Decisions, Incentives and Contracts

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This describes what we happened to cover this year. I will also mention a few things I find useful to know but didn't have time to discuss in class.

1. *Intro to decisions and decision analysis.* We started by introducing the setting of decision under uncertainty with some simple examples, soon guessing that the two basic elements key to decisions are (utility) payoffs and probability judgments, which lead us to define the familiar Savage model. With that on hand we quickly got to the simplest way to combine utility and probability, that is the expected utility functional. We then delineated the logic of axiomatic decision theory and of its main results, and their motivation.

2. *vonNeumann-Morgenstern Theorem.* We decided to skip the big Savage Theorem and of course the more modern and more advanced non-expected utility theories, to concentrate on the classical simple but still quite useful original vonNeumann-Morgenstern Theorem, which we were able to prove in its entirety thanks to the beautiful presentation of the theorem contained in Peter Wakker's *Prospect Theory.* We devoted some time to the problem of elicitation of utility which is so important in practice. We then discussed the Allais paradox, and counter-arguments to it based on the notion of time consistency in dynamic decisions. We finally applied the theory to a couple of non-trivial real-world examples. Again, we skipped Savage theorem. A place where the interested reader can find the core of its proof in clear and accessible form is Wakker's book, Chapter 4 (you'd like it if you liked his proof of vNM).

3. *Risk Aversion.* Next topic has been risk aversion (also drawing on *Prospect Theory*), defined for general preferences over lotteries and characterized for vNM utilities. We did comparative risk aversion and its characterization in terms of the familiar Arrow-Pratt index, the associated notions of certainty equivalent and risk premium and their relations to the risk aversion index. We related these concepts to trade among agent of differing degrees of risk aversion and the associated potential for gains from trade. We saw the related notion of relative risk aversion and examined the two most useful families of vNM utilities, CARA and CRRA and their basic properties. As an application we looked (based on Mas-Colell-Whinston-Green's *Microeconomic Analysis,* Chapter 6) at the choice between safe and risky assets in partial equilibrium context. Incidentally, we did not cover the notion of stochastic dominance and its relation to risk aversion, which the reader can find in MWG's chapter 6. A topic I would have liked to present is that of risk sharing and the related fundamental Arrow-Lindt Theorem, which asks how a government should evaluate a risky project which has to be financed by a large population of risk averse individual (the answer being: as if they were risk neutral). For this one possible source is the good old Gravelle-Rees, *Microeconomics.*

4. *Asymmetric Information: Adverse Selection.* We then passed to Incentive Theory, i.e. the problem of delegation, whose main aspects were easily grasped thanks to Laffont-Martimort's great *Theory of Incentives*, starting with the adverse selection model. We identified the basic rent-efficiency trade-off arising from the agent's private information about her type at contracting time - she has to be compensated to reveal useful information and this has an efficiency cost. Then saw that the problem is mitigated if private information is acquired *after* contracting, where loss of efficiency is produced by the combination of asymmetric information and the agent's risk aversion. We saw in particular how to implement the first best with risk neutral agent. In studying ex-post contracting model we showed that in fact the previous ex-ante case could be seen as the special case where the agent is "infinitely" risk averse, and we looked at the special CARA utility case where the closed formulas illustrate this phenomenon in a transparent way. We looked at some of the various applications the book presents, and skipped many others. Notably, we did not talk about the adverse selection model when the agent can be one of many types (not just two). This is covered in the body and appendix of Laffont-Martimort's Chapter 3, or in Chapter 2 of Bolton-Dewatripont's *Contract Theory*. The other important assumption we have not relaxed is that of equal reservation utility across types. Relaxing this strong assumption leads to "countervailing incentives", which require a little time to digest - see Laffont-Martimort Chapter 3.

5. *Asymmetric Information: Moral Hazard.* We turned to the moral hazard problem, where private information concerns not who the agent is but what he does after signing her contract with the principal. We saw that the efficiency cost of asymmetric information comes in this case from the necessity of compensating the risk averse agent for producing good outcome, which entails her bearing some risk and consequently the need for an expected transfer strictly in excess of effort cost to ensure her non-negative expected utility. The first best can again be implemented if the agent is not risk averse, but only if she is also not liquidity constrained. We looked at a couple of application of the model, namely sharecropping where the standard contract we have studied has interesting competitors, and the insurance market where asymmetric information in a competitive market can impede the Pareto improving trade between risk neutral insurer and risk averse consumer. We only covered two-by-two models. A nice introduction to the continuous effort case including the CARA-Normal example is in the first three sections of Bolton-Dewatripont Chapter 4.

