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Lecture with Computer Exercises:
Modelling and Simulating Social Systems with MATLAB

Project Report

The Second-Order Tocqueville Paradox.
How Social Inequality and Class-Dependent Decisions May Dampen Frustration - An Agent-Based Simulation

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We hereby agree to make our source code for this project freely available for download from the web pages of the SOMS chair. Furthermore, we assure that all source code is written by ourselves and is not violating any copyright restrictions.

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Contents

1 Abstract

The term *Tocqueville's paradox* refers to the empirical pattern, that in a social system (e.g. a society or a firm) under improved social or economic conditions frustration may increase rather than decrease, as one would assume intuitively. The French sociologist Raymond Boudon suggests a game theoretic model that explains this phenomenon as the consequence of individual decisions in interdependent competition situations. The model is based on homogeneous and perfectly rational agents. We relax these assumptions by introducing social inequality and class-specific decision behaviour in order to investigate how the main model prediction of an increasing frustration rate under improved conditions is affected. Surprisingly, the rise in frustration is dampened when assuming heterogeneous agents deciding non-rationally. We refer to this as *second-order Tocqueville paradox*.

2 Individual Contributions

Generally, all members contributed to all parts of this project and took part in regular meetings. More specifically, Joel Berger focused mainly on the literature and the mathematical model, Milan Bombsch is responsible for the main part of the Matlab implementation and Dai Zhonghuan engaged in both of these task equally.

3 Introduction and Motivations

According to the historian Alexis de Tocqueville, before the French revolution, economic and social conditions improved. Due to these improvements, the French got more frustrated and this ultimately lead to the outbreak of the revolution (Tocqueville 1952 [1856]). Based on this observation, the phenomenon that in a social system aggregate frustration may increase when conditions improve and that regimes are regularly overthrown during times of political liberalisation and economic growth is called "Tocqueville's paradox" (Neckel 2010). Tocqueville's paradox has been observed in further studies: In Iran, the Shah was overthrown after a phase of economic growth and the Soviet Union collapsed during reforms by Gorbatschow (Coleman 1990). Moreover, the English, American, and Russian revolutions occurred in correspondence with Tocqueville's hypothesis (Brinton 1965). A similar phenomenon from a cross-sectional perspective is that soldiers in the US-army were more dissatisfied in branches with high chances for upward mobility compared to low-mobility branches (Stouffer et al. 1965).

Although many explanations of Tocqueville's paradox have been proposed (e.g. Merton and Rossi 1957), the game theoretic model by the French sociologist Raymond Boudon (1988, 1982) provides the most elaborated one (Raub 1984). In the basic model, homogeneous and fully rational actors are assumed. In the study at hand we relax both assumption and investigate into how this changes the main model implications. More specifically, we implement the competition model as an agent-based simulation (Epstein 2007, Nigel 2008), extending the basic model by two features. First, we implement the model dynamically, which leads to the endogenous emergence of social inequality. Second, we account for the empirical fact that upper-class individuals invest with a higher probability in upward mobility than people from lower social strata (Breen and Goldthorpe 1997). Our research question is whether social inequality in combination with class-specific decision behaviour alters the model predictions of rising frustration under improved circumstances. It is important to know under which conditions Tocqueville's paradox occurs: When opening a mobility structure, it is essential to prevent the diffusion of frustration and a waste of resources.

The further paper is organised as follows. First, we outline the basic model and its extension (4) and describe the model implementation (5). Subsequently, the results are presented and discussed (6). The paper concludes with a summary and an outlook (7).

4 Description of the Model

4.1 Basic Model

The competition model was introduced by Boudon (1982, 1988), but more exactly specified by Raub (1984). The following sketch of the basic model relies on work by Berger and Diekmann (2013) and Raub (1984).

In a social system, N players can decide whether or not to invest resources C, e.g. effort or money, in a competition for a lucrative and scarce good such as a well paid position within a firm. There are k available positions (equivalently: opportunities) and n investors. While k is common knowledge, the number of investors can range from 0 to N. Successful investors get access to the highly valued good and therefore receive the high payoff α, which is given by gross benefit B (e.g. power, money or prestige) minus investment costs C. In the case of a university student, C might be time and money invested in education while other individuals of the same age have already entered the labour market, earning money.

