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Abstract

A principal hires an agent to provide a verifiable service. Initially, the agent can exert unobservable effort to reduce his disutility from providing the service. If the agent is free to waive his right to quit, he may voluntarily sign a contract specifying an inefficiently large service level, while there are insufficient incentives to exert effort. If the agent's right to quit is inalienable, the underprovision of effort may be further aggravated, but the service level is ex post efficient. Overall, it turns out that the total surplus can be larger when agents are *not* permitted to contractually waive their right to quit work. Yet, we also study an extension of our model in which even the *agent* can be strictly better off when the parties have the contractual freedom to waive the agent's right to quit.

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1 Introduction

The Thirteenth Amendment to the United States Constitution prohibits *involuntary* servitude, except as a punishment for crime. But what if an agent *voluntarily* signs a contract to provide a service for a principal? Should such contracts always be enforceable? Or should the freedom of contract be restricted, such that the agent cannot waive his or her right to quit work?

According to the Coase Theorem, restricting the freedom of two rational parties to contract with each other cannot be welfare-enhancing when there are no externalities on third parties.[1] After all, when two parties voluntarily agree to a contract, then both parties must be (at least weakly) better off than in the absence of the contract. When the freedom of contract is not restricted, the Coase Theorem asserts that the two parties will agree on a contract maximizing the total surplus that can be generated in their relationship. Thus, prohibiting certain contracts (e.g., labor contracts in which the agent waives the right to quit work) cannot be desirable from an economic efficiency point of view.

However, the Coase Theorem holds only if there are no transaction costs. Contract theory has identified *moral hazard* problems due to unobservable actions as an important source of transaction costs.[2] In this paper, we argue that in the presence of moral hazard problems there are circumstances under which it may be welfare-enhancing *not* to enforce contracts in which the agent's quitting rights are waived. Specifically, in our setup the total surplus generated in a relationship between two parties may be strictly larger when the freedom of contract is restricted such that agents have an inalienable right to quit work.

In our baseline model it is always the case that the principal weakly prefers contractual freedom, while the agent weakly prefers having an inalienable right to quit. Yet, in an extension of our model we show that there are circumstances under which also the *agent* may be strictly better off when the parties have the contractual freedom to waive the agent's right to quit.

[1] See the recent review article by Medema (2020) for an extensive discussion of the work initiated by Coase's (1960) seminal contribution. For a concise introduction to the Coase Theorem, cf. Singh (2016).

[2] On the origins of contract theory and the analysis of moral hazard problems, see Hart and Holmström (1987). For modern textbook expositions of contract theory, see Laffont and Martimort (2002) and Bolton and Dewatripont (2005). Cf. also the recent survey articles by Hart (2017) and Holmström (2017).

Background. Pope (2010) has pointed out that an inalienable right to quit work did not arise straightforwardly from the Thirteenth Amendment.[3] On the one hand, one can argue that if a worker voluntarily enters into a contract, it is hard to see how the worker could be in a condition of involuntary servitude. If workers were granted the right to quit at any time, then they would lose the freedom to make fully enforceable labor contracts. On the other hand, one can argue that servitude becomes involuntary the moment that a worker wishes to cease work and is prevented from doing so.[4] According to Pope (2010, p. 1491), today the right to quit is "the only major, unenumerated constitutional right to win near-universal approval".

But why do we have to protect workers against their own free choice? Pope (2010, p. 1492) argues that a worker's choice might not be truly free, workers might not know their rights, and they "might need paternalistic protection". Our contribution in the present paper is to develop a contract-theoretic model in order to supplement these reasons with a purely efficiency-based rationale. However, we also point out that it can actually be in a rational agent's self-interest to have the contractual freedom to waive the right to quit.

Outline of the model. We consider a principal (she) who hires an agent (he) to provide a service in the future (i.e., at stage 2). The service level is verifiable, so in principle it is possible to enforce a contractually agreed-upon service level. However, at stage 1 the agent can exert effort in order to reduce his disutility from performing the second-stage task. The ex ante uncertain outcome of the first stage is either a success (i.e., the disutility will be small) or a failure (i.e., the disutility will be large). It is verifiable whether there is a success or a failure, so it is possible to write a contract that specifies a second-stage service level depending on the first-stage outcome.[5] However, the effort level is unobservable; i.e., there

[3] The Thirteenth Amendment was adopted in 1865. On the legislative origins of the right to quit work as set forth in the Northwest Ordinance of 1787 and the Anti-Peonage Act of 1867, see also the discussions in VanderVelde (1989), Wonnell (1993), Oman (2009), Zietlow (2010), Soifer (2012), and Brandwein (2017).

[4] Initially, in *Robertson v. Baldwin* (165 U.S. 275 [1897]) the Supreme Court resolved the tension between the freedom of contract and the right to quit in favor of the former (the "Illinois rule"). Yet, the Court reversed direction (thereby adopting the "Indiana rule") in *Clyatt v. United States* (197 U.S. 207, 215 [1905]) and reaffirmed this position in *Bailey v. Alabama* (219 U.S. 219 [1911]) and in *Pollock v. Williams* (322 U.S. 4, 25 [1944]).

[5] We will show in Section 5 that the insights gained in our model carry over to the case in

is a moral hazard problem. We assume throughout that while both parties are risk-neutral, the agent has no wealth. Hence, we consider an "efficiency wage" model in which payments from the principal to the agent must not be negative.[6]

For example, in the first stage the agent might engage in R&D activities with an uncertain outcome, whereas in the second stage the agent performs a routine production task which is fully contractible. As an illustration, suppose the agent is in charge of developing a new vaccine. While the agent's effort in the research stage is a hidden action, it is possible to verify the outcome (say, whether or not the vaccine requires deep-freezer units, which would make handling the vaccine much more costly). Note that already at the outset of the principal-agent relationship the principal can specify a verifiable number of doses of the vaccine that the agent will have to produce after the vaccine has been developed.[7]

We consider two scenarios. In *Scenario I*, the freedom of contract is unrestricted, so the parties can agree on a contract in which the agent's quitting rights are waived. The principal offers a contract to the agent which specifies payments and second-stage service levels depending on the outcome of the first stage. Given such a contract, the agent might want to quit at the beginning of the second stage, even though at the beginning of the first stage the agent voluntarily agreed to the contract waiving his right to quit.[8] Indeed, it turns out that under some circumstances the contract will specify an ex post inefficiently large service level. The reason is that in order to incentivize the agent to exert high effort in the first stage, the principal can reward the agent with a large payment in case of a success, but she cannot use a negative payment to punish the agent in case of a failure. Instead, the parties agree on a contract according to which utility is transferred from the

which the agent has private information about the first-stage outcome.

[6] The term "efficiency wage" is used here in the contract-theoretic sense of Tirole (1999, p. 745), Laffont and Martimort (2002, p. 174), and Schmitz (2005c).

[7] One can think of numerous other real-world situations that fit in with our formal framework. For instance, in the first stage a worker may invest relationship-specific effort in his human capital. It is unobservable how hard the worker learns, but at the end of the first stage the worker's qualification can be certified. The worker's verifiable second-stage responsibilities can be contractually specified depending on his qualification. Cf. the recent work by Fudenberg and Rayo (2019) for a model in which a cash-constrained apprentice is free to walk away at any time.

[8] Note that in Scenario I it is assumed that an agent can enter into a labor contract that is enforceable by specific performance. See Shavell (2006, p. 855), who emphasizes the desirability of specific performance when an agent is judgment-proof in the sense that the agent's assets are limited such that he cannot pay damages.

agent to the principal by an ex post inefficiently large service level in the case of a first-stage failure. Moreover, due to the deadweight loss caused by the upward distortion of the service level, the principal will not always induce high effort when she would do so in a first-best world without frictions.

In *Scenario II*, the freedom of contract is restricted, such that labor contracts in which the agent waives his right to quit are prohibited by law. Hence, the agent must voluntarily agree to the contractual terms at the beginning of the first stage and at the beginning of the second stage.[9] This means that in the second stage the principal must always reimburse the agent for his disutility of providing the specified service level, so the parties will always agree on the ex post efficient service level. Since the agent cannot be punished for a first-stage failure with an ex post inefficient service level, the principal must now leave a rent to the agent in order to motivate him to exert high effort in the first stage. Thus, inducing high effort in Scenario II is more expensive for the principal than in Scenario I. As a consequence, in Scenario II the principal will inefficiently refrain from inducing high effort for an even larger range of parameters than in Scenario I.

To summarize, our model highlights the following trade-off. If the freedom of contract is unrestricted (Scenario I), then compared to the first-best benchmark there may be an upward distortion of the second-stage service level and a downward distortion of the first-stage effort level. If the right to quit work cannot be waived (Scenario II), the problem of the downward distortion of the effort level is aggravated, but the service level is ex post efficient. Overall, as might have been expected, there are circumstances under which the total surplus is larger in Scenario I than in Scenario II. Yet, there are also circumstances under which restricting the freedom of contract by an inalienable right to quit can yield a larger total surplus. In particular, not permitting the agent to waive his right to quit can be welfare-enhancing when the optimal second-stage service level depends on the outcome of the first stage and when it is important to motivate the agent to exert high first-stage effort. Given that legal rules must be general and cannot rely on evaluating welfare on a case-by-case basis, our model thus suggests that the lawmaker may conclude that (compared to a situation in which the freedom of contract is not restricted) an inalienable right to quit work indeed fares better

[9] Thus, in Scenario II the courts do not enforce specific performance contracts. Indeed, current law does not grant specific performance in the case of a personal-services contract. Cf. the famous English case of *Lumley v. Wagner*, 42 Eng. Rep. 687 (1852).

on average.

However, it should be emphasized that in our baseline model it is assumed that the principal's technology that is used by the agent to perform his tasks is already in place. When the principal must first make a non-contractible investment to install the technology, then in Scenario II the principal's expected profit may be too small to make the investment worthwhile. In this case, a strictly positive total surplus can be generated only in Scenario I. Hence, when the agent is able to get a share of the total surplus generated by the two parties, then also the agent may strictly prefer Scenario I. We should thus be aware of the fact that restricting the freedom of contract by making the right to quit inalienable can actually hurt both the principal and the agent.

Organization of the paper. The remainder of the paper is organized as follows. In the next section, we briefly discuss the relation of our model to the contract-theoretic literature. In Section 3, the model is presented. We analyze the model and derive our main results in Section 4. In Section 5, we show that our results are robust when only the agent learns the first-stage outcome. In Section 6, we point out that in an extension of our model even the agent can be strictly better off when the right to quit may be waived. Concluding remarks follow in Section 7. Some formal proofs have been relegated to the Appendix.

2 Related literature

It is well-known that restricting the freedom of contract can be desirable if a contract between two parties may have negative external effects on a third party (see e.g. Spier and Whinston, 1995). In contrast, we focus on the gains from trade that are generated within the relationship of a principal and an agent; i.e., our results do not depend on externalities on third parties.

Moreover, it is important to emphasize that in our model the parties are always symmetrically informed at the time of contracting. Our setup is thus different from papers such as Aghion and Hermalin (1990) and Schmitz (2004), who show that legal restrictions on private contracts can be welfare-enhancing when the contract is written by asymmetrically informed parties.[10]

[10] Aghion and Hermalin (1990) argue that it can be desirable to restrict the class of contracts that a privately informed party is allowed to offer, because in this way inefficient signalling can be ruled out. In a screening model, Schmitz (2004) shows that employment protection laws can

The driving force in our "efficiency wage" model is a moral hazard problem with bounded payments.[11] To the best of our knowledge, the present paper is the first contribution to the moral hazard literature highlighting a trade-off between insufficient incentives to exert unobservable effort in the first stage and the specification of an inefficiently large service level in the second stage. While several papers in the literature on moral hazard problems with bounded payments have studied two-stage models, these models are typically focused on the implications of second-stage rents for first-stage incentives (see e.g. Schmitz, 2005a, Kräkel and Schöttner, 2016, or Pi, 2018). In these papers the decision to be taken in the second stage is a hidden action, so it is impossible to contractually specify a second-stage service level that the agent would not provide voluntarily. In contrast, in our model the service level is verifiable, allowing us to study how under unrestricted freedom of contract overwork in the second stage may be used to ex post inefficiently extract the rent that the agent would get if he had an unalienable right to quit.

Our model is also related to the literature on non-compete clauses, which are meant to protect employers from employees taking away technological know-how or key customers to competitors of the employer.[12] In contrast, in our model we focus on the principal-agent relationship and do not consider competitors of the principal.[13] Our Scenario II is also related to Englmaier et al. (2014), who consider

enhance welfare when an employer makes a contract offer to a privately informed employee.

[11]Moral hazard models with risk-neutral but wealth-constrained agents have become incresingly popular in the contract-theoretic literature. For early papers in this vein, see e.g. Innes (1990), Baliga and Sjöström (1998), and Pitchford (1998). More recent contributions include e.g. Ohlendorf and Schmitz (2012), Kragl and Schöttner (2014), Pi (2014, 2018), Tamada and Tsai (2014), Axelson and Bond (2015), Green and Taylor (2016), Kräkel (2016), Kräkel and Schöttner (2016), Cato and Ishihara (2017), Schöttner (2017), Altan (2019), At et al. (2019), Au and Chen (2019), and Hoppe and Schmitz (2021).

[12]Non-compete agreements also play an important role in the sports and entertainment industries. In the classic English opera dispute *Lumley v. Wagner* (42 Eng. Rep. 687 [1852]), German soprano Johanna Wagner signed a contract to perform at the opera house owned by plaintiff Benjamin Lumley. Wagner wanted to perform at a rival theatre. The court found that while an affirmative injunction was not appropriate (i.e., specific performance of personal service arrangements cannot be enforced), a negative injunction could be issued. The Lumely rule has become the progenitor of many cases in sports law (see Rapp, 2005).

