



# Natural Experiments in Television Shows

Dissertation

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## Foreword

On March 2, 2006 Sherman Mitchell from Compton, California faced a choice between \$250,000 for certain and 50%-50% chances of receiving either \$300 or \$500,000. Sherman has chosen \$250,000 for sure and discovered with relief that had he chosen the lottery he would have received only \$300. Contestants like Sherman appear on regular basis in the television show *Deal or No Deal* broadcasted in the U.S. and 24 other countries worldwide.

Why do we as economists not use these publicly observed decisions for testing different theoretical predictions about the economic behavior of individuals? Few of us know, however, that this is the topic of a new and rapidly developing field of natural experiments in television shows. The purpose of this dissertation is to offer a new agenda for the research on natural experiments in television shows. Particularly, this dissertation attempts to show that natural experiments could be used to test various predictions from descriptive theories, for example cumulative prospect theory (CPT) and expected utility theory (EUT) to name a few. Specific research questions addressed in this dissertation are the following:

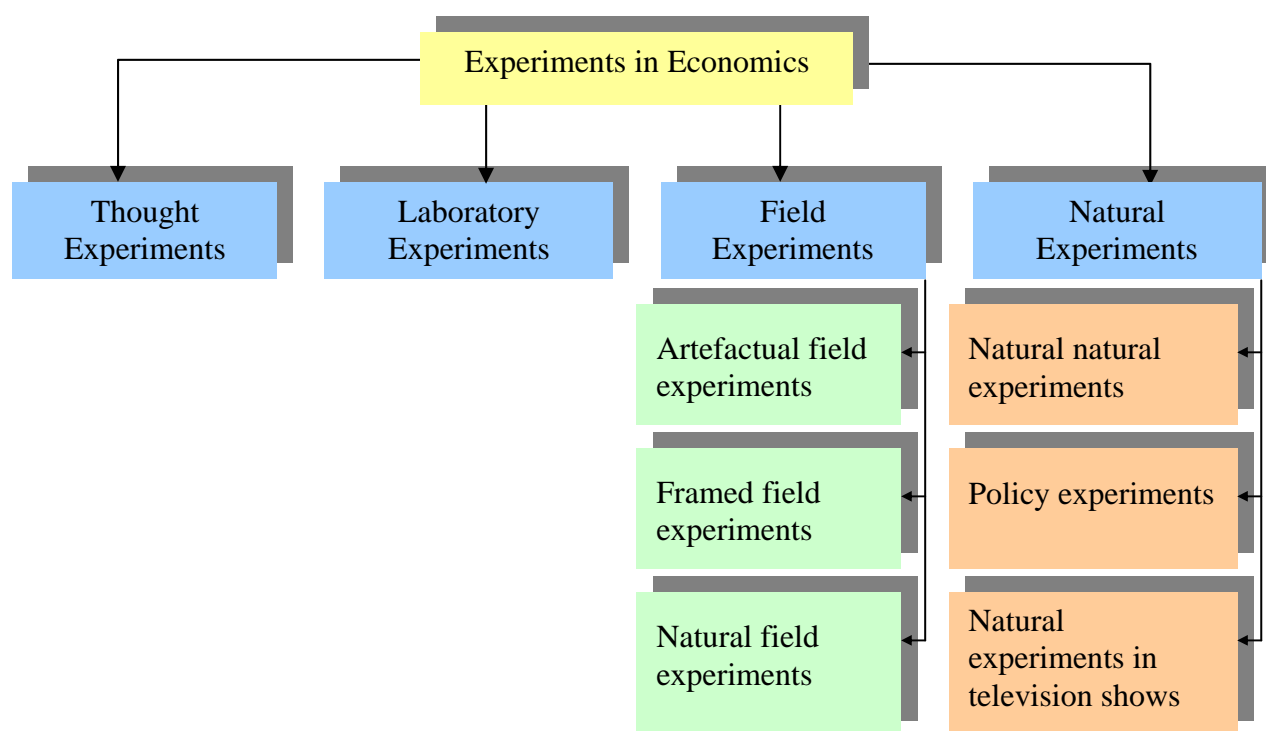
1. Does the behavior of contestants in the large-stake environment of television shows differ from the behavior of subjects in the laboratory and field experiments, which have a similar setting but use lower monetary incentives? Why?
2. How the data from the television shows could be used to test existing descriptive theories? Do the data collected from television shows provide evidence for the existing descriptive theories? Which descriptive theories can explain and predict the behavior of contestants in television shows?
3. How this proposed new methodology of testing descriptive theories on the data from television shows can affect the future agenda of experimental economics?