If the number of investors n exceeds the amount of free positions k, some investors fail to obtain a lucrative position. Even though they have spent the same amount of C as the successful investors, the losers get nothing in return and consequently are frustrated. That is, the losers receive the low payoff γ, which is given by the status quo minus C. A real-life example is an overeducated, yet underpaid university graduate (Peiro, Agut and Grau 2010). Sustainers, e.g. individuals entering the labour market early and not competing for desirable but scarce positions, will neither get a well high-prestige job nor will they lose any resources. This is represented by the moderate payoff β. The payoffs satisfy the inequalities $\alpha > \beta > \gamma$.

Probability of promotion for an agent choosing the strategy 'invest' is given by the ratio of the number of lucrative positions k to the number of investors n. It should be noted that all N players decide simultaneously whether or not to invest. Thus, before the decisions are made, the actual number of investors n is not known while the number of desirable positions k is common knowledge. The higher the number of investors for a given number positions, the lower the chances of success for each agent.

Given α, γ, and k the expected payoff $E\_invest(k, n, \alpha, \gamma)$ for a specific number of investors n can be obtained from equation (1):

$$E\_invest(k, n, \alpha, \gamma) = \begin{cases} \frac{k}{n}\alpha + \frac{n-k}{n}\gamma & \text{for } k < n \\ \alpha & \text{for } k \geq n \end{cases} \tag{1}$$

Given this, the game matrix from the perspective of a player i can be constructed (see figure 1). The assumptions of this baseline model are in accordance with classical game theory. The rules of the game are common knowledge and each player knows that the other players are rational and maximise their expected utility.

Number of other investors (n – 1)

		0	1	2	...	$N-1$
Player i	invest	E(k, 0)	E(k, 1)	E(k, 2)	...	E(k, N – 1)
	not invest	β	β	β	...	β

Figure 1: *Game matrix from perspective of player i.* $E(k, n-1) = E\_invest(k, n, \alpha, \gamma)$.

If the expected payoff of the strategy 'invest' for a specific number of positions and competitors $E\_invest(k, n, \alpha, \gamma)$ exceeds the sustainers payoff β independently of the actual number of investors, 'invest' is the dominant strategy. For the case that no dominant strategy exists, there is a threshold n^* with the following property: As long as maximally n^* players choose to invest, the expectation of an investment exceeds the payoff β. So there are $\binom{N}{n}$ asymmetrical Nash equilibria in pure strategies, in which n^* agents choose 'invest' and $1 - n^*$ gents choose 'not invest'. However, since homogeneous actors are assumed and communication is not possible, none of these pure-strategy equilibria is likely to be realised. Thus, the rational solution lies in mixed strategies (Gintis 2009), with an optimal investment probability p^* that can be derived from equation (2). The more positions k there are, the higher is the probability that a given actor chooses to compete.

$$\begin{aligned} & E\_investOverall(k, N, \alpha, \beta, \gamma) \\ =& \binom{N-1}{0} \cdot p^0 \cdot (1-p)^{N-1} \cdot E\_invest(k, 1, \alpha, \gamma) + \\ & \binom{N-1}{1} \cdot p \cdot (1-p)^{N-2} \cdot E\_invest(k, 2, \alpha, \gamma) + \\ & ... + \\ & \binom{N-1}{N-1} \cdot p^{N-1} \cdot (1-p)^{N-N} \cdot E\_invest(k, N, \alpha, \gamma) = \beta \end{aligned} \tag{2}$$

The expected relative share of investors then equals p^*, which is the solution of $E\_investOverall$. In the case that there are more investors than free positions, the relative frequency of winners in a group of N is given by the ratio of scarce positions k and the group size (k/N) and the loser rate can be obtained by subtracting the winner rate from the investor rate ($p^* - k/N$). In the case that the number of investors is lower than the number of positions, every investor wins and the rate of the frustrated equals zero.

