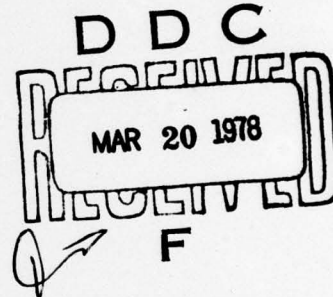FINAL TECHNICAL REPORT

OFFICE OF NAVAL RESEARCH

CONTRACT N00014-76-C-0033

New York University

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Prepared by

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This report is filed in order to provide a final technical report for Contract N00014-76-C-0033 given to New York University through its principal investigator, the late Professor Oskar Morgenstern by the Office of Naval Research.

Professor Morgenstern, with the help of the Office of Naval Research had created an active group of scholars engaged in research on applied game theory. This report summarizes the activities of that group. (This year the group included Professor Oskar Morgenstern, Professor Andrew Schotter, Professor Dietrich Fischer, Professor Steven Brams, Dr. Frank Zagare, Ms. Dori Newman (a graduate student in the Department of Economics), Professor Dermot Gately, and Dr. Ira Sohn.)

Despite the illness of Professor Morgenstern and his eventual death in late July of 1977, the work proposed under the contract proceeded smoothly. Professor Morgenstern initiated a study with Dr. Frank Zagare whose aim was to provide a critical survey of the concept of economic and political power. Dr. Zagare is now engaged in work connected to this topic. Plans had been made by Dr. Morgenstern to write several papers in the field of game theory; one entitled "The Indeterminacy Problem and the Theory of Games" was to be written with Professor Schotter. The paper was intended to defend the idea of indeterminacy as a necessary fact of life in social science and to describe how the indeterminacy found in many solution concepts in the theory of games might be considered a strong point of the theory and not a fault. A paper written by Professors Morgenstern and Schwodiauer entitled "Competition and Collusion in Bilateral Markets" appeared in the Zeitschrift für Nationalökonomie in December 1976.

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The other members of the game theory group at New York University were quite active during this past year. To begin, a project on experimental economics and game theory was started by Professor Schotter who, with Professor Braunstein (now at Brandeis University) performed a controlled experiment on 92 N.Y.U. students in an effort to experimentally test a hypothesis (called the "hypothesis of theory absorption") found in the recent paper written by Oskar Morgenstern and Gerhard Schwödiauer entitled, "Competition and Collusion in Bilateral Markets" (mentioned above). The hypothesis, most simply put, is as follows: if an equilibrium theory or a stability concept is to be a usefuly one in the social sciences, then knowledge of the theory by participants in the situation under investigation should reinforce the predicted stability, not lead to its disruption. In other words, the theory or concept should not be vulnerable to "theory absorption." Our investigations, so far, have indicated that one of the most frequently used solution concepts for n-person games, the concept of the core, is indeed vulnerable to theory absorption. Consequently, its usefulness must be called into doubt.

The paper was presented by Professor Schotter at the Second Conference on Experimental Economics in Winzenhohl, West Germany, in August 1977 and will appear in Contributions to Experimental Economics (edited by Heinz Sauermann).

In addition to this area, the group's ongoing interest in the question of economic and political power and power games is being investigated. In addition to the collaboration of Professor Morgenstern and Dr. Zagare, Professor Brams, a political scientist in our group, has

continued his important work on power in a political context. His
game theoretical interest resulted in the publication of several
papers this year, along iwth the writing of "Power and Satisfaction
in a Representative Democracy" (written with Professors Scraffin and
Davis).

Professors Schotter and Fischer have written a paper entitled
"The Inevitability of the Paradox of Redistribution in the Allocation of
Voting Weights," which is derivative of a paper by Professor Brams
entitled "Power and Size: A New Paradox, "Theory and Decision, Vol. 7
written with Paul Affuso. It proves some theorems about a paradox that
arose in the voting bodies of the Common Market and International Monetary
Fund in which, after a redistribution in votes occurred, some members had
their percentage of the total votes decreased, yet their power within the
organization (as measured by the Banshaf index) increased. This paradox
was proven to be inevitable for games with $n \geq 6$ when power is measured
by the Banshaf power index and for games with $n \geq 7$ when power is measured
by the Shapley-Shubik index. This paper will be published in Public Choice
in the summer of 1978.

Further research into the question of linear economic systems
and the von Neumann model, and the problem of economic contraction out-
lined by Professor Morgenstern in his recent book, Mathematical Theory
of Expanding and Contracting Economies (written with G. Thompson), has
been done by Professor Fischer in his article, "Externalities and Inter-
dependence in a von Neumann growth Model," and by Professor Schotter in
"Economically Efficient and Politically Sustainable Economic Contractions."
Both articles were published in Mathematical Economics and Game Theory

(Berlin: 1977). Dr. Sohn, another member of our group, has published a paper entitled, "The Morgenstern-Thompson Model of an Open Economy in Closed Form," in <u>Mathematical Economics and Game Theory</u>.

In addition to this work, Professor Gately has continued his investigations into game theoretical models of O.P.E.C. pricing and a dissertation, formerly under the direction of Professor Morgenstern and now directed by Professor Gately, is being written by Ms. Dori Newman on a model of O.P.E.C. oil pricing. The model is a variation of a model created by Doctors Gately and Fischer.

A book series on applied game theory started by Professor Morgenstern at the Center for Applied Economics at New York University has acquired two new books that will be published this year. One, by Dr. James Case entitled "Elements of Economic Competition" is an original manuscript and another volume edited by Professor Peter Ordershook will contain the proceedings of a conference on game theory and political science held on Cape Cod in the Summer of 1977. Both will be excellent volumes.

To conclude, despite his illness during the year and eventual death, Professor Morgenstern still was able to carry on his scholarly work and encourage others to do so.

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S. Brams and M. Lake, "Power and Satisfaction in a Representative Democracy," presented at Conference on Game Theory and Political Science, Hyannis, Massachusetts, July 10-17, 1977.

S. Brams, M. Davis and P. Scraffin, "The Geometry of the Arms Race, (manuscript submitted for publication).

D. Newman, A Pricing Model for O.P.E.C. Oil, (dissertation in progress).

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This report is filed in order to provide a final technical report for Contract N00014-76-C-0033 given to New York University through its principal investigator, the late Professor Oskar Morgenstern by the Office of Naval Research.

and completed by his colleagues. Papers were published on game theory applications to economic and political power and power games, etc.

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