Economic experiments emerged as a useful tool for studying various aspects of human behavior. Last three decades saw a new era of experimental expansion into different fields of economics. The evolution of experimental methodology has undergone major shifts. While first experiments have relied primarily on hypothetically incentivized imaginary scenarios, currently the evidence is collected in the laboratory, from the field or from natural situations with large monetary stakes. All economic experiments can be classified into four broad groups (e.g. Figure 1).

Historically, the first experiments in economics were thought experiments pioneered in philosophy. Methodology of thought experiments relies on the construction of a hypothetical problem and a suggested solution, which the reader is invited to accept or reject (e.g. Roy Sorenson, 1992). The disadvantage of thought experiments is their reliance on hypothetical incentives and that the results are reported only for one subject – namely, the reader. However, the latter aspect is also exploited as the biggest advantage of thought experiments that gives them enormous credibility when the reader subscribes to the proposed solution. Well-known examples of thought experiments in economics are the St. Petersburg paradox (e.g. Daniel Bernoulli, 1738) and the Allais paradox (e.g. Maurice Allais, 1953).

Since complex economic phenomena cannot be always easily tested in a simple thought experiment, economists embraced the methodology of laboratory experiments that relies on eliciting behavioral responses across randomized treatments in abstract setting. The main advantages of laboratory experiments are controlled experimental conditions and the replicability of treatments. Their disadvantages are a non-representative subject pool (typically of undergraduate students) and relatively low or hypothetical monetary incentives that might jeopardize the external validity of results. Laboratory experiments in economics were pioneered by Edward Chamberlin (1948) and popularized by Vernon Smith and Charles Plott.

To increase their external validity, laboratory experiments were exported to the natural environment evolving into a new methodology of field experiments. The main advantage of field experiments is a more representative subject pool than in conventional laboratory experiments. Field experiments often use field rather than abstract framing, which may leave the experimenter with less control over the treatment. The disadvantage of field experiments is that they provide relatively low monetary incentives (though there are exceptions with field experiments in the developing countries). One of the first examples of field experiments in economics was conducted by Michael Levine and Charles Plott (1977). Glenn Harrison and John List (2004) provide a recent overview and classification of field experiments (see Figure 1).



**Figure 1 Experiments in Economics**

Finally, the youngest and one of the most rapidly developing approaches in experimental economics is the methodology of natural experiments. Natural experiments allow a researcher to analyze and draw conclusions from naturally occurring data, organized by a neutral force. Depending on the nature of this neutral force, natural experiments could be partitioned into

three groups: natural natural experiments, policy experiments and natural experiments in television shows.

Natural natural experiments employ biological and climate mechanisms to construct randomized treatments. Random outcomes such as twin births, birth dates, gender or weather events are typically used in natural natural experiments in labor economics. One of the most advocated advantages of natural natural experiments is a naturally created randomness across treatments (as opposed to “manmade” treatments). However, natural random events exploited in these experiments are often compounded by numerous behavioral, social and technological factors that might be difficult to control. Mark R. Rosenzweig and Kenneth I. Wolpin (2000) provide a detailed description of methodology of natural natural experiments.

Policy experiments refer to studies that investigate the effect of policy changes or economic reforms on selected groups of population. Obvious advantages of policy experiments are very high monetary incentives and large fractions of population that are involved in the experiment. However, the other side of this coin is that these experiments are typically very expensive and, therefore, rare. Examples of policy experiments are given in Bruce Meyer (1995).

The most recent addition to the methodology of natural experiments in economics are natural experiments in television shows, which are reviewed in this foreword. Television shows provide an appealing material for economists, because they are often structured as strategic games and well-defined decision problems (Andrew Metrick (1995)). Natural experiments in television shows have advantages of very high monetary incentives, a representative subject pool and data that are publicly available. The disadvantage of these experiments is that the experimenter has no control over the treatments (i.e. not all hypotheses can be readily tested on the data from television shows).

