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From Theories of Human Behavior to Rules of Rational Choice: Tracing a Normative Turn at the Cowles Commission, 1943-1954

By

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From Theories of Human Behavior to Rules of Rational Choice: Tracing a Normative

Turn at the Cowles Commission, 1943-1954¹

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Abstract
This article traces a normative turn between the middle of the 1940s and the early 1950s reflected in the reformulation, interpretation, and use of rational choice theories at the Cowles Commission for Research in Economics. This turn is paralleled by a transition from Jacob Marschak’s to Tjalling Koopmans’ research program. While rational choice theories initially raised high hopes that they would serve as empirical accounts to inform testable hypotheses about economic regularities, they became increasingly modified and interpreted as normative approaches offering behavioral recommendations for individual agents, organizations, government, or teams. The predefined elements constitutive of these accounts, inspired by simple rules of logic were now meant to represent the basic demands of rationality, while theories of rational decision-making specified rules of conduct that were meant to shape rather than explain behavior.

Keywords: history of rational choice theory, Cowles Commission, normative turn

JEL Classification: B00, B2, B3, B4

Introduction

This article argues that there was a normative turn in mathematical economics during the early Cold War era at the Cowles Commission for Research in Economics. Between 1943 and 1954, this turn is revealed in the re-formulation, interpretation, and intended applications of

¹ I thank participants of the HOPE Lunch Seminar 2013 taking place at the Center for the History of Political Economy at Duke University for their extremely valuable feedback. I also thank Marcel Boumans, Simon Cook, Malte Doehne, Pedro Duarte, Crauford Goodwin, Harro Maas, Ivan Moscati, E. Roy Weintraub and two anonymous referees for comments on an earlier draft. I finally thank the archivists at the Ford Foundation and the University of California, Los Angeles Special Collections Library and at the Ford Foundation Archives for their help. This research benefitted from a grant by the Humboldt Foundation and a fellowship at the Center for the History of Political Economy at Duke University.
economic approaches to human behavior, and paralleled by a transition from the research program of Jacob Marschak to that of Tjalling Koopmans. The article argues that while innovative mathematical tools and approaches originating in the “new decision sciences” emerging after World War II (Amadae 2003, 6, Heyck 2012) initially raised hopes for empirical theories of human behavior, they were soon reformulated, reinterpreted, and applied as normative accounts to compute the course of behavior considered ‘optimal’ or ‘best’ in a decision-making situation. The Cowles Commission, a non-profit institution and emerging stronghold of mathematical economics housed at the University of Chicago, was one of the first places where economists engaged with rational choice theories and the mathematical tools they were grounded on.2

Such a normative turn in the history of rational choice theories has been traced in the so-called “Cold War social sciences” literature (Solovey 2012).3 The literature tends to explain this turn in relation to the rise of the decision sciences and the political, institutional, and social particularities of the Cold War context.4 While the impact of the Cold War context should not be underestimated, and it is clear that the development and application of models of decision-making to optimal allocation and planning problems was prevalent at Cowles as it was at

2 While for example Dimand/Dimand (1996, 1) distinguish between game theory and the conceptual tools, such as probability theory and treatment of preferences under uncertainty that von Neumann and Morgenstern had introduced, I consider the tools and the two conceptualizations of rationality as not being easily distinguishable because those new tools were conceptually constitutive of game and decision theory.

3 See Erickson et al. (2013) on the emergence of a rule-based understanding of rationality in the early Cold War years, and on the use of game theory at the RAND Corporation to address problems of military strategy, also: Düppe/Weintraub 2014, Erickson 2015, Mirowski 2002a, Thomas 2015. On the term “Cold War social sciences” see Solovey (2012, 2013), and Solovey/Cravens (2012).

4 The presence of major funding bodies like the Ford and Rockefeller foundations, a rising interest in optimal decision-making in the political and the military context, and the involvement of scientists in research institutions such as RAND and the U.S. Office of Naval Research (ONR) are taken as major explanatory factors for such a turn (e.g., Abella 2008, Amadae 2003, Erickson 2015, Erickson et al. 2013, Heyck 2013, Klein 2016a, Mirowski 2002a, 2002, Solovey 2013, Solovey/Cravens 2012, Thomas 2015). An important motivation across the institutional landscape was to avoid irrational, and produce rational choices in relevant decision-making situations, which in turn could be achieved by the right social and technical mechanisms. The underlying rule-based understanding of rational action was convenient for informing strategic decision-making in the political and military context. Their application as normative accounts could furthermore guarantee the internal consistency of society and individual within a world perceived as complex, risky, and highly uncertain (Heyck 2012).
RAND (Abella 2008, Amadae 2003, Heyck 2012, 110, Mirowski 2002b, Thomas 2015). Nevertheless, the diversity of the institutional landscape and the plurality of concerns of individual social scientists should not be neglected, and is vital to give nuance to our current historical picture. For example, while game theorists at RAND often aimed at improving practical decision-making in military contexts, scholars at Cowles and the CASBS developed abstract theories that defined rational decision-making for epistemic reasons (Erickson et al. 2013, Thomas 2015, 7). Focusing on the still under-researched Cowles Commission, this article aims to introduce just such nuance.

Cowles was a hybrid institution, something between a national laboratory and a university (Düppé/Weintraub 2014, 463). Cowles scholars engaged in applied research on decision-making to improve management, investment, and inventory decisions. Nevertheless, practical concerns were complemented with basic research, using newly available mathematical tools such as probability theory, the axiomatic method, topology and fixed point techniques, set theory, the theory of relations, Bayesian statistics, engaged in mathematical modeling, and developed experimental and computing approaches (Erickson et al. 2013, 14, Isaac 2010) to redefine theory and practice around the study of choice (Erickson et al. 2013, ch. 4, Heyck 2012, 102, Isaac, 2010). As such, the goal of defining rationality algorithmically (Erickson et al. 2013) was motivated in part by pure intellectual curiosity among Cowles researchers, and their fascination with using the new mathematical tools to develop new theoretical and empirical innovations that would ultimately secure the scientific status of the social sciences (Isaac 2010, 138). Cowles also differed from other research institutions in developing its research program in econometrics.

Cowles scholars engaged with new approaches to decision-making by way of specific difficulties their research program posed, being led by shared epistemic values, methodological commitments, and a common set of scientific norms that would eventually result in a new
intellectual culture that shaped academic economics (Düppe/Weintraub 2014). Many Cowles scholars distanced themselves from any political connotations of their research, pursuing foundational and conceptual issues and advancing mathematical techniques (ibid.) to respond to pressures of legitimacy from within the economics discipline, rather than pleasing the interest of external funding bodies. As Düppe and Weintraub (2014, 469) have argued, while tacitly agreeing about the potential of approaches to decision-making for practical purposes of social engineering, the reason for developing them at Cowles was often independent of any explicit political or moral justification. The two Cowles directors, Jacob Marschak and Tjalling Koopmans, unintentionally achieved a depolitization via prioritizing their enthusiasm for mathematical methods and statistical techniques and a joint commitment to shared scientific standards of evidence and rigor prevalent in prescriptive approaches such as linear programming and activity analysis.⁵

The following analysis rests on the premise that those theoretical considerations contributed to the normative turn at Cowles and as such suggests that the relevant factors behind the normative turn differed across the institutional landscape of the early Cold War period. By revealing the reasons for, and the nature of such a normative turn at the Cowles Commission, it is assumed that social scientific communities had distinct reasons for engaging with approaches to human behavior in that they followed distinct research agendas and committed to different epistemic values and methodological rules to push those agendas. As the factors mentioned were specific to the circumstances at Cowles, they cannot be easily generalized to other research institutions. While the turn revealed is thus a local turn, its analysis is meant to contribute to a nuanced yet comprehensive understanding of the emergence of what has been labeled “Cold War rationality” (Erickson et al. 2013) in particular, and the

⁵ Koopmans (1953, 406) defined activity analysis as the “construction of conceptual models to study and appraise criteria, rules, and practices for the allocation of resources”.

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history of rational choice theories and their oscillating normative and empirical interpretations in general.

I argue that the normative turn at Cowles started with the engagement of mathematical economists with new mathematical tools emerging in the so-called decision sciences after WWII to cope with a set of challenges posed by Marschak’s research program in econometrics lacking a theory of human behavior under uncertainty. Cowles scholars became increasingly aware that the simple model of *homo oeconomicus*, enshrined in traditional utility theory under certainty, was limited and sought new approaches to confront the difficulty of finding a theory of economic behavior under uncertainty. While this hope was not fulfilled, active engagement with those tools allowed Marschak and Koopmans to stay true to their epistemic values and scientific norms. At the same time, however, those tools influenced the set of problems to which they could be applied. Those problems largely demanded prescriptive solutions, and the new approaches came to be used to compute rational decisions in uncertain situations, leading to a shift in emphasis towards normative interpretations of rational choice theories.

To trace this normative turn at Cowles, I rely on annual research reports of the commission as major sources of evidence (Cowles 1943, 1944, 1945, 1942-46, 1947, 1948-1949, 1949-50, 1950-51, 1952-54). Those reports – written by the respective research director – were mainly used to inform the economics profession and (potential) funding bodies about research advances at the commission (Cowles 1952-54, 1 f.). As the formal work at Cowles was initially conceived as exotic and inaccessible by the rest of the profession, the reports served as a source of information for ‘outsiders,’ containing detailed but non-technical presentations of the commission’s research agenda, changes in problems addressed, major projects undertaken and methods used, previous and planned conferences and workshops, placements in staff and new appointments, talks held by fellows, as well as publications and ongoing work in progress. To confront the challenge that such sources might have partly played
a rhetorical role in favorably presenting the research at Cowles to the outside world, I complement those reports with archival and published material.6

Theories of Economic Behavior in Marschak’s Research Program

‘Rational choice theory’ had referred to ordinal utility theory, but from the 1940s mainly became an umbrella term covering the emerging formal-mathematical approaches to human behavior. Where the earlier usage identified rational behavior with the maximization of utility, the latter embodied the idea that a rational choice results from acting consistently, i.e., in line with preferences supposedly ordered according to a set of rationality axioms, such as transitivity and completeness. The newer meaning arose in the wake of John von Neumann and Oskar Morgenstern’s *Theory of Games and Economic Behavior* (1944), which developed Bernoulli’s principle of moral expectation (Bernoulli 1954 [1739]) into a “theory of rational behavior” under risk and posited the “minimax theorem” as a rule for rational behavior under strategic uncertainty, thereby laying the grounds for game theory. From different mathematical traditions (Weintraub 2002) other axiomatic theories of choice soon followed (e.g., Arrow 1963 [1951], Debreu 1959). Unifying these theories was a common grounding in a new set of mathematical tools and research techniques, primarily axiomatic set theory, the theory of relations, and topology.7

*Theory of Games* helped establish axiomatic choice theories in economics (Boumans/Davis 2010; Debreu 1986, Isaac 2010). While von Neumann and Morgenstern remained ambivalent regarding the interpretation of strategic rationality (Giocoli 2003, 215),

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6 While I found no sources giving further insights into the intention behind the research reports, a current staff member and a past director indicated [email exchange on June 18, 2015 with Ames Glena] that reports were written (and distributed) in the 1940s, 1950s and 1960s to review the novel research conducted at Cowles for outsiders.

