

## Accepted Manuscript

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PII: S0378-4371(17)30665-9

DOI: <http://dx.doi.org/10.1016/j.physa.2017.06.024>

Reference: PHYSA 18409

To appear in: *Physica A*

Received date: 3 May 2017

Please cite this article as: L. Zhu, J. Chen, Z. Di, L. Chen, Y. Liu, H.E. Stanley, The mechanisms of labor division from the perspective of individual optimization, *Physica A* (2017), <http://dx.doi.org/10.1016/j.physa.2017.06.024>

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# The Mechanisms of Labor Division from the Perspective of Individual Optimization

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## Abstract

Although the tools of complexity research have been applied to the phenomenon of labor division, its underlying mechanisms are still unclear. Researchers have used evolutionary models to study labor division in terms of global optimization, but focusing on individual optimization is a more realistic, real-world approach. We do this by first developing a multi-agent model that takes into account information-sharing and learning-by-doing and by using simulations to demonstrate the emergence of labor division. We then use a master equation method and find that the computational results are consistent with the results of the simulation. Finally we find that the core underlying mechanisms that cause labor division are learning-by-doing, information cost, and random fluctuation.

*Keywords:* Division of labor; Multi-agent systems; Learning by doing; Master equation.

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## 1. Introduction

The division of labor in real-world settings is ubiquitous. In a bee hive the worker bees work and the queen bee reproduces [1]. In an ant colony queens and males reproduce, workers build and expand the colony and gather and store food, and soldiers protect the colony [2, 3]. The labor division in different groups varies, but in each case specialization enables the group to reproduce and survive [4]. Labor division is also pervasive in human society. Employees in an organization divide the work to be done according to function. The use of the division of labor by scientists carrying out research allows an increase in the level of specialization, reduces cost, and improves overall efficiency.

Most current research on the division of labor offers an experimental interpretation of the phenomenon as found in biological systems. Robinson found

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