Another question that remains unresolved is to what extent the behavior of contestants recorded on television represents behavior in real life economic situations. Although natural

experiments in television shows involve high monetary incentives, contestants rarely have an experience with making decisions over such large stakes. It is also not clear whether being in the limelight has an influence on the decisions of contestants. However, several recent innovative studies demonstrate that these limitations are less restrictive than they may appear at the first sight.

**a) Natural experiments on individual risk attitudes**

The majority of studies on television shows concentrate on the elicitation of risk attitudes of contestants. This appears to be one of straightforward applications of natural experiments in television shows primarily due to large stakes used in the shows. For example, Robert Gertner (1993), Metrick (1995), and Roel M. W. Beetsma and Peter C. Schotman (2001) measure individual risk attitudes in the television shows *Card Sharks*, *Jeopardy!* and *Lingo* respectively.

Using the bonus round of *Card Sharks*, Gertner (1993) estimates that the lower bound of the coefficient of relative risk aversion is 4.8, i.e. contestants are extremely risk-averse. However, their behavior appears to be inconsistent with the expected utility maximization, because contestants base their decisions on accumulated winnings in the current round but do not take into account their earnings, accumulated in previous rounds. This suggests that *Card Sharks* contestants do not derive utility from the final wealth levels.

Metrick (1995) considers the final round of *Jeopardy!* television show and finds that contestants are nearly risk-neutral. He also shows that observed choices of contestants are not always optimal, i.e. contestants may be boundedly rational. Metrick (1995) finds evidence that contestants may have personal biases (for example they overestimate the probability of their success in bidding).

Beetsma and Schotman (2001) use television show *Lingo* to elicit risk attitudes of contestants, assuming constant relative and absolute risk aversion utility functions. It appears

that both functions perform almost equally well. Beetsma and Schotman (2001) find that contestants exhibit robust risk aversion.

Connel Fullenkamp, Rafael Tenorio, and Robert Battalio (2003) use gambling decisions of *Hoosier Millionaire* contestants to elicit risk attitudes. Fullenkamp et al. (2003) show that the majority of contestants exhibit risk aversion. However, the degree of risk aversion varies dependent of the stakes in the game.

Due to its simple design and high monetary incentives, the television show *Deal or No Deal* has attracted economists as a perfect laboratory for studying individual decision making under risk. Thierry Post, Martin Van den Assem, Guido Baltussen, and Richard Thaler (2004) analyze risk attitudes of Belgian, Dutch and German *Deal or No Deal* contestants. Matilde Bombardini and Francesco Trebbi (2005) elicit risk attitudes of *Affari Tuoi* (Italian version of *Deal or No Deal*) contestants. Daniel Mulino, Richard Scheelings, Robert Brooks and Robert Faff (2006) and Nicolas de Roos and Yianis Sarafidis (2006) measure risk attitudes and study the endowment effect in the Australian version of *Deal or No Deal*. All these studies conduct a *parametric* estimation of expected utility theory by assuming that all contestants exhibit constant relative or absolute risk aversion.<sup>1</sup> Pavlo R. Blavatskyy and Ganna Pogrebna (2006a) study the decisions of *Affari Tuoi* contestants, when they can exchange two ex ante identical risky lotteries, and find that contestants do not appear to be predominantly loss averse.

#### **b) Natural experiments on discrimination**

Apart from risk attitudes, economic researchers turn to the data from television shows to study discrimination. Particularly, Steven D. Levitt (2004) uses the US broadcasts of *The Weakest Link* television show to test the predictions of two theories of discrimination. While Levitt (2004) finds only limited evidence of discrimination, he shows that some contestants

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<sup>1</sup> In addition to expected utility theory, several of these studies also consider one generalized non-expected utility theory. Post et al. (2004) estimate a parametric form of cumulative prospect theory with so-called Quiggin's probability weighting function and an ad hoc reference point. Bombardini and Trebbi (2005) estimate a parametric form of (original) prospect theory with power probability weighting function and zero reference point. De Roos and Sarafidis (2006) estimate a parametric form of rank-dependent expected utility theory with power probability weighting function.

tend to discriminate against Hispanics and elderly contestants. He also finds some support for the strategic voting behavior in the show.