7 While *Theory of Games and Economic Behavior* was informed by the Hilbertian tradition and von Neumann’s conviction that mathematics ultimately had to remain a servant of the sciences, the work by Debreu in the Bourbakian tradition and Arrow in the Tarskian tradition differed profoundly from this ideal (e.g., Weintraub 2002).
their concepts were initially received with enthusiasm (Dimand/Dimand 1996, 151). Most of the excitement arose from their move to introduce mathematical and statistical tools into economics, axiomatically ground traditional utility theory, and conceptualize the ideas that decisions were often made in risky situations and that market behavior was interdependent.⁸

High hopes were raised that new mathematical approaches and both accounts of rational behavior – the axiomatic version of the expected utility principle and the minimax theorem – would be useful in what Marschak and colleagues called “empirical economics” (Cowles 1947, Dimand/Dimand 1996, Hurwicz 1953, Leonard 2010).

Theories of economic behavior were thus initially intended to play an important empirical role in Marschak’s research program at Cowles. A strong promoter of von Neumann and Morgenstern’s ‘theory of rational behavior’ and a pioneer in developing their axiom system (e.g., Marschak 1950), Marschak pushed the research on axiomatic theories of decision-making under uncertainty at Cowles in the early 1950s. One problem that concerned him was to find an improved theory of economic behavior under risk and uncertainty. What set Cowles apart from research institutions in the wake of the emerging decision sciences was Marschak’s research program in econometrics, i.e. the application of mathematical statistics to empirical problems (Epstein 1987).⁹ Marschak had pushed this program as research director since 1943 (Cherrier 2010, Weintraub 2002, 118), and it was in this context that he believed a theory of decision-making under uncertainty a crucial first step to improve economic analysis.

Before coming to Cowles in 1943, Marschak had already developed a structural estimation method that involved constructing large models of the economy. In line with Haavelmo (1944), Marschak’s specific understanding of the role of what he called ‘pure theory’ in empirical work (Epstein 1987, 64) was taking a theory as a system of simultaneous

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⁸ Of the 22 reviewers of the Theory of Game until 1950, 8, namely Maurice Kendall, Herbert Simon, David Hawkins, Ernest Nagel, Marschak, Hurwicz, and Abraham Wald, were directly or indirectly affiliated with Cowles.

⁹ For an overview of the Cowles research program in econometrics at Cowles, see Christ (1994).
structural equations describing economic relationships. Most of those equations were behavioral hypotheses expressing “the average behavior [of, e.g., demand for inventories or consumer goods] of a social group or market” (Cowles 1945, 2). The program had a theoretical component in that economic theory was used to formulate such equations and an empirical component, namely the statistical estimation of model parameters and data fitting to statistically test predictions of the models in a systematic way (e.g., Christ 1952, Epstein 1987, Hoover 2006b, 241). As the equations were formulated by drawing upon a priori information about the structure obtained from economic theory, it was crucial for the predictive power of those models that the theories used approximated economic reality (Christ 1994, 36).

The major role of traditional theories of rational behavior in this program was to inform the formulation of behavioral relationships, their interrelations and change in form of equation systems. The Cowles report (1942-46, 5) reads:

The statistical estimation of the structural relations [human behavior, technology, legal rules] is the ‘filling of empty boxes of economic theory’. The theory is a set of hypotheses. Most of these hypotheses state which variables enter which structural equations, or state certain inequalities […]. This is based, essentially, on experience independent of the material that is to be used in estimation. This experience may include statements on rational (i.e. utility-maximizing) behavior and on deviations from it; on a plausible psychology of anticipations; on technological data; etc.

Theories of economic behavior entered this work on two levels: on the theoretical level, for hypothesis formulation, and estimation of model parameters; and on the level of empirical analysis, for data gathering and testing. To formulate and subsequently test behavioral
hypotheses, an empirically adequate, yet quantitative theory of human behavior was a crucial step towards making predictions and policy recommendations.

In the mid-1940s, the commission aimed to improve their models for numerical statistical estimation (Epstein 1987). Traditional theories were deemed unsatisfactory (Christ 1952). Marschak understood economic relationships (the ‘economic structure’) between economic variables as fundamentally stochastic in character, and so needing formulation in probabilistic terms. This implied that the set of structural equations representing behavioral relationships had to be based upon probability distributions. Similarly, predictions about changes in economic relationships were probabilistic. To predict, first, the effects of alternative policies under non-controlled conditions and, second, the non-controlled conditions themselves (a prediction needed because of the lack of experiments in economics), mathematical theories of human behavior under uncertainty were sought to improve the formulation, estimation, and testing of stochastic economic relationships and how they changed (Christ 1952). “[R]ealism requires more complicated models” and thus better economic theory (Cowles 1942-46, 10).

Marschak and Koopmans thus pointed to the importance of theories of economic behavior for improving empirical research. In his debate with Arthur Burns and Wesley Mitchell, Koopmans argued in 1948 against the purely data-driven program of the National Bureau for Economic Research:

Measurable effects of economic actions are scrutinized, to all appearance, in almost complete detachment from any knowledge we may have of the motives of such actions. The movements of economic variables are studied as if they were the eruptions of a mysterious volcano whose boiling caldron can never be penetrated (Koopmans 1947, 167).
Without adequate economic theories, empirical relationships identified in the data were not guaranteed invariant across time and predictive power would therefore be severely restricted. As no experiments with the economic system were possible, the identification of causal relationships, and thus genuine explanations of economic fluctuations, could be given only on the theoretical basis of behavioral relationships. Koopmans warned that “the decision not to use theories of man’s economic behavior, even hypothetically, limits the value to economic science and to the maker of policies, of the results obtained or obtainable by the methods developed” (Koopmans 1947, 172; emphasis mine).

Traditionally, utility theory under certainty had been used to inform behavioral equations. The use of calculus allowed for describing economic behavior as an optimization problem, conceptualizing rational behavior as utility-, or profit-maximizing behavior, given the agent’s best knowledge and justified before the late 1940s as best approximation of actual economic behavior (Cowles 1942-46, 12). It could be used to describe a) specific behavior of the investor or the consumer; or b) group behavior, and as such inform econometric models that tried predicting economic fluctuations.

Priority is given to hypotheses that are compatible, apart from random deviations, with rational economic behavior – e.g., with each firm trying to achieve highest profits. Only if such hypotheses fail in statistical tests, uniformly foolish behavior […] is admitted as a second line of statistical attack (Cowles 1945, 2 f.).

While some studies investigated the individual behavior of the consumer or producer, the general procedure was to aggregate over individuals in order to define groups of actors and posit behavioral laws for each group to observe the outcome of their interactions (Epstein 1987, 65 ff.). The data mostly used was time series data of aggregate variables such as prices, average
income, consumption quantities, etc. instead of variables describing individual behavior directly.

While utility theory offered a useful way to start, finding a theory of economic behavior under uncertainty became an increasing concern. Marschak believed that his structural equation method would primarily yield *objective* solutions to economic and social problems. He aimed at developing a “rational empirical” approach that enabled effective policy making on the ground of solid scientific research, given that the model was correct and that the aggregate data represented homogenous underlying behavior (Epstein 1987, 70). Studies using traditional utility theory under certainty, such as Lawrence Klein’s work on index numbers and business cycle models and Leonid Hurwicz’ work on investment behavior (Hurwicz 1946, Klein 1946a, 1946b, see Cowles 1945) are exemplary illustrations of how utility theory lost its usefulness to inform behavioral equations and fueled discussions of the empirical limitations of the approach for approximating actual behavior. For instance, Hurwicz emphasized its limitations in acknowledging heterogeneity and expectations of real economic agents:

The traditional principle of (money) *profit maximization* is subject to attack from several quarters. First, of course, it is the *expected* profits that are being maximized. Second, when risk and uncertainty are present (the case of “stochastic expectations”), not only the most probable value of profits is of relevance, but also the degree of uncertainty; a cautious entrepreneur will choose a course of action promising one bird in the hand rather than two in the bush (Hurwicz 1946, 110; emphasis mine).

In 1946, Hurwicz still saw the advantages of traditional utility theory. It served for exploring “the possibilities of ‘rationalizing’ the entrepreneur’s behavior […] to sharpen the tools of analysis so that fruitful empirical work can be carried out” (Hurwicz 1946, 110). While
people deviated from the predicted rational course under certainty, such behavioral deviations would – Hurwicz hoped – still be rationalizable, once uncertainty entered the conceptual picture:

It is not a priori inconceivable that business is run more by routine than by rationality, and, if such were the case, theorizing based on the utility- (or profit) maximization principle would be little more than idle pastime. Whether the ‘rational’ or the ‘routine’ approach is more realistic can only be decided by appeal to empirical evidence […] But for such evidence to be conclusive, the implications of the ‘rational’ approach must be analyzed more rigorously than has as yet been done. Many phenomena may appear irrational and ‘routine’ from the viewpoint of a purely static theory devoid of the uncertainty elements, but turn out to be quite ‘rational’ when elements of uncertainty and long-run effects are taken into account (Hurwicz 1946, 110).

Hurwicz also noted the theory’s shortcomings for further empirical study. Because of the challenges that uncertainty in expectations formation posed to the theory and its inadequacy in capturing human motives, he saw the need for empirically more accurate approaches to human behavior and social interaction, as for example von Neumann and Morgenstern had offered, to improve the theory of economic fluctuations (Hurwicz 1946, 111). Although he believed Theory of Games had not offered a fully elaborated account, a discussion of uncertainty and the integration of stochastic expectations was important, according to Hurwicz, to arrive at “a more realistic theory of the demand for cash, inventories, and the like” (Hurwicz 1946, 132). As utility depended upon the probability distributions of the relevant variables, the maximization problem for the economic agent and the way in which expectations were formed under uncertainty would eventually require reconceptualization.
The way in which Klein’s work would later be extensively criticized also illustrates how, in the mid-1940s, the traditional image of the *homo oeconomicus* began to crumble in the face of uncertainty and how the need for an improved approach steadily increased. Klein’s attempt to build a macroeconometric model of the whole economy was representative of the early econometrics program. Klein drew upon traditional utility theory to develop improved measurement procedures to theorize about the economy as a whole (Klein 1946a). By relying upon different hypotheses about group behavior, he constructed an appropriate set of index numbers that was consistent with microeconomic and macroeconomic theory, offering microfoundations to macroeconomic theories of, for example, business cycles (Cowles 1947, 4). To make adequate predictions of consumption and investment levels, Carl Christ, Evsey Domar, Andrew Marshall and others requested an improved theory of economic behavior for Klein’s models that included, for instance, behavioral factors of money or bond holding considered particularly relevant after the war (Cowles 1948-49, 16). The program was still at an early stage (Christ 1952), but the criticism reveals how empirical shortcomings of traditional utility theory were increasingly made complicit in the explanatory weaknesses, the estimation difficulties, and the predictive failure of Marschak’s research program.  

