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Jaroslav Pazdera, Johannes M. Schumacher, Bas J.M. Werker

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The Composite Iteration Algorithm for Finding Efficient and Financially Fair Risk-Sharing Rules

Jaroslav Pazdera*, Johannes M. Schumacher†, Bas J.M. Werker‡

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Abstract

We consider the problem of finding an efficient and fair ex-ante rule for division of an uncertain monetary outcome among a finite number of von Neumann-Morgenstern agents. Efficiency is understood here, as usual, in the sense of Pareto efficiency subject to the feasibility constraint. Fairness is defined as financial fairness with respect to a predetermined pricing functional. We show that efficient and financially fair allocation rules are in one-to-one correspondence with positive eigenvectors of a nonlinear homogeneous and monotone mapping associated to the risk sharing problem. We establish relevant properties of this mapping. On the basis of this, we obtain a proof of existence and uniqueness of solutions via nonlinear Perron-Frobenius theory, as well as a proof of global convergence of the natural iterative algorithm. We argue that this algorithm is computationally attractive, and discuss its rate of convergence.

Keywords: risk sharing, fair division, Perron-Frobenius theory, eigenvector computation, collectives.

*CentER, Department of Econometrics and Operations Research, Tilburg University, PO Box 90153, 5000 LE Tilburg, the Netherlands; jaroslav.pazdera@gmail.com.

†Faculty of Economics and Business, University of Amsterdam, Roetersstraat 11, 1018 WB Amsterdam, the Netherlands; J.M.Schumacher@uva.nl. Most of the research for this paper was done while this author was with the Department of Econometrics and Operations Research, Tilburg University.

‡Netspar, CentER, Department of Econometrics and Operations Research and Department of Finance, Tilburg University, PO Box 90153, 5000 LE Tilburg, the Netherlands; B.J.M.Werker@TilburgUniversity.nl.