6. *Optimal Taxation: Efficiency-Equity trade-off.* As an illustration of the power and generality of the principal-agent model we considered the seemingly unrelated problem of optimal redistribution. We started from Bolton-Dewatripoint section 2.2 to go on to a little more in-depth analysis of the mathematics of the problem the involved trade-offs and the economic conclusions of the model, which concern a non-trivial interplay between marginal and lump-sum taxation.

7. *Ramsey Pricing and other regulation problems.* When the government produces a good through a regulated firm to which it reimburses production cost the question arises of what price to impose. The answer with full information is Ramsey price, which is between competitive and monopolistic price depending on the shadow cost of public funds. With adverse selection pricing and rent problems have to be solved together, and the result is that the two problems do not interfere with each other. Ramsey pricing remains optimal given the second best values of realized production costs. This topic is covered in Chapter 2 of Laffont-Tirole's *Theory of Incentives in Procurement and Regulation*. Another interesting model, that of "Regulatory Capture", is developed in Chapter 11 of the book. It is a three-tier model that captures bureaucracy as a "supervisor" between principal and the agent, the underlying idea being that the possibility of collusion between supervisor and agent induces the principal to reduce the power of incentives (by reducing production).

8. *Shapley Value.* We had to apply Shapley Value in the incomplete contracts part, and I took the liberty of presenting this fundamental concept - useful to know in many real-life situations - and proving a characterization theorem in terms of the three axioms of Dummy, Symmetry and Additivity. Of course we also stated the balanced-contribution alternative astonishing characterization. We enjoyed discussing the value and challenging Shapley's concept of fairness, to find in the end that it is indeed quite deeply rooted. We studied the theorem and a few examples from Osborne-Rubinstein's classic *Course in Game Theory.* [1]

9. *Incomplete contracts.* Incomplete contracts are the only available option when the parties are not in a position to specify in advance all the variables of interest without incurring unreasonable costs. Think of a long-term employment contract, or one involving a good which a party has to develop, or very extremely political voting to delegate to the leader the task of doing essentially what he will see fit given a very incomplete "program". Even in seemingly simpler settings the impossibility of writing complete contracts exists and it's relevant, as in the case when the contracting parties know perfectly well the objects involved but such knowledge is not in the hands of third parties, so that even when the relevant variables are observed by the parties they still cannot be verified by a court, hence they cannot form basis of contractual obligations - in jargon they are not contractible. Using Bolton-Dewatripont Chapter 11 we have looked at latter type of situation, where in particular non-contractible initial investments are desirable for creation of value from trade and are therefore made by the parties independently, in anticipation of negotiations over surplus created (which may take place using Shapley imputations). This separation from investment stage and surplus appropriation distorts incentives, typically causing underinvestment relatively to social optimum. To overcome such loss of value the parties can at the initial stage contract upon property rights - for example by vertically

[1] For the sake of historical curiosity: Shapley's Theorem is early fifties (1953), while Savage was proving Savage Theorem, Nash was doing Nash Equilibrium, Arrow and Debreu were establishing coherence of the competitive economy, Solow was writing the Solow model...

integrating - to alleviate the incentive problems. So the question becomes whether efficient allocation of property rights always emerges in equilibrium, the answer being that no, it isn't always the case. The models we saw clarifies some reasons why inefficiency can emerge. The case where the problem lies in the difficulty of describing the variable at contracting time - which we didn't have time to discuss - is in general harder to attack, but the reader may study the illuminating example in section 3.3 of the paper "Theory of Contracts" by Oliver Hart and Bengt Holmstrom (in Truman Bewley *Advances,* CUP 1987), which we covered last year.

10. *Repeated Interaction.* Except for what we described in the previous point, we did not rally get into the quite relevant area of long term interactions, commitments and renegotiation. A main message here is that with complete contracts, in repeated interaction commitment in general helps. The reason is simple, for absence of commitment implies possibility of breaching the contract, and having to anticipate this makes the parties wearier of one another at contracting time. With adverse selection for example it will be very costly to make the efficient agent reveal his type because he knows that if he does then in the second period the principal knowing his type will renege the contract and stop paying him the informational rent in the future. This part is nicely explained in Salanié's *The Economics of Contracts,* Chapter 6. Bolton and Dewatripont go deeper in section 9.1 in the analysis of Coasian Dynamics in the buyer-seller model (the seller not knowing the buyer's type).