[13]For an analysis of non-compete arrangements from an economic perspective, see Kräkel and Sliwka (2009).

a moral-hazard model in which a "knowledge worker" is free to leave after he has exerted effort in a first stage. Yet, if the worker stays, there is no second-stage decision to be taken. Hence, in contrast to the model that we study, there can never be ex post inefficient overproduction in their framework.

Finally, it should be noted that while renegotiation in contractual relationships plays a central role in incomplete contracting models (cf. Hart, 1995), renegotiation has no bite in our model. In particular, the ex post inefficiency that occurs in Scenario I cannot be renegotiated away. When an ex post inefficiently large second-stage service level has been specified, then at the beginning of the second stage the agent would prefer to renegotiate. Yet, since the agent has no wealth he cannot compensate the principal, who will therefore insist on the contract being fulfilled.[14]

3 The basic model

A principal hires an agent to conduct a project on her behalf. Both parties are risk-neutral. The agent has no wealth, so payments to the agent must not be negative (i.e., we study a framework with limited liability). The project consists of two stages. First, there is a preparation stage. Second, there is a project implementation stage. In the preparation stage, the agent can exert unobservable preparatory effort to reduce the expected difficulty of project implementation, which is measured by the ex ante uncertain disutility (e.g., the physical or psychological stress) associated with managing a project of a given size. The contractible size of the project which is to be implemented by the agent can be conditional on the realized difficulty of project implementation, which is verifiable in our baseline model. For simplicity, we assume that there is no discounting. In the remainder of this section, we describe the principal-agent relationship in more detail.

3.1 Project preparation and project implementation

If a project of size $y \in [0, 1]$ is implemented in the second stage, the project's benefit by accrues to the principal, while the cost of project implementation in form of the non-monetary disutility cy is borne by the agent. From an ex ante

[14]In contrast, discussing whether or not contractual non-renegotiation clauses should be enforceable, Schmitz (2005b) considers a two-stage moral hazard problem in which there is scope for mutually beneficial renegotiation at the beginning of the second stage. On the law and economics of contract modifications, see also Davis (2006).

point of view, the implementation cost parameter c can be either low or high; i.e., $c \in \{c_L, c_H\}$, where $0 < c_L < c_H$ and $b > c_L$. The actual realization of the cost c of project implementation is determined by a random draw of nature after the agent has decided how much effort to devote to the preparation of the project in the first stage. Specifically, if the agent decides to exert preparatory effort $e \in \{0, 1\}$ at non-monetary cost $K(e) = ke$, where $k > 0$, then $Prob\{c = c_L|e\} = p_e$. We assume that $0 < p_0 < p_1 < 1$; i.e., the probability of a low disutility is larger when the agent exerts effort $e = 1$ than when he exerts effort $e = 0$.

3.2 Information and contracts

The ex post realization of the cost of project implementation, measured by c, is verifiable.[15] The agent's choice of preparatory effort, on the other hand, is a hidden action and thus non-verifiable. Hence, a contract can specify a transfer payment from the principal to the agent and a level of project size that is conditioned on the realization of the cost of project implementation.

Specifically, at some initial contracting stage the principal offers the agent a contract $\Gamma = (t_L, t_H, y_L, y_H)$, which bindingly specifies transfer payment t_i and project size y_i for the case that the implementation of the project turns out to be associated with cost c_i, where $i \in \{L, H\}$. Note that t_i is paid from the principal to the agent and must be non-negative due to limited liability.

We consider two different contracting scenarios. In *Scenario I*, the freedom of contract is not restricted. Hence, the principal can offer a contract to the agent under which the agent waives his right to quit work; i.e., the agent can contractually bind himself to the principal for both stages of the project. In *Scenario II*, the agent cannot waive his right to quit work. Here, signing the initial contract binds the agent to the principal only for the preparation stage of the project. The agent cannot commit not to unilaterally terminate the contractual relationship with the principal after the completion of the preparation stage and before the start of the implementation stage.

3.3 Sequence of events

The sequence of events is as follows. At date $T = 0$, the contracting stage, the principal offers the contract $\Gamma = (t_L, t_H, y_L, y_H)$ and the agent rejects or accepts.

[15] We will relax this assumption in Section 5.

In case of rejection, the two parties go separate ways and each party receives a reservation utility equal to zero.[16] In case of acceptance, the preparation stage begins. At date $T = 1$, the agent chooses preparatory effort $e \in \{0, 1\}$. Thereafter, at date $T = 2$, the cost $c \in \{c_L, c_H\}$ of project implementation is realized. The realization of c is observed by both the principal and the agent, which concludes the preparation stage. At the interim date $T = 3$, before the implementation stage begins, in Scenario II the agent decides whether or not to quit work. In case the agent quits work, the two parties go separate ways and each party receives a reservation utility equal to zero. In case the agent does not quit work, the relationship moves on to the implementation stage. In Scenario I, where the agent waived his right to quit work when accepting the principal's contract offer at date $T = 0$, nothing happens at date $T = 3$ and the relationship moves on to the implementation stage. At date $T = 4$, the agent implements the project of the size that was contractually specified for the realized cost c, and the principal pays the corresponding transfer to the agent.

4 Analysis

4.1 The first-best benchmark

In a first-best world without contracting frictions, the Coase Theorem holds and thus the parties would agree on the decisions that maximize the expected total surplus. Specifically, in our setup the expected gains from trade are

$$G(y_L, y_H, e) = p_e(b - c_L)y_L + (1 - p_e)(b - c_H)y_H - ke,$$

which comprise the expected net benefit from project implementation minus the effort cost for project preparation. The first-best levels of project size and preparatory effort maximize the expected gains from trade:

$$(y^{FB}(c_L), y^{FB}(c_H), e^{FB}) \in \underset{(y_L, y_H, e) \in [0,1]^2 \times \{0,1\}}{\arg\max} G(y_L, y_H, e).$$

Given realization $c \in \{c_L, c_H\}$ of the implementation cost, ex post efficiency requires maximum project size if the benefit from implementation exceeds the

[16] While it is beyond the scope of the present paper, in future research it might be interesting to embed our model in a framework with competing principals where the agent's reservation utility is endogenously determined.

associated cost; i.e., $y^{FB}(c) = 1$ if $c < b$. If, in contrast, the cost of project implementation exceeds the associated benefit, then ex post efficiency requires the project to be cancelled; i.e., $y^{FB}(c) = 0$ if $b < c$. Hence, in the case of low implementation cost the first-best project size is $y^{FB}(c_L) = 1$, since $c_L < b$ holds by assumption. In the case of high implementation cost, the first-best project size $y^{FB}(c_H)$ depends on whether b exceeds c_H or not.

The ex ante efficient effort level maximizes the expected gains from trade given the ex post efficient project size. A comparison of $G(1, y^{FB}(c_H), 1)$ and $G(1, y^{FB}(c_H), 0)$ then leads to the following characterization of the first-best levels of project size and effort.[17]

Proposition 1 *The first-best levels of project size and effort are given by*

$$y^{FB}(c_L) = 1, \qquad y^{FB}(c_H) = \begin{cases} 1 & \text{if } c_H \leq b, \\ 0 & \text{if } b < c_H, \end{cases} \qquad e^{FB} = \begin{cases} 1 & \text{if } k \leq k^{FB}, \\ 0 & \text{if } k^{FB} < k, \end{cases}$$

where

$$k^{FB} := (p_1 - p_0)\left[(b - c_L) - (b - c_H)y^{FB}(c_H)\right].$$

The decision rule that governs first-best effort choice is very intuitive. If $c_H \leq b$, then maximum project size is implemented irrespective of whether the implementation cost is low or high. Hence, high rather than low preparatory effort should be exerted if the associated decrease in expected cost of implementing a project of maximum size, $(p_1 - p_0)(c_H - c_L)$, exceeds the associated increase in effort cost, k. If, on the other hand, $b < c_H$, then the project is canceled if the implementation cost turns out to be high. In this case, high rather than low effort should be exerted if the associated increase in the expected net benefit from implementing a project of maximum size at low cost, $(p_1 - p_0)(b - c_L)$, exceeds the associated increase in effort cost, k.

4.2 Scenario I: Unrestricted freedom of contract

In Scenario I, the principal and the agent are free to write a contract according to which the agent waives his right to quit work. The agent may thus bind himself to the principal for both the preparation stage and the implementation

[17]For simplicity, we assume that $y = 1$ is chosen in case of indifference regarding the project size, and $e = 1$ is chosen in case of indifference regarding the effort level.

stage. Suppose that at date $T = 0$ the principal and the agent sign a contract $\Gamma = (t_L, t_H, y_L, y_H)$ under which the agent exerts effort $e \in \{0, 1\}$. The principal's expected utility in this case consists of the expected benefit from project implementation minus the expected transfer payment to the agent:

$$U_P(\Gamma, e) = b[p_e y_L + (1 - p_e)y_H] - [p_e t_L + (1 - p_e)t_H]$$

The agent's expected utility consists of the expected transfer payment from the principal minus the expected cost of project implementation minus the cost for preparatory effort:

$$U_A(\Gamma, e) = p_e t_L + (1 - p_e)t_H - [p_e c_L y_L + (1 - p_e)c_H y_H] - ke.$$

The principal's contract design problem thus takes the following form:[18]

$$\max_{\Gamma \in \mathbb{R}^2 \times [0,1]^2} U_P(\Gamma, e)$$

subject to

$$U_A(\Gamma, e) \geq U_A(\Gamma, e') \quad \text{with} \quad e, e' \in \{0, 1\},\ e \neq e', \tag{IC$_e$}$$

$$U_A(\Gamma, e) \geq 0, \tag{PC$_e$}$$

$$t_L \geq 0,\ t_H \geq 0. \tag{LL}$$

The incentive compatibility constraint (IC$_e$) reflects that the principal correctly anticipates that at date $T = 1$ the agent will choose the effort level which maximizes his own expected utility under the contract offered by the principal. The participation constraint (PC$_e$) ensures that at date $T = 0$, the agent (who correctly anticipates his own date-1 effort choice) is willing to accept the contract offered by the principal. Finally, the limited liability constraint (LL) requires the transfer payments specified in the principal's contract offer to be non-negative.

Two preliminary remarks are in order. First, recall that the sum of the principal's and the agent's expected utilities is equal to the expected gains from trade; i.e., $U_P(\Gamma, e) + U_A(\Gamma, e) = G(y_L, y_H, e)$. As a consequence, when making her contract offer, the principal effectively aims at maximizing the expected gains from trade minus the agent's expected utility.

Second, according to the incentive compatibility constraint (IC$_e$), the agent is willing to devote high effort $e = 1$ to project preparation whenever

$$(p_1 - p_0)[(t_L - t_H) - (c_L y_L - c_H y_H)] \geq k; \tag{1}$$

[18] Throughout, we assume that the agent exerts the level of preparatory effort desired by the principal in case that he is indifferent between exerting high effort and exerting low effort.

i.e., whenever the associated change in the difference of the expected transfer payment and the expected cost of project implementation exceeds the associated increase in the effort cost for project preparation.

Case 1: $c_H \leq b$. If the benefit b from project implementation (at least weakly) exceeds the high realization of the implementation cost, then the first-best project size and the first-best effort will be attained when the freedom of contract is not restricted. To see this, consider a contract that specifies the same transfer payment for both realizations of the implementation cost; i.e., suppose that $t_L = t_H$. In this case, the expected transfer payment does not depend on the agent's decision regarding preparatory effort and, as can be seen from (1), the agent's effort choice in the preparation stage is independent of the two transfer payments. If, in addition, the contract specifies the ex post efficient levels of project size (i.e., if $y_L = y_H = 1$), then according to (1) the agent is willing to exert high rather than low preparatory effort if the associated "saving" on the expected cost of implementing a project of maximum size, $(p_1 - p_0)(c_H - c_L)$, exceeds the associated increase in effort costs for preparatory effort, k. Hence, as revealed by comparison with Proposition 1, the agent is always willing to exert the first-best effort level under such a contract. Finally, note that the principal can fully extract the expected gains from trade (i.e., the agent's participation constraint becomes binding) by setting the identical transfers t_L and t_H equal to the overall expected cost of project preparation and project implementation (given first-best effort and first-best levels of project size). As this is the best the principal can do, we have established the following observation:[19]

Lemma 1 *Consider Scenario I and suppose that $c_H \leq b$. Then the contract Γ that specifies transfer payments $t_L = t_H = ke^{FB} + p_{e^{FB}}c_L + (1 - p_{e^{FB}})c_H$ and levels of project size $y_L = y_H = 1$ is an optimal contract.*

Hence, the optimal contract specifies ex post efficient maximum project size and provides the agent with ex ante efficient incentives. Therefore, in case the

[19] Note that the contract characterized in the following lemma is an optimal contract, but it is not the unique optimal contract. In fact, given that the participation constraint is satisfied with equality for given levels of project size, the principal does not care about the exact specification of the transfers (as long as the incentive compatibility constraint and the limited liability constraint hold as well). The same qualifier applies to the rest of our results whenever there are multiple optimal contracts.

principal's benefit from project implementation (at least weakly) exceeds the high realization of the agent's implementation cost, contracting in Scenario I *always* results in first-best project size and first-best effort.[20]

Proposition 2 *Consider Scenario I and suppose that $c_H \leq b$. The levels of project size and effort implemented under the optimal contract are given by*

$$y_L^I = 1, \qquad y_H^I = 1, \qquad e^I = \begin{cases} 1 & \text{if } \; k \leq k^{FB}, \\ 0 & \text{if } \; k^{FB} < k. \end{cases}$$

Case 2: $b < c_H$. In order to determine the levels of effort and project size that prevail in case that the benefit b from project implementation is strictly smaller than the high realization of the implementation cost, we proceed in two steps. First, for each effort level, we determine the contract that maximizes the principal's expected utility conditional on the agent exerting this effort level. Second, we compare the principal's expected utility under these contracts to determine which effort level she will actually implement.

