Spring 2018 Complexity Challenge

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Individual Strategies Implemented in the Model

- **Long-term investment:** agents are only interested in the long-term gains.
- **Gambling:** agents are short-term investors who depend on luck and/or do not use meaningful information in their investment decisions.
- **Speculation:** agents are short-term investors but they use sophisticated observation and analysis (i.e. better tools than the gamblers) in making their investment decisions.

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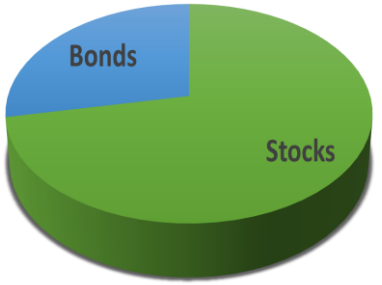
Potential Returns

- **Fixed Interests** which are paid by a bond (the case of the stable pool).
- **Dividends** which are shared between the owners of a certain company's stocks (the case of the low pool and high pools).

Meta-strategies Implemented in the Model

Single Strategy
(i.e. individual agents)

For example, investing in certain stocks or in a certain bond



Mutual Funds
(i.e. meta-agents)

Decentralised/Democratic Meta-strategies: combine a certain subset of individual strategies without involving in the decision-making process of these individual strategies.

Centralised/Authoritarian Meta-strategies: take absolute power and directly control the movements of their subsets between the pools.

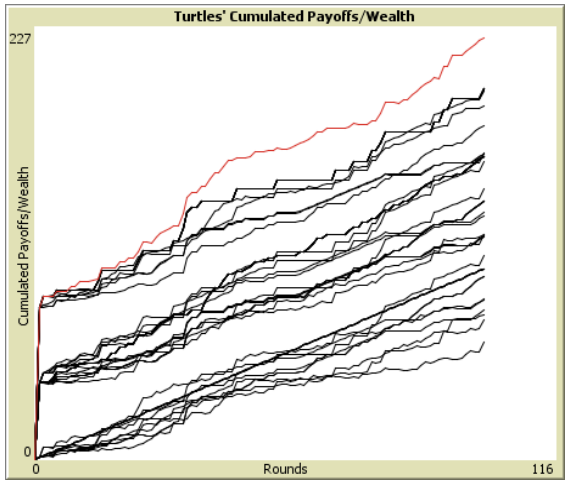
Stockbrokers

They facilitate the buying and selling of stocks and bonds. In return, they charge a commission/switching fee (i.e. tau) which can be seen as money sucked out of the system's wealth.

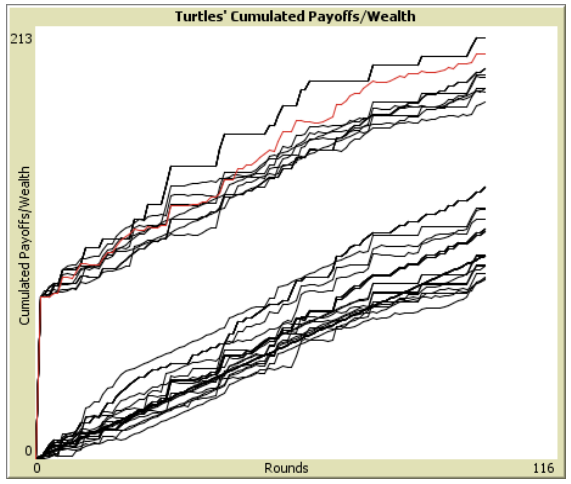
Characteristics of a Good Strategy

- **Stability and Constancy:** ability to provide reasonable performance which does not fluctuate significantly (important for strategies aiming at less risky activities in the short term).
- **Profitability:** ability to generate a high outcome over a number of rounds (might fluctuate a bit but the end result is desirable).
- **Versatility:** not requiring many pre-set parameters based on a pre-analysis of the system.
- **Adaptivity:** ability to evolve and/or make dramatic changes, if required, based on the emerging data during the game.
- **Unpredictability:** ability to prevent other players from predicting its next action.

First Round



(1)



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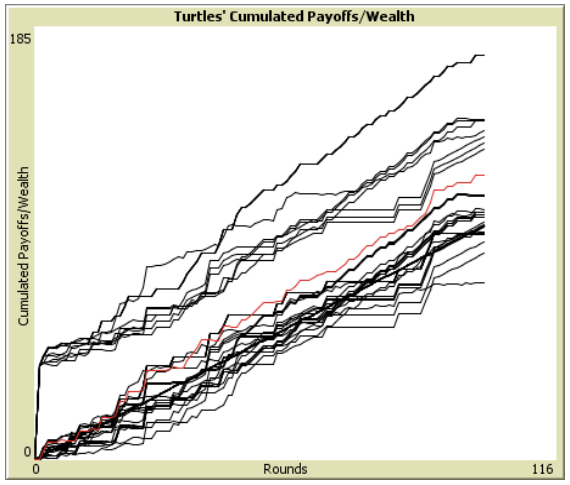

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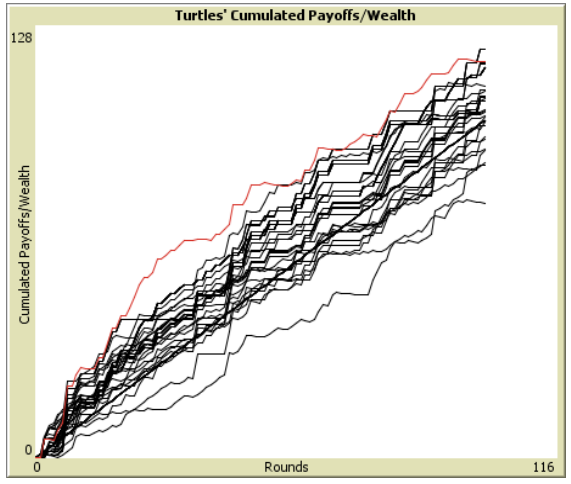


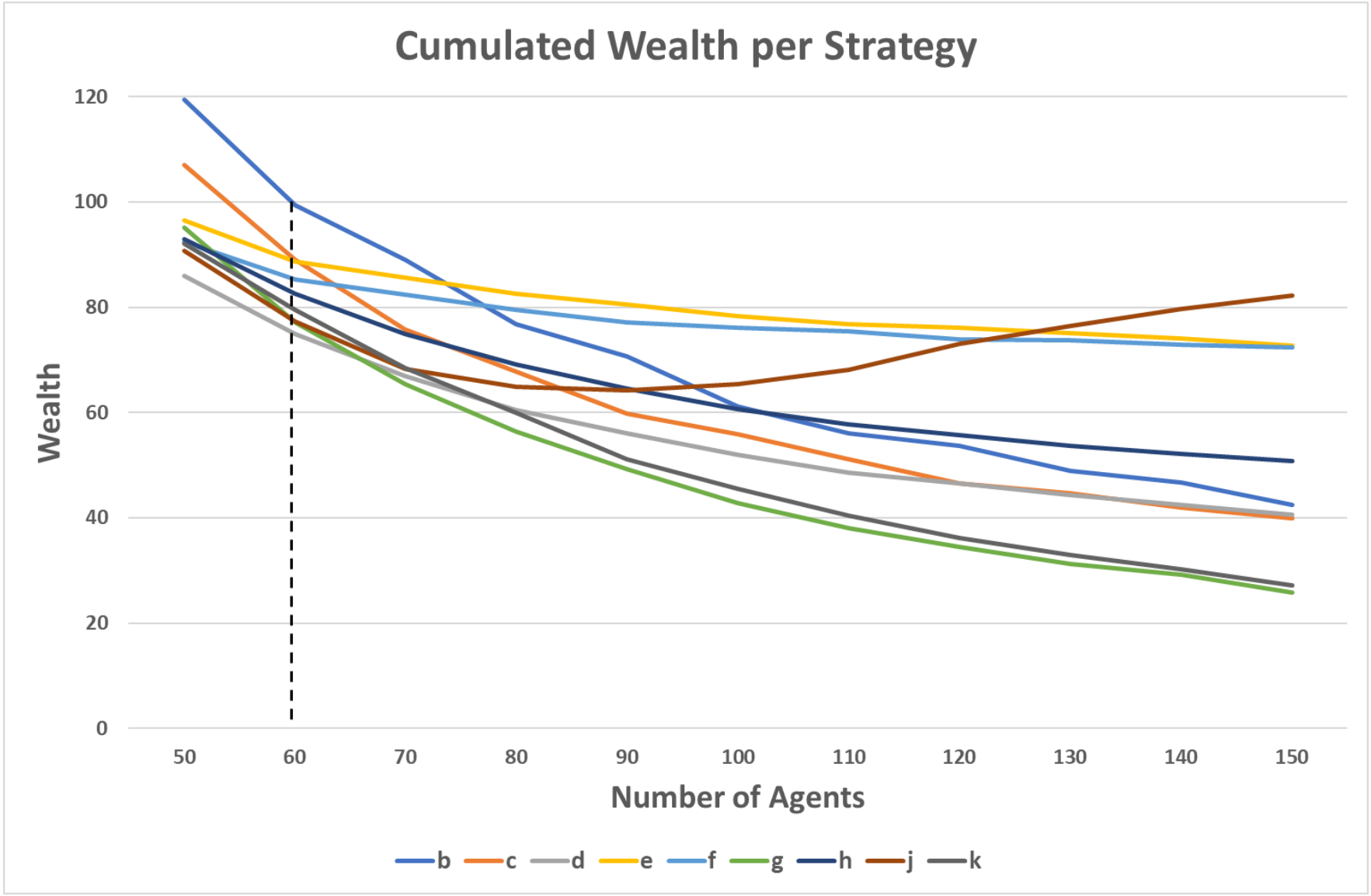
(4)

Graph 1: the returns of stable, low and high pools are 1, 40 and 80, respectively.

Graph 2: the returns of stable, low and high pools are 1, 0 and 80, respectively.

Graph 3: the returns of stable, low and high pools are 1, 40 and 0, respectively.

Graph 4: the returns of stable, low and high pools are 1, 0 and 0, respectively.



If we assume that agents are distributed equally among the three pools, and the number of agents in the system is 60.

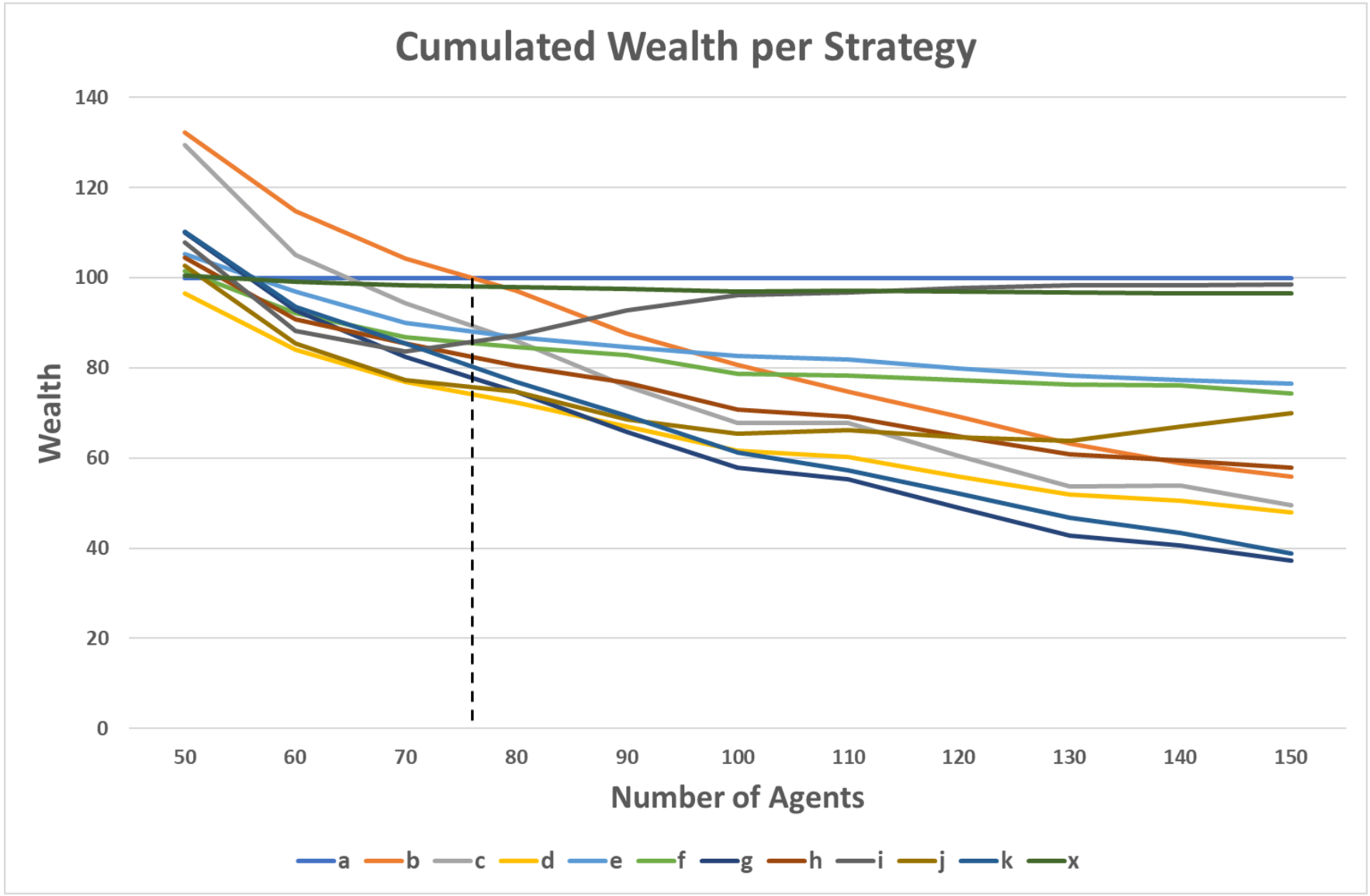
60/3 = 20 agents for each pool.

The potential return per agent in the high pool is (80*0.25)/20= 1.

The potential return per agent in the low pool is (40*0.5)/20= 1.

After the threshold of 60 agents, it is more profitable for the agents to invest in the stable pool.

Averaged data from 1100 runs overall - 100 runs for every 10 agents (from 50 to 150)
Each run lasts for 100 rounds



By including strategy a, strategy i and strategy x – which give some attention to the stable pool – in the game; the threshold slides further to the right.

Averaged data from 1100 runs overall - 100 runs for every 10 agents (from 50 to 150)
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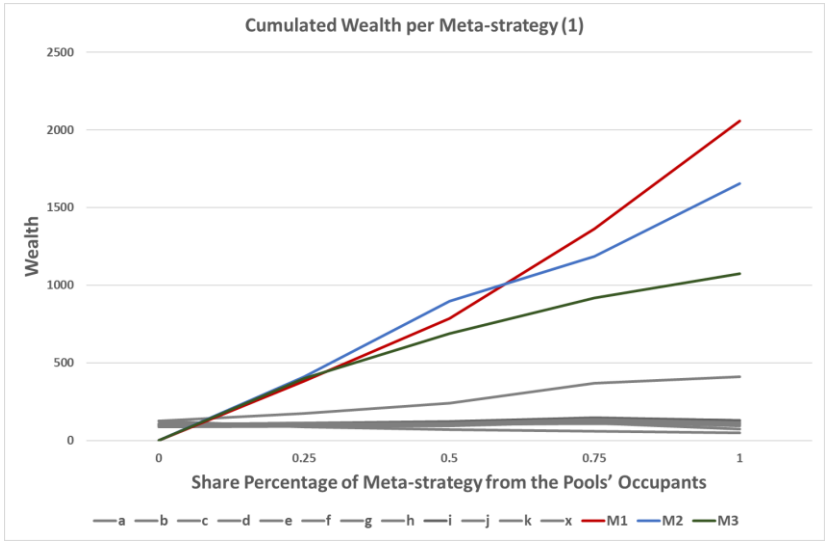
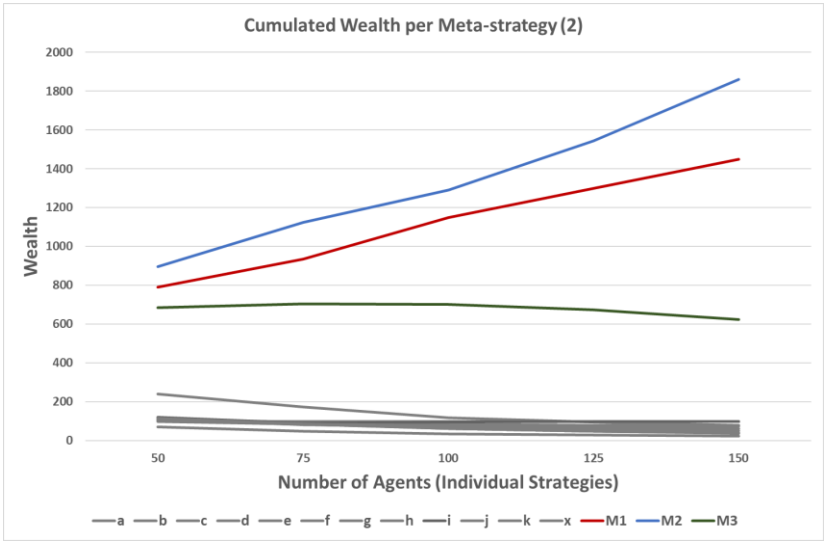
Meta-strategies can use this knowledge to maximise the wealth of the system, reduce the instances of switching pools and drive the stockbrokers out of the stock market.



Averaged data from 5000 runs overall (1000 runs for each value in the horizontal axis)



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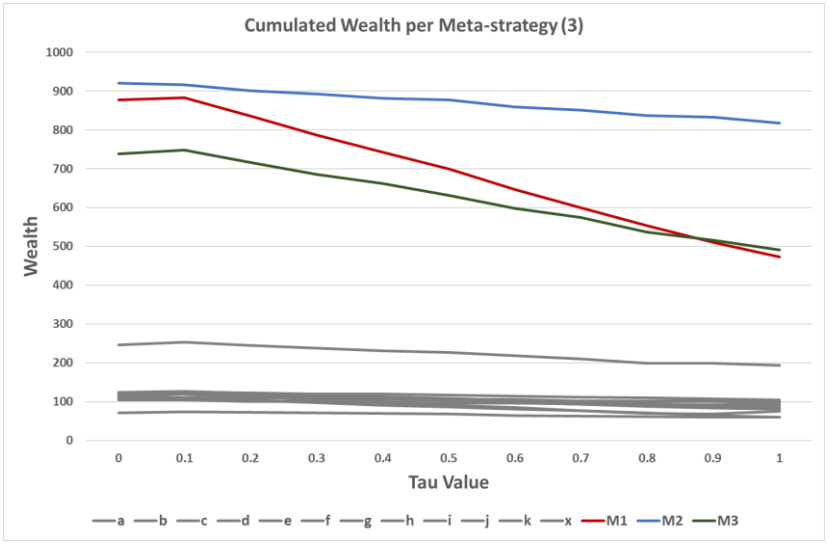


