0.196)
Likelihood-ratio test of alpha=0							
$Prob \geq chi^2$	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	862	522	364	431	431	431	431
Prob > chi				0.000	0.000	0.000	0.000
Log likelihood	-23317.904	-11476.671	-7067.177	-29340.016	-28960.404	-2551.841	-2541.726

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

then β can be interpreted as an elasticity. In this case, one percentage change in x leads to β percent change in $E[y|x]$ (Cameron and Trivedi, 2007). Likewise, if the explanatory variable is not a log variable, then β can be interpreted as a semi-elasticity. Knowing this, one unit change in x changes the conditional expected value ($log(E[y|x])$) by $100 * \beta$. In this case one unit change of x, can result in $(exp(\beta_i) - 1).100$ percent change in the expected value of y (Wooldridge, 2010).

The first four columns of Table (8) report the result of a Poisson regression model appropriate for the company-year panel data. The first column suggests that a one-percent increase in the R&D investment leads to an expected increase in the patent count by 0.27%. In this sense, 0.27 shows the elasticity of the patent number against R&D expenditure. The FE method is also applied in the model, as proposed by Cameron and Trivedi (2007). In case of an FE the following equation is valid, $log\lambda_{it} = \delta_i + \beta X_{it}$, where δ_i presents the fixed effect for company i. Here, one way to estimate β is to run conventional Poisson regression based on the maximum likelihood procedure while incorporating $n-1$ dummies for all companies. An alternative approach, which is also applied by STATA, is estimating the conditional Poisson model. This method calculates the maximum likelihood conditional on the total count ($\sum_t y_{it}$) for each company. Doing so, parameter δ_i is eliminated from the model (Cameron and Trivedi, 2007).

To test the moderating role of the conflict index's, the number of proposals is added to the next column model. The significant coefficients beside the maximum log-likelihood indicate that regression (2) gives a more convenient estimation concerning the goodness-of-fit. However, the effect of R&D increases when the conflict index enters into the model. Here, the Poisson model implies that expected increase in the count variable is 0.25% for a one-percent increase in R&D expenses, while one extra proposal leads to 2.7% more patents ($(exp(0.027) - 1) \times 100 = 2.7$). The next column incorporates the conflict index of the previous year beside the size as two new control variables. By incorporating the company size, the effect of the R&D expenditure decreases to 0.22%, and the impact of the company size seems non-trivial. The coefficient suggests that having one level higher number of employees lead to a 39% ($(exp(0.33) - 1) \times 100 = 39$) rise in the patent number. The results seem to be meaningful and reliable.

Similar to the OLS method, the Poisson model also assumes the **homoskedasticity**. This assumption implies that the error term, u, has the same variance independent of the explanatory variable value:

$$Var[u|x] = \sigma^2$$

So, presence of the heteroskedasticity can cause bias. In the case of Poisson model, heteroskedasticity appears in the form of over-dispersion, which implies that the variance varies over different segments of the population (Wooldridge, 2010). To test if Poisson regression with the current specification is the best fit for the given hypothesis, two further robustness checks are executed. Firstly, the result of the test with H_0: $\alpha = 0$ is included, where α is the over-dispersion parameter. In Table (8), the value of $prob < chi^2$ for this test is reported, implying that $\alpha = 0$ can be rejected, and therefore the over-dispersion is present.

Wooldridge (2010) suggests that the Poisson model has a robustness property, under which it gives consistent and asymptotically normal estimators. This assumption holds even in the presence of over-dispersion. In the general form, Poisson uses a maximum likelihood estimation (MLE). However, when the distribution does not fulfill the Poisson model requirements, quasi-maximum likelihood estimation (QMLE) is applied. This method estimate fixed-effects Poisson regression with robust standard errors. The STATA package written by Wooldridge for this specification is *-xtpqml-*. It also enables clustering the data at any appropriate level. Here, the heterogeneity comes from each industry. So it is perceived that fixed-effects should be preferably controlled at the industry level than the company level. Command *-xtpqml-* provides such clustering while using the Poisson framework. Column (4) shows the result of this regression when the panel variable is a company, but the companies are grouped at the sector level. In this sense, all companies sharing the same background are supposed to show similar characteristics. Here, because robust standard error (SE) is higher than regular SE for all estimators, the standard errors adjustment has decreased the significance of the conflict index coefficient. In contrast, both control variables show significant estimators. In the next column, the conflict index is broken down into its three types.