Three Challenges of Marschak’s Research Program

When *Theory of Games* was published and the rise of axiomatic choice theories began, Marschak sought a theory of decision-making under uncertainty to meet three challenges for his research program. The first challenge was that traditional utility theory under certainty did not explain economic behavior under uncertainty. The problem of uncertainty had become a major concern for social scientists during the early Cold War years. To avoid irrational choices

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10 Kenneth Arrow and Trygve Haavelmo continued the problem of finding “best index numbers” for macroeconomic variables in 1947, who combined aggregate time series data with producer-level data on costs and outputs or their attitudes, a macro-level problem that also required theories informing behavioral equations.
and make cautious predictions in an uncertain world was an important driver for decision scientists to develop new mathematical tools and work on conceptualizations of rationality (e.g., Erickson et al. 2013, Heyck 2012). While their biographies differed, many Cowles scholars shared the idea that uncertainty had a strong impact on human choice and economic policy-making. Like Hurwicz and other European émigrés, Marschak had experienced the world’s social and political instabilities and contingencies (Arrow 1978, Cherrier 2010). From his point of view, conceptualizing behavior under uncertainty was crucial for any model that wanted to make predictions about the development of the economy.

Marschak’s urge to address uncertainty was already apparent in the mid-1940s, in his question: “How should rational economics of the behavior of single firms and households be developed or corrected to become realistic in conditions of uncertainty?” (Cowles 1942-46, 14). Similarly, Koopmans was aware that the problem of uncertainty was a weak point in economic theory and that the problem would have to be addressed by econometricians.

[E]conomists do possess more elaborate and better established theories of economic behavior than the theories of motion of material bodies known to Kepler. […] While much of these theories is incomplete and in need of reformulation and elaboration (particularly in regard to behavior over time under conditions of uncertainty), such theory as we have is an indispensable element in understanding in a quantitative way the formation of economic variables (Koopmans 1947, 166; emphasis mine).

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11 See Cherrier (2010, sect. 3) about Marschak’s concern for the problem of uncertainty, Leonard (2010) for history of von Neumann and Morgenstern’s formalization of rational behavior under uncertainty, as well as Klein (2016b) and Rancan (2013) for Franco Modigliani’s and Herbert Simon’s concerns with conceptualizing rationality given the problem of uncertainty.

12 Marschak had already developed a theory of money demand under uncertainty in the late 1930s at the Oxford Institute of Statistics. Besides being an early instance of mathematical modeling, it also was an attempt to cope with the idea of decision-making under uncertainty with methods from mathematical statistics (Marschak 1938).
Engaging with the problem was particularly important for Koopmans because of the crucial role that theories of human behavior played in his research program. The problem empirically challenged traditional utility theory, calling into question the assumptions that the outcomes of possible courses of actions were known and that the agent could calculate and maximize her utility accordingly. As Marschak explained in a letter to Schumpeter in 1946, agents had multiple motives and their behavior was grounded upon differing expectations about the future.

The great difficulty in deriving a macro-dynamic system from the postulate of individual rational behavior consists (apart from the aggregation question) in the fact that the equations of rational behavior relate optimal (i.e. profit maximizing) values of certain measurable variables to certain variables that are mere expectations of individuals. One might look for help from the principle of rational behavior in the following way: one assumes the individuals to handle their past experience in the way a rational inductive investigator, i.e. a statistician, would do it. But this complete substitution of rational for traditional behavior [...] goes probably too far. Give it up and you are faced with an enormous variety of equally eligible "psychological" expectation equations (Marschak in Epstein 1987, 194).

The problem threatened economic models because behavioral equations could not describe stable relationships and their changes in a reliable way unless uncertainty was conceptually acknowledged. When it was unknown (or only known with a certain probability), how environmental conditions – including other agent’s behavior – would impact the option set of the agent, traditional utility theory would be empirically inadequate not only in approximating
individual but also group behavior. Behavioral changes were even more difficult to foresee, which impeded its use for reliable prediction.

The problem of uncertainty increasingly affected the attitudes of Marschak and colleagues to the practical usefulness of their discipline more generally. The problem was so severe that it would challenge not only the scientific status of economics but also its role as a policy science. The use of structural equation models aimed at giving advice to firms and government agencies for ‘rational economic policy making’ (Cowles 1944, Epstein 1987, 61). Although, as a general rule, Cowles scholars rarely commented on contemporary political issues (Epstein 1987, 81), Marschak and Koopmans supported the idea of ‘social engineering’ (later simply labeled ‘economic policy’) and saw economics as instrumental in serving its practical purpose.

The criterion of social usefulness of scientific analysis gives us the right to discuss the merits of any particular approach to the problem of economic fluctuation on the basis of the guidance it gives to economic policy (Koopmans 1947, 166).

But empirical analysis was prerequisite for prediction, which in turn was required for choosing the best economic policies for intervention and for improving the performance of the economy (Christ 1994, 31, Epstein 1987, 61 f.). Addressing the conceptual dimension of the problem required the reformulation of the first principles of economics (Cowles 1942-46, 12). Behavioral principles could be tested and their scope of application clearly delineated only if they were formulated in a mathematically precise and quantifiable way, “logically consistent, clear, and susceptible of measurement” (Cowles 1943, 2). To cope with the factual dimension of the problem, Marschak and colleagues requested caution. If the first principles in economics
were empirically questionable, the propositions derived from them had to be considered with care when giving policy recommendations to avoid serious harm (Cowles 1945, 1).

The problem of uncertainty called for basic research, implied a precise formulation of first principles, required logical reasoning, and demanded epistemic humility. In Marschak’s view, a commitment to mathematical methods and epistemic values such as clarity, rigor, and efficiency of theories was a key. Because the problem was highly demanding, a set of principles conforming to such epistemic values would at least allow for valid deductions and determine the set of conclusions that would, or would not, follow from behavioral principles. It would ensure that the scope and limitations of economic theories be clearly delineated and unjustified conclusions from mere data analysis avoided. As Koopmans pointed out later in his famous *Three Essays on the State of Economic Science*:

> [O]ur economic knowledge has not yet been carried to the point where it sheds much light on the core problem of economic organization of society: the problem of how to face uncertainty. In particular, the economics profession is not ready to speak with anything approaching scientific authority on the economic aspects of the issue of individual versus collective enterprise which divides mankind in our time. Meanwhile, the best safeguard against overestimation of the range of applicability of economic propositions is a careful spelling out of the premises on which they rest (Koopmans 1957, 147).

Koopmans here hints at a second, related challenge for Marschak’s program that required an improved mathematical theory of economic behavior under uncertainty, namely that aggregative models relying upon theories about community or class behavior had to be logically consistent with theories of individual behavior, the so-called problem of aggregation
(Klein 1946a, 93, Cowles 1947, 4). More specifically, Marschak began to ask in the mid-1940s not only how economic fundamentals could be revised to accommodate uncertainty but also how to aggregate laws of economic behavior to a proposition that would reliably describe the behavior of the whole system. In the research report of 1942-46, he wrote:

\[ \text{[G]iven a theory of behavior (rational or not) of single individuals in the markets for single commodities, what is the best method of combining these innumerable atomistic structural relations into a useful system of relations between national aggregates […] Inasmuch as construction of economic models and estimation of structural relations has so far proceeded without waiting for complete answers to fundamental problems of economic behavior, the work has been on a somewhat intuitive basis. To improve our theoretical postulates means revising basic economics (Cowles 1942-46, 12).} \]

What Marschak meant by ‘revising basic economics’ was precisely finding a rigorous definition of rational behavior under uncertainty to build better models about economic fluctuations (Cowles 1942-46, 12). After formulating “[l]aws of optimal behavior” (e.g., Hurwicz 1946, 128), the common procedure was to introduce them into macrodynamic economic models and then aggregate to capture behavior of the particular group under investigation. However, logically connecting the Keynesian model and the Walrasian theory, for example, had important statistical implications. If aggregate relationships were subject to random disturbances, those would originate, at least to some degree, in the random elements affecting the economic, political and climatic environment characterizing individual behavior. Since 1943, Marschak had pointed out the need for quantitatively studying actual individual behavior and its heterogeneity (Cowles 1944, 1), ultimately leading to an improved theory of human behavior.
Traditionally, this procedure to aggregate from a simple theory of rational behavior had been justified by reference to the law of large numbers in that “random variations of behavior from one individual to another (or, for the same individual, from one day to another) tend to ‘cancel out’ when one deals with masses of man” (Marschak 1954, 194). By using average data of consumption, prices, income etc., individual behavior would be automatically aggregated to apply a system of equations, modeling the behavior of each group, i.e. entrepreneurs, bankers, workers, consumers. However, because econometric models suffered from large standard errors of the estimate and the prediction interval questioning their predictive value, the explaining factors of this residual was sought at the micro-level. For example, the influence of particular “fashion” or fads taken as an independent variable would rely heavily upon individual characteristics and particular circumstances of a fashion leader. When a group would follow such a leader, those characteristics would have systematic macro-level effects. Those individual specificities reflected in data should be taken into account to inform what Marschak called “atomistic structural relations,” equations of micro-level behavior that would be combined into a “useful system of relations between national aggregates” (Cowles 1942-46, 12). A theory of economic behavior under uncertainty was needed that had to be so general that it could capture this heterogeneity to back up time-series data of average demand, income and price (Cowles 1943, 4 ff.). Otherwise, no reliable predictions about group behavior under uncertainty could be made.

The last, and closely related challenge of the program concerned the stage of data collection. Economic theory was used to inform the collection about individual demand, production, savings, and investment data. A specific difficulty in this context was the so-called problem of identification, i.e. of identifying the underlying behavioral economic relationships

13 Projects such as Klein’s tried to tackle this issue in combining aggregate time series data with data about individuals, i.e. cross-section data on family budgets, costs and outputs on firms, and firm attitudes (Cowles 1947, 4).
(e.g., supply and demand behavior) from observable consequences of those relationships (e.g.,
data of commodity prices and quantities). Identifying the causally relevant variables required
some minimal prior information about economic behavior to arrive at the correct set of
structural equations. Three major sources would inform this identification: (1) direct
observation, potentially systematized by the interview method; (2) broad expert experience;
and (3) economic theory, which would eventually be understood as “logical deduction from
some general principle of behavior […], [which] will yield realistic conclusions to the extent
that the assumed principle of behavior is realistic” (Cowles 1948-49, 8). So far, the best
solution to the problem of identification had been drawing upon a priori information given by
economic theory (Hendry/Morgan 1995). As the economist could not conduct controlled
experiments to identify the causes behind observably equivalent systems, theories were
required that described the behavior of the various groups of economic agents – investors,
consumers, firms – under uncertain conditions.\(^\text{14}\) Given this persisting importance of theories
of rational behavior to inform data collection and identify the relevant causal variables, further
exploration of theoretical problems of rational behavior under uncertainty should eventually
replace the traditional principle of utility-maximization.