Step 1. First, suppose that the principal wants to induce low effort $e = 0$. In this case, the optimal contract specifies the ex post efficient levels of project size and the principal fully extracts the expected gains from trade. To see this, consider a contract that specifies ex post efficient levels of project size, $y_L = 1$ and $y_H = 0$, and transfer payments t_L and t_H that exactly reimburse the agent for his respective cost of project implementation; i.e., $t_L = c_L$ and $t_H = 0$. As can be seen from (1), with transfers exactly covering the cost of project implementation, the agent will exert low preparatory effort because there is no benefit associated with exerting high effort that would make it worthwhile for the agent to incur the associated effort cost. Finally, note that the expected transfer payment corresponds to the agent's overall expected cost in case he exerts low effort, such that the agent's participation constraint is binding and the principal's expected utility coincides with the expected gains from trade under low preparatory effort and implementation of the ex post efficient project size. As this is the best the principal can do *given that she implements low effort*, we have established the following observation:

[20] We follow the usual convention that the principal implements high preparatory effort in case that she is indifferent between implementing high effort and implementing low effort. Furthermore, we assume that the principal implements maximum project size in case that she is indifferent between implementing maximum size and implementing any other project size.

Lemma 2 *Consider Scenario I and suppose that $b < c_H$. If the principal wants to implement low effort ($e = 0$), then the contract Γ_0 that specifies transfer payments $t_L = c_L$ and $t_H = 0$ and levels of project size $y_L = 1$ and $y_H = 0$ is an optimal contract.*

Next, suppose that the principal wants to induce high effort $e = 1$. To determine the optimal contract in this case, we proceed as follows. First, we determine the "cost-minimizing" transfers for exogenously fixed levels of project size. Thereafter, we determine the optimal level of project size given that transfers are chosen in a cost-minimizing fashion.

For given levels of project size $(y_L, y_H) \in [0,1]^2$, the problem of finding the cost-minimizing transfers can be stated as follows:

$$\min_{(t_L,t_H)\in\mathbb{R}^2_{\geq 0}} p_1 t_L + (1-p_1)t_H \qquad \text{subject to} \qquad (\text{IC}_1),\ (\text{PC}_1),\ (\text{LL}).$$

To get an intuition for the solution to this cost-minimization problem, consider the effect of a small decrease in y_H. A decrease in y_H "tightens" the incentive compatibility constraint (cf. (1)) because avoiding high implementation cost by exerting high preparatory effort becomes less valuable for the agent. On the other hand, a decrease in y_H "relaxes" the participation constraint because the agent's expected cost of project implementation decreases. Thus, it stands to reason that the principal's choice of transfers is restricted by the incentive compatibility constraint (together with the limited liability constraint) rather than the participation constraint if y_H is low, whereas the participation constraint should impose a binding restriction if y_H is high. Indeed, in the proof of Lemma 3 below we show that there exists a threshold

$$\tilde{y} := \frac{kp_0}{c_H(p_1 - p_0)},$$

such that the participation constraint does not impose a binding restriction if $y_H < \tilde{y}$. In this case, the unique cost-minimizing pair of transfers satisfies the incentive compatibility constraint with equality when the wage levels are set as low as possible; i.e., t_H is set equal to zero and t_L is set such that (IC_1) binds. If, in contrast, $y_H \geq \tilde{y}$, the participation constraint must be binding under the cost-minimizing transfer combination. Specifically, any feasible transfer combination that satisfies (PC_1) with equality and additionally satisfies (IC_1) and (LL) is a cost-minimizing transfer combination. In consequence, the transfer combination with t_H being set equal to zero and t_L being set such that the participation constraint is satisfied with equality is always a cost-minimizing transfer combination. The cost-minimizing transfer combination for levels $(y_L, y_H) \in [0,1]^2$ of project size then (w.l.o.g.) can be summarized as follows:

$$\bar{t}_H = 0 \qquad \text{and} \qquad \bar{t}_L = \begin{cases} \frac{k}{p_1 - p_0} + c_L y_L - c_H y_H & \text{if } \; y_H \leq \tilde{y}, \\ \frac{k}{p_1} + c_L y_L + \frac{1-p_1}{p_1} c_H y_H & \text{if } \; y_H \geq \tilde{y}. \end{cases} \tag{2}$$

For future reference, note that the agent's expected utility from signing a contract that specifies the levels of project size y_L and y_H and the associated cost-minimizing transfers $\bar{t}_L$ and $\bar{t}_H$ is given by

$$U_A((y_L, y_H, \bar{t}_L, \bar{t}_H), 1) = c_H \max\{0, \tilde{y} - y_H\}. \tag{3}$$

Given the cost-minimizing specification of the transfer payments in (2), the optimal levels of project size are uniquely determined and solve

$$\max_{(y_L, y_H) \in [0,1]^2} \Psi(y_L, y_H)$$

with

$$\Psi(y_L, y_H) := \begin{cases} b[p_1 y_L + (1-p_1) y_H] - p_1 \left[\frac{k}{p_1 - p_0} + c_L y_L - c_H y_H \right] & \text{if } \; y_H \leq \tilde{y}, \\ b[p_1 y_L + (1-p_1) y_H] - p_1 \left[\frac{k}{p_1} + c_L y_L + \frac{1-p_1}{p_1} c_H y_H \right] & \text{if } \; y_H \geq \tilde{y}. \end{cases}$$

The function $\Psi(\cdot, \cdot)$ is continuous and additively separable in y_L and y_H. As

$$\frac{\partial \Psi(y_L, y_H)}{\partial y_L} > 0 \qquad \text{and} \qquad \frac{\partial \Psi(y_L, y_H)}{\partial y_H} \begin{cases} > 0 & \text{if } \; y_H < \tilde{y}, \\ < 0 & \text{if } \; y_H > \tilde{y}, \end{cases}$$

the optimal levels of project size are given by $y_L = 1$ and $y_H = \min\{1, \tilde{y}\}$, which inserted in (2) yields the following observation.

Lemma 3 *Consider Scenario I and suppose that $b < c_H$. If the principal wants to implement high effort ($e = 1$), then the contract Γ_1^I that specifies transfer payments $t_L = \frac{k}{p_1 - p_0} + c_L - c_H \min\{1, \tilde{y}\}$ and $t_H = 0$ and levels of project size $y_L = 1$ and $y_H = \min\{1, \tilde{y}\}$ is an optimal contract.*

Proof: See the Appendix.

In comparison to the first-best benchmark, implementation of high preparatory effort comes along with excessive (i.e., with ex post inefficiently high) project size in case of high implementation cost. According to (3), if the capacity constraint on project size imposes a binding restriction (i.e., if $1 < \tilde{y}$), then the participation constraint is slack and the agent obtains a strictly positive rent. If, on the other hand, the capacity constraint on project size does not have bite (i.e., if $\tilde{y} \leq 1$), then the participation constraint binds and, despite high effort being induced, the agent does not obtain a rent but receives only his reservation utility. Formally, the agent's expected utility under this contract amounts to

$$U_A(\Gamma_1^I, 1) = c_H(\tilde{y} - \min\{1, \tilde{y}\}).$$

Step 2. According to Lemma 2, the principal's maximum expected utility from implementing low effort is

$$U_P(\Gamma_0, 0) = p_0(b - c_L). \tag{4}$$

According to Lemma 3, the principal's maximum expected utility from implementing high effort is

$$U_P(\Gamma_1^I, 1) = b\left[p_1 + (1 - p_1)\min\{1, \tilde{y}\}\right] - p_1\left[\frac{k}{p_1 - p_0} + c_L - \min\{1, \tilde{y}\}\, c_H\right]. \tag{5}$$

Comparison of (4) and (5) reveals the following levels of project size and effort to be induced under the optimal contract.[21]

Proposition 3 *Consider Scenario I and suppose that $b < c_H$. The levels of project size and effort implemented under the optimal contract are given by*

$$y_L^I = 1, \qquad y_H^I = \begin{cases} \tilde{y} & \textit{if } k \leq k^I, \\ 0 & \textit{if } k^I < k, \end{cases} \qquad e^I = \begin{cases} 1 & \textit{if } k \leq k^I, \\ 0 & \textit{if } k^I < k, \end{cases}$$

where

$$k^I := \frac{c_H(p_1 - p_0)^2(b - c_L)}{c_H p_1(1 - p_0) - b(1 - p_1)p_0}. \tag{6}$$

Proof: See the Appendix.

As $0 < k^I < k^{FB}$, comparison of Propositions 1 and 3 reveals that the first-best allocation is failed whenever first-best effort is high, i.e., whenever $k \leq k^{FB}$.

[21]Note that when p_0 goes to zero or when p_1 goes to one, then k^I approaches k^{FB}.

Specifically, preparatory effort is inefficiently low if $k^I < k \leq k^{FB}$, whereas project size is inefficiently high if $k \leq k^I$.

Notably, whenever the principal induces high effort, the capacity constraint on project size has no bite; i.e., $k < k^I$ implies that $\tilde{y} < 1$. Hence, under the optimal contract the participation constraint is *always* satisfied with equality such that the agent *never* obtains a rent. To understand this result, suppose that the levels of project size are fixed on the ex post efficient levels, $y_L = 1$ and $y_H = 0$. As $y_H = 0 < \tilde{y}$, from our discussion of Lemma 3, we know that the principal then has to leave a strictly positive rent to the agent if she wants to induce high preparatory effort for these levels of project size. An increase in y_H above the ex post efficient level, however, decreases the agent's rent ($\frac{dU_A}{dy_H} = -c_H$, according to (3)) by more than it decreases the expected gains from trade ($\frac{dG(y_L,y_H,1)}{dy_H} = -(1-p_1)c_H$)), such that the principal finds it beneficial to increase project size in case of high implementation cost as far as possible (i.e., until the agent's participation constraint binds). The principal thus "abuses" the project size in case of high implementation cost to extract any rent that she otherwise would have to leave to the agent.

4.3 Scenario II: The inalienable right to quit

In Scenario II, the freedom of contract is restricted, such that the agent's right to quit work cannot be waived by the contract. Thus, the agent cannot commit not to unilaterally terminate the contractual relationship with the principal at date $T = 3$, i.e., after both parties learned the actual cost of project implementation.

If $c_H \leq b$, then welfare (measured by the expected gains from trade) in Scenario II cannot be strictly larger than in Scenario I, because Scenario I already results in first-best project size and first-best preparatory effort (cf. Proposition 2). For the remainder of this section, we thus focus on the case where $b < c_H$.

For the agent to be willing to continue the contractual relationship at date $T = 3$, the following two interim participation constraints have to be satisfied:

$$V(t_L, y_L | c_L) \geq 0 \tag{PC_L^{II}}$$

and

$$V(t_H, y_H | c_H) \geq 0, \tag{PC_H^{II}}$$

where $V(t, y|c) := t - cy$ denotes the agent's utility from receiving transfer t for implementing a project of size y at implementation cost c. The principal's contract design problem thus takes the following form:

$$\max_{\Gamma \in \mathbb{R}^2 \times [0,1]^2} U_P(\Gamma, e) \qquad \text{subject to} \qquad (\text{IC}_e),\ (\text{PC}_e),\ (\text{LL}),\ (\text{PC}_L^{II}),\ (\text{PC}_H^{II}).$$

Compared to Scenario I, the principal faces two additional constraints, the interim participation constraints (PC_L^{II}) and (PC_H^{II}). In consequence, the best that the principal can hope for in Scenario II is to be as well off as in Scenario I.

To determine the optimal contract, we again follow a two-step procedure: First, for each effort level, we determine the contract that maximizes the principal's expected utility conditional on the agent exerting this effort level. Second, we compare the principal's expected utility under these contracts to determine which effort level she will implement.

Step 1. First, suppose that the principal wants to induce low effort $e = 0$. Recall that the optimal contract to implement low effort in Scenario I (i.e., the contract Γ_0 as identified in Lemma 2) specifies the ex post efficient levels of project size ($y_L = 1$ and $y_H = 0$) and transfer payments that exactly compensate the agent for his cost of project implementation ($t_L = c_L$ and $t_H = 0$). As the two interim participation constraints (PC_L^{II}) and (PC_H^{II}) are satisfied under contract Γ_0, this contract must also be optimal to implement low effort in Scenario II.

Lemma 4 *Consider Scenario II and suppose that $b < c_H$. If the principal wants to implement low effort ($e = 0$), then the contract Γ_0 that specifies transfer payments $t_L = c_L$ and $t_H = 0$ and levels of project size $y_L = 1$ and $y_H = 0$ is an optimal contract.*

Next, suppose that the principal wants to implement high effort $e = 1$. To derive the optimal contract in Scenario II for this case, consider the following relaxed problem:

$$\max_{\Gamma \in \mathbb{R}^2 \times [0,1]^2} U_P(\Gamma, 1) \qquad \text{subject to} \qquad (\text{IC}_1),\ (\text{PC}_H^{II}),$$

where, according to (1), the incentive compatibility constraint (IC_1) requires $(p_1 - p_0)[(t_L - t_H) - (c_L y_L - c_H y_H)] \geq k$. Under the solution to this relaxed problem the interim participation constraint in case of high implementation cost (PC_H^{II}) must be satisfied with equality; i.e., for any given level of project size y_H, we must have $t_H = c_H y_H$. If this was not the case, the principal could adjust her contract offer and slightly reduce the transfer t_H, which would strictly increase her expected utility without violating any constraint (as the incentive compatibility constraint would be relaxed and the interim participation constraint would still hold as long as the reduction in t_H is sufficiently small). With (PC_H^{II}) being satisfied with equality by construction of the transfer t_H, it follows that under the solution to the relaxed problem the project must be canceled in case of high implementation cost; i.e., we must have $y_H = 0$. Otherwise y_H could be reduced, which would strictly increase the principal's expected utility (because $b < c_H$) without violating (IC_1). The transfer t_L then must be set as low as possible; i.e., $t_L = c_L y_L + \frac{k}{p_1 - p_0}$, such that the incentive compatibility constraint just binds. With (IC_1) being satisfied with equality by construction of the transfer t_L, it follows that the project size must be maximized in case of low implementation cost; i.e., we must have $y_L = 1$. Otherwise y_L could be increased which would strictly increase the principal's expected utility (because $c_L < b$).

