

Investigating revolutions in a model of democratization

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Abstract

'A Theory of Political Transitions' by Acemoglu and Robