

## Contract Theory

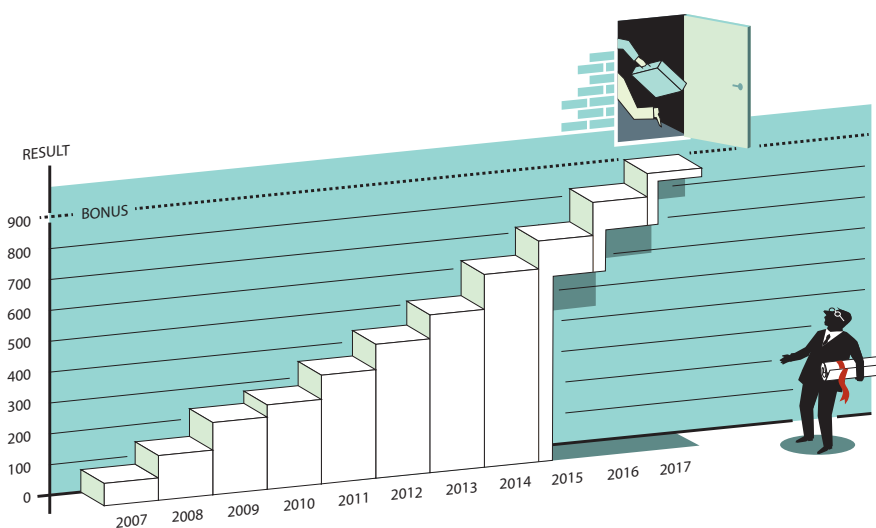
*Contracts are essential to the functioning of modern societies. **Oliver Hart's** and **Bengt Holmström's** research sheds light on how contracts help us deal with conflicting interests.*

Contracts help us to be cooperative and trusting when we may otherwise be disobliging and distrusting. As employees, we have employment contracts. As borrowers, we have credit contracts. As accident-prone owners of valuable property, we have insurance contracts. Some contracts fill less than a page, while others run over hundreds of pages.

One important reason for drawing up a contract is to regulate future actions. For example, employment contracts can stipulate rewards for good performance and conditions for dismissal, but it is important to note that contracts often have other purposes too, such as sharing risk among the parties to the contract.

Contract theory provides us with a general means of understanding contract design. One of the theory's goals is to explain why contracts have various forms and designs. Another goal is to help us work out how to draw up better contracts, thereby shaping better institutions in society. Should providers of public services, such as schools, hospitals, or prisons, be publicly or privately owned? Should teachers, healthcare workers, and prison guards be paid fixed salaries or should their pay be performance-based? To what extent should managers be paid through bonus programmes or stock options?

Contract theory does not necessarily provide definitive or unique answers to these questions, as the best contract will typically depend on the specific situation and context. However, the power of the theory is that it enables us to think clearly about the issues involved. The contributions of this year's laureates, Oliver Hart and Bengt Holmström, are invaluable in helping us understand real-life contracts and institutions, as well as the potential pitfalls when designing new contracts.



Holmström's multi-tasking model shows that if a manager's performance pay emphasises short-term cash flow, his actions may neglect the company's long-term health.

## The tension between insurance and incentives

If you have vehicle insurance, it is unlikely that you will be fully reimbursed if you have an accident. What is the motivation for deductibles and co-pay? If accidents happen by pure chance, surely it would be better to have insurance contracts that perfectly pool risks and thus relieve you of all the losses associated with a particular accident. But full insurance invites *moral hazard*: if we are fully insured, we may become more careless.

The tension between insurance and incentives is due to a combination of two factors. The first is a *conflict of interests*: not everyone is an angel. If we were all equally careful, regardless of whether or not we bore the full consequences of our behaviour, full insurance would be unproblematic. The second factor is *measurement*: not all our actions can be perfectly observed. If an insurer could see every careless action, an insurance contract might fully cover all losses caused by true accidents, but not those caused by reckless behaviour.

The same type of tension may be present in many other contractual settings, like employment relationships. In most cases, an employer is better able to bear risk than an employee. If the employee were always to act in both parties' best interest, no incentives to the contrary would be needed: the tension between insurance and incentives would be moot, and it would be optimal to offer the employee the insurance of a fixed salary. But if his interests clash with those of the employer *and* his behaviour is difficult to observe directly, an employment contract with a stronger link between pay and performance may be desirable.

## Paying for performance

Although the problem of providing incentives for employees had been known for a long time, the level of analysis was dramatically raised in the late 1970s, when researchers arrived at more exact answers to the question of how to design an optimal incentive contract. The first major insights were derived in the context of employment contracts involving risk-averse *agents* (employees) whose actions could not be directly observed by the *principal* (employer). Instead, the principal could only imperfectly observe a measure of the agent's performance.

A central result, published separately and independently by Bengt Holmström and Steven Shavell in 1979, is that an optimal contract should link payment to all outcomes that can potentially provide information about actions that have been taken. This *informativeness principle* does not merely say that payments should depend on outcomes that can be affected by agents. For example, suppose the agent is a manager whose actions influence her own firm's share price, but not share prices of other firms. Does that mean that the manager's pay should depend only on her firm's share price? The answer is no. Since share prices reflect other factors in the economy – outside the manager's control – simply linking compensation to the firm's share price will reward the manager for good luck and punish her for bad luck. It is better to link the manager's pay to her firm's share price relative to those of other, similar firms (such as those in the same industry).

A related result is that the harder it is to observe the manager's effort – perhaps due to many distorting factors blurring the relationship between her effort and the company's performance – the less the manager's pay should be based on performance. In industries with high risk, payment should thus be relatively more biased towards a fixed salary, while in more stable environments it should be more biased towards a performance measure.

This early work, especially Holmström's 1979 article, gave precise answers to basic questions about performance pay. However, it soon became clear that important aspects of reality were missing from the underlying model. The early work therefore led to a great deal of subsequent research, both by Holmström and by others.

## Strong incentives versus balanced incentives

In an article published in 1982, Holmström analysed a dynamic situation in which an employee's current salary does not explicitly depend on his performance. Instead, the employee is motivated to work hard due to concern about his career and future salary. In a competitive labour market, a company must reward current performance with higher future earnings, otherwise the employee will simply switch employer. Although this may appear to be an efficient system for rewarding and motivating workers, it has one drawback: career concerns may be so strong for people starting their working lives that they work excessively hard, while older people without this incentive tend to slack off. Holmström's *career-concerns* model has also been applied to other contexts, such as the relationship between politicians and their voters.

In Holmström's original 1979 article, the agent was assumed to be responsible for a single task. In 1991, Holmström and Paul Milgrom extended the analysis to a more realistic scenario where an employee's job consists of many different tasks, some of which may be difficult for the employer to monitor and reward. To deter the employee from concentrating on tasks for which performance is easier to measure, it may be best to offer weak overall incentives. For instance, if teachers' salaries depend on (easy to measure) student test scores, then teachers might spend too little time teaching equally important (but harder to measure) skills such as creativity and independent thinking. A fixed salary, independent of any performance measures, would lead to a more balanced allocation of effort across tasks. The results of this *multi-tasking* model changed how economists think about optimal compensation schemes and job design.

*Team work* also modifies the original pay-for-performance framework. If performance reflects the joint efforts of a group of individuals, some members may be tempted to shirk, free-riding on the efforts of their workmates. Holmström addressed this issue in an article from 1982, showing that when the firm's entire income is divided among team members (as in a worker-owned firm), effort will generally be too low. An outside owner for the firm can boost individual incentives because compensation can be more flexible: total compensation for the team members no longer needs to add up to the total income they generate. This example hints at another important issue that can be addressed by contract theory, namely ownership and control.

## Incomplete contracts

Imprecise performance measurement is not the only obstacle to drawing up efficient contracts. Parties are frequently unable to realistically articulate detailed contract terms in advance. The problem then becomes how to design the best rudimentary contract. This is the domain of incomplete contracts.

A major breakthrough arrived in the mid-1980s, in the work of Oliver Hart and his collaborators. The main idea is that a contract that cannot explicitly specify what the parties should do in future eventualities, must instead specify who has the right to decide what to do when the parties cannot agree. The party with this decision right will have more bargaining power, and will be able to get a better deal once output has materialised. In turn, this will strengthen incentives for the party with more decision rights to take certain decisions, such as investing, while weakening incentives for the party with fewer decision rights. In complex contracting situations, allocating decision rights therefore becomes an alternative to paying for performance.

## Property rights

In several studies, Hart – along with different co-authors, such as Sanford Grossman and John Moore – analysed how to allocate the ownership of physical assets, for example whether they should be owned by a single firm, or separately by different firms. Suppose a new invention requires the use of a particular machine and a distribution channel. Who should own the machine and who should own the distribution channel – the inventor, the machine operator, or the distributor? If innovation is the activity for which it is most difficult to design a contract, which seems realistic, the answer could be that the innovator should own all the assets in one company, even though she may lack production and distribution expertise. As the innovator is the party that has to make greater non-contractible investments, she also has greater need of the future bargaining chip that property rights bring to the assets.

## Financial contracts

One important application of incomplete-contract theory has been in financial contracts. Suppose, in the example of the manager, that true performance is difficult to use in a contract because the manager is able to divert the firm's profits. The best solution may be for the manager to become an entrepreneur and own the firm herself – an entrepreneur can freely decide how to run the firm, and make the appropriate trade-off between actions that raise profits and actions that increase her private benefits.

The limitation of this solution is that the manager sometimes cannot afford to buy the firm, so that outside investors have to finance the purchase. But if profits cannot be contracted on, how can investors be sure they will get their money back? One solution is to promise them a fixed future payment (regardless of profits) with collateral: if the payment is not made, ownership is transferred to the investors, who can liquidate the firm's assets. This is actually how most bank loans work – and the theory explains why. More generally, incomplete-contract theory predicts that entrepreneurs should have the right to make most decisions in their firms as long as performance is good, but investors should have more decision rights when performance deteriorates. This feature is typical of real-world financial contracts, such as the sophisticated contracts signed by entrepreneurs and venture capitalists.

## Privatisation

Another application of Hart's theory of incomplete contracts concerns the division between the private and public sectors. Should providers of public services, such as schools, hospitals, and prisons, be privately-owned or not? According to the theory, this depends on the nature of non-contractible investments. Suppose a manager who runs a welfare-service facility can make two types of investment: some improve quality, while others reduce cost at the expense of quality. Additionally, suppose that such investments are difficult to specify in a contract. If the government owns the facility and employs a manager to run it, the manager will have little incentive to provide either type of investment, since the government cannot credibly promise to reward these efforts. If a private contractor provides the service, incentives for investing in both quality and cost reduction are stronger. A 1997 article by Hart, together with Andrei Shleifer and Robert Vishny, showed that incentives for cost reduction are typically *too strong*. The desirability of privatisation therefore depends on the trade-off between cost reduction and quality. In their article, Hart and his co-authors were particularly concerned about private prisons. Federal authorities in the United States are in fact ending the use of private prisons, partly because – according to a recently released U.S. Department of Justice report – conditions in privately-run prisons are worse than those in publicly-run prisons.

## **Real-life understanding**

Contract theory has greatly influenced many fields, ranging from corporate governance to constitutional law. Thanks to the work of Oliver Hart and Bengt Holmström, we now have the tools to analyse not only contracts' financial terms, but also the contractual allocation of control rights, property rights, and decision rights between parties. The contributions by the laureates have helped us understand many of the contracts we observe in real life. They have also given us new ways of thinking about how contracts should be designed, both in private markets and in the realm of public policy.

---

## LINKS AND FURTHER READING

Additional information on this year's prizes, including a scientific background in English, is available on the website of the Royal Swedish Academy of Sciences, <http://kva.se>, and at <http://nobelprize.org>. There, and at <http://kvatv.se>, you can watch video footage of the press conferences, the Nobel Lectures and more. Information on exhibitions and activities related to the Nobel Prizes and the Prize in Economic Sciences is available at [www.nobelmuseum.se](http://www.nobelmuseum.se).

### Book

**Aghion, P., Dewatripont, M., Legros, P., & Zingales, L.** (2016). *The Impact of Incomplete Contracts on Economics*. Oxford: Oxford Scholarship Online.

### Interview

**Holmström, B.** (2013) Open Markets

<http://openmarkets.cmegroup.com/6987/why-bengt-holmstrom-is-an-economist-you-should-know>

### Biography

**Hart, O.** (2016) The Journal of FINANCE

<http://scholar.harvard.edu/files/hart/files/journal-of-finance-bio.pdf?m=1464115840>

---

## The Royal Swedish Academy of Sciences has decided to award the Sveriges Riksbanks Prize in Economic Sciences in Memory of Alfred Nobel 2016 to

### **OLIVER HART**

Born 1948 in London, UK. Ph.D. 1974 from Princeton University, NJ, USA. Andrew E. Furer Professor of Economics at Harvard University, Cambridge, MA, USA.

<http://scholar.harvard.edu/hart/home>

### **BENGT HOLMSTRÖM**

Born 1949 in Helsinki, Finland. Ph.D. 1978 from Stanford University, CA, USA. Paul A. Samuelson Professor of Economics and Professor of Economics and Management at Massachusetts Institute of Technology, Cambridge, MA, USA.

<http://economics.mit.edu/faculty/bengt>

*“for their contributions to contract theory”*

Science Editors: Per Strömberg, Torsten Persson and Mats Persson, the Committee for the Prize in Economic Sciences in Memory of Alfred Nobel  
Text: Tore Ellingsen, Torsten Persson and Mats Persson  
Illustrations: ©Johan Jarnestad/The Royal Swedish Academy of Sciences  
Editor: Carl-Victor Heindol  
Translation: Clare Barnes  
©The Royal Swedish Academy of Sciences