Thus, the contract that solves the relaxed problem specifies the ex post efficient levels of project size, and the transfers are set as low as possible and in a way such that the incentive compatibility constraint is satisfied with equality. Notably, this contract also satisfies the constraints (PC_1), (LL), and (PC_L^{II}). Specifically, with $y_H = 0 < \tilde{y}$, we know from our discussion of the cost-minimizing transfers in the case of high effort being implemented in Scenario I that the participation constraint (PC_1) does not impose a binding restriction. With the constraints (LL) and (PC_L^{II}) being satisfied trivially because $t_H = 0$ and $t_L > c_L > 0$, we have established the following observation:

Lemma 5 *Consider Scenario II and suppose that $b < c_H$. If the principal wants to implement high effort ($e = 1$), then the optimal contract Γ_1^{II} specifies transfer payments $t_L = c_L + \frac{k}{p_1 - p_0}$ and $t_H = 0$ and levels of project size $y_L = 1$ and $y_H = 0$.*

Notably, in case the principal implements high preparatory effort, the agent obtains a strictly positive rent:

$$U_A(\Gamma_1^{II}, 1) = \frac{p_0 k}{p_1 - p_0}.$$

Thus, in contrast to Scenario I, the agent's inalienable right to quit work in Scenario II prevents the principal from abusing the project size in case of high implementation cost as an inefficient rent-extraction device.

Step 2. According to Lemma 4, the principal's maximum expected utility from implementing low effort is

$$U_P(\Gamma_0, 0) = p_0(b - c_L). \tag{7}$$

According to Lemma 5, the principal's maximum expected utility from implementing high effort is

$$U_P(\Gamma_1^{II}, 1) = p_1(b - c_L) - \frac{p_1 k}{p_1 - p_0}. \tag{8}$$

Comparison of (7) and (8) reveals the following levels of project size and effort to be implemented under the optimal contract.[22]

Proposition 4 *Consider Scenario II and suppose that $b < c_H$. The levels of project size and effort implemented under the optimal contract are given by*

$$y_L^{II} = 1, \qquad y_H^{II} = 0, \qquad e^{II} = \begin{cases} 1 & \text{if } k \leq k^{II}, \\ 0 & \text{if } k^{II} < k, \end{cases}$$

where

$$k^{II} := \frac{(p_1 - p_0)^2}{p_1}(b - c_L). \tag{9}$$

While in Scenario II the project size is always ex post efficient, moral hazard in the project preparation stage results in inefficiently low effort provision. Specifically, as $k^{II} < k^{FB}$, it follows that $e^{II} < e^{FB}$ for $k^{II} < k \leq k^{FB}$, and $e^{II} = e^{FB}$ otherwise.

4.4 Comparison of the scenarios

Recall that in Scenario I, the principal fully extracts the expected gains from trade, so in contrast to Scenario II the agent never obtains a rent. Moreover, recall that in Scenario II the principal faces additional constraints (the interim participation constraints), so the principal cannot be better off than in Scenario I. As a consequence, it is clear that in the baseline model the agent (weakly) prefers having an inalienable right to quit (Scenario II), whereas the principal (weakly) prefers contractual freedom (Scenario I).[23] Yet, the comparison between the two scenarios is much more intricate from the perspective of a lawmaker who wants to maximize expected welfare.

[22] Note that when p_0 goes to zero, then k^{II} approaches k^{FB}, since the rent that the agent must obtain in order to be induced to exert high effort vanishes. Observe that this is not the case when p_1 goes to one.

[23] However, see Section 6 for an extension of our model in which also the agent may be strictly better off when he has the freedom to contractually waive his right to quit.

Note that project size and effort provision in Scenario I differ starkly depending on whether the benefit of project implementation exceeds the high realization of implementation cost or not. As established in Proposition 2, if $c_H \leq b$, then contracting in Scenario I entails both ex post efficient project size and ex ante efficient effort. In this case, Scenario II can never yield a strictly larger welfare (measured by expected gains from trade) than Scenario I. If $b < c_H$, a welfare comparison is less straightforward. In this case, in Scenario I the first-best outcome cannot be attained if the first-best allocation involves high preparatory effort (i.e., if $k \leq k^{FB}$). Specifically, effort is below the first-best level (while project size is ex post efficient) if $k^I < k \leq k^{FB}$, whereas project size is inefficiently high (while effort equals the first-best effort) if $k \leq k^I$. On the other hand, Scenario II always results in ex post efficient project size (cf. Proposition 4). Yet, the necessity to leave a rent to the agent in case that high effort is to be induced leads to inefficiently low effort provision for intermediate levels of the effort cost (i.e., if $k^{II} < k \leq k^{FB}$).

Comparing (6) and (9) reveals that $0 < k^{II} < k^I < k^{FB}$. Clearly, if $k^I < k$, expected gains from trade are identical in Scenario I and in Scenario II, because both scenarios result in low preparatory effort and ex post efficient project size. If $k \leq k^I$, on the other hand, expected gains from trade in the two scenarios differ.

Specifically, if $k^{II} < k \leq k^I$, then in both scenarios the first-best outcome cannot be achieved, because effort is below the first-best level in Scenario II and project size is inefficiently high in Scenario I. Nevertheless, expected gains from trade in this case are unambiguously larger in Scenario I. To see this, recall that the principal in Scenario I always fully extracts the expected gains from trade. The fact that in Scenario I the principal strictly prefers to induce high effort rather than low effort if $k^{II} < k \leq k^I$ (where the expected gains from trade in case of low effort would correspond to the expected gains from trade in Scenario II), thus implies that expected gains from trade must be strictly higher in Scenario I than in Scenario II.

Finally, if $k \leq k^{II}$, Scenario II results in ex ante efficient effort and ex post efficient project size. Yet, the first-best outcome cannot be attained in Scenario I, where the principal implements an inefficiently large project in case of high implementation cost in order to fully extract the associated gains from trade by completely eliminating the agent's rent. Hence, in this case Scenario II strictly outperforms Scenario I in terms of expected gains from trade, because it avoids inefficient rent-seeking by the principal.

Proposition 5 *(i) Suppose $c_H \leq b$. The expected gains from trade in Scenario I are at least as large as the expected gains from trade in Scenario II.*

(ii) Suppose $b < c_H$. If $k \leq k^{II}$, then the expected gains from trade are strictly larger in Scenario II than in Scenario I. If $k^{II} < k \leq k^{I}$, then the expected gains from trade are strictly larger in Scenario I than in Scenario II. If $k^I < k$, then the expected gains from trade in both scenarios are identical.

5 Hidden information

Since c reflects the agent's disutility from implementing the project (e.g., the physical and psychological stress from managing the project), one might argue that the agent is better informed about the realization of c than the principal. To address the robustness of our findings in this regard, suppose that at date $T = 2$ the agent privately learns the realization of the implementation cost parameter c; i.e., we now consider a situation with not only hidden action but also hidden information. Hence, in contrast to before, the principal now has to infer the probability distribution over the possible realizations of the implementation cost that results under the unobservable effort that the agent will exert given the contractual arrangement under consideration.

According to the revelation principle (cf. Myerson, 1982), the best the principal can do is to offer a direct revelation mechanism to the agent. That is, at date $T = 3$, the agent is asked to make a report $\hat{c} \in \{c_L, c_H\}$ regarding his private observation of the realized level of the implementation cost c.[24] The contract $\hat{\Gamma} : \{c_L, c_H\} \rightarrow \mathbb{R} \times [0, 1]$ offered by the principal at date $T = 0$ specifies for each feasible report $\hat{c}$ of the agent a transfer payment $\hat{t}(\hat{c})$ to be paid from the principal to the agent and a level of project size $\hat{y}(\hat{c})$ to be implemented by the agent at date $T = 4$. Denoting $t_i = \hat{t}(c_i)$ and $y_i = \hat{y}(c_i)$ for $i \in \{L, H\}$, a contract then effectively again takes the form $\hat{\Gamma} = (t_L, t_H, y_L, y_H)$.

For the agent to be willing to truthfully report the realization of the implementation cost c, the following two ex post truth-telling constraints must be satisfied:

$$V_A(t_L, y_L|c_L) \geq V_A(t_H, y_H|c_L) \qquad (\text{TT}_L)$$

[24] In case of Scenario II it is irrelevant whether this report is made before or after the agent decides whether to quit work.

and

$$V_A(t_H, y_H|c_H) \geq V_A(t_L, y_L|c_H), \tag{TT$_H$}$$

where, as before, $V(t, y|c) = t - cy$. Except for these two additional constraints the principal's contract design problem in Scenario I, where the agent can waive his right to quit work, and in Scenario II, where the agent cannot waive his right to quit work, takes the same form as in Sections 4.2 and 4.3, respectively. Clearly, with two additional constraints, in both scenarios it must hold that the principal can never be better off in the case of hidden information than in the case where the implementation cost is verifiable.

If a contract specifies $t_L = t_H$ and $y_L = y_H$, then the truth-telling constraints are satisfied trivially. Therefore, if $c_H \leq b$, in Scenario I the optimal contract in case of verifiable implementation cost (cf. Lemma 1) must also be optimal in the case of hidden information. In consequence, if $c_H \leq b$, contracting in Scenario I always results in the first-best outcome even if the agent is privately informed about the realization of the implementation cost, and thus Scenario I cannot be welfare-inferior to Scenario II.

Now consider the case $b < c_H$, which is less straightforward. The contract Γ_0, which in case of verifiable implementation cost is optimal if low effort is to be implemented in both Scenario I and Scenario II (cf. Lemmas 2 and 4), satisfies the ex post truth-telling constraints (TT$_L$) and (TT$_H$). Specifically, at date $T = 3$, the agent is indifferent between telling the truth and lying if $c = c_L$, and he strictly prefers to tell the truth if $c = c_H$. Yet, the ex post truth-telling constraints (TT$_L$) and (TT$_H$) are not necessarily satisfied under the contracts Γ_1^I and Γ_1^{II}, which in case of verifiable implementation cost are optimal if high effort is to be implemented in Scenario I and Scenario II, respectively (cf. Lemmas 3 and 5). Importantly, however, the contracts Γ_1^I and Γ_1^{II} satisfy the ex post truth-telling constraints whenever the first-best preparatory effort is high (i.e., if $k \leq k^{FB}$) and, thus, *whenever they are the overall optimal contract in their respective contracting scenario.* Thus, if $b < c_H$, the contracts which are optimal in Scenario I and Scenario II, respectively, in case of verifiable implementation cost (cf. Propositions 2 and 4) both satisfy the ex post truth-telling constraints and therefore must be optimal also in case of hidden information.

Taken together, the above observations imply that the welfare comparison of the two scenarios does not depend on whether the realization of the implementation cost is verifiable or privately learned by the agent.

Proposition 6 *If the agent privately learns the realization of the implementation cost c at date $T = 2$, then the comparison of Scenario I and Scenario II in terms of expected gains from trade is as characterized by Proposition 5.*

Proof: See the Appendix.

It should be noted that it might be interesting to extend our framework by adding further sources of informational asymmetries. In particular, in order to isolate the novel effects on which our analysis is focused, we have assumed that in the implementation stage there are no unobservable effort decisions to be taken. If in a addition to a verifiable production decision there were also hidden actions in the implementation stage, then limited liability rents might have to be paid in order to induce high second-stage effort, which in turn could have an impact on the first-stage effort incentives.[25] It may be a promising avenue for future research to explore the impact of restrictions on the freedom to contract when such incentive spillovers come into play.

6 An extended model with ex ante investment

So far, we have assumed that the principal's production technology used by the agent is already in place. We now extend our model by adding a prior stage in which the principal decides whether or not to make non-contractible investments in order to develop the production technology. Moreover, following many papers in the principal-agent literature, we have assumed so far that the principal has all the bargaining power. We now generalize the contract negotiations by allowing also the agent to have some bargaining power.

Recall that in the baseline model, the agent was always (weakly) better off in Scenario II, i.e. when having an inalienable right to quit. In contrast, we will show that in our extended model there are circumstances under which the agent is strictly better off in Scenario I, i.e. when the freedom of contract is not restricted.