Column (5) also reports the robust standard errors for the estimated parameter as recommended by Cameron and Trivedi (2007); Wooldridge (2010). Here again, the data for different sectors are clustered. By controlling the over-dispersion, the standard errors increase so high that the coefficients are not significantly different from zero for the variables of interest. But the hypothesis that all coefficients are equal to zero can be rejected at the 0.05 level of significance. Very similar to the OLS estimators, corporate governance's effect turns negative, while the other two types are positively correlated with the number of patents. Also, the effect of a-one percent increase of the R&D has increased to 0.5% when robust SE are used.

In addition to the QMLE method, there is another way to get around heterogeneity within the panels in the literature. A specific type of the Poisson model appropriate for the count data with over-dispersion is used. Hausman, Hall, and Griliches (1984) introduced the negative binomial model to estimate the count data while taking the over-dispersion into account. Negative binomial model is a generalization of the Poisson regression, with a similar mean structure, but one more parameter (α), that estimates the over-dispersion, $Var[Y_i|x_i] = \mu_i + \alpha\mu_i{}^2$. Therefore, as soon as the over-dispersion has been recognized, the model applies the parameter to correct it. This model also does not assume a large amount of zero for the dependent variable (Cameron and Trivedi, 2007). Therefore, the negative binomial model is plausibly more appropriate in comparison to other models. The reason is that it can fit the count data very well while omitting the unnecessarily restricted constraint of equal conditional mean and variance. Columns (6) and (7) of Table (8) report the estimation of a negative binomial regression.

The coefficients are highly significant. Moreover, the total P-value shows that they are also jointly significant. The negative binomial model is also a maximum likelihood procedure and it iterates until the variations in the log-likelihood get small enough. Also, the maximum likelihood has dramatically increased and therefore is less negative for the negative binomial model. The amount of log-likelihood alone does not imply goodness-of-fit because it is a function of the number of observations. Because all factors remain constant, one can however infer that the negative binomial model gives a better fit for having a higher maximum likelihood value. Column (6) suggests that one extra proposal in the current year is associated with a 0.1% $((exp(0.001)-1).100 = 0.1\%)$ increase in the number of patents. Also, increasing the number of employees by one level raises the expected number of patents by $(exp(0.28)-1).100 = 45\%$. Moreover, the elasticity of patent with respect to the R&D expenses equals 0.17. The last column runs a negative binomial regression, while breaking down the conflict index. A negative binomial estimator with FE suggests that a one-percent increase in the R&D expenses probably leads to a 0.49% rise in the patent count. Moreover, the effect of the company size increases to 0.36 in comparison to the previous regression. The results also imply that disagreements over social policy are associated with a negative growth rate in the patent $((exp(-0.087)-1).100 = -8,6\%)$. At the same time, the other two types have a positive effect on the patent number. So one extra proposal concerning social policy changes the log of the expected patent by -0.087. In comparison to other models, negative binomial estimator suggests a positive and meaningful impact of the proposals on corporate governance $((exp(0.08)-1).100 = 8\%)$. However, the highest effect concerns the controversy over the management's payment or expressed in the field of agency theory, the wage of the agent. In this sense, the expected increase in the patent number through one more executive compensation proposal equals to $(exp(0.1)-1).100 = 10\%$.

At the bottom of the Table (8), the number of observations, besides the Likelihood-ratio test of $alpha = 0$, is reported. The latter, as mentioned before, indicates the parameter of over-dispersion. It tests if a negative binomial model parameter is significantly different from zero, which is here the case. If $alpha$ is zero, then the negative binomial turns to a Poisson model.

As a summary, the derived empirical results suggest a positive and significant effect of conflict on the shareholder proposals. The magnitude of the conflict effect on innovation varies across different models. It also differs for each type of conflict. A detailed summary of the results is provided here:

- Conventional OLS appropriate for the panel data shows that the presence of conflict positively affects the innovation outcome (by 28%). Also one extra proposal is associated with 19% higher revenue in a year (Table (5)). These coefficients seem to be biased and high.

- The findings suggest that an FE estimator is more appropriate than an random-effects one. Intuitively, one can think of several unobserved factors that affect the number of proposals that do not change over time; factors like the firm's industry, the organizational structure, specific rules and regulations that hold for the company's region. These factors can distort the estimated coefficients. Therefore, an FE OLS can be run to estimate the effect of the proposals. For an OLS model with the FE specification, one more proposal of type corporate governance decreases the number of patents by nine units. In contrast, social policy proposals are associated with 11 more patents (Table (6)).