Addressing these three challenges for ‘social engineering’-goals were crucial. But there
was an additional driver for investigating the more fundamental causal structures behind human
behavior. Marschak and Koopmans had a deep concern for improving economic analysis along
the lines of the set of epistemic values embodied by deduction, rigor, generality and conceptual
precision. Causal knowledge about individuals and the economy was also important out of
“[s]heer scientific curiosity” (Koopmans 1947, 167), which:

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\(^{14}\) Whether the problem of mapping theory and data already required economic theory to be absolutely prior to
data was disputed and posed the question of how economic theory could ultimately be justified empirically if it
was presupposed for data collection. However, Marschak and Koopmans understanding of theory was rather
loose and they remained rather vague in what they considered to be the scope and evidential basis for economic
theory (e.g., Hoover 2014, 2006a).
urges [the economist] on to penetrate to the underlying structural equations. This curiosity is reinforced and justified (if you wish) by the awareness that knowledge of the behavior patterns will help in understanding or analyzing different situations […] in the same way (although one would not expect with the same exactness) in which the law of gravitation explains celestial and terrestrial phenomena alike (Koopmans 1947, 167).

Because the underlying behavioral patterns, institutional rules, and laws of production would change, those laws had to be precisely formulated and justified empirically to facilitate deduction. Theoretically informed hypotheses would be confronted with observation and revised, if failing the test. As such, “[t]o be fruitful, quantitative studies of economic behavior have to avoid haphazard empiricism as thoroughly as they have to be skeptical – pending empirical tests – of pure theory” (Cowles 1944, 1; emphasis mine). Only a set of accurate fundamental principles allowing rigorously deducing testable hypotheses would avoid false conclusions and foster scientific analysis.

In light of these challenges, the need to study individual economic behavior theoretically and quantitatively while committing to scientific norms and epistemic values impacted upon the hopes and needs of Cowles scholars in the mid-1940s. As the existing behavioral principles about consumer, producer and investor informed by traditional utility theory were at best “first approximations, derived from the meager assumption of rationality of individual actions and supplemented by vague and arbitrarily assorted general experience” (Cowles 1944, 1 f.), mathematically precise yet empirically adequate theories of economic behavior under uncertainty would improve economic models (Cowles 1942-46, 12). This is where rational choice theories entered the scene. Although von Neumann and Morgenstern’s were not a
product of Cowles, they raised hope among Cowles scholars regarding new empirical theories.\textsuperscript{15}

**Searching for an Empirical Theory of Economic Behavior under Uncertainty**

The problem of theoretically grounding human behavior under uncertainty would turn into a core concern at Cowles beyond Marschak’s directorship. In a research plan for the commission that Marschak drafted for the Rockefeller Foundation in 1947, he placed the ‘revision of economic fundamentals’ at the forefront.

This part of activities includes the revision of hypotheses on the behavior of firms and households in conditions of uncertainty and of imperfect markets; the problem of ‘aggregation’ (‘transition from micro-to macro-economics’). It will probably spill over into the no-man’s land between economics and political science: the study of the behavior of legislators, administrators under the impact of economic conditions (thus relaxing the assumption used to far, which treated fiscal policy as an ‘exogenous variable.’)\textsuperscript{16}

To address the problem of uncertainty, the focus on carefully re-thinking the fundamentals of economic theory also required new tools from mathematics not only for the immediate concerns but within the long-term research agenda of the commission. Koopmans would later note that, until the problem of uncertainty was satisfactorily addressed, “we shall continue to be groping for the proper tools of reasoning” in economics (Koopmans 1957, 183). At the same time, such tools allowed upholding epistemic values, commitment to rigor and precision, and

\textsuperscript{15} While the commission had a clear research direction, it was not a homogenous group of researchers working on the same problems. The problems and methods pursued at Cowles were diverse and reflected the different disciplines represented at Cowles, namely mathematics, (mathematical) statistics, and mathematical economics, working on econometric models, statistical estimation, economic theories, and methodology.

compliance with the scientific method. According to Marschak, the commission was the “only institute in the world formulating economic theories precisely.” Attempting to clearly differentiate the methodological course at Cowles from the focus of other economics research institutions, Marschak began to lay the ground for shifting the commission’s focus towards axiomatics, which would become central under Koopmans directorship; but initially, it was axiomatics in an empirically useful way.

One of the early examples of engagement with new mathematical tools to revise economic fundamentals in the mid-1940s was Marschak’s and Hurwicz’s reviews of Theory of Games (Hurwicz 1945, Marschak 1946). Both lamented the intuitive basis of economic theory and engaged with ways to ground economic theory in more rigorous and precisely formulated behavioral assumptions (Cowles 1942-46). Marschak saw the new concepts and mathematical tools from probability theory, axiomatic set theory, and topology contained in the Theory of Games as potentially useful for addressing those foundational problems, illustrating the attention concepts of rational behavior provoked at Cowles (Debreu 1983, 3) and particularly with Marschak (Cherrier 2010, 451 ff.). In May 1945, Marschak invited von Neumann to give a two-day seminar, and while concerns at Cowles were voiced that this “new approach to static economics” was “far from having reached the stage of empirical test and measurement,” it promised to become empirically “fruitful if developed further” (Cowles 1945, 6).

Marschak’s and Hurwicz’s first reading of Theory of Games exemplifies how, in terms of their virtue as highly mathematical approaches to human behavior and social interaction, the two concepts of rationality – maximizing expected utility and the minimax rule - could become

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19 While they were not necessary for the structural estimation method cultivated at Cowles, the axiomatic method and expected utility theory provided one way to theoretically capture economic behavior under uncertainty.
empirically illuminating. Marschak presented an accessible and widely read review in the *Journal of Political Economy* (1946) to illustrate how this theoretical apparatus could prove descriptively valuable (Hildreth 1986, 98). While applying game theory and the principle of expected utility to economically interesting situations did not automatically entail their empirical testing and data analysis (Dimand 2000, 202), Hurwicz illustrated their epistemic potential by way of relating the concepts to concrete and representative economic problems, such as monopolistic, duopolistic and oligopolistic competition. As calculus had been the dominant mathematical approach in economics before 1944 (Herstein 1953, 250), most economists were not familiar with axiomatic set theory, topology, and the theory of relations. By translating the new concepts into a conceptual language that economists would understand, both reviews revealed the concepts’ potential for illuminating empirical questions about economic behavior under risk and uncertainty more generally (Hildreth 1986, 98).

Furthermore, Marschak made suggestions for the empirical application of concepts such as the ‘rules of the game,’ re-interpreting them as physiological conditions or psychological habits; ‘standards of behavior’ could be interpreted as moral or legal codes (Marschak 1946, 104). He thereby hoped to “acquaint the reader with [the book’s] economic results” (ibid., 98). He praised *Theory of Games* as offering two mathematically highly innovative, rigorous, and generalizable accounts of rational behavior and strategic interaction and presented them as exemplary cases of how new mathematical tools could be used to develop economic theory in ways required for the discipline to progress (Marschak 1946, 114 ff., see also Cherrier 2010, 449 ff.). It was the positive, not the normative interpretation of those axiomatically formulated

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20 The discussion culture of distributed papers at Cowles suggests that it had been read and discussed widely among scholars like L. Hurwicz, T. Koopmans, K. Arrow, L. Klein, D. Patinkin, and H. Simon.
rational choice theories that were initially central for Marschak when he concluded, “[t]en more such books and the progress of economics is assured” (1946, 115).²¹

The new set of mathematical tools reflected the epistemic and methodological commitments prevailing when Marschak defended his research program, and which would become even more prevalent in the course of the Cowles research program under Koopmans. According to Marschak, the main achievement of Theory of Games was “its having introduced into economics the tools of modern logic and in using them with an astounding power of generalization” (Marschak 1946, 114). Marschak praised the books “meticulous formalism,” the clear separation between the axiomatic structure of the theory of behavior and empirical reality, the flexibility this detachment brought in its train regarding the theory’s applicability, and the rigor and precision that an improved scrutiny of logical foundations and deductive analysis was accompanied by.

Every empirical situation – be it poker or bilateral monopoly – is divested of inessential features and expressed in unambiguous symbols. Formalized concepts and axioms are constructed […]; thus, concepts […], the axioms which these concepts satisfy, and the theorems derived from those axioms need not be attached to the empirical images of the market or the card table. ‘Intuitive’ or ‘heuristic’ considerations generated in the authors’ minds by experience are formalized into concepts and propositions which, once stated, are detached from experience until the final conclusions are reached (Marschak 1946, 115).

²¹ Most of the reviewers were careful about a final judgment about the usefulness of the Theory of Games for economics. Nevertheless, their general tone reveals the hopes for a set of improved mathematical instruments to empirically analyze decision-making and social interactions among the social scientists.
At the same time, for Marschak, those tools would ultimately improve the empirical power of economic models. It was obvious to Marschak that a major advantage of using this set of tools was their wide scope of application. Because of the separation between mathematical formulation and empirical content, the principle of expected utility and the minimax theorem could be applied to a large number of structurally similar problems. The scientist had to take both concepts, equip them with an interpretation and complement them with the relevant set of assumptions so that they could be applied to a concrete problem. After translating the formal conclusions “into the language of the concrete field […] economics in our case,” the theory would be subjected to empirical test (Marschak 1946, 115). Thus, in Marschak’s view, this separation of formal-axiomatic structure and empirical interpretation was a virtue rather than a vice. Similarly to Debreu’s *Theory of Value* (1959) and Koopmans’ later articulation in his *Three Essays* (1957), von Neumann and Morgenstern’s *Theory of Games* reflected how economics should proceed in order to secure rigorous and consistent reasoning, yet improving the “agreement [of economic theories] with facts” when coping with the challenge of a complex empirical reality of competitive and non-competitive market scenarios (ibid., 98, Düppe/Weintraub 2014, Weintraub 2002).

Hurwicz also acknowledged the potential of the contributions to both theoretical and empirical dimensions. He saw the advantage of using axiomatic set theory to theoretically ground, and not simply postulate, economic principles such as utility-maximization in the larger context of a market theory (Hurwicz 1945, Copeland 1945).

At the same time, von Neumann and Morgenstern acknowledged the empirical fact that economic agents not only

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22 As Koopmans also recalls in a letter to A.H. Taub dated July 24, 1959: “I remember very well the discussions I had with von Neumann […] there were several discussions in Chicago on the theory of games, just about at the time that the von Neumann Morgenstern book appeared. Reviews of that book by Hurwicz, Marschak, and Simon in various journals reflect in part the effects of these discussions” (Koopmans cited in Mirowski 2002, 176).