Specifically, suppose now that at date $T = -1$, the principal has to decide whether or not to invest the fixed amount $\mathcal{I} > 0$ in installing the production

[25] Specifically, starting with Schmitz (2005a) several papers have studied the effect that under some circumstances an agent may have an incentive *not* to be successful in the first stage in order to get a larger rent in the second stage (see e.g. the recent contributions by Kräkel, 2016, Pi, 2018, and Hoppe and Schmitz, 2021). Overcoming such dysfunctional incentives can make implementing high effort in the first stage particularly costly for the principal.

technology that the subsequent principal-agent relationship is based on in the first place. The non-contractible investment decision is denoted by $x \in \{0, 1\}$. Here, $x = 0$ corresponds to the principal not investing the amount $\mathcal{I}$ and thus not installing the production technology, whereas $x = 1$ corresponds to the principal investing the amount $\mathcal{I}$ and installing the production technology. In the former case, with no production technology being built, nothing else happens and both the principal and the agent each receive a reservation utility equal to zero. In the latter case, at date $T = 0$ the parties negotiate a contract. In order to allow the agent to have some bargaining power, we model the negotiations in the following way. With probability $\varepsilon \in (0, 1)$, the agent can make a take-it-or-leave-it offer to the principal, while otherwise the principal can make a take-it-or-leave-it offer to the agent.[26] Thereafter, the sequence of events is as in our baseline model outlined in Section 3. For the sake of exposition, we restrict our attention to the case where $b < c_H$ holds.

Suppose that at date $T = -1$ the principal has invested in installing the production technology. If at date $T = 0$ the draw of nature determines that the principal can make the contract offer, then the equilibrium of the subgame starting at date $T = 0$ corresponds to the equilibrium outcome of our baseline model. As a consequence, in Scenario I, by (4) and (5) together with Proposition 3, the expected utilities of the principal and the agent under the optimal contract from the date-0 perspective are given by

$$U_P(\Gamma^I_{e^I}, e^I) = \begin{cases} b\left[p_1 + (1 - p_1)\tilde{y}\right] - p_1\left[\frac{k}{p_1 - p_0} + c_L - \tilde{y}c_H\right] & \text{if } k \leq k^I, \\ p_0(b - c_L) & \text{if } k^I < k \end{cases} \tag{10}$$

and

$$U_A(\Gamma^I_{e^I}, e^I) = 0, \tag{11}$$

respectively. Likewise, in Scenario II, by (7) and (8) together with Proposition 4, the expected utilities of the principal and the agent under the optimal contract from the date-0 perspective are given by

$$U_P(\Gamma^{II}_{e^{II}}, e^{II}) = \begin{cases} p_1(b - c_L) - \frac{p_1 k}{p_1 - p_0} & \text{if } k \leq k^{II}, \\ p_0(b - c_L) & \text{if } k^{II} < k \end{cases} \tag{12}$$

[26] This simple bargaining game has often been used in the literature on hold-up problems, where parties can make non-contractible investments before negotiations take place; see e.g. Hart and Moore (1999, p. 135) and Schmitz (2006).

and

$$U_A(\Gamma^{II}_{e^{II}}, e^{II}) = \begin{cases} \frac{p_0 k}{p_1 - p_0} & \text{if } k \leq k^{II}, \\ 0 & \text{if } k^{II} < k, \end{cases} \tag{13}$$

respectively.

What is the equilibrium of the subgame starting at date $T = 0$ if the draw of nature determines that the agent can make the contract offer? In Scenario I, the agent faces the following contract design problem:

$$\max_{\Gamma \in \mathbb{R}^2 \times [0,1]^2} U_A(\Gamma, e)$$

subject to

$$U_A(\Gamma, e) \geq U_A(\Gamma, e') \quad \text{with} \quad e, e' \in \{0, 1\}, e \neq e', \tag{IC$_e$}$$

$$U_P(\Gamma, e) \geq 0. \tag{$\widehat{\text{PC}}_e$}$$

Here, the incentive compatibility constraint (IC$_e$) reflects that the agent correctly anticipates his own behavior at date $T = 1$. The participation constraint ($\widehat{\text{PC}}_e$) ensures that at date $T = 0$, the principal (who correctly anticipates the agent's date-1 effort choice) is willing to accept the contract offered by the agent.[27] With $U_A(\Gamma, e) = G(y_L, y_H, e) - U_P(\Gamma, e)$, the best that the agent can hope for in either scenario is to contractually specify the first-best project size for each level of implementation cost and to impose associated transfer payments that not only induce the agent to exert the first-best effort level (i.e., such that (IC$_{e^{FB}}$) is satisfied), but also fully extract the expected gains from trade (i.e., such that ($\widehat{\text{PC}}_{e^{FB}}$) is satisfied with equality). As is readily verified, this in fact can be achieved by transfer payments that equal the principal's respective gross benefit from implementing a project of the first-best project size. Notably, this contract specification also satisfies the two interim participation constraints that have to be taken into consideration in Scenario II, which require that $V(t_i, y_i|c_i) = t_i - c_i y_i \geq 0$ for all $i \in \{L, H\}$. Thus, we come to the following conclusion regarding the agent's optimal contract offer at date $T = 0$.

Lemma 6 *Consider Scenario $S \in \{I, II\}$ and suppose that $b < c_H$. If the agent can make the contract offer at date $T = 0$, then the optimal contract $\widehat{\Gamma}$ specifies transfer payments $\hat{t}_L = b$ and $\hat{t}_H = 0$. The levels of project size and effort*

[27] A limited liability constraint is absent in the agent's contract design problem, because we did not assume that the principal is protected by limited liability.

implemented under the optimal contract are given by

$$\hat{y}_L = 1, \qquad \hat{y}_H = 0, \qquad \hat{e} = \begin{cases} 1 & \textit{if} \;\; k \leq k^{FB}, \\ 0 & \textit{if} \;\; k^{FB} < k. \end{cases}$$

Notably, the agent's optimal contract offer does not depend on whether the freedom of contract is restricted or not. In consequence, from the date-0 perspective, the principal's and the agent's expected utilities under the agent's optimal contract offer are given by

$$U_P(\widehat{\Gamma}, \hat{e}) = 0 \qquad \text{and} \qquad U_A(\widehat{\Gamma}, \hat{e}) = G(1, 0, e^{FB}), \tag{14}$$

respectively.

From the perspective of date $T = -1$, the expected utilities of the principal and the agent in case that the principal makes the investment decision $x \in \{0, 1\}$ in Scenario $S \in \{I, II\}$ amount to

$$\widehat{U}_P(x|S) = x[(1-\varepsilon)U_P(\Gamma^S_{e^S}, e^S) - \mathcal{I}]$$

and

$$\widehat{U}_A(x|S) = x[(1-\varepsilon)U_A(\Gamma^S_{e^S}, e^S) + \varepsilon G(1, 0, e^{FB})],$$

respectively. Assuming, as a tie-breaking rule, that the principal will make the investment at date $T = -1$ if and only if her expected utility from investing strictly exceeds her expected utility from not investing, the equilibrium investment decision in Scenario $S \in \{I, II\}$ can be described as follows:

$$x^S = \begin{cases} 1 & \text{if} \;\; \mathcal{I} < \widehat{\mathcal{I}}^S, \\ 0 & \text{if} \;\; \widehat{\mathcal{I}}^S \leq \mathcal{I}, \end{cases}$$

where we have defined $\widehat{\mathcal{I}}^S := (1-\varepsilon)U_P(\Gamma^S_{e^S}, e^S)$.

For $k \geq k^I$, from (10) and (12) it follows that $\widehat{\mathcal{I}}^I = \widehat{\mathcal{I}}^{II}$; i.e., the principal's investment decision is independent of the scenario that the transaction takes place in. As a consequence, for $k \geq k^I$, also the expected utilities (from the perspective of date $T = -1$) of both the principal and the agent are independent of whether we are in Scenario I or in Scenario II.

For $k < k^I$, on the other hand, (10) and (12) imply $\widehat{\mathcal{I}}^{II} < \widehat{\mathcal{I}}^I$, such that the range of the investment cost parameter $\mathcal{I}$ in which the principal invests is strictly larger in Scenario I than in Scenario II. If the investment cost is so low that the principal invests in either scenario (i.e., $\mathcal{I} < \widehat{\mathcal{I}}^{II}$), then as in our baseline model the principal is strictly better off in Scenario I (where she can fully extract the agent's rent in case that she can make the contract offer), whereas the agent is weakly better off in Scenario II (where he obtains a strictly positive rent in case that the principal can make the contract offer and high effort is implemented). If, however, the investment cost parameter takes on an intermediate value such that the principal is willing to invest only in Scenario I but not in Scenario II (i.e., $\widehat{I}^{II} \leq I < \widehat{I}^{I}$), then in contrast to our baseline model both parties are strictly better off in Scenario I. The reason for the agent now being strictly better off in Scenario I is that he is guaranteed a strictly positive expected rent in Scenario I (since he can make the contract offer with strictly positive probability), while he receives only his reservation utility of zero in Scenario II. Finally, if the investment cost is so large that the principal is not willing to invest in either scenario (i.e., $\widehat{\mathcal{I}}^{I} \leq \mathcal{I}$), then the expected utilities (from the perspective of date $T = -1$) of both the principal and the agent equal zero under either scenario.

The following proposition summarizes these observations.

Proposition 7 *Suppose that $b < c_H$. From the perspective of date $T = -1$,*

(i) if $k < k^I$ and $\mathcal{I} < \widehat{\mathcal{I}}^{II}$, then the principal's expected utility is strictly higher and the agent's expected utility is weakly lower in Scenario I than in Scenario II, i.e., $\widehat{U}_P(x^I|I) > \widehat{U}_P(x^{II}|II)$ and $\widehat{U}_A(x^I|I) \leq \widehat{U}_A(x^{II}|II)$;

(ii) if $k < k^I$ and $\widehat{\mathcal{I}}^{II} \leq \mathcal{I} < \widehat{\mathcal{I}}^{I}$, then the principal's expected utility and the agent's expected utility are strictly higher in Scenario I than in Scenario II, i.e., $\widehat{U}_P(x^I|I) > \widehat{U}_P(x^{II}|II)$ and $\widehat{U}_A(x^I|I) > \widehat{U}_A(x^{II}|II)$;

(iii) the principal's expected utility and the agent's expected utility are identical in Scenario I and in Scenario II otherwise, i.e., $\widehat{U}_P(x^I|I) = \widehat{U}_P(x^{II}|II)$ and $\widehat{U}_A(x^I|I) = \widehat{U}_A(x^{II}|II)$.

7 Concluding remarks

Given the gains from trade that can be realized by Coasean bargaining, a fundamental question in economic policy is when lawmakers should restrict individuals' freedom to enter into voluntary contracts.

Indeed, today there are many restrictions on the freedom of contract.[28] In the present paper, we have focused on the fact that workers are not permitted to enter into labor contracts in which they waive their right to quit work.[29] Similarly, Basu (2003, p. 141) has somewhat provocatively pointed out that "under current U.S. law, a firm cannot offer a job contract in which the pay is high and the benefits good—but the employer reserves the right to sexually harass the worker", even though a worker who accepts such a job must find the cost of sexual harassment to be less than the benefits associated with the job. Usury laws restrict the rate of interest to which parties may agree. Following the so-called penalty doctrine, courts do not enforce stipulated damage clauses when the contractually specified payments seem to be punitive. It is forbidden to sell one's organs. Labor market regulations limit the hours of work and stop workers from being exposed to excessive health hazards.

In these and similar instances, ethical considerations and agents' bounded rationality may well be important reasons not to enforce every contract, even if the contract is entered voluntarily.[30] Our contribution is complementary to arguments along these lines, as we focus on a pure economic efficiency perspective in a contract-theoretic setting with fully rational agents. Our model illustrates that already in such a setup it can be beneficial to restrict the freedom of contract, even if there are no negative externalities on third parties and even if the contract is written under symmetric information. In particular, giving agents an inalienable right to quit work can be desirable in employment relationships plagued by moral hazard, because it can restrain principals from offering labor contracts that are motivated by inefficient rent-seeking behavior.

[28] Note that from "a constitutional standpoint, the notion of contractual liberty has a spotted history" (Talley, 1994, p. 1195). Starting with *Lochner v. New York* (198 U.S. 45, 64 [1905]), the United States Supreme Court struck down several state regulations that constrained the freedom of contract (such as state legislation limiting weekly working hours). Yet, the Court reversed its view in the case *West Coast Hotel Co. v. Parrish* (300 U.S. 379 [1937]), in which it upheld a state law setting a minimum wage. For discussions of the so-called "Lochner era," see Sunstein (1987) and Bernstein (2003).

[29] This topic has recently seen a renewed interest in the context of illegal immigration of "undocumented workers" (see e.g. Kim, 2015, and Ontiveros, 2019).

[30] See Köszegi's (2014) recent survey on behavioral contract theory for a discussion of exploitative contracts, in which a principal tries to profit from an agent's bounded rationality. See also the recent work by Buechel et al. (2020) for an analysis of law enforcement when subjects may be naïve.

However, as highlighted in our extended model, while restricting the freedom of contract may appear to be a well-intentioned policy in a world in which production technologies are already in place, in the long run such a policy might actually hurt not only the principal but also the agent. In particular, when the principal first has to make non-contractible investments to come up with new technologies and thus to create jobs, then restrictions on the freedom of contract may well disincentivize such investments.

Appendix A: Proofs

Proof of Lemma 3.