- Also, one extra executive compensation proposal leads to an averagely 7% more patents in a year, when running OLS FE regression. The findings confirm the negative effect of cooperate governance proposal, while the other two types are positively associated with the innovation outcome (Table (6)).

- In the OLS model, adding conflict resolution into the R&D-patent regression enhances the goodness-of-fit. It means even for the R&D companies, this is beneficial to undertake this kind of activity. The findings suggest that without any conflict activities, a one-percent change in the R&D expenses lead to 0.72 more patents, however, after incorporating the proposal variations, the share of R&D increases to 0.82 while one proposal being averagely associated with 10 more patents. This effect increases for a model with both conflict and R&D expenses of the previous years (Table (7)). So one can infer a moderate role for conflict when considering the R&D-patent relationship.

- Due to the nature of the patent data, a Poisson with the robust standard errors is used in Table (8). Robust standard errors are applied to control for heteroskedasticity. The results show a negative effect of corporate governance proposal, whereas a positive effect of social policy and executive compensation proposals.

- Furthermore, a negative binomial regression is run because the data suffers from overdispersion. Consequently, it is arguable that a negative binomial estimator provides an unbiased and efficient estimation. The results suggest a positive and significant effect of executive compensation (i.e. 11%) and corporate governance (i.e. 8%) proposals. The effect of executive compensation seems to be robust across different models. The coefficient of the social policy proposals is, however, negative (i.e. -9%).

- The derived results on the corporate governance and social policy proposals confirm the shareholder activism literature, suggesting that the shareholder proposals have no apparent effect on the company's performance. In contrast, the results imply that the executive compensation proposals affect innovation positively, and their coefficients seem to be robust across different specifications. It suggests that companies or industries in which the negotiations over managers' monetary payment may happen are more prone to generate innovation.

- Also the findings support the hypothesis regarding the positive effect of the conflict on the monetary outcome at the industry level. In this sense, one more executive compensation proposal from shareholders is associated with 13% more revenue (Table (6)).

- Last but not least, the positive, remarkable effect of company size on the innovation can be referred from the result. The variable size coefficient varied over different models and settings; however, it always exceeds the effect of the R&D investment.

4 Conclusion

This work tries to determine whether conflict can be constructive to the innovation outcome. The main argument is that an organizational culture that encourages different stakeholders to interact and freely speak up is more prone to innovation. It argues that the role of conflict in generating innovation is via the knowledge transfer within each discussion. This is due to the fact that under information asymmetry, individuals do not possess the same set of knowledge and information. In this sense, the manager and the owner each have a piece of the puzzle, and therefore discussing different ideas may bring all pieces together. The conflict in the relationship between the stockholders and the board management is considered to depict a principal-agent relationship, as on this level, the decisions about the company's policies and strategies are made. Also, the number of patents serves as a proxy for innovation. To test the aimed hypothesis empirically, a dataset collected from over 134 companies of S&P 500 across 14 years was used, containing the data on patent and company's performance indicators. To find the best regression model fitting the data and the aimed hypothesis, different specifications were also checked.

The first building block of the argument is that innovation does not merely happen within one department or a separate procedure, but instead it happens along with a task and is highly affected by the organizational culture (Ritter and Gemünden, 2004). Another part of the argument focuses on the patent grant process. It hints that the patent does not need to be applied only to produce innovation, but the process can also be patented. Therefore, the management decision for creating a workplace where conflict is allowed and managed can explain the patent number changes.

Furthermore, to analyze the effect of different conflict types, the proposals were grouped by topic into executive compensation, corporate governance, and social policy. With this methodology, this work also tried to contribute to the non-R&D innovation literature and show the importance of such factors and particularly when taking conflict clarification activities as input. Another dependent variable used here is the annual revenue of the company. This variable was incorporated to test whether the conflict has a meaningful effect on the financial outcome. Analogue to the innovation literature, the current research controlled for R&D expenditure (Griliches, 1998; Hall et al., 2001) company size (Cohen, 2010; Stock et al., 2002) and the company's sector (Evangelista and Vezzani, 2010; Kam et al., 2003; Quadros et al., 2001).

In summary, the effect of conflict on the innovation is positive and significant for two types of proposals, executive compensation (i.e. 11%), and corporate governance (i.e. 8%). The conflict's effect seems to be remarkable compared to other factors, such as size (36% more patents for one level higher number of employees) and the R&D expenditure (0.49% increase in number of patents for 1% more R&D expenditure). This remark makes sense from an economic point of view. Moreover, the findings suggest that one more proposal of type executive compensation is associated with 13% higher revenue.

In addition to the primary hypothesis, it was also tested whether there is a proposal number for which the positive effect of the conflict is maximum. The result of the empirical investigation implies that the optimal number of proposals equals to four.

Despite the findings of the current studies, there still remains a significant gap in the literature concerning non-R&D innovations. However, a portion of those non-R&D activities is considered complementary to R&D (OECD/Eurostat, 2005). The findings of this thesis showed that conflict in running the business could positively affect the innovation outcome. This result can also be generalized to other non-R&D factors.

This work also brought up new questions that can be addressed in future investigations in several fields of study. For instance, research can be conducted to examine the role of conflict in the venture capitalist-entrepreneur relationship. On the one hand, the existing philosophy of a start-up is creating innovation. On the other hand, this feature makes the VC market prone to creating conflict. Moreover, further works can be conducted on how non-R&D investment can affect TFP. It can be done by addressing which type of non-R&D investments are associated with what type of innovation (See Lopez-Rodriguez and Martinez-Lopez (2017).). Also, this study did not investigate how the perception of the non-R&D side of the innovation can be changed. This serves as an essential topic when talking about the decision making procedure at the top level. Throughout well-known methods, such as devil advocacy, can be conducted.

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Thesis Conclusion

This thesis focused on the agency relationship through observing the role of conflict. Within the principal-agent dyad, it particularly set the focal point on one specific type of conflict, i.e., task conflict and concentrated on the corporate governance and the mutual interactions of corporate components as the main field of study. Then they were investigated once theoretically and once empirically. Doing so, more dimensions of conflict of interests were managed to be addressed. For the theory setting, the general mathematical model of the agency theory was adopted, which was developed to a conflict clarification (CC) model. Then, it was demonstrated that such a model outperforms the one which takes only operational efforts into account. Findings of the CC model confirm the existing conflict management literature to a fair extent. There are shreds of evidence, suggesting that the agency theory fails to observe and model non-operational efforts (Nilakant and Rao, 1994) , and in this manner, the agent's problem-solving competence and preferences as an individual have been overlooked (Amason, 1996; Jensen and Meckling, 1976; Smith, 2010).

In addition to the conflict aroused from the agent side, in the empirical section, the role of shareholder activism on the innovation index was examined. For this purpose, the role of granting a voice to the principals, when the agents are the key business decision-makers was investigated. Doing so it was tried to show that no matter, from which party the conflict arises, it can affect the team performance constructively. The major argument is derived from three propositions. Firstly, after any discussion over the way of doing the task, some knowledge about the task is transferred to the other party, which was hidden before. This is like each party having one piece of the puzzle in the hand, where sharing knowledge servers as putting the puzzle pieces together. Furthermore, the process of resolving conflict helps the principal to observe the agent's will and to have a better evaluation of his type. The presence of such a process reduces the uncertainty by making the contract more transparent. Finally, granting the agent a voice provides him with a higher intrinsic incentive to work.

Within the general agency theory paradigm, the conflict of interest serves as a building block. The agency theory takes the agent's operational effort as the input and tries to maximize the payoff while setting the benefit of the principal as the ultimate objective. By this specification, the separation of management and ownership can be costly and consequently destructive to the corporation's ultimate goal (Jensen and Meckling, 1976; Smith, 2010). On the contrary, the findings of the real world suggest the constructive role of task conflict (Rahim, 2002; Tversky and Kahneman, 1992). Similarly, in the agency literature, there are several examples that examine the role of behavioral factors in mitigating agency problem (Eisenhardt and Bourgeois, 1988; McGraw and McCullers, 1979). Carnegie School advocates argue that the theory of the firm puts little emphasizes on the decision-making process, which is directly affected by behavioral and psychological factors in a business firm. Based on the behavioral postulates, Carnegie School developed a model to predict decision-making behaviors by applying real-life incentives. To this end, they developed several rational concepts as the basis for the firm's behavioral theory (Argote and Greve, 2007; Eisenhardt and Bourgeois, 1988; Gavetti et al., 2012). Among them, the "quasi-resolution of conflict" counts as the concept of dealing with the conflict clarification context. This concept considers the firm as a coalition of different groups of people, stakeholders, and stockholders, who should seek a middle point in the conflict of interests (Cyert and March, 2015). Despite several number of researches conducted in the behavioral agency theory, a study that addresses the role of the conflict within the agency paradigm is missing. Being aware of this gap, the current thesis tries to address the inconsistency between the role of conflict in theory and practice.

The findings of this thesis indicate that observing and utilizing conflict provides the firm with a larger innovation capacity. They show that in line with the explained assumptions, an agency model with conflict clarification activity as the second input produces a higher total outcome compared to a general agency model. This result is independent of the observability level of this type of effort. Moreover, the effect of the conflict settlement grows greater as the company becomes more innovative. For the empirical examination, the data was collected from over 134 companies of SP 500 in 14 years. Bey means of this dataset, the effect of various types of shareholder proposals on the patent number was tested. The results suggest a positive and significant effect of executive compensation (i.e. 11%) and corporate governance (i.e. 8%) proposals. Also, one extra executive compensation proposal is associated with 13% higher revenue.

The current study depicts a new paradigm in the organizational relationship. It also supports the literature that believes in the critical task of the organizational culture in defining an agent's role and authority in corporate governance. For example, through a survey Yoshimori (1995) found that a corporation's objectives are a function of behavioral and cultural factors that have been understated so far. He tried to observe how diverse is the definition of corporate governance across different cultures. Over a total of 300 managers from Japan, the UK, the USA, and Germany were asked to answer the question: "Who is the company's owner?". The result notably stands in complete consistency with the cultural backgrounds of the managers.

Over 97% and 83% of Japanese and German managers respectively believed that the Company belongs to all stakeholders and not only the shareholders. In contrast, 76% and 71% of all US and UK managers respectively stated that only shareholders own the company. Undoubtedly, in a corporation whose manager believes in all stakeholders' ownership of the firm, the employees are possibly granted a voice to alter the corporation's strategies effectively. For instance, in Germany or Japan, the managers decide based on a stakeholder-oriented system and seek to preserve all stakeholders' rights. The latter scenario is promoted in recent decades, and endeavors to force large concerns to prioritize the stakeholders' interest (Goergen, 2012).

Similarly, the results propose a redefinition of the principal-agent relationship based on cooperative values rather than competitive ones. Furthermore, each group of stakeholders' perceptions of their rights and authorities can vary based on location and cultural appropriations. For example, in the organizational cultures adopted in the US or UK, where the *principle of shareholders primacy* is intact, the managers tries to secure the interest of the shareholders.

This thesis also contributes to the literature on non-R&D innovation. The result has been driven from concentrating on the conflict clarification activities, but it can also be generalized to other non-R&D factors. Therefore, further works need to be carried out, as there is still a significant gap in the literature concerning non-R&D innovations. For example, research can be conducted on how non-R&D investment can affect total factor of productivity (TFP). Such a research can be done by addressing which type of non-R&D investments are associated with what type of innovation (See Lopez-Rodriguez and Martinez-Lopez (2017)). Moreover, behavioral scholars are encouraged to study how the perception of the non-R&D side of the innovation can be changed. This serves as an essential question when talking about the decision-making procedure at the top level, where well-known methods, like devil advocacy, can be applied.

From another point of view, the current thesis can serve as a basis for future studies on the role of conflict in the relationship between venture capitalists and entrepreneurs. The existing philosophy of a start-up is creating innovation. At the same time, its business model and its special corporate governance attributes make information asymmetry a very critical issue. Since besides the management role, the entrepreneur possesses the expertise, as the party with additional information about the project process they can change their actions to the detriment of principal (Jensen, 1983; Smith, 2010).A very common example of this encounter is when an entrepreneur invests in an idea, which has a high personal return and recognition for them in the scientific community, but it postpones the investor's expected payoff. This controversial course of actions between the entrepreneur and the external investor is called a "grandstanding problem" Parker (2005).

Finally, the current thesis has some implications for the managers and policymakers in developing new policies in a behavioral context. In this sense, further investigations regarding the job profile can be conducted, which was not carried out in the current thesis due to the existing limitations. The proper question then would be, what combination of the operational and non-operational task leads to an optimal state. Another application for the current thesis is for scholars to build more modern decision-making models which take more humanistic preferences into account. It includes models that obsolete the conventional strategy of the carrot and stick and look for authentic factors that trigger the individual's action.

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