23 Note that there had been attempts, even before the World War II, to test demand theory empirically (Moscati 2007). Individual demand behavior was formulated as a maximization problem, yet the utility function of the individual had been postulated in that it had not been given an axiomatic foundation.
acted, but interacted and thus extended economic analysis beyond the well-known ‘Robinson Crusoe problem’ (Hurwicz 1945, 909, Stone 1948). Hurwicz was also explicit about the conceptual apparatus needed to address the important problem of decision-making under uncertainty (Hurwicz 1948). His praise of those attributes clearly originated in a hope that the principle of expected utility and the minimax theorem would increase the realism of the economic theory of human behavior. As Hurwicz (1945, 923) put it: “The potentialities of von Neumann’s and Morgenstern’s new approach seem tremendous and may, one hopes, lead to revamping, and enriching in realism, a good deal of economic theory,” something that von Neumann and Morgenstern aspired to themselves. Both reviews thus reveal mathematical economists’ initial reading of those two approaches as positive accounts of human behavior and social interaction (see also Bronfenbrenner 1950, 484 ff.).

Marschak’s own works in the late 1940s and 1950s were strongly influenced by that of von Neumann and Morgenstern (Cherrier 2010, see e.g., Marschak 1950, 1951), but his admiration for their mathematical approach to the problem of uncertainty was also revealed in his assessment of other work in economics, for example in his review of W. L. Crum and J. A. Schumpeter’s *Rudimentary Mathematics for Economists and Statisticians*:

The modern economic theory of risk and uncertainty – applied, for example, in the discussion of effects of profit taxes on investment of various types – requires the introduction of simple probability distributions and the construction of stochastic equations. And the recent fundamental revision of economics as a *Theory of Games and Economic Behavior* […] has shown that usefulness, for economists, of symbolic logic and the theory of sets (Marschak 1947, 272 f.).
While Marschak praised the new mathematical tools, his hope was to use them for empirically illuminating economic behavior to make reliable predictions. Hurwicz expressed his worry that, despite the book’s epistemic and theoretical advantages, both approaches to rational behavior would in the short run not be more useful for empirical work than traditional utility theory. As long as important and immediate policy problems could be addressed with the traditional (mathematically less sophisticated) approaches to monopoly, duopoly and perfect competition, economist should remain with mathematical calculus to retain a certain “degree of concreteness desired by the economic theorist” (Hurwicz 1945, 923), even if the departure of economic reasoning from empirical observation required accepting logically unnecessary assumptions and sacrifice of mathematical proof.

[E]conomics cannot afford the luxury of developing in the theoretically most ‘logical’ manner when the need for the results is as strong as it happens to be the case of the ups and downs of the employment level! (Hurwicz 1945, 932).

While Hurwicz appreciated the theoretical derivation of coalitions from an axiomatic basis, he highlighted that economists had “empirical knowledge which can be used as a substitute (again imperfect) for theory” (ibid, 924). An empirical theory was central at this point in time.

The hopes of mathematical economists at Cowles, especially regarding the usefulness of game theory, were quickly disappointed (Debreu 1983). Hurwicz’s cautious attitude reflected a more general worry among mathematical economists at Cowles, who noticed that game theory was “far from having reached the stage of empirical tests and measurement” (Cowles 1945, 6). While a Cowles seminar series in 1949 on topics surrounding the minimax theorem attracted a number of important speakers,24 this line of research was – for now – abandoned.

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The axiomatic theory of expected utility, however, continued to raise interest at Cowles. It was perceived as having the potential for an empirical account that at the same time drew upon the new mathematical tools that Marschak praised. The theory eventually entered the heart of his research program to become “fundamental to the study of decision making under uncertainty” (Debreu 1983, 5). By the late 1940s, William Baumol, Hurwicz, Herman Rubin, Israel Nathan Herstein, John Milnor, and Leonard “Jimmie” Savage, all directly or indirectly affiliated with Cowles, began to further develop it. Articles, such as Koopmans’ *On Flexibility of Future Preferences* (1949), Debreu’s *Real Representation of a Preference Ordering* (1952), and Marschak’s own exposition of the von Neumann and Morgenstern axioms (1950, 1951a, 1951b) became exemplary contributions to its further development. Given the state of Marschak’s research program, expected utility theory marked an important step towards theoretically formulating decision-making under uncertainty while holding up the epistemic values and scientific commitments that mathematical economists at Cowles increasingly subscribed to. But this hope would not last for long.

**The Study of Human Behavior Emphasized**

When Koopmans took over the directorship in 1948, the commitment to a reductionist program and the need to conduct basic research to arrive at adequate first principles became more explicit. Such principles required careful empirical and theoretical studies of the various kinds of economic decisions under uncertainty (Cowles 1948-49, Cowles 1949-50). In

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25 Game theory became further developed and extensively applied especially to problems of military strategy was at RAND, signaling major differences between the various research institutions of Cold War social sciences. It began to play a fundamental role in (mathematical) economics only after the work on the existence of equilibrium points in n-person games published by John Nash in 1950 (Debreu 1983, Erickson et al. 2013 ch. 5, Leonard 1992, 67 ff.).

26 Examples for research drawing on game and decision theoretic concepts were Arrow/Harris/Marschak (1951) on optimal inventory policy, Arrow et al. (1949), Hurwicz on decision rules for choice under risk and uncertainty (1951a, 1951b), Abraham Wald (1945, 1950a, 1950b), Friedman/Savage (1948) testing the principle of expected utility maximization, Savage (1951) on statistical decision-making and statistical decision functions, and Rubin and Chernoff (1954) on rational selection of decision functions. Others worked on axiomatics more generally, such as the mathematicians Israel N. Herstein, and John Milnor (1953).
particular, there was “a relative shift toward theoretical work to obtain better models preparatory to another phase of empirical work” (Christ 1952, 47). Basic research was needed to arrive at plausible behavioral principles that would be formulated theoretically. Empirical research was required to test their predictions. The principle’s agreement with facts had to be checked, and – via trial and error – modified to remedy the problems of Marschak’s program; a procedure that would allow for a “rationally derived model of the economy as a whole” (Cowles 1948-49, 12).27 As Koopmans put it in August 1950:

As a result, and in view of our limited resources, it seems wise to postpone temporarily the construction of aggregative economic models until we have advanced a little further in our work on the reduction of aggregative relations to the underlying decisions and interactions of individuals […]. Various aspects of work in this direction have been mentioned and may be summed up in conclusion: In the field of economic theory, we have to study individual behavior under conditions of uncertainty, to understand better the interaction and mutual adjustments in the markets, preparatory to a rational dynamic theory.28

To formulate plausible first principles, economists, according to Koopmans, should take advantage of being human agents, introspect and thereby gain insights about “economic behavior of other individuals and explore their motives, in a way no physicist can get at his molecule” (Cowles 1948-49, 5). Approaching the problem of individual and social decision-making under uncertainty that way would “achieve greater simplicity and realism in the

27 An example was Markowitz (1950).
analysis of decisions affecting a distant future” and inform econometric modeling (Cowles 1948-49, 12, Cowles 1949-50, 10).

As opposed to previous years, the 1948-49 research report devoted a long section to the new research focus of studying economic behavior. Previously, projects had mostly been divided according to subject matter, but in this report all activities were now categorized as studies of ‘actual behavior’, of ‘rational behavior,’ or of ‘optimal behavior’: actual behavior was defined as the observable response of individual persons or firms to their economic circumstances; rational behavior was defined as utility-maximizing behavior, a definition informed by economic theory; optimal behavior, from welfare economics, was defined as behavior that followed from conforming to pre-formulated rules, targeting the achievement of an objective that would be considered as economically good for society. Rational behavior and optimal behavior were distinct concepts, but studies in those categories initially were intended to improve the theory of economic behavior. Only studies of optimal behavior belonged to normative economics understood as what John Stuart Mill (1836) had called ‘art’, namely the normative realm of practical ethics, of duties and morality separate from the scientific realm that studied matters of fact by employing the scientific method.

The three-fold distinction reveals how between 1948 and 1954 the normative turn materialized in the kinds of studies then undertaken. Studies of actual behavior would first be complementary to, then become instrumental for, and later replaced by studies of rational and optimal behavior. Initially, the three kinds of studies were present at Cowles to the same degree. Studies of actual and rational behavior were complementary to each other, both serving the ultimate purpose of econometric analysis. Studying rational behavior would improve economic theory that could then be used for informing hypotheses about actual behavior. But studies of actual behavior were equally important because an improved economic theory required reliable knowledge about actual behavior. Such studies amounted to describing actual behavior by
mathematical equations, specifying how a so-called ‘decision variable’, like consumption or investment and how it depended upon environmental variables, such as soil, water, tax rates, prices, etc. to arrive at an “aggregate or average behavior equation for a specific group” (Cowles 1948-49, 6). The selection of variables was informed by introspection or the interview method, i.e. asking people about their habits, codes, motivations, and objectives. Those answers were interpreted and generalized towards specifying equations describing group behavior (Cowles 1948-49, 6). If they adequately described the data, those equations could then inform economic theory.

That studies of rational and actual behavior were initially complementary is revealed, for example, by the way in which the indirect “statistical method” was used to arrive at behavioral ‘laws’ (Cowles 1948-49, 7). Based upon plausible hypotheses about behavior equations, Cowles scholars estimated numerical behavioral constants or tested group behavior equations from annual or quarterly statistical data on investment, consumption, price index numbers, etc. representing past decisions. Once the relevant variables had been identified, more detailed hypotheses about average consumption behavior, given an average income, etc. could then be formulated, statistically tested, and modified if necessary. Besides direct observation, interviews, and broad experience from other comparable economic case studies, economic theory (i.e., the principle of “rational economic behavior”) was a means to study actual behavior in deducing a set of testable relationships from behavioral principles that would allow for the modification of the equations (Cowles 1948-49, 8). Stephen Allen’s work on inventory fluctuations in the flaxseed and linseed oil industry, or Franco Modigliani’s work on investment and the formation of expectations on investment plans were examples of such studies (Cowles 1948-49, 16). Both studies of actual and of rational behavior were thus crucial in this research.

Knowledge about actual behavior was also essential for studies of optimal behavior in welfare economics, where the underlying standard was efficiency. Those studies started “with
the accurate formulation of some objective to be regarded as economically good for society and derives rules of behavior from that objective” (Cowles 1948-49, 9). Their main contribution was that economics should address normative questions about desirable social distributions and the means to get there. Naturally, this research was closely related to the question about efficient resource allocation in production and optimal policy decisions of government and thus concerned a discussion that was “normative with respect to the behavior of the government, but [that] is realistically descriptive with respect to the behavior of all other parties that make economic decisions” (Cowles 1948-49, 10). For instance, knowledge about actual behavioral relationships of consumer groups and businessmen was required to predict policy effects and decide which policy instruments would best achieve a given economic objective of society (Cowles 1948-49, 16) in order to ensure “a useful discussion of public economic policy” (Cowles 1948-49, 10). But such normative questions and studies of optimal behavior were a separate category that was not yet prioritized. More important were studies of actual and rational behavior, which would initially target the problem of economic behavior under uncertainty.