If the winners' payoff α is sufficiently attractive in comparison to the sustainers' payoff β and the losers' payoff γ, a small increase in the number of opportunities k can lead to excessive over-investment. The number of competitors exceeds the number of free positions by far and thus, the share of the frustrated grows: Tocqueville's paradox emerges at the aggregate level as the unintended consequences of rational, interdependent individual decisions. Nevertheless, in case that α is not too tempting in comparison to the other payoffs, an increase in the opportunities leads to a comparable increase in investors. Consequently, frustration does not increase (Berger and Diekmann 2013). In the following, we investigate parameter constellations that produce an over-investment and thus, a waste of resources. This is the more problematic and thus, the more interesting case.

4.2 Model Extensions

Boudon's model predicts the occurrence of Tocqueville's paradox based on the assumptions of homogeneous and perfectly rational agents. In order to make the model more realistic, we relax these assumptions. First, we introduce social inequality, that is, agents with different endowments (*dynamic baseline model*). Second, the agents' investment decisions depend on their endowments (*extended dynamic model*) - a fact that has been empirically established (e.g. Breen and Goldthorpe 1997).

We introduce social inequality by implementing the model dynamically. In doing so, starting from a perfectly equal society, inequality emerges endogenously, which is more elegant than introducing heterogeneous agents by assumption (Epstein 2007).[1] The central question is, how the main model prediction of an increasing frustration rate under improved conditions is changed when investment decisions are not perfectly rational but depend on an agents financial endowment. Rich agents, that is, agents with an endowment that deviates positively from the starting value, invest with a higher than the optimal probability while poor agents whose endowment deviates negatively from the starting value rather abstain from investing. This captures the empirical fact that people from higher social strata rather invest in higher education than people from lower strata, given the same ability (Breen and Goldthorpe 1997). According to Breen and Goldhorpe (1997), people have a preference for maintaining their social position. The higher the social position, the higher the investment necessary in order to reproduce this position in the next generation. For instance, for reproducing the parents' upper-middle class position, an offspring has to graduate at the university level. Contrarily, some vocational training is sufficient to reproduce a working class position. In the framework of our model, one can also argue that the weight of the investing cost C (that is, the difference between β and γ) increases, the lower an endowment of an agent is (analogically to Engel's law, see Pasinetti 1981).

In order to describe the state of the system, we introduce the following measures. *Happiness* H is defined as the relative share of winners minus the relative share of losers in the population, divided by group size N. Negative values indicate a system with more losers while positive values indicate the opposite. Specifically, -1 describes the worst and 1 the best of all possible societal states. The Gini coefficient G represents the amount of financial *inequality* (see Pyatt 1976). While 0 describes a perfectly equal society, the measure takes on the value 1 if one single individual possesses the whole amount of wealth available. Finally, the *mean wealth* M in a social system is defined as the mean endowment of all agents. M indicates wether the financial resources of the society as a whole lies above or below the starting value of $M = 0$.

5 Implementation

The simulation model was implemented using Matlab. First, we programmed the static game theoretic model (static baseline model). As a second step, we implemented the model as a dynamic agent-based simulation model (dynamic baseline

[1] We implemented the model in a flexible way: In principle, it is possible to start with an already socially stratified society. Nevertheless, for a first analysis it is sufficient to investigate the most simple case of an equal system.

model). As a third step, we introduced the class-specific bias c (extended dynamic model).[2]

5.1 The Static Baseline Model

First we implemented the function $E\_invest(k, n, \alpha, \gamma)$, which corresponds to equation (1) and provides the expected payoff for an agent i, given the total number of investors n, the number of positions k, the winners' payoff α and the losers' payoff γ. γ is typically negative because an agent investing in vain loses the resources C. That is, $\gamma = \beta - C$.

The function $E\_investOverall(k, N, \alpha, \beta, \gamma)$ calculates the optimal probability p^* for choosing the strategy invest (using equation 2). As discussed when outlining the model, p^* corresponds to the percentage of investors, given specific values of all of the other parameters (number of positions k, total number of agents N an the payoffs α, β and γ).[3]

With these functions we can conclude the *static baseline model* and produce the $win\_lose\_plot(N, \alpha, \beta, \gamma)$, which demonstrates the Tocqueville paradox and will be discussed later (see figure 6).