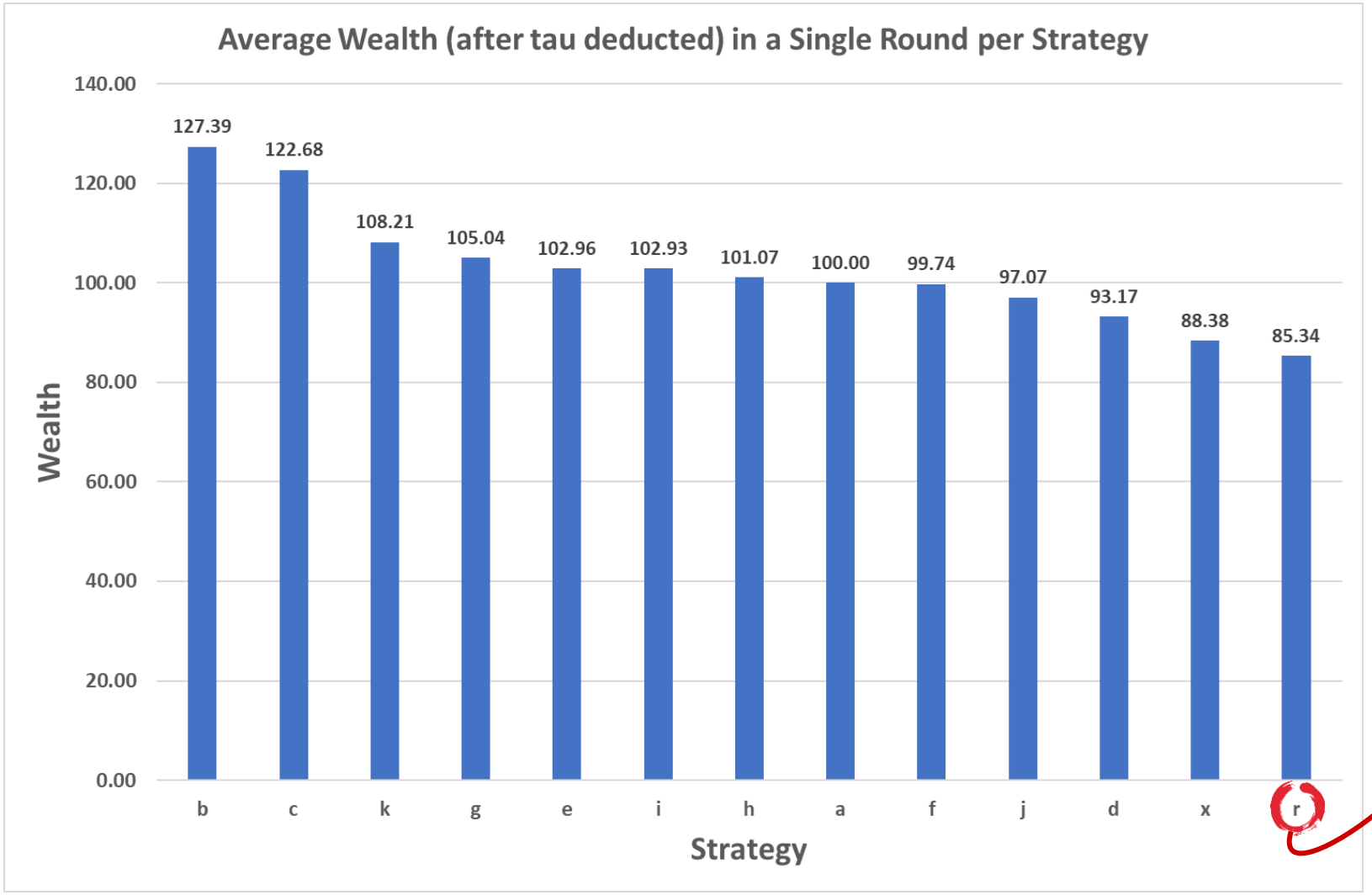
Averaged data from 11000 runs overall (1000 runs for each value in the horizontal axis)

Decentralised/Democratic Meta-strategies:

- **M1**: randomly combine a subset of the individual strategies.
- **M2**: combine a subset of strategy e and strategy f which are chosen randomly (50-50 chance).

Centralised/Authoritarian Meta-strategies:

- **M3**: impose a monopoly on the system by directing its sub-agents to occupy the high pool every third round and occupy the low pool every fifth round.



Strategy r, which can spy on other individual strategies, achieves the poorest payoff for a single round.

Averaged data from 10000 runs


thank you
for listening