Despite the strong focus on economic behavior, an improved theory under uncertainty remained far away. Koopmans kept acknowledging that traditional utility theory could approximate actual behavior, or at least “the outcome of those decisions where informed consideration or calculation prevails over habit or prejudice” (Cowles 1948-49, 8). Yet by the end of the 1940s it was apparent that economic theory did not even adequately capture the ‘typical behavior’ of groups (Cowles 1949-50, 5). The criticism of Klein’s study explicitly voiced by Christ and others as being grounded upon an outdated theory of rational behavior “before the theoretical problems of rational behavior were more fully explored” (Cowles 1948-49, 14), for instance, exemplified that uncertainty had still not been integrated into economic theory in a satisfactory way (Cowles 1948-49, 20). The difficulty of conducting experiments
in economics called into question whether an empirically fruitful theory of economic behavior under uncertainty would be possible at all.

The worries about an empirically inadequate theory of economic behavior had so far targeted traditional utility theory. Yet, the empirical usefulness of expected utility theory became equally controversial. In the context of the so-called ‘measurability controversy’ (Mongin 1997) in early 1950, Marschak, Savage, Baumol and other Cowles scholars began to dispute the interpretation of the rationality axioms; until Savage made an explicit move towards a normative interpretation of his axioms (Allais 1953, Heukelom 2014, Heukelom 2015, Jallais et al. 2005, Jallais et al. 2008, Moscati 2016, 1972 [1954]). According to Koopmans, even if economic theories of behavior under uncertainty fail the empirical test, they could at least be used to prescribe the rational course of behavior in such situations (Cowles 1948-49, 8). Furthermore, the problem of uncertainty itself suggested a prescriptive solution posed by the question of “how rational buyers and sellers should behave when the future is uncertain,” thereby requesting a behavioral rule that would allow for a rational decision in circumstances in which an agent cannot make an informed choice (Cowles 1948-49, 11).

An early theoretical study by Marschak (1948, 1949), for example, discussed the appropriateness of von Neumann and Morgenstern’s rule of minimizing the maximum expected loss and Savage’s minimax regret rule by investigating how rational demand behavior and a firm’s best investment strategy under uncertainty depended upon the firm’s liquidity under different degrees of information (Marschak 1949, 193). While actual behavior diverged from what rational choice theories predicted, their implications deserved study not only as a possible first approximation to the description of actual behavior but also “as a set of practical norms, to be used by firms or governments” (Marschak 1949, 182). The empirical and the normative dimension were still considered complementary by 1948. However, in light of the difficulty of finding an empirically adequate theory of economic behavior together with the
conviction that behavior under uncertainty should be first studied theoretically, a door was opened to investigate practical norms for situations with uncertain outcomes. Such studies could help replace the “vague concept” of calculating risk “by more clear-cut guides to action” (Cowles 1949-50, 10) to tame uncertainty.

**Prioritizing Mathematical Modeling over Empirical Research**

While the failure of traditional theory to adequately cope with behavior under uncertainty had been an important motivator in revising behavioral foundations, a slow turn occurred away from considering theories of rational behavior as empirical accounts towards using them to formulate norms to guide decision-making. The normative turn is reflected in and can be partly explained by a three-fold shift of the research focus, which paralleled it. First, emphasis was increasingly placed on the development of mathematical models (Düppe/Weintraub 2014b, 77, Christ 1952, Mirowski 2002b, Weintraub 2002, 118). Second, mathematical tools that allowed for retaining a commitment to scientific values of rigor, deductibility, and mathematical method were highly appreciated and prioritized, contributing to a stronger focus on studying rational and optimal behavior instead of empirical research on human behavior. Third, alongside these tools, a strong emphasis was placed on studying what it meant to make good *choices* at the expense of empirically studying actual behavior within the market context.

The engagement with new mathematical tools – from the axiomatic method and set theory, to fixed-point techniques, probability theory, and topology – steadily increased under Koopmans’ directorship (Weintraub 2002). Theoretical work on decision rules such as the minimax expected utility or regret rules undertaken by Chernoff, Hildreth, Rubin, Savage, and Marschak were considered as “clarifying the fundamental issues of human choice under

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29 Koopmans’s interest in setting basic research as priority became apparent already early on when he wrote to Marschak: “[b]efore any great amount of collection of data and calculation of regression is done, I feel very strongly that one or two years’ work on the exploration and exposition of the method itself should be done” (Letter from Koopmans to Marschak, August 22, 1943, folder “T. Koopmans – Correspondence”, box 92, JMP).
uncertainty” (Cowles 1948-49, 12). While they departed from von Neumann and Morgenstern’s axiomatic representation, they contributed to axiomatic choice theories by drawing upon their set of “rigorous logical tools” (Cowles 1948-49, 12). Such decision theories still aimed at arriving at an explanatory theory of economic aggregates from the micro-level theory (Cowles 1948-49, 12). But empirical attempts to study rational behavior under uncertainty failed at Cowles. For example, Franco Modigliani and Herbert Simon’s efforts to empirically investigate rational decision-making under uncertainty by using interview techniques and existing survey data to arrive at behavioral principles that also had the potential of becoming mathematically grounded, were not taken up by Cowles members (Cowles 1948-49, 15, Modigliani 1952, Rancan 2013). Instead, Koopmans was convinced that the problem of uncertainty could be remedied by theoretical studies alone. To improve economic theory, the formulation of precise definitions, the use of the rigorous logical and mathematical tools von Neumann and Morgenstern had helped to establish, and new modeling techniques were needed (Cowles 1948-49, 12). They were to be “of more basic character,” allow for clarity and simplicity in expressing the logical structure of economic theory (Koopmans 1957, 5), and would save the “study of rational behavior” from getting bogged “down in vague platitudes” (Cowles 1948-49, 12).

To “develop a genuine science of economic behavior” that acknowledged the problem of uncertainty, the theoretical research into decision-making under uncertainty slowly became representative of a new methodological approach at Cowles, namely abstract model building (Cowles 1950-51, 4). Abstraction became defined as “exploring the common elements in many

30 Other exemplary cases were Haavelmo’s study of investment motives (Haavelmo 1949).
31 See Klein (2016b, 18 ff.) for an account of Modigliani and Simon’s research on decision rules under uncertainty at the Carnegie Institute of Technology.
situations while ignoring what is particular and incidental” and was considered a powerful and economical procedure (Cowles 1950-51, 4). It aligned with the strong commitment to mathematics and deduction characterizing theoretical studies such as those of Marschak, Savage, and Hurwicz on decision rules (Cowles 1950-51, 4). Abstraction, together with other epistemic virtues such as rigor, simplicity, and generality was the unifying element between the staff involved in Koopmans’ project on uncertainty, a group that was “trained in the application of logical reasoning to theoretical analysis of the interplay of economic motives, to the collection and interpretation of facts and data, and to relationships between numbers” (Cowles 1950-51, 4).33

The pursuit of this new methodological direction was decisive in how research on behavior proceeded at Cowles (Düppe/Weintraub 2014). The language of ‘mathematical tools’ in addressing the problem of uncertainty became more widely accepted and discussions of model construction began (e.g., Cowles 1950-51, 10). Until an adequate solution of the problem of uncertainty was found, economics would build “economic behavior models” and focus on disaggregation, entailing “a further increase in our understanding of individual behavior,” to ultimately understand the economy as a whole (Koopmans 1957, 212 ff.). To safeguard against overestimating the range of applicability of economic propositions, “a careful spelling out of the premises on which they rest [was needed]. Precision and rigor in the statements of premises and proofs can be expected to have a sobering effect on our beliefs about the reach of the propositions we have developed” (Koopmans 1957, 147). Being mathematically sophisticated, those models, while ‘naïve’, could be tested and, if false, improved in precise and explicit steps. They would furthermore help to explore specific

33 As the principle investigator, Marschak would work with a troop of scholars with a clear theoretical orientation. Besides Hurwicz, Roy Radner, Kenneth Arrow, Gérard Debreu, and Erling Sverdrup joined the team, all with a considerable background in mathematical statistics and the mathematics (Christ 1952).
economic relationships rather than already accommodate the expectation of having to model a whole economy à la Klein.

To what extent this methodological course and the use of new mathematical tools determined the choice of research problems at Cowles, or to what extent pressing problems such as uncertainty determined the choice of the tools, cannot be entirely untangled. But as Koopmans pointed out years later, some mutual influence between choice of tools and the choice of problems existed.

[T]ools also have a life on their own. […] our servants may […] become our guides, for better or for worse, depending on the accidents of the case. But […] changes in tools and changes in emphasis on various problems go together and interact (Koopmans 1957, 170).

Indeed, while the step to draw upon new tools had originally been motivated by the problem of lacking a theory of decision-making under uncertainty in Marschak’s research program, “with this change in tools, there has been a change in emphasis as between various aspects of the theories in which the tools are applied” (Koopmans 1957, 5). While the new tools ultimately did not solve the original problem of uncertainty, they lent themselves better to normative problems. They were adopted for studying rational and optimal behavior. In consequence, the research focus at Cowles slowly turned away from investigating actual behavior towards studies of rational and optimal behavior.

**Adopting the Tools to Study Optimal Behavior**

Using new mathematical tools influenced the conceptualization of rational behavior exemplified not only by Debreu (1959), Arrow (1963 [1951]), and research in organization theory at Cowles (Cowles 1952-54), but already by Marschak’s two papers ‘Rational Behavior, Uncertain Prospects, and Measurable Utility’ (1950) and ‘Why ‘Should’ Statistician and
Businessmen Maximize ‘Moral Expectation?’ (1951). Marschak extended von Neumann and Morgenstern’s axiomatic representation of rational choice under uncertainty by adding the independence axiom, assuming that one’s preference order was independent of irrelevant options that become available to the agent. Arguing that a rational agent should conform to basic rules of logic and arithmetic, Marschak took the four axioms as additional ‘rules of rational behavior,’ reinforcing von Neumann and Morgenstern’s definition of rationality in terms of a set of formal properties, such as transitivity and completeness, that were usually attributed to formal systems, arguing for their status as rules for proper (i.e., rational) reasoning and making it recommendable to behave according to those rules.

The results of decisions based on ‘correct’ conclusions are, in some sense, ‘preferable’ to results of decisions based on incorrect ones. It is ‘advisable’ to follow the rules of logic and arithmetic. In dealing with his environment […] a man who often makes mistakes in his inferences and his sums is, in the long run, apt to fare less well than if he had been a better logician and arithmetician […]. [Yet, t]he fulfillment of rules of conventional logic and arithmetic is a necessary but not a sufficient condition for a decision to be advisable. We need additional definitions and postulated rules, to ‘prolong’ logic and arithmetic into the realm of decision. We shall define rational behavior as that which follows those rules, in addition to the rules of logic and arithmetic (Marschak 1950, 112).