5.2 The Dynamic Baseline Model

For the *dynamic baseline model* we wrote the function $plot\_society\_sim(k, N, \alpha, \beta, \gamma, c, it, popu)$. The parameters k, N, α, β, and γ denote the same values as before. The parameter c[4] describes the strength of the class-specific decision bias and is only relevant for the extended dynamic model. For now we set it to 0. With the parameter *it* the number of iterations of the simulation can be determined. One iteration corresponds to a time step in which each agent decides whether or not to invest. The winners are rewarded with α and the losers end up with γ while the sustainers receive the medium payoff β. As we set β to zero, the sustainers will keep their current endowment. The last parameter *popu* can be used to start from a different endowment distribution, namely a socially stratified society. It is a matrix which corresponds to the starting society. In this function all parameters can be omitted, which will set them to default values for the simulation.

[2] The code is available online at: https://github.com/MiB3/project_Tocqueville_msssm.

[3] Note that the size of N should not be chosen to be > 100 as equation 2 because the large number of binomial coefficients are difficult to calculate for Matlab. This is not a problem since the behaviour of bigger societies is similar to the one of small ones. This is the reason why we restrict ourselves to a society of 49 agents in the course of our analyses. 49 is a quadratic number and this produces more appealing visualisations then an even number such as 50.

[4] It should be noted that c is not the same as the costs of investing C.

Figure 2: Snapshot of the wealth distribution during one run of the simulation model. Extreme values: 1 = rich agent (white), 0 = poor agent (black).

The outputs of the function are two plots and a video. In order to add the Gini coefficient to some of the graphs, we exploited the external function *ginicoeff(In,dim,nosamplecorr)*. Its license is provided in the source code of the project at hand.

The first plot (see figure 2) displays the wealth distribution of the simulated society. Each agent is assigned a colour between black (lowest possible endowment) and white (highest possible endowment). The plot changes in every iteration and at the end of the simulation, the final state of the system is displayed. In each iteration the mean wealth M (mean of all endowments), the Gini coefficient, describing the distribution of the endowments G and happiness H (defined as the number of winners minus the number of losers, divided by N) for the current step is shown.

The second plot (see figure 3) displays the development of mean wealth, the Gini coefficient and happiness over time. For each iteration step, the values of these measures are recorded. The video *society_sim.mp4* includes all the overview-plots and can be watched to see the dynamic of the simulated social system over time.

5.3 The Extended Dynamic Model

The implementation of the *extended dynamic model* was achieved by writing the function $plot\_society\_sim(k, N, \alpha, \beta, \gamma, c, it, popu)$. The crucial parameter describing the class-specific decision bias is c. If c is set to zero, this corresponds to the dynamic baseline model. If c is greater than 0, this means that agents with a larger endowment invest with higher probability and agents with a lower endowment invest with a lower

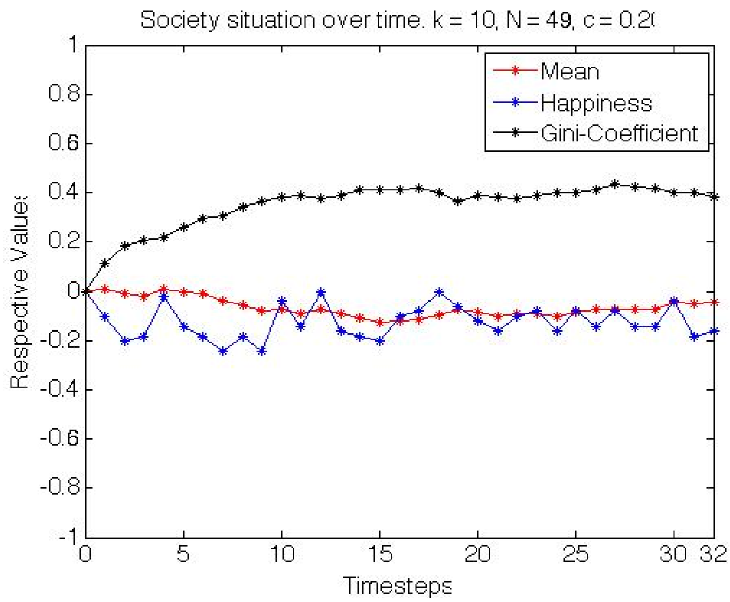

Figure 3: Development of mean wealth, Gini coefficient and happiness over time.

than the optimal probability p^*. For a given agent i, this probability is calculated by $p^* + p^* \cdot c \cdot (endowment\ of\ agent\ i)$, where p^* is the optimal probability of investing.