It remains to formally derive the cost-minimizing transfers for given levels of project size $(y_L, y_H) \in [0,1]^2$. The problem of finding the cost-minimizing transfers can be stated as follows:

$$\min_{(t_L,t_H)\in\mathbb{R}^2_{\geq 0}} p_1 t_L + (1-p_1)t_H$$

subject to

$$t_L \geq \Phi^{IC}(t_H) \quad \text{with} \quad \Phi^{IC}(t_H) := t_H + \frac{k}{p_1 - p_0} + c_L y_L - c_H y_H, \tag{IC$_1$}$$

$$t_L \geq \Phi^{PC}(t_H) \quad \text{with} \quad \Phi^{PC}(t_H) := -\frac{1-p_1}{p_1}t_H + \frac{k}{p_1} + c_L y_L + \frac{1-p_1}{p_1}c_H y_H, \tag{PC$_1$}$$

$$t_L \geq 0, \ t_H \geq 0. \tag{LL}$$

In the (t_H, t_L)–space, $\Phi^{PC}(\cdot)$ is a straight line with negative slope and a strictly positive vertical intercept (i.e., $\Phi^{PC}(0) > 0$), and $\Phi^{IC}(\cdot)$ is a straight line with strictly positive slope. Furthermore, the isocost line

$$\left\{(t_L, t_H) \in \mathbb{R}^2 \mid p_1 t_L + (1-p_1)t_H = \tau\right\}$$

contains all transfer combinations (t_L, t_H) that, given the agent exerts high effort, result in the same expected transfer payment τ. Hence, in the (t_H, t_L)–space, the family of isocost lines consists of parallel straight lines with the same negative slope as $\Phi^{PC}(\cdot)$. An isocost line with a smaller vertical intercept contains combinations of transfer payments that result in a strictly lower expected transfer payment than combinations of transfer payments contained by an isocost line with a greater vertical intercept. The solution to the above cost-minimization problem thus is a transfer combination $(\bar{t}_L, \bar{t}_H)$ that satisfies (IC$_1$), (PC$_1$), and (LL) such that there is no other transfer combination $(\tilde{t}_L, \tilde{t}_H)$ that satisfies (IC$_1$), (PC$_1$), and (LL) and lies on a lower isocost line than $(\bar{t}_L, \bar{t}_H)$.

Note that $\Phi^{IC}(0) \gtreqless \Phi^{PC}(0)$ if and only if $y_H \lesseqgtr \tilde{y}$, where

$$\tilde{y} := \frac{k p_0}{c_H(p_1 - p_0)}.$$

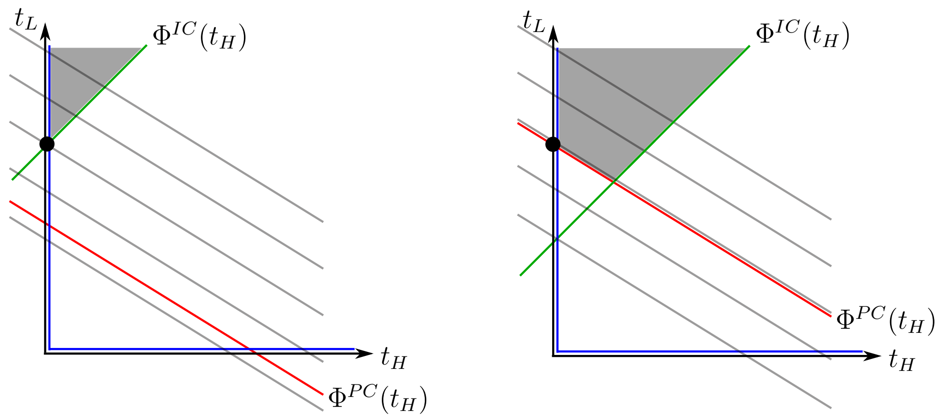

Figure 1. Cost-minimizing transfers payments implementing $e = 1$ in the case $y_H < \tilde{y}$ (left panel) and in the case $y_H > \tilde{y}$ (right panel). The green lines depict the incentive compatibility constraints, the red lines depict the participation constraints, and the blue lines depict the limited liability constraints.

Hence, if $y_H < \tilde{y}$, as depicted in the left panel of Figure 1, the participation constraint (PC_1) does not impose a binding restriction. The lowest feasible isocost line is reached by setting transfer t_H equal to zero and transfer t_L such that (given $t_H = 0$) the incentive compatibility constraint is satisfied with equality. If, in contrast, $y_H \geq \tilde{y}$, as depicted in the right panel of Figure 1, the participation constraint (PC_1) must be binding under the cost-minimizing transfer combination. Specifically, any feasible transfer combination that satisfies (PC_1) with equality and additionally satisfies (IC_1) and (LL) is a cost-minimizing transfer combination. In consequence, the transfer combination with transfer t_H being set equal to zero and transfer t_L being set such that (given $t_H = 0$) the participation constraint is satisfied with equality is always a cost-minimizing transfer combination. The cost-minimizing transfer combination for levels $(y_L, y_H) \in [0,1]^2$ of project size then (w.l.o.g.) can be summarized as follows:

$$\bar{t}_H = 0 \qquad \text{and} \qquad \bar{t}_L = \begin{cases} \Phi^{IC}(0) = \frac{k}{p_1 - p_0} + c_L y_L - c_H y_H & \text{if } \; y_H \leq \tilde{y}, \\ \Phi^{PC}(0) = \frac{k}{p_1} + c_L y_L + \frac{1-p_1}{p_1} c_H y_H & \text{if } \; y_H \geq \tilde{y}. \end{cases}$$

■

Proof of Proposition 3.

First, consider the case $k \geq \frac{c_H(p_1-p_0)}{p_0}$ such that $\min\{1, \tilde{y}\} = 1$. Here, $U_P(\Gamma_0, 0) > U^l_P(\Gamma_1, 1)$ if and only if

$$k > \frac{p_1 - p_0}{p_1}[(p_1 - p_0)(b - c_L) + (1 - p_1)b + p_1 c_H]. \tag{15}$$

As $k \geq \frac{c_H(p_1-p_0)}{p_0}$ by hypothesis and

$$\begin{aligned} & \frac{p_1 - p_0}{p_1}[(p_1 - p_0)(b - c_L) + (1 - p_1)b + p_1 c_H] < \frac{c_H(p_1 - p_0)}{p_0} \\ \iff \quad & p_1(1 - p_0)c_H > p_0(1 - p_0)b - p_0(p_1 - p_0)c_L \end{aligned}$$

holds by $0 < p_0 < p_1$ and $0 < c_L < b < c_H$, condition (15) is satisfied and the principal implements low effort (i.e., $e = 0$).

Next, consider the case $k < \frac{c_H(p_1-p_0)}{p_0}$ such that $\min\{1, \tilde{y}\} = \tilde{y}$. Here, $U^l_P(\Gamma_0, 0) > U^l_P(\Gamma_1, 1)$ if and only if $k > k^I$, where

$$k^I := \frac{c_H(p_1 - p_0)^2(b - c_L)}{c_H p_1(1 - p_0) - b(1 - p_1)p_0}.$$

Since

$$k^I < \frac{c_H(p_1 - p_0)}{p_0} \iff p_1(1 - p_0)c_H > p_0(1 - p_0)b - p_0(p_1 - p_0)c_L,$$

$0 < p_0 < p_1$ and $0 < c_L < b < c_H$ imply that $0 < k^I < \frac{c_H(p_1-p_0)}{p_0}$, such that the principal implements high effort (i.e., $e = 1$) if $k \leq k^I$ and low effort (i.e., $e = 0$) if $k^I < k < \frac{c_H(p_1-p_0)}{p_0}$. ■

Proof of Proposition 6.

It remains to show that the contracts Γ^I_1 (identified in Lemma 3) and Γ^{II}_1 (identified in Lemma 5) satisfy the ex post truth-telling constraints (TT_L) and (TT_H) in case that they are the optimal contract in Scenario I and Scenario II, respectively. To this end, in what follows, suppose that $e^{FB} = 1$ or, equivalently, $\frac{k}{(p_1-p_0)(b-c_L)} < 1$.

First, consider the contract Γ^I_1. As $e^{FB} = 1$ implies that $\tilde{y} = \frac{kp_0}{c_H(p_1-p_0)} < 1$, the contract Γ^I_1 specifies $t_L = c_L + k\frac{1-p_0}{p_1-p_0}$, $t_H = 0$, $y_L = 1$, and $y_H = \tilde{y}$. If $c = c_L$, the agent weakly prefers to tell the truth whenever $V_A(t_L, y_L|c_L) = [c_L + k\frac{1-p_0}{p_1-p_0}] - c_L$ is at least as large as $V_A(t_H, y_H|c_L) = -\tilde{y}c_L$ or, equivalently, $\frac{1-p_0}{p_0} \geq -\frac{c_L}{c_H}$, which clearly is satisfied. If $c = c_H$, the agent weakly prefers to tell the truth whenever $V_A(t_H, y_H|c_H) = -\tilde{y}c_H$ is at least as large as $V_A(t_L, y_L|c_H) = c_L + k\frac{1-p_0}{p_1-p_0} - c_H$ or, equivalently, $k \leq (p_1 - p_0)(c_H - c_L)$, which holds given that $e^{FB} = 1$.

Next, consider the contract Γ_1^{II}, which specifies $t_L = c_L + \frac{k}{p_1 - p_0}$, $t_H = 0$, $y_L = 1$, and $y_H = 0$. If $c = c_L$, the agent weakly prefers to tell the truth whenever $V_A(t_L, y_L|c_L) = [c_L + \frac{k}{p_1-p_0}] - c_L$ is at least as large as $V_A(t_H, y_H|c_L) = 0$, which clearly is satisfied. If $c = c_H$, the agent weakly prefers to tell the truth whenever $V_A(t_H, y_H|c_H) = 0$ is at least as large as $V_A(t_L, y_L|c_H) = c_L + \frac{k}{p_1-p_0} - c_H$ or, equivalently, $k \leq (p_1 - p_0)(c_H - c_L)$, which holds given that $e^{FB} = 1$.

The result then follows from Γ_1^I being the optimal contract in Scenario I if and only if $k \leq k^I$, Γ_1^{II} being the optimal contract in Scenario II if and only if $k \leq k^{II}$, and the fact that $k^{II} < k^I < k^{FB}$. ■

Appendix B: Robustness

In our paper, the outcome of the first stage determines the costs that the agent has to incur when the project is implemented in the second stage. Our findings are robust with regard to the connection of the two stages. It turns out that qualitatively similar results hold when the costs are independent of the first-stage outcome, but instead the benefit of project implementation is determined by the outcome of the first stage.

Specifically, assume now that the marginal cost of project implementation equals a fixed amount c. Furthermore, if the agent has exerted preparatory effort $e \in \{0,1\}$ at date $T = 1$, then the realization of the marginal benefit at date $T = 2$ is b_H with probability p_e and b_L with probability $1 - p_e$. We restrict attention to the case $0 \leq b_L < c < b_H$. Apart from that, the model is as described in Section 3 of the paper.

In what follows, y_L and t_L refer to the project size that is to be implemented and the transfer that is to be paid from the principal to the agent in case that the marginal benefit of project implementation equals b_L. Likewise, y_H and t_H refer to the project size that is to be implemented and the transfer that is to be paid from the principal to the agent in case that the marginal benefit of project implementation equals b_H.

The first-best benchmark

The expected gains from trade are

$$\widehat{G}(y_L, y_H, e) = p_e(b_H - c)y_H + (1 - p_e)(b_L - c)y_L - ke. \tag{16}$$

The first-best levels of project size and preparatory effort maximize the expected gains from trade:

$$(\widehat{y}^{FB}(b_L), \widehat{y}^{FB}(b_H), \widehat{e}^{FB}) \in \underset{(y_L, y_H, e) \in [0,1]^2 \times \{0,1\}}{\arg\max} \widehat{G}(y_L, y_H, e). \tag{17}$$

With $b_L < c < b_H$, we have $\widehat{y}^{FB}(b_L) = 0$ and $\widehat{y}^{FB}(b_H) = 1$. Hence, with $\widehat{e}^{FB} = \arg\max_{e \in \{0,1\}} \widehat{G}(0, 1, e)$, we have $\widehat{e}^{FB} = 1$ if and only if $k \leq \widehat{k}^{FB}$, where

$$\widehat{k}^{FB} := (p_1 - p_0)(b_H - c). \tag{18}$$

Scenario I: Unrestricted freedom of contract

Suppose that at date $T = 0$ the principal and the agent sign a contract $\Gamma = (t_L, t_H, y_L, y_H)$ under which the agent exerts effort $e \in \{0,1\}$. The principal's expected utility in this case comprises the expected benefit from project implementation minus the expected transfer payment to the agent:

$$\widehat{U}_P(\Gamma, e) = [p_e b_H y_H + (1-p_e) b_L y_L] - [p_e t_H + (1-p_e) t_L] \tag{19}$$

The agent's expected utility comprises the expected transfer payment from the principal minus the expected cost of project implementation minus the cost for preparatory effort:

$$\widehat{U}_A(\Gamma, e) = p_e t_H + (1-p_e) t_L - c[p_e y_H + (1-p_e) y_L] - ke. \tag{20}$$

The principal's contract design problem thus takes the following form:

$$\max_{\Gamma \in \mathbb{R}^2 \times [0,1]^2} \widehat{U}_P(\Gamma, e)$$

subject to

$$\widehat{U}_A(\Gamma, e) \geq \widehat{U}_A(\Gamma, e') \quad \text{with} \quad e, e' \in \{0,1\}, e \neq e', \tag{IC$_e$}$$

$$\widehat{U}_A(\Gamma, e) \geq 0, \tag{PC$_e$}$$

$$t_L \geq 0,\ t_H \geq 0. \tag{LL}$$

Implementation of low effort.—Suppose that the principal wants to induce low effort $e = 0$ and consider a contract Γ' that specifies ex post efficient levels of project size, $y'_L = 0$ and $y'_H = 1$, and transfer payments that exactly reimburse the agent for his respective cost of project implementation, $t'_L = 0$ and $t'_H = c$. Clearly, Γ' satisfies the (LL) constraint. Furthermore, $\widehat{U}_A(\Gamma', 0) = 0$ and $\widehat{U}_A(\Gamma', 1) = -k$, such that Γ' satisfies the both the (PC$_0$) constraint and the (IC$_0$) constraint. Specifically, with the (PC$_0$) constraint being satisfied with equality, offering the contract Γ' allows the principal to fully extract the expected gains from trade, such that the principal's expected utility coincides with the expected gains from trade under low preparatory effort and implementation of the ex post efficient project size. As this is the best the principal can do *given that she implements low effort*, we have established the following observation:

Lemma 7 *Consider Scenario I and suppose that $b_L < c < b_H$. If the principal wants to implement low effort ($e = 0$), then the contract $\widehat{\Gamma}_0$ that specifies transfer* *payments $t_L = 0$ and $t_H = c$ and levels of project size $y_L = 0$ and $y_H = 1$ is an optimal contract.*

Implementation of high effort.—Suppose that the principal wants to induce high effort $e = 1$. To determine the optimal contract in this case, we proceed as follows. First, we determine the "cost-minimizing" transfers for exogenously fixed levels of project size. Thereafter, we determine the optimal level of project size given that transfers are chosen in a cost-minimizing fashion.