The best set of rationality axioms would be decided upon, not on the basis of actual psychology and especially reasoning procedures of real human beings, but their formulation and discussion would be a purely logical problem.
To discuss a set of norms of reasonable behavior (or possibly two or more such sets, each set being consistent internally but possibly inconsistent with other sets) is a problem in logic, not in psychology. It is a normative, not a descriptive, problem (Marschak 1951a, 493).

By establishing this formal-axiomatic definition of rational behavior as rule-based behavior at Cowles, rational choice theories slowly lost their empirical status and increasingly became exercises in logic.

The strategies discussed included those of statisticians and businessmen and can be conceived to include human decisions in general. At no point was it claimed that reasonable behavior is actually practiced by men: the paper is a study in consistent sets of norms, not an empirical study (Marschak 1951a, 505).

Developments of alternative axiom sets interpreted as rational decision rules followed Marschak’s work (e.g., Arrow 1951, Chernoff 1954, Hurwicz 1951a and 1951b, Koopmans 1949, Marschak 1951b). Such norms were not only to guide the economic agent under uncertainty; the analysis could be expanded to “other fields of human decision as well, such as games, political and military strategy, administrative decision, and the design of scientific experiments and statistical samples” (Cowles 1949-50, 10).

A great advantage of the new tools pointed out later by Debreu (1959, x) and Koopmans (1957, 133) was that the set of rationality axioms allowed for a clear detachment of their interpretation and for two types of analyses, namely “explanatory and normative analysis” (Koopmans 1957, 134; emphasis in original). It was the latter – studies of optimal behavior – that those tools were naturally applied to. As such, not only did mathematical tools foster normative studies of rational behavior at Cowles, they also had a profound impact on
emphasizing studies of optimal behavior. The collapse of the distinction between optimal and rational behavior from 1950-51 onwards was indicative of the impact of their increasing use at Cowles (Cowles 1950-51). While, for instance, the research report 1948-49 was obsessed with ‘rational behavior,’ the buzzwords in research reports from 1949-50 onwards were optimization and efficiency.

While optimality as welfare criterion would apply to any decision-problem, a distinction was drawn only between single- and multi-person decision problems on the organizational or governmental level (Cowles 1950-51, 14 ff.). Studies of optimal behavior had the purpose of “recommending, to one or more of the persons or organizations represented in the analysis, a choice or course of action which can be expected to serve his or their objectives better than, or at least as well as, alternative actions open to them” (Koopmans 1957, 134). They were grounded in what previously had been part of welfare economics and had targeted the level of society. They were clearly normative in that they formulated rules to prescribe optional solutions for decision and allocation problems on the individual level and in large systems (Erickson et al. 2013, 62 ff., Mirowski 2002b). They sought to clarify what, according to the efficiency criterion, the best way was to satisfy human wants (Koopmans 1957, 169). The calculator of the best course of action was no longer the economic agent, whose behavior was being described, but the economist, occupying the role of a consultant to support agents in computing the optimal decision.

Here the question is not ‘how do consumers, investors, dealers, governments actually behave?’ but ‘what behavior rules or patterns would best serve the purposes of economic activity?’ (Cowles 1949-50, 3).

Those studies were also considered as suitable for applying the new tools because they were abstract in being “without reference to the question as to which individual or authority
implements the behavior or decisions regarded as optimal, and in what institutional framework” (Cowles 1948-49, 17). While traditional calculus had been used to:

describe the formation of prices and quantities in competitive markets through unique […] solutions of equation systems […], [t]he new tools allow us to shed new light on older and perhaps also more fundamental problems.

*The emphasis has shifted to the specification of conditions under which decentralization of economic decisions through a price system is compatible with efficient utilization of resources* (Koopmans 1957, 5 f.; emphasis mine).

Studies of rational production policies by Debreu, Hurwicz, or Simon, as well as linear programming problems, Koopmans’ research on activity analysis, and Arrow’s work on social choice theory were examples where those new tools contained in the *Theory of Games*, for example, could become influential in formulating problems of decision-making (e.g., Debreu 1983, 1959, x). They were deductive in that, for a specified end and given a set of principles, solutions could be computed. Extending the welfare economic problem of optimal behavior to decision-making under uncertainty neatly aligned with a second project of Koopmans on developing a theory of optimal resource allocation in alliance with RAND scholars and methods for optimal inventory control problems (Cowles 1950-51, 80).

We understand that a small number of leading concerns has, rather recently, accepted these methods and successfully reduced the rate of inventories to sales. Possibly these methods can be adapted to the uses of noncommercial institutions such as schools, hospitals, and governmental depots (Cowles 1950-51, 8).

Placing optimization problems in the spotlight also lead to the application of those tools and contributed to redefining rationality in terms of efficiency.
[A] process of widening the horizons of economists in regard to mathematical tools used in their theories can be observed. In particular, the work on resource allocation has led away from differential calculus, called ‘marginal analysis’ by economists and appropriated from mechanics and physics towards the methods of point set theory, which are more abstract, more general, logically simpler, and better adapted to many problems of social science (Cowles 1950-51, 22 f.).

For Koopmans, activity analysis – while relying on fixed point techniques, convexity analysis, and set theory, for example – provided simple descriptions of technologies available that could serve as a basis for a “normative discussion of efficient allocation in a social sense” and allowed for developing “[r]ules of action to achieve efficiency in a society with decentralized decision-making.” But it was also enthusiasm about the new tools that made this research interesting (Düppe/Weintraub 2014).

In Cowles reports and in their own work, Marschak and Koopmans repeated that such theoretical endeavors were largely motivated by excitement, scientific curiosity and by holding on to their epistemic values (Marschak 1946, Koopmans 1957). Studying guiding rules for efficient decision-making under uncertainty was justified because such studies allowed Koopmans and colleagues to align with their methodological and epistemic commitments. In studies of optimal behavior, the deductive element “is strongest” (Cowles 1949-50, 6 and 19). As Marschak had announced in his review of *Theory of Games*, the new mathematical tools also promised simple, general, precise, and highly formal approaches for optimization problems.

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Koopmans still believed that the formulation of norms of rational choice should be inspired by actual behavior. Yet, as Marschak had noted, those norms would not have to be based upon an empirical theory of human behavior or generalizable to cases of everyday actions. While for studying those norms, it would suffice to focus on that small sample of reasonable people following them, the everyday man would have to be helped in learning how to behave rationally. This support was justified because according to Cowles scholars, very much as in welfare economics, behaving rationally would likely be in everybody’s interest.

These norms are, of course, suggested by and distilled from actual practice; but they are no less valid if only a small minority of practitioners has applied them in the past. [...] In other words, though few people behave rationally, people can learn to behave that way. And this learning process may be in the public interest (Cowles 1950-51, 8; emphasis mine).

So what before had been the study of actual behavior to reveal behavioral deviations would now become the study of rational behavior manifesting among a small group of wise people.

According to Koopmans, the problem of best economic organization, i.e., the problem of how to face uncertainty on the actor level, the government level, or the level of society as a whole (Cowles 1950-51, 15) was the “central problem of our time.”\(^35\) The idea of efficiency enshrining the normative dimension of decision-making also fitted neatly with how Koopmans understood economics. The goal of economics was about constrained optimization and efficiency along the lines of what J. R. Hicks had called the “logic of choice” (Cowles 1950-51, 7); it was about prescribing how to “economize” by way of looking at the relation between means and ends, as Robbins had defined it (Backhouse/Medema 2009b, 492). Efficient decision-making was attributed the same logical content, independent of the decision maker

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and the situation. Any kind of behavior could be analyzed in terms of its efficiency or failure of efficiency.

We apply a similar criterion when judging the efficiency of a housewife or a hospital administrator: they can make a good or bad use of limited money. The concept of “economical” decision-making has an even wider application. Army commanders are trained to choose decisions that are likely to achieve a given objective at the smallest cost in life and material, or decisions that are likely to yield, at a given cost, the most desirable result. And is not our concept of an efficient party leader or a diplomat similar? Finally, decisions on how to carry out a national policy are also judged by their success in achieving proclaimed goals – be they security, prosperity, justice, or freedom, or any combination of these values – within limits set by the skills, habits, and natural resources of the people (Cowles 1950-51, 7 f.).

All those decisions should be treated the same in that they were concerned with finding an optimal solution to a decision problem under uncertainty. The logic that underlie any kind of choice would give human beings a way to secure making the most efficient choices in every situation. This shift towards choice problems required, if their rationality should be secured, a prescriptive account of rational decision-making.36

To study how to choose best decisions is to study norms of behavior, not actual behavior. Abstract though such a study may seem in the first stages, its ultimate ambition is to enable people to make reasonable

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36 Robbins defined economics as “the science which studies human behavior as a relationship between ends and scarce means which have alternative uses” (1932, 15). Note that Robbins’s definition of economics was unambiguously endorsed in the early 1950s only at the Cowles Commission (Backhouse/Medema 2009a, 227).
recommendations whenever goals and opportunities are specified (Cowles 1950-51, 8).

While thinking about solutions to optimization problems could still be inspired by how people actually behaved, the ultimate objects of study were norms for efficient decision-making under uncertain conditions.

This ever increasing concern with optimality was revealed even in decision-making in science and especially in statistics where the statistician has to choose between different ways of constructing a model, select a method for statistical estimation, or identify structural characteristics in a given model and respective parameters, etc. Rational design in statistics – of the experiment, the sample, the inferences – had already been mentioned in previous reports (e.g., Cowles 1942-1946, 13). Statistical decision-making had also been mentioned as an area for further study. The statistician would confront a decision problem in hypotheses selection that, coupled with some minimal set of first principles, would be used to estimate structural equations. Early on, Marschak had already stated that a “statistical theory should be developed that would guide the selection of such additional hypotheses” (Cowles 1942-46, 13). But in the early 1950s, even fact-finding in statistics was framed as a decision problem under incomplete information that should be made efficiently (e.g., Marschak 1951):

Application of ideas and insights obtained by abstract analysis requires fact-finding about technology and about behavior of people, acting individually or in organizations. Most of these facts are naturally expressed in numbers and in relationships between numbers. Analysis is needed once more to decide which facts to look for, and how to distill general conclusions from the vast mass of facts collected; in short, to make the fact-finding itself efficient (Cowles 1950-51).
Making “efficient statistical inferences” was now grounded upon what formerly had been optimality considerations about welfare.

Mirowski (2002a, 249 ff.) explains the shift from what he calls “Cowles Mark I” to “Cowles Mark II” – entailing a turn from econometrics towards neoclassical theory – by the commission’s increasing dependency on its new patrons. New funding contracts with RAND and the ONR had tightened the commission’s relationship with them and enabled a flow of mathematical modeling tools used at RAND that would ultimately lead to a shift in the commission’s research program towards abstract mathematical work leading to neoclassical orthodoxy (Mirowski 2002a, 2002b).37 And the contracts between Cowles and other research institutions indeed fostered collaborations that led to the exchange of those tools (Christ 1952). Marschak, Arrow, and Hurwicz navigated between Cowles, RAND, and the CASBS, increasingly engaging with new tools for studying decision-making, making contributions to game theory, to linear and dynamic programming, which could give assistance to political and military decision-makers (Erickson et al. 2013, 14, Louçã 2007, 310). Nevertheless, it was not the contracts with RAND that primarily made such studies attractive; Cowles scholars were engaged in multiple other collaborations as well (Cowles 1949-50, 4). Rather, innovative mathematical tools that were conceived of as having a value of their own in upholding the epistemic and methodological values of Koopmans and Marschak, affected the choice of research problems that could be addressed and vice versa.