If c is set to a value lower than 0, agents with a high endowment invest with a lower probability and agents with a low one with lower probability. Nevertheless, we do not discuss this case in detail because, as mentioned before, empirical evidence suggests that the opposite (given the same ability, individuals with a higher class background invest with a higher probability in higher education than individuals from lower social strata) is the more realistic case. Test runs suggested that $c = 0.2$ is a good choice and we the reported results are generated with this level of c.

5.4 Additional Functions and Scripts

$default.mat$ stores default values for the parameters k, N, α, β and γ and can be loaded into Matlab with the command *load('default.mat')*. The script *create_all_plots.m* creates a comparison plot for different values of k and c. Additionally, it produces a video for each combination of k and c. In the end, it plots all overview-plots next to each other (see figure 4) and, additionally, produces a figure displaying the dynamics of mean wealth M, the Gini coefficient G and happiness H (see figure 5).

The script $compare\_for\_c.m$ creates a plot, which compares the different hapiness values over time using different c-values for the simulation. (see figure 7)

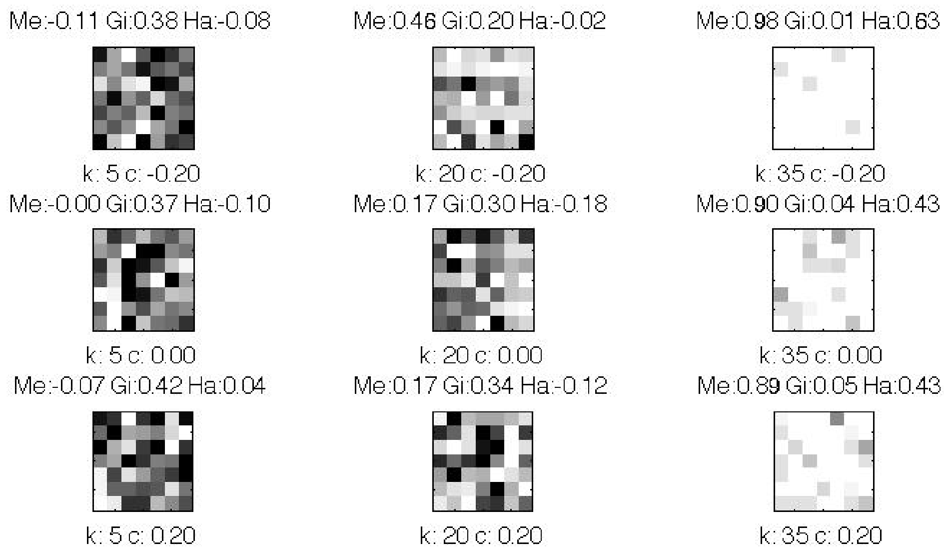

Figure 4: The distribution of wealth for different values of k and c.

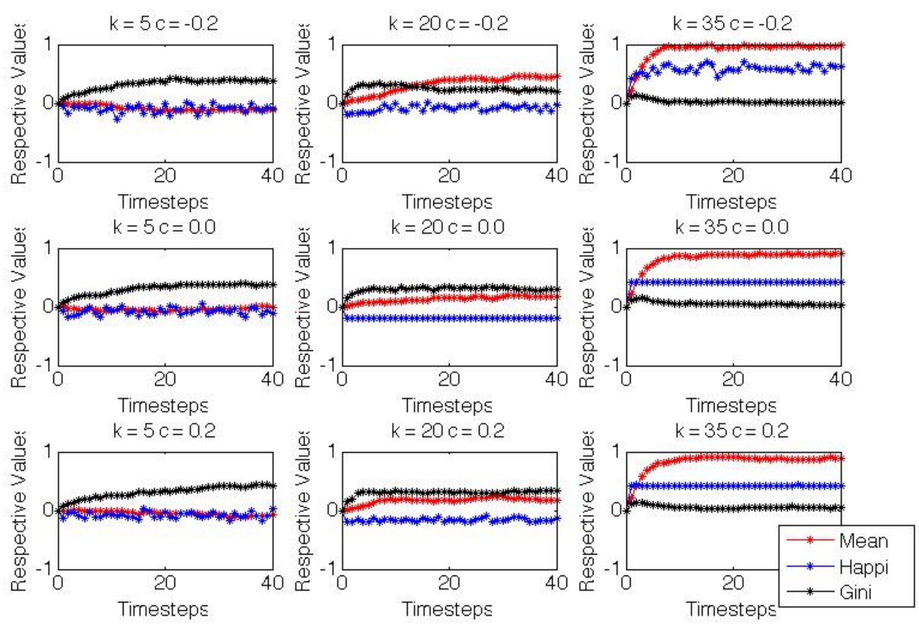

Figure 5: The evolution of the mean wealth M, the Gini coefficient G and happiness H over time for different values of k and c.

sectionSimulation Results and Discussion

5.5 Results

For the purpose of analysing the simulation model we chose the payoffs $\alpha = 0.38$, $\beta = 0$ and $\gamma = -0.23$. It is known how the model reacts to chances in the payoffs (see Raub 1984). Hence, we do not report results on this. As mentioned before, these values were chosen because this leads to the emergence of Tocqueville's paradox, which is a problematic phenomenon: If a society invests in social improvements or an organisation in better chances of promotion this should be done in a way not leading to a waste of resources and an increase in frustration.

To provide the reader with an intuition of the system behaviour, we selected three typical competition structures, namely a *low-mobility* ($k = 5$), a *moderate-mobility* ($k = 20$), and a *high-mobility* ($k = 35$) structure. All other values of k lead to outcomes that are mixtures of these three ideal types. For each of the three typical values of k we report the results of a simulation that is based on 40 iterations and 49 agents. Robustness checks indicate that both of these values are sufficient to produce stable results. After a short note on the static baseline model, we report results from the dynamic baseline model with rational investment behaviour. Subsequently, the results from the extended dynamic model with biased decisions are presented. To describe the system state, we report aggregate happiness (H) and, if meaningful, social inequality (G) and average wealth (M). Additionally, we refer to the rates of investors and losers, if necessary. Moreover, graphical visualisations are provided.

In the *static baseline model*, the number of agents choosing to invest increases with the number of opportunities. More specifically, the investor rate grows faster than the number of free positions (and even faster then the winner rate). Thus, the loser rate increases and peaks at $k = 19$. This demonstrates Tocqueville's paradox of an increasing frustration rate under improved conditions. Thereafter, the rate of the frustrated loser decreases again (see figure 6). This suggests that competition structures with either low or high mobility chances lead to more aggregate happiness than moderate-mobility systems - a result that has already been demonstrated by Boudon (1982, 1988).

When running the *dynamic baseline model*, starting with a perfectly equal society, the model generates social inequality endogenously. That is, agents that invest in vain lose money while lucky agents get richer. Thus, in the second round, the losers from the previous round have a lower and the winners a higher endowment compared to the standard endowment. After each round, the endowment of the agents choosing to invest changes. This is reflected by the Gini coefficient that starts with zero and rises over the iterations until reaching a certain level depending on the number of