Kate Antonovics, Peter Arcidiancono and Randall Walsh (2005) perform another test of discrimination in American version of *The Weakest Link* television show. Using conditional logit analysis, they do not find evidence that men discriminate against women or white contestants discriminate against black contestants. In contrast, their results suggest that females tend to discriminate against males in the early rounds of the game.

### **c) Natural experiments on behavior in strategic games**

Several studies test for Nash equilibrium play and rationality using the data, obtained from the natural experiments. For example, Randall Bennett and Kent Hickman (1993) and Jonathan Berk, Eric Hughson and Kirk Vandezande (1996) employ the natural laboratory of *The Prize is Right* to test for the optimal information updating and rational bidding strategies correspondingly.

Using a simple theoretical model, Bennett and Hickman (1993) find that while contestants in *The Prize is Right* often resort to the suboptimal strategies and repeatedly make mistakes despite a developed system of punishments for such mistakes, introduced in the show, they gradually learn to play the game more efficiently. Berk et al. (1996) perform a test of rational decision theory and show that while contestants in *The Prize is Right* bid in a suboptimal way, their behavior could be explained in terms of bounded rationality. In addition, Berk et al. (1996) argue that fairness considerations do not significantly influence bidding behavior.

Ganna Pogrebna (2006) analyzes voting decisions of contestants in the British version of *The Weakest Link* and finds that in the early stages of the elimination tournament contestants play a pure strategy Nash equilibrium—they coordinate on voting off the weakest player (which appears to be the focal principle in the game) with an overwhelming majority. However, in the last rounds of the game contestants apparently play a strictly mixed Nash equilibrium. Pogrebna (2006) also finds that contestants overweigh small probabilities of

large outcomes in accordance with cumulative prospect theory or rank-dependent expected utility theory.

Philippe Fevrier and Laurent Linnemer (2006) analyze a simplified strategic game similar to actual game played by three contestants when they vote in the last round of *The Weakest Link*. They identify two pure strategy Nash equilibria of the simplified game and argue that the voting patterns observed in the French version of *The Weakest Link* suggest that contestants coordinate on a payoff dominant equilibrium “if it is not too risky”. Instead of analyzing voting strategies of *The Weakest Link* contestants, Marco Haan, Bart Los, and Yohanes Riyanto (2004) focus on how efficiently contestants use the technology that transforms correctly answered general knowledge questions into money. They find that contestants in the British version of the *The Weakest Link* use this technology suboptimally and loose on average 17% of their earnings.

As this brief review demonstrates, the methodology of natural experiments in television shows has a greater potential for being used not only for simple descriptive analysis of the data (e.g. elicitation of risk attitudes) but also for testing different hypotheses of economic theory. To meet the latter objective, data from television shows have to be used more creatively. Specifically, the researcher needs to divide the contestants across necessary treatments and make sure that the show regulations result in contestants being allocated across these treatments as a result of pure chance events.

For example, in the Italian version of *Deal or No Deal* contestants make several choices between a risky lottery (with prizes up to half a million euros) and an amount for certain. Risky lotteries, which contestants face in the show, are determined by chance events. This allows Blavatsky and Pogrebna (2006b) to divide contestants across randomized treatments. Given an individual, whose preferences are described by a particular decision theory, Blavatsky and Pogrebna (2006b) construct a treatment where this individual faces relatively unattractive lotteries (higher likelihood of choosing a sure amount) and a treatment where this

individual faces relatively attractive lotteries (higher likelihood of choosing a risky lottery). By comparing behavioral patterns across two treatments, Blavatskyy and Pogrebna (2006b) test the predictions of decision theories without making any assumptions about their parametric forms.

Thus, although an experimenter has no control over the scenario of the television show, it is possible to construct man-made randomized treatments by exploiting random outcomes embedded in the show. This appears to be more promising avenue for future research than an alternative use of natural experiments in television shows as complements to laboratory experiments, suggested, for example, by Harrison and List (2004). Future research can exploit a high potential of natural experiments in television shows for testing even broader range of research hypotheses than the existing applications highlighted in this brief overview.

The dissertation consists of seven parts. Each part uses data, collected from a particular television show, aired on the publicly available channels. Then, the data is analyzed using game theoretical analysis and econometric methods. After that, the theoretical predictions are compared with the actual behavior observed in the data. The conclusions are drawn as to whether the theories used can explain or predict observed behavior.

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