Towards Norms of Rational Choice

From the early 1950 on, the ultimate purpose of studies of actual behavior became normative, that is to say, they were largely reduced to an instrumental value in enriching studies of rational behavior. Koopmans’ Project on Decision-making under Uncertainty, which had

37 See e.g., RAND Corporation website for a list of problems in the early years of the Corporation, http://www.rand.org/about/history/a-brief-history-of-rand.html [accessed on March 20, 2014].
become a core project in his research agenda from 1950 onwards, illustrated this increasing neglect. In a draft memorandum of the project, Marschak laid out the different levels of study of uncertainty arising in the ‘logical sequence of three steps.’

Step I: How *should* rational people – especially business firms - make decisions in the face of uncertainties: i.e. what is a firm’s best decision, given its goal, its resources, and the uncertain information at its disposal?; Step II: How do people *actually* respond to available uncertain information in making decisions?; Step III: How can one utilize the knowledge about actual responses of people to uncertainties – e.g., the actual behavior of the customers and competitors of a firm, or the actual behavior of citizens of a nation - to achieve the decisions that are best from the point of view of the firm, or of the nation?

Marschak himself noted that steps I and III were normative. Step III would result in “efficient methods for business firms and governments,” the terminology that allocated them into the category of optimal behavior. Step I would provide a benchmark for step II to measure irrational deviations from the rational course observable in reality. It would be informed by traditional or expected utility theory and was justified as point of departure to compare the ideal with the real. Step II would involve empirical studies of actual behavior: “its purpose is to observe the most frequent habits of behavior of various decision-makers (including business firms and governments), habits that are possibly obsolete, inefficient, irrational.”

Furthermore, empirical information about “typical behavior of modern people under conditions

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38 The project was ultimately supported by a grant of the U.S. Office of Naval Research in July 1951.
40 Ibid., emphasis in original.
41 Ibid., 2 f.
of uncertainty” was collected that would then be used in step III to prescribe the ‘best’ course of action from the actor’s point of view.42

While the three-step procedure encompassed investigating human beings’ actual psychology, such studies were decreasingly conducted for their own sake and the empirical ‘step II’ was largely outsourced. Marschak paid lip service to psychologists by claiming that the formulation of rationality norms still required the investigation of actual behavior and human motives. But he had mostly deferred responsibility for empirical studies by either allocating them to other institutions, undertaking them in cooperation with external institutions or drawing upon survey methods and publicly available data collected by private companies and research institutions, e.g., the Survey Research Center in Michigan or a research group at University of Illinois. Marschak suggested using portfolios of investments trusts that were made available by the research departments of firms, banks, or the government, analyses of balance sheets of enterprises including insurance companies, and price data. Thus, investigations into actual behavior to study behavior under uncertainty were not in fact undertaken at the commission.43 And if they were, their results were used only “because of the strong support lent to the latter by the former” (Cowles 1949-50, 9).

While Koopmans and colleagues neither studied human psychology nor extensively consulted psychologists, they still assisted in formulating hypotheses to cover the study of actual behavior at the commission. On their view, their research on building theories of decision-making was instrumental for empirical analysis in a second step, which was undertaken in cooperation with other institutions; all else, they argued, would amount to dissipating expertise and skill:

42 Ibid., 2 ff.
43 Considering the studies of actual versus those on rational behavior conducted between 1948 and 1951 listed the research reports (Cowles 1948-49, Cowles 49-50, Cowles 50-51), 8 (descriptive) studies of actual behavior were conducted compared to around 40 (prescriptive) studies of rational behavior, either on optimal single-person decision problems or on optimal multi-person decision problems.
The cooperation would not consist in our taking over ready-made results. The surveys of individual behavior, not different in this from the use of aggregative data, have as a prerequisite the formulation of hypotheses. *This is where we should assist and cooperate. It would be wasteful, and would not correspond to the nature of our own resources if we tried to duplicate the existing survey centers. But it should be possible to coordinate the work of the groups.*

The only behavioral hypotheses in fact tested at Cowles concerned inventory behavior of firms, import demand, financial behavior patterns, demand elasticities for imports, etc. The empirical insights gained from such tests could be “applied to develop rational techniques for firms or governments, in ways depending on the nature of the firms concerned and on the national goal of the government.” But mostly, such tests were not directly about studying actual behavior experimentally or via interviews but rather consisted in drawing statistical inference from non-experimental data of economic time series (i.e. prices, production, consumption, investment, etc.) that enabled measuring the aggregative effects of such variables on large-group behaviors.

By 1954, the motivation behind studying rational behavior had largely developed into a prescriptive undertaking, serving the end to find ‘good’ rules of reasoning. Von Neumann and Morgenstern’s principle of expected utility was part of the conceptual core in this research as it allowed the economist to go beyond well specified goals to be maximized, such as profit, “average military worth” and “calculated risk,” and take the general criterion of “maximum expected utility” (Cowles 1952-54, 20). Its axiomatic form allowed for a rule-based definition

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of rational choice applicable to any decision-problem under uncertainty, of “single persons” but also of teams and organizations (Cowles 1952-54, 20). Its conceptual generality and abstractness became a virtue, as it was in a first instance detached from any empirical interpretation and therefore made its use as a normative theory possible.

*With the help of the concept of maximum expected utility, one can [...] define ‘good rules’ for the decision-maker.* Such rules have been extended to the realistic case when one does not know in advance the probabilities of relevant events but can gradually improve his decisions helped by the inflow of successive observations (Cowles 1952-54, 20; emphasis mine).

To address the problem of optimal organization, another growing area at Cowles from 1952 on, Marschak and Radner began to use “admittedly unrealistic, yet [...] useful” models similar to physics that “might prove essential for practical engineering by clarifying certain basic principles that could be applied to complicated reality” (Cowles 1952-54, 15). It was the clarification of the essential principles of efficient organization that would lay the grounds for computing an efficient organizational structure. Formulating principles for efficient forms of organization “in private business as well as in the civilian or military agencies of the government” became a central concern in projects headed by Marschak together with Radner (Cowles 1952-54, 15). Problems regarding operational efficiency in transportation systems such as railroads or highways or efficient social planning necessitated normative considerations on the basis on some standard of optimality in order to formulate and prescribe their optimal solution. Such decision problems concerned, for instance, a shipping company or a team of executives having to choose a decentralized or centralized structure, given the company’s or team’s goal, given uncertain conditions, and given the multiple agents involved that have different kinds of information at hand. Or it concerned the choice of “good decision rules” for
the use of the information available as well as for efficient communication, the analysis of how information can transform into a “good decision,” or of how decision-makers constituting a team make good decisions to accomplish their assignments within their particular role in the team (Cowles 1952-54, 17 ff.). Participating in the routine of management consultant firms to gather data in exchange for recommendations regarding optimal inventory control or efficient information transmission was how the abstract work on such problems could lead to concrete application (Cowles 1952-54, 20).

Thus, the investigation into, and the formulation of norms of rationality had become independent from the study of actual behavior. The idea of calculating the optimal solution was too demanding or just not what economic agents in fact did. Koopmans and colleagues began to argue, however, that the rational course of behavior could not only be suggested but also acquired as a skill and via practice. For actively improving decision-making and avoiding inconsistent behavior, deviations from the rationality-ideal would have to be detected to subsequently bring people’s decision-making on the ‘rational’ track. It was investigated:

- how ideally ‘good’ decision-making, based on consistent goals and quiet deliberation, compares with habits of actual decisions by men in our society – decisions that are often made under pressure of time and are sometimes contradictory – and how the practice of good decision-making could be developed by training (Cowles 1952-54, 21; emphasis mine).

The norms of rationality could prescribe the wise behavior, i.e. the course of action that people should want if they would only be aware of their ‘irrationality.’

Marschak had empirically investigated behavioral regularities at the macro-level to ground rational economic policy-making in his research program in the mid-1940s. By the early 1950s, he and Koopmans made an attempt to theoretically formulate basic principles to
lay the basis for channeling the behavior of economic agents, teams and organizations towards rational decision-making. Underlying this theoretically orientated research program under Koopmans was thus a similar kind of individual, organizational, and political engineering that had characterized Marschak’s research program from very early on. The underlying normative premise was, however, a minimally value-laden one, namely a notion of rationality as consistency and of efficiency of a relation between means and ends, not determining the ends themselves. The ends themselves would have to be determined by the decision-maker asking for advice and training. The economist would only occupy the role of an engineer who computes the optimal allocation of resources, chooses the right combination of available means, determines the most efficient coordination between decision-makers, or the most efficient ways of communication and information exchange in an organization.

Studies of actual decision-making were required, sometimes to detect deviations of actual from rational behavior and sometimes to determine the ends of a decision-maker. However, those studies were now largely in the hands of psychologists, which categorized the research at Cowles as still theoretical but trying to conceptually incorporate heterogeneity again:

For such studies there has been occasional co-operation with psychologists.

One effect of this co-operation may be mentioned here: in line with the results of psychological experiments, we relax the assumption of consistent decision-making and assume that a man's choices are subject to variations; we continue to assume, however, that these choices obey definite probability laws and can therefore be studied statistically (Cowles 1952-54, 21).

By 1954, the normative interpretation of rational choice theories at Cowles had become dominant. Efficient choice was “around every corner in economic analysis,” which according
to Koopmans made economics as a field of study fascinating and relevant for the educated citizen and layperson alike and who should be reached by the economist (Cowles 1952-54, 3).

It is not contested that the vindication of the effort that goes into research on such a practical subject as economics must lie in increased ability of mankind to make the best of its circumstances, resources, and endowments. However, the appraisal of what economists are contributing in this regard would be helped if their subject could be made to come to life more fully to the interested citizen. Somehow economists have so far not succeeded in putting across the fact that […] there is a whole category of human decisions (Cowles 1952-54, 3).

One contribution of economics to society was to suggest improvements of current conditions, thereby accepting the engineering of human, social and political decision-making as a consequence of economic analysis. But the means to help making the best out of the given circumstances were axiomatic theories of rational decision-making and the tools they were grounded upon. Koopmans was confident that giving “free reign to intellectual curiosity may open up the pathways to useful and applicable knowledge more readily than carefully charted plan of approach” (Cowles 1952-54, 24). And ultimately, it was the mutual influence between intellectually demanding, epistemically acceptable tools and practically relevant problems that Cowles would become famous for.