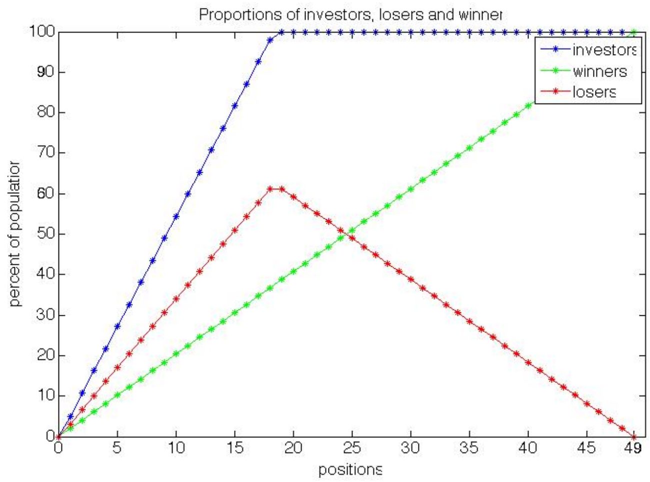

Figure 6: Win-Lose-Plot for a society of 49 agents.

free positions ($G \approx 0.37$[5] in the case of 5 positions, $G \approx 0.32$ in the case of 20 and $G \approx 0.04$ in the case of 35 positions). When comparing the three typical systems, as in the static model, the loser rate is highest and hence, happiness is lowest, in the system with moderate mobility ($H \approx -0.18$) while it is higher in both other cases (low mobility: $H \approx -0.07$, high mobility: $H \approx 0.43$). The model demonstrates that on the aggregate level, happiness must not necessarily correlate positively with wealth: Mean wealth increases with k while aggregate happiness does not. Note however that the model does not account for happiness that is generated by the absolute amount of wealth, which would probably change this result.[6]

Finally, we ran the *extended dynamic model* based on class-specific decision behaviour. That is, 'poor' agents with an endowment below the starting value invest with a lower than the rational probability p^* while rich agents invest with a higher probability. More specifically, the bias c of the optimal investment probability depends linearly on an agent's endowment. This leads to counterintuitive results: The frustration rate lies lower and thus, aggregate happiness higher when the agents behave non-rationally. We refer to this effect as the *second-order Tocqueville paradox*: While more opportunities can lead to a lower level of happiness (Tocqueville paradox), more inequality in combination with class-dependent non-rational investment decisions can rise aggregate happiness (second-order Tocqueville paradox).

[5] All reported measures are calculated with the values from iterations 20 to 40, where the simulation has stabilised.

[6] Nevertheless, studies demonstrate that at in affluent societies an individual's relative standing in the income distribution matters more for her happiness than absolute income (see Easterlin 1995).

To discuss this in some more detail, let us first focus on the moderate-mobility system ($k = 20$). While in the dynamic baseline model happiness equals -0.18 strictly, in the extended model, it lays around -0.12, but never below -0.18. An increase in aggregate happiness is also observed in the low and the high-mobility system. Importantly, in the extended dynamic model happiness H is never lower than the H-value of the dynamic baseline model after the first 10 rounds, when the simulation has stabilised. Also when implementing the opposite, more unrealistic case of setting c to a negative value (in this case to -2) a higher happiness level compared to the baseline model is produced (see figure 7).[7]

How is this possible? A key element leading to over-investment is a coordination problem inherent to the interdependent decision situation. Because actors cannot coordinate, they invest with a certain probability that results in a Nash equilibrium in mixed strategies that, as we have demonstrated, may imply over-investment. Class-specific investment decisions dampens investment and thus frustration. More specifically, when in a given round the competition generates more losers than winners, in the subsequent iteration more individuals are discouraged from investing (the losers) than are encouraged to invest (the winners). Consequently, in the extended model, potential losers are prevented from investing (and losing again) while for the remaining investors the probability of winning increases. This results in a smaller number of losers and a higher number of winners than in a comparable situation in the basic model. Thus, aggregate happiness lies higher in a system with heterogeneous agents that invest with a class-specific bias that depends on their financial endowment.

Is it possible that class-dependent investment behaviour leads to the opposite effect of producing more frustration under certain parameter-constellations? In the long run, the answer is no. In principle, this would only be possible in situations, in which the system produces more risk seeking winners than risk aversive losers. A precondition for the winners outnumbering the losers is a large share of opportunities k. However, if k is large,investing becomes a dominant strategy, that is, the optimal probability of investing p^* equals 1. This implies that the distortion parameter c only affects the losers' but not the winners' decisions since p^* by definition cannot lie above 1. Thus, even in this situation the rate of the frustrated is somewhat lower and happiness somewhat higher than in the basic model (see figure 7). Note however that this only holds true in the long run. It is possible, that in the first few rounds this rule does not hold and in some cases happiness gets lower when introducing c.

