Strategy, division, and competition

VALORISATION

Knowledge valorisation refers to the process of translating academic knowledge to societal benefit. Traditionally, the way to measure the scientific impact of research was by counting the number of scientific publications. However, it became clear that the number of publications (on its own) is not a good indicator. In this addendum I try to outline ways to valorise the knowledge of the results obtained from my research in the past four years.

This thesis applies game-theoretic tools to several well-known problems. Each chapter considers a specific problem and contributes to the topic in a different way. A common feature of all chapters is the focus on equilibrium situations. Recall that a given situation is in equilibrium if no individual player has an incentive to deviate. Even though the existence of an equilibrium is desirable as it describes a stable situation, there are three main drawbacks. First, even if an equilibrium exists, the question is how such equilibrium is reached. Second, the equilibrium concepts in this thesis are not stable against deviations by groups of players. One could easily think of situations in which players cooperate. Think for example of a close brother and sister in the estate division problem, or two colluding firms in Hotelling's model. Third, the concept of a Nash equilibrium seems restrictive. One interpretation of a Nash equilibrium is to view the profile of (possibly mixed) strategies as the beliefs that a player holds about the other players' choices. Such beliefs correspond to a Nash equilibrium if there is common belief in rationality plus additional restrictions, like, for example, each player believes that the other players are correct about the beliefs he holds about the other players' choices. One could argue how basic such condition is.

There is a lot of literature on each of these three points, but since they are not the focus of this thesis let us refrain from going into too much details. Moreover, despite its shortcomings, the Nash equilibrium has been extremely important for the development of game theory and provides a good benchmark. After all, if we want to investigate whether a specific social institution has any weaknesses, it can be very helpful to analyse the institution under the assumption that individuals are not flawed themselves. Otherwise, we cannot say whether a potential failure implies a reform of the institution or better education for the individuals. Thus an argument for reform of social institutions (rather than for education of individuals) is most persuasive when it is based on a model which assumes that individuals intelligently understand their environment and rationally act to maximize their own welfare.[5]

5 For a more extensive argument, see Myerson (1999).

Let me now return to the question of societal impact. How can the results of this thesis be used to affect our society?

One answer is that the models explain real-life phenomena. For example, the motivation for the research in Chapter 3 comes from an observation in every day life. A typical Dutch lunch consists of sandwiches. Just outside the School of Business and Economics, there are two neighbouring sandwich shops. Why did these two firms decide to locate next to each other?

One explanation is Hotelling's law. Firms have an incentive to locate close together in order to minimize product differentiation. This observation does not only apply to businesses (think of burger chains, gas stations), but also to political candidates. The assumption underlying this result is that consumers choose a product that is closed to them. Even though the model is very simplistic, it might capture parts of the motivation of a firm.

However, in many situations consumers are also impatient. If a person is hungry and walks towards these two sandwich shops and sees a long queue at one of them, then he decides to choose the other one. So for multiple applications, it is reasonable to assume that waiting time is also important. From our results, it actually turns out that there are equilibria in which two firms choose the same location. Hence the behaviour of the two sandwich shops is rational according to our model.

A second answer is to give people room for thought. Consider the situation in which a firm goes bankrupt. It has to be decided on a fair division of the liquidation value among the creditors. In the last two decades a lot of appealing properties for division rules for this problem have been proposed. Then given a specific situation, you could use the appropriate properties to compare several division rules and choose the rule that suits the situation best.

In the Netherlands the bankruptcy of a firm is arranged by law. The procedure works as follows. Basically, there is an order of priority according to which creditors get there money back. The highest priority applies to costs related to the bankruptcy, for example the salary of the executor. The second highest priority applies to the taxes, social charges and remaining salary payments of employees. The third priority applies to the remaining creditors. On average these creditors only receive 4% of their total.

It is clear from above procedure that in many cases only the executor and the government receives money. It is possible to think of other fair ways of distributing the money such that other creditors receive a larger amount of their total by using some of the properties that are proposed in the literature.

The third and hopefully most appealing answer is that results can be used by companies. As an illustration, consider traffic networks. A user in a traffic network only cares about his own travel time. The fact that this could imply additional waiting time for other users is irrelevant for his own choice. So

traffic participants seem to be a good example of rational players that act selfishly.

Analysing such network routing games has lead to insightful observations. One of the most famous results, a phenomena that actually has been observed in several cities over the world, is called Braess's paradox. Simply said, the result states that closing down a road might improve the performance in the network. The reason for this is the selfish choice of new routes can be beneficial overall. This result can be applied in the design of a traffic network, both during construction and for the end result.

Despite the dynamic nature of traffic networks, many models and corresponding results are obtained in static frameworks. The justification for this is that the static game represents the steady state of a dynamic model. Recently, more people focus on dynamic congestion games, which are able to capture phenomena like periodicity of traffic flows. Think of daily traffic jams during rush hours. This has lead to new insights compared to the static setting. Our paper Scarsini, Schröder, and Tomala (2015) focusses on this periodic behaviour to find the additional delay due to periodicity. But how can we use all these insights?

We live in a world full of modern technology. One of the (many) implications is that many traffic users make use of GPS navigation. This implies that a lot of information is available on the location and the delays incurred by these users, which can be used for the navigation of other users.

The Consumer Association is an organisation that stands up for the interests of the Dutch consumers. Recently, they tested the quality of several well-known navigation systems.[6] Their tests showed that in at least one thirds of all test drives the information provided was inaccurate. This means that there is room for improvement.

Problems one could think of are the following. First of all, the information provision should be fast and accurate. Delays are very dynamic, so it is important to have an idea how the delay evolves over time.

Second, the problem that has to be considered is very complex and is difficult to compute. There are lots of users and each one of them has a different destination. So it is complicated to determine alternative routes such that each user has an incentive to choose the indicated route. Think of a situation in which people try to avoid a traffic jam by using a small side road that then also becomes congested. If a user believes he is better off by choosing a different route, the redirection has no purpose.

Third, companies should have an incentive to work together. Globally speaking, the best results can be obtained, the more information is available. This can only be achieved if companies are willing to cooperate. Unfortunately, each company has an incentive to keep its information private in order to gain a competitive advantage.

6 See http://www.consumentenbond.nl/tests/bestanden/elektronica-communicatie/201502p56_Test_ navigatiesystemen.pdf

Our models provide insights and techniques that can be used in order to deal with some of the above problems. The fact that there are quite some hurdles to take only proves that there is still a lot of work to be done.