Available online at www.sciencedirect.com

ScienceDirect

Journal of Economic Theory 175 (2018) 624–651

JOURNAL OF Economic Theory

www.elsevier.com/locate/jet

Dynamic relational contracts under complete information

Jonathan P. Thomas, Tim Worrall *

School of Economics, University of Edinburgh, Edinburgh, United Kingdom

Received 12 February 2016; final version received 3 February 2018; accepted 7 February 2018
Available online 12 February 2018

Abstract

This paper considers a long-term relationship between two agents who both undertake an action or investment that produces a joint benefit. Agents have an opportunity to expropriate some of the joint benefit for their own use. Agents have quasi-linear preferences. Two cases are considered: where agents are risk averse but where limited liability constraints do not bind, and where agents are risk neutral and subject to limited liability constraints. We ask how to structure the investments and division of the surplus over time to avoid expropriation. In the risk-averse case, the dynamics of actions and surplus may or may not be monotonic depending on whether or not a first-best allocation can be sustained. Agents may underinvest but never overinvest. If the first-best allocation is not sustainable, there is a trade-off between risk sharing and surplus maximization; surplus may not be at its constrained maximum even in the long run and the "amnesia" property of pure risk-sharing models fails to hold. In contrast, in the risk-neutral case there may be an initial phase in which one agent overinvests and the other underinvests. Both actions and surplus converge monotonically to a stationary state, where surplus is maximized subject to the self-enforcing constraints.

JEL classification: C61; C73; D86; D91; L14

Keywords: Relational contracts; Self-enforcement; Limited commitment; Risk sharing

* Corresponding author.
E-mail addresses: jonathan.thomas@ed.ac.uk (J.P. Thomas), tim.worrall@ed.ac.uk (T. Worrall).

https://doi.org/10.1016/j.jet.2018.02.004

1. Introduction

This paper considers a situation where two agents repeatedly engage in joint production. In each period, both agents simultaneously undertake an action or investment that produces a joint output. Agents must also decide how to share the joint output each period. We assume there is a hold-up problem, that is, contracts on actions or the division of the joint output are not enforceable and in addition the outside option of each agent is increasing in the investment of the other agent. We allow joint output and the outside options of the agents to depend on an exogenous state. We consider cases where the agents are risk averse and where they are risk neutral. The only link between periods is a Markov process determining states. There is complete information: apart from the fact that the agents choose their actions simultaneously each period, everything is observable. The only friction is that contracts cannot be enforced. We consider allocations or contracts from which no agent has an incentive to renege by imposing self-enforcing constraints at each date and state. We refer to feasible contracts that satisfy these constraints as dynamic relational contracts. We characterize the Pareto-efficient dynamic relational contracts; we refer to such contracts as optimal contracts.

We impose two simplifying assumptions on our model. First, we assume that agents' preferences are quasi-linear in consumption and actions. This simplifies the problem because with quasi-linear preferences efficient actions (and hence, surplus) are determined independently of the distribution of resources (the marginal rate of substitution between consumption and the action is equal to unity). Second, we impose sufficient conditions such that the constrained Pareto-frontier is concave. This simplifies our problem because it allows us to focus on non-random contracts.[1] We examine two main cases: where agents are risk averse but preferences are such that non-negativity constraints on consumption can be ignored, and where agents are risk neutral but consumption is constrained to be non-negative (limited liability).

If agents are risk averse results depend on whether or not it is possible to sustain a first-best allocation for some division of the surplus. If it is possible, convergence to the first best is monotone. Otherwise there might be an initial monotone phase, but in the long-run, when there are two or more states, monotonicity does not generally obtain: when the same state recurs, surplus will sometimes be higher at the later date and sometimes lower. There is also a trade-off between achieving efficient risk-sharing and maximizing current surplus even in the long run. In particular, and in contrast to the risk-neutral case, current surplus is not maximized. Better risk-sharing is achieved by holding the action of one agent inefficiently low because this reduces the outside option of the other agent, that is, it relaxes the latter's self-enforcing constraint. We show that the optimal contract depends on the past history of states and so the "amnesia" property of the risk-sharing limited commitment model does not hold.

When agents are risk neutral, we consider the implications of limited liability constraints and show that optimal contracts involve two phases. In the first phase there is backloading with zero consumption for the constrained agent, who overinvests up to the last period of the backloading phase and the terms of the contract move monotonically in his/her favor. This overinvestment arises because it allows a further transfer of utility to the other agent who consumes the extra output. It occurs despite the hold-up problem, that in a static model would lead to underinvestment. Nevertheless, we demonstrate that because of backloading it is never the case that both

[1] It would be straightforward to allow for random contracts by introducing a public randomization device, but at the cost of considerable complexity of notation and statements of our results. Furthermore, the assumptions we make are consistent with those that are commonly made in the literature.