[7] Especially in the second half of the iterations the effect of a negative c is even stronger than the effect of a positive c. The reason is the following. The winners' payoff deviates stronger from the starting value of 0 than the losers' payoff. This means, that in case of $c < 0$ the winners are stronger discouraged from investing than the losers in case of $c > 0$. Over the iterations more and more winners abstain from investing and more and more former losers receive a high payoff, which raises the level of allover satisfaction.

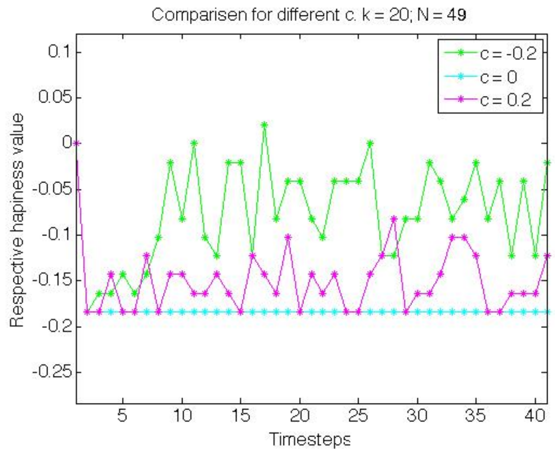

Figure 7: Dynamic of happiness for $k = 20$ and $N = 49$. Main result: Class-dependent investment behaviour ($c \neq 0$) can only positively affect the societal level of happiness.

5.6 Discussion

The extended model accounting for social inequality and class-specific investment behaviour leads to higher aggregate happiness. This implies that Tocqueville's paradox occurs with a higher probability in systems with equal agents.

Does this mean that policy should foster social inequality? The answer is no. First, the model is still very simple and further factors not considered might affect the well-being of a population. For instance, inequality aversion might dampen happiness when inequality becomes to extreme (Fehr and Schmidt 1999). Further, the positive side effect of inequality and class-dependent decision behaviour lies in dampening the inefficient investment of resources and consequently preventing an increase in frustration. Evidently, any mechanism that produces this effect is an alternative to class-specific investment behaviour. Optimally, exactly k actors would invest and $N - k$ actors would abstain from investing. However, it will not be easy to find an individual decision mechanism that leads to this result. An alternative to a decentralised mechanism is an institutional solution. A real life example are grades: Only individuals with sufficiently high grades are allowed to attend a university and this prevents an inflation of university certificates.

6 Summary and Outlook

The paper at hand discusses a game theoretic competition model that explains the puzzling phenomenon that improved social conditions such as an increase of chances for upward mobility in a social system might foster frustration - a phenomenon that is called Tocqueville's paradox. The original model is based on the restrictive assumptions of homogeneous and perfectly rational actors. By implementing the originally static model as a dynamic model, a system of heterogeneous agents is produced, which is more realistic than a system of homogeneous agents. Additionally, we implemented a class-specific decision bias. That is, an agent's probability of investing depends on his endowment. The higher the endowment lies above the starting value, the more risk seeking an agent becomes. Contrarily, the more an agent's endowment negatively deviates from the starting value, the more risk aversively an agent behaves. Surprisingly, this wealth-dependent, irrational decision behaviour dampens Tocqueville's paradox: Aggregate happiness is higher when social inequality exists and agents decide with a class-specific bias. We refer to this as second-order Tocqueville paradox.

However, this does not imply that social policy should foster social inequality. The crucial problem of the competition situations described by the model at hand is over-investment. Hence, a promising direction for further research would be to investigate into other individual decision mechanisms or institutions that dampen the occurrence of Tocqueville's paradox. More complex models then could be used to inform the design of institutions such as promotion systems or educational systems. In doing so, systems could be implemented in a way that prevents a waste of resources and produces a maximum level of happiness.

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