For given levels of project size $(y_L, y_H) \in [0,1]^2$, the problem of finding the cost-minimizing transfers can be stated as follows:

$$\min_{(t_L,t_H)\in\mathbb{R}^2_{\geq 0}} \; p_1 t_H + (1-p_1)t_L$$

subject to

$$t_H \geq \widehat{\Phi}^{IC}(t_L) \quad \text{with} \quad \widehat{\Phi}^{IC}(t_L) := t_L + \frac{k}{p_1 - p_0} + c(y_H - y_L), \tag{IC$_1$}$$

$$t_H \geq \widehat{\Phi}^{PC}(t_L) \quad \text{with} \quad \widehat{\Phi}^{PC}(t_L) := -\frac{1-p_1}{p_1}t_L + \frac{k}{p_1} + c\left(y_H + \frac{1-p_1}{p_1}y_L\right), \tag{PC$_1$}$$

$$t_L \geq 0,\; t_H \geq 0. \tag{LL}$$

Noting that $\widehat{\Phi}^{IC}(0) \gtreqless \widehat{\Phi}^{PC}(0)$ if and only if $y_L \lesseqgtr \widehat{y}$, where

$$\widehat{y} := \frac{kp_0}{c(p_1 - p_0)},$$

we will have to distinguish the two cases depicted in Figure 2: $y_L < \widehat{y}$ and $y_L \geq \widehat{y}$.

The isocost line

$$\left\{(t_L, t_H) \in \mathbb{R}^2 \mid p_1 t_H + (1-p_1)t_L = \tau\right\}$$

contains all transfer combinations (t_L, t_H) that, given the agent exerts high effort, result in the same expected transfer payment τ. Hence, in the (t_L, t_H)–space, the family of isocost lines consists of parallel straight lines with the same negative slope as $\widehat{\Phi}^{PC}(\cdot)$. An isocost line with a smaller vertical intercept contains combinations of transfer payments that result in a strictly lower expected transfer payment than combinations of transfer payments contained by an isocost line with a greater vertical intercept. The solution to the above cost-minimization problem thus is a transfer combination $(\bar{t}_L, \bar{t}_H)$ that satisfies (IC$_1$), (PC$_1$), and (LL) such that there is no other transfer combination $(\tilde{t}_L, \tilde{t}_H)$ that satisfies (IC$_1$), (PC$_1$), and (LL) and lies on a lower isocost line than $(\bar{t}_L, \bar{t}_H)$.

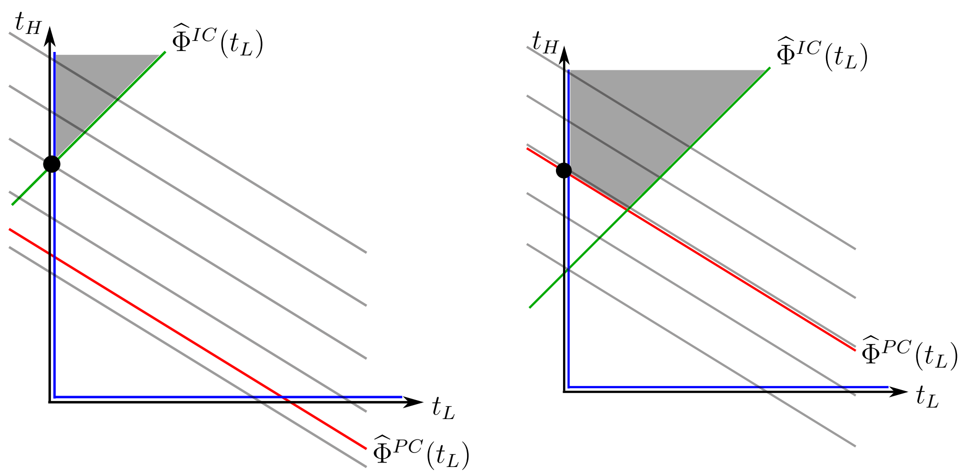

Figure 2. Cost-minimizing transfers payments implementing $e = 1$ in the case $y_L < \widehat{y}$ (left panel) and in the case $y_L > \widehat{y}$ (right panel). The green lines depict the incentive compatibility constraints, the red lines depict the participation constraints, and the blue lines depict the limited liability constraints.

Hence, if $y_L < \widehat{y}$, as depicted in the left panel of Figure 2, the participation constraint (PC$_1$) does not impose a binding restriction. The lowest feasible isocost line is reached by setting transfer t_L equal to zero and transfer t_H such that (given $t_L = 0$) the incentive compatibility constraint is satisfied with equality. If, in contrast, $y_L \geq \widehat{y}$, as depicted in the right panel of Figure 2, the participation constraint (PC$_1$) must be binding under the cost-minimizing transfer combination. Specifically, any feasible transfer combination that satisfies (PC$_1$) with equality and additionally satisfies (IC$_1$) and (LL) is a cost-minimizing transfer combination. In consequence, the transfer combination with transfer t_L being set equal to zero and transfer t_H being set such that (given $t_L = 0$) the participation constraint is satisfied with equality is always a cost-minimizing transfer combination. The cost-minimizing transfer combination for levels $(y_L, y_H) \in [0,1]^2$ of project size then (w.l.o.g.) can be summarized as follows:

$$\bar{t}_L = 0 \qquad \text{and} \qquad \bar{t}_H = \begin{cases} \widehat{\Phi}^{IC}(0) = \frac{k}{p_1 - p_0} + c(y_H - y_L) & \text{if } \ y_L \leq \widehat{y}, \\ \widehat{\Phi}^{PC}(0) = \frac{k}{p_1} + c\left(y_H + \frac{1-p_1}{p_1} y_L\right) & \text{if } \ y_L \geq \widehat{y}. \end{cases}$$

Given the cost-minimizing specification of the transfer payments, the optimal levels of project size are uniquely determined and solve

$$\max_{(y_L,y_H)\in[0,1]^2} \widehat{\Psi}(y_L, y_H)$$

with

$$\widehat{\Psi}(y_L, y_H) := \begin{cases} p_1 b_H y_H + (1-p_1) b_L y_L - p_1 \left[\frac{k}{p_1-p_0} + c(y_H - y_L)\right] & \text{if } y_L \leq \widehat{y}, \\ p_1 b_H y_H + (1-p_1) b_L y_L - p_1 \left[\frac{k}{p_1} + c\left(y_H + \frac{1-p_1}{p_1} y_L\right)\right] & \text{if } y_L \geq \widehat{y}. \end{cases}$$

The function $\widehat{\Psi}(\cdot,\cdot)$ is continuous and additively separable in y_L and y_H. As

$$\frac{\partial \widehat{\Psi}(y_L, y_H)}{\partial y_L} \begin{cases} > 0 & \text{if } y_L < \widehat{y}, \\ < 0 & \text{if } y_L > \widehat{y}, \end{cases} \qquad \text{and} \qquad \frac{\partial \widehat{\Psi}(y_L, y_H)}{\partial y_H} > 0$$

the optimal levels of project size are given by $y_L = \min\{1, \widehat{y}\}$ and $y_H = 1$, which yields the following observation.

Lemma 8 *Consider Scenario I and suppose that $b_L < c < b_H$. If the principal wants to implement high effort ($e = 1$), then the contract $\widehat{\Gamma}_1^I$ that specifies transfer payments $t_L = 0$ and $t_H = \frac{k}{p_1-p_0} + c(1 - \min\{1, \widehat{y}\})$ and levels of project size $y_L = \min\{1, \widehat{y}\}$ and $y_H = 1$ is an optimal contract.*

Optimal contract.—According to Lemma 7, the principal's maximum expected utility from implementing low effort is

$$\widehat{U}_P(\widehat{\Gamma}_0, 0) = p_0(b_H - c). \tag{21}$$

According to Lemma 8, the principal's maximum expected utility from implementing high effort is

$$\widehat{U}_P(\widehat{\Gamma}_1^I, 1) = p_1 b_H + (1-p_1) b_L \min\{1, \widehat{y}\} - p_1 \left[\frac{k}{p_1 - p_0} + c(1 - \min\{1, \widehat{y}\})\right]. \tag{22}$$

Comparison of (21) and (22) reveals that $\widehat{U}_P(\widehat{\Gamma}_0, 0) \gtreqless \widehat{U}_P(\widehat{\Gamma}_1^I, 1)$ if and only if

$$k \gtreqless \frac{p_1 - p_0}{p_1} \left\{(p_1 - p_0)(b_H - c) + [(1-p_1) b_L + p_1 c] \min\{1, \widehat{y}\}\right\}. \tag{23}$$

First, suppose that $\widehat{y} \geq 1$ or, equivalently, $k \geq \frac{c(p_1-p_0)}{p_0}$. In this case, $\frac{c(p_1-p_0)}{p_0} > \frac{p_1-p_0}{p_1}\{(p_1-p_0)(b_H - c) + (1-p_1)b_L + p_1 c\}$ if and only if $f(p_0) > 0$, where

$$f(p_0) := p_0^2 - p_0 \frac{p_1 b_H + (1-p_1) b_L}{b_H - c} + \frac{p_1 c}{b_H - c}. \tag{24}$$

If the quadratic function $f(\cdot)$ has no real-valued zeros, then $f(p_0) > 0$ holds trivially. If the quadratic function $f(\cdot)$ has one (two) real-valued zero (zeros), this zero (the smaller of these zeros) is given by

$$p_0^- = \frac{p_1 b_H + (1-p_1)b_L - \sqrt{[p_1 b_H + (1-p_1)b_L]^2 - 4(b_H - c)p_1 c}}{2(b_H - c)}. \tag{25}$$

As can readily be verified, $b_L < c$ implies that $p_0^- > p_1$, such that we must have $f(p_0) > 0$ for all $p_0 \in (0, p_1)$. Hence, if $k \geq \frac{c(p_1 - p_0)}{p_0}$, then the principal will implement low effort $e = 0$.

Next, suppose that $\widehat{y} < 1$ or, equivalently, $k < \frac{c(p_1-p_0)}{p_0}$. In this case, $k \gtreqless \frac{p_1-p_0}{p_1}\{(p_1-p_0)(b_H - c) + [(1-p_1)b_L + p_1 c]\widehat{y}\}$ if and only if $k \gtreqless \widehat{k}^I$, where

$$\widehat{k}^I := \frac{c(p_1-p_0)^2(b_H - c)}{cp_1(1-p_0) - b_L(1-p_1)p_0}. \tag{26}$$

Notably, the fact that $f(p_0) > 0$ implies that $\widehat{k}^I < \frac{c(p_1-p_0)}{p_0}$. Hence, if $k \leq \widehat{k}^I$, the principal will implement high effort $e = 1$. Otherwise, the principal will implement low effort $e = 0$.

Thus, we come to the following observation regarding the levels of project size and effort to be induced under the optimal contract.

Proposition 8 *Consider Scenario I and suppose that $b_L < c < b_H$. The levels of project size and effort implemented under the optimal contract are given by*

$$\widehat{y}_L^I = 1, \qquad \widehat{y}_L^I = \begin{cases} \widehat{y} & \text{if } k \leq \widehat{k}^I, \\ 0 & \text{if } \widehat{k}^I < k, \end{cases} \qquad \widehat{e}^I = \begin{cases} 1 & \text{if } k \leq \widehat{k}^I, \\ 0 & \text{if } \widehat{k}^I < k. \end{cases}$$

Scenario II: The inalienable right to quit

For the agent to be willing to continue the contractual relationship at date $T = 3$, the following two interim participation constraints have to be satisfied:

$$\widehat{V}(t_L, y_L) \geq 0 \tag{PC_L^{II}}$$

and

$$\widehat{V}(t_H, y_H) \geq 0, \tag{PC_H^{II}}$$

where $\widehat{V}(t,y) := t - cy$. The principal's contract design problem thus takes the following form:

$$\max_{\Gamma \in \mathbb{R}^2 \times [0,1]^2} \widehat{U}_P(\Gamma, e) \qquad \text{subject to} \qquad (\mathrm{IC}_e), (\mathrm{PC}_e), (\mathrm{LL}), (\mathrm{PC}_L^{II}), (\mathrm{PC}_H^{II}).$$

Compared to Scenario I, the principal faces two additional constraints, the interim participation constraints (PC_L^{II}) and (PC_H^{II}). In consequence, the best that the principal can hope for in Scenario II is to be as well off as in Scenario I.

Implementation of low effort.—Suppose that the principal wants to induce low effort $e = 0$. Recall that the optimal contract to implement low effort in Scenario I (i.e., the contract $\widehat{\Gamma}_0$ as identified in Lemma 7) specifies the ex post efficient levels of project size ($y_L = 0$ and $y_H = 1$) and transfer payments that exactly compensate the agent for his cost of project implementation ($t_L = 0$ and $t_H = c$). As the two interim participation constraints (PC_L^{II}) and (PC_H^{II}) are satisfied under contract $\widehat{\Gamma}_0$, this contract must also be optimal to implement low effort in Scenario II.

Lemma 9 *Consider Scenario II and suppose that $b_L < c < b_H$. If the principal wants to implement low effort ($e = 0$), then the contract $\widehat{\Gamma}_0$ that specifies transfer payments $t_L = 0$ and $t_H = c$ and levels of project size $y_L = 0$ and $y_H = 1$ is an optimal contract.*

Implementation of high effort.—Suppose that the principal wants to implement high effort $e = 1$. To derive the optimal contract in Scenario II for this case, consider the following relaxed problem:

$$\max_{\Gamma \in \mathbb{R}^2 \times [0,1]^2} \widehat{U}_P(\Gamma, 1) \qquad \text{subject to} \qquad (\text{IC}_1),\ (\text{PC}_L^{II}),$$

where the (IC_1) constraint requires $(p_1 - p_0)[(t_H - t_L) - c(y_H - y_L)] \geq k$. Under the solution to this relaxed problem the (PC_L^{II}) constraint must be satisfied with equality; i.e., for any given level of project size y_L, we must have $t_L = cy_L$. If this was not the case, the principal could adjust her contract offer and slightly reduce the transfer t_L which would strictly increase her expected utility without violating any constraint. With (PC_L^{II}) being satisfied with equality by construction of the transfer t_L, it follows that under the solution to the relaxed problem the project must be canceled in case of low marginal benefit; i.e., we must have $y_L = 0$. Otherwise y_L could be reduced which would strictly increase the principal's expected utility (because $b_L < c$) without violating (IC_1). The transfer t_H then must be set as low as possible; i.e., $t_H = cy_H + \frac{k}{p_1 - p_0}$, such that the ($\text{IC}_1$) just binds. With ($\text{IC}_1$) being satisfied with equality, it follows that the project size must be maximized in case of high marginal benefit; i.e., we must have $y_H = 1$. Otherwise

y_H could be increased which would strictly increase the principal's expected utility (because $c < b_H$).

Notably, the contract that solves the relaxed problem also satisfies the constraints (PC_1), (LL) and (PC_L^{II}). In consequence, the contract that is optimal in the relaxed problem is optimal also in the principal's original problem.

Lemma 10 *Consider Scenario II and suppose that $b_L < c < b_H$. If the principal wants to implement high effort ($e = 1$), then the optimal contract $\widehat{\Gamma}_1^{II}$ specifies transfer payments $t_L = 0$ and $t_H = c + \frac{k}{p_1 - p_0}$ and levels of project size $y_L = 0$ and $y_H = 1$.*

Optimal contract.—According to Lemma 9, the principal's maximum expected utility from implementing low effort is

$$\widehat{U}_P(\Gamma_0, 0) = p_0(b_H - c_L). \tag{27}$$

According to Lemma 10, the principal's maximum expected utility from implementing high effort is

$$\widehat{U}_P(\widehat{\Gamma}_1^{II}, 1) = p_1(b_H - c_L) - \frac{p_1 k}{p_1 - p_0}. \tag{28}$$

Comparison of (27) and (28) reveals that the principal will implement high effort $e = 1$ if $k \leq \widehat{k}^{II}$, where

$$\widehat{k}^{II} := \frac{(p_1 - p_0)^2}{p_1}(b_H - c). \tag{29}$$

Otherwise, the principal will implement low effort $e = 0$.

Thus, we come to the following observation regarding the levels of project size and effort to be implemented under the optimal contract.

Proposition 9 *Consider Scenario II and suppose that $b_L < c < b_H$. The levels of project size and effort implemented under the optimal contract are given by*

$$\widehat{y}_L^{II} = 1, \qquad \widehat{y}_H^{II} = 0, \qquad \widehat{e}^{II} = \begin{cases} 1 & \text{if } k \leq \widehat{k}^{II}, \\ 0 & \text{if } \widehat{k}^{II} < k. \end{cases}$$

Comparison of the scenarios

Comparing (18), (26), and (29) reveals that $0 < \widehat{k}^{II} < \widehat{k}^{I} < \widehat{k}^{FB}$. First, if $\widehat{k}^{I} < k$, expected gains from trade are identical in Scenario I and in Scenario II, because both scenarios result in low preparatory effort and ex post efficient project size.

Next, if $\widehat{k}^{II} < k \leq \widehat{k}^{I}$, expected gains from trade are unambiguously higher in Scenario I. To see this, recall that the principal in Scenario I always fully extracts the expected gains from trade. The fact that in Scenario I the principal strictly prefers to induce high effort rather than low effort if $\widehat{k}^{II} < k \leq \widehat{k}^{I}$ (where the expected gains from trade in case of low effort would correspond to the expected gains from trade in Scenario II), thus implies that expected gains from trade must be strictly higher in Scenario I than in Scenario II.

Finally, if $k \leq \widehat{k}^{II}$, Scenario II results in ex ante efficient effort and ex post efficient project size. Yet, the first-best outcome is failed in Scenario I, where the principal implements an inefficiently large project in case of a low marginal benefit of implementation in order to fully extract the associated gains from trade by completely eliminating the agent's rent. Hence, in this case Scenario II strictly outperforms Scenario I in terms of expected gains from trade.

Proposition 10 *Suppose $b_L < c < b_H$. If $k \leq \widehat{k}^{II}$, then the expected gains from trade are strictly larger in Scenario II than in Scenario I. If $\widehat{k}^{II} < k \leq \widehat{k}^{I}$, then the expected gains from trade are strictly larger in Scenario I than in Scenario II. If $\widehat{k}^{I} < k$, then the expected gains from trade in both scenarios are identical.*

References

Aghion, P., Hermalin, B., 1990. Legal restrictions on private contracts can enhance efficiency. *Journal of Law, Economics, and Organization* 6, 381–409.

Altan, B., 2019. Dynamic moral hazard with sequential tasks. *Economics Letters* 183, 108606.

At, C., Friehe, T., Gabuthy, Y., 2019. On lawyer compensation when appeals are possible. *BE Journal of Economic Analysis and Policy* 19, 1–11.

Au, P.H., Chen, B.R., 2019. Objective and subjective indicators in long-term contracting. *Journal of Economic Behavior and Organization* 166, 309–331.

Axelson, U., Bond, P., 2015. Wall street occupations. *Journal of Finance* 70, 1949–1996.

Baliga, S., Sjöström, T., 1998. Decentralization and collusion. *Journal of Economic Theory* 83, 196–232.

Basu, K., 2003. The economics and law of sexual harassment in the workplace. *Journal of Economic Perspectives* 17, 141–157.

Bernstein, D.E., 2003. Lochner's legacy's legacy. *Texas Law Review* 82, 1–71.

Bolton, P., Dewatripont, M., 2005. *Contract Theory.* MIT Press.

Brandwein, P., 2017. The labor vision of the Thirteenth Amendment, revisited. *Georgetown Journal of Law and Public Policy* 15, 13–58.

Buechel, B., Feess, E., Muehlheusser, G., 2020. Optimal law enforcement with sophisticated and naïve offenders. *Journal of Economic Behavior and Organization* 177, 836–857.

Cato, S., Ishihara, A., 2017. Transparency and performance evaluation in sequential agency. *Journal of Law, Economics, and Organization* 33, 475–506.

Coase, R.H., 1960. The problem of social cost. *Journal of Law and Economics* 3, 1–44.

Davis, K.E., 2006. The demand for immutable contracts: Another look at the law and economics of contracts modifications. *New York University Law Review* 81, 487–549.

Englmaier, F., Muehlheusser, G., Roider, A., 2014. Optimal incentive contracts for knowledge workers. *European Economic Review* 67, 82–106.

Fudenberg, D., Rayo, L., 2019. Training and effort dynamics in apprenticeship. *American Economic Review* 109, 3780–3812.

Green, B., Taylor, C.R., 2016. Breakthroughs, deadlines, and self-reported progress: Contracting for multistage projects. *American Economic Review* 106, 3660–3699.

Hart, O.D., 1995. *Firms, Contracts and Financial Structure.* Oxford University Press.

Hart, O., 2017. Incomplete contracts and control. *American Economic Review* 107, 1731–52.

Hart, O., Holmström, B., 1987. The theory of contracts. In: Bewley, T. (ed.), *Advances in Economics and Econometrics, Econometric Society Monographs, Fifth World Congress.* Cambridge University Press, 71–155.

Hart, O., Moore, J., 1999. Foundations of incomplete contracts. *Review of Economic Studies* 66, 115–138.

Holmström, B., 2017. Pay for performance and beyond. *American Economic Review* 107, 1753–77.

Hoppe, E.I., Schmitz, P.W., 2021. How (not) to foster innovations in public infrastructure projects. *Scandinavian Journal of Economics* 123, 238–266.

Innes, R.D., 1990. Limited liability and incentive contracting with ex-ante action choices. *Journal of Economic Theory* 52, 45–67.

Kim, K., 2015. Beyond coercion. *UCLA Law Review* 62, 1558–1584.

Köszegi, B., 2014. Behavioral contract theory. *Journal of Economic Literature* 52, 1075–1118.

Kragl, J., Schöttner, A., 2014. Wage floors, imperfect performance measures, and optimal job design. *International Economic Review* 55, 525–550.

Kräkel, M., 2016. Human capital investment and work incentives. *Journal of Economics and Management Strategy* 25, 627–651.

Kräkel, M., Schöttner, A., 2016. Optimal sales force compensation. *Journal of Economic Behavior and Organization* 126, 179–195.

Kräkel, M., Sliwka, D., 2009. Should you allow your employee to become your competitor? On noncompete agreements in employment contracts. *International Economic Review* 50, 117–141.

Laffont, J.-J., Martimort, D., 2002. *The Theory of Incentives: The Principal-Agent Model.* Princeton University Press.

Medema, S.G., 2020. The Coase theorem at sixty. *Journal of Economic Literature* 58, 1045–1128.

Myerson, R.B., 1982. Optimal coordination mechanisms in generalized principal–agent problems. *Journal of Mathematical Economics* 10, 67–81.

Ohlendorf, S., Schmitz, P.W., 2012. Repeated moral hazard and contracts with memory: The case of risk-neutrality. *International Economic Review* 53, 433–452.

Oman, N.B., 2009. Specific performance and the thirteenth amendment. *Minnesota Law Review* 93, 2020–2099.

Ontiveros, M.L., 2019. "Liquidated Damages" in guest worker contracts: Involuntary servitude, debt peonage or valid contract clause? *Nevada Law Journal* 19, 413–445.

Pi, J., 2014. Job design with sequential tasks and outcome externalities revisited. *Economics Letters* 125, 274–277.

Pi, J., 2018. Another look at job design with conflicting tasks. *Australian Economic Papers* 57, 427–434.

Pitchford, R., 1998. Moral hazard and limited liability: The real effects of contract bargaining. *Economics Letters* 61, 251–259.

Pope, J.G., 2010. Contract, race, and freedom of labor in the constitutional law of "involuntary servitude". *Yale Law Journal* 119, 1474–1567.

Rapp, G.C., 2005. Affirmative injunctions in athletic employment contracts: Rethinking the place of the Lumley rule in American sports law. *Marquette Sports Law Review* 16, 261–285.

Schmitz, P.W., 2004. Job protection laws and agency problems under asymmetric information. *European Economic Review* 48, 1027–1046.

Schmitz, P.W., 2005a. Allocating control in agency problems with limited liability and sequential hidden actions. *Rand Journal of Economics* 36, 318–337.

Schmitz, P.W., 2005b. Should contractual clauses that forbid renegotiation always be enforced? *Journal of Law, Economics, and Organization* 21, 315–329.

Schmitz, P.W., 2005c. Workplace surveillance, privacy protection, and efficiency wages. *Labour Economics* 12, 727–738.

Schmitz, P.W., 2006. Information gathering, transaction costs, and the property rights approach. *American Economic Review* 96, 422–434.

Schöttner, A., 2017. Optimal sales force compensation in dynamic settings: Commissions vs. bonuses. *Management Science* 63, 1529–1544.

Shavell, S., 2006. Specific performance versus damages for breach of contract: An economic analysis. *Texas Law Review* 84, 831–876.

Singh, R., 2016. Ronald Coase on firms and externalities. Working Paper, Delhi School of Economics.

Soifer, A., 2012. Federal protection, paternalism, and the virtually forgotten prohibition of voluntary peonage. *Columbia Law Review* 112, 1607–1640.

Spier, K.E., Whinston, M.D., 1995. On the efficiency of privately stipulated damages for breach of contract: Entry barriers, reliance, and renegotiation. *Rand Journal of Economics* 26, 180–202.

Sunstein, C.R., 1987. Lochner's legacy. *Columbia Law Review* 87, 873–919.

Talley, E.L., 1994. Contract renegotiation, mechanism design, and the liquidated damages rule. *Stanford Law Review* 46, 1195–1243.

Tamada, Y., Tsai, T.S., 2014. Delegating the decision-making authority to terminate a sequential project. *Journal of Economic Behavior and Organization* 99, 178–194.

Tirole, J., 1999. Incomplete contracts: Where do we stand? *Econometrica* 67, 741–781.

VanderVelde, L.S., 1989. Labor vision of the Thirteenth Amendment. *University of Pennsylvania Law Review* 138, 437–504.

Wonnell, C.T., 1993. The contractual disempowerment of employees. *Stanford Law Review* 46, 87–146.

Zietlow, R.E., 2010. Free at last – Anti-subordination and the Thirteenth Amendment. *Boston University Law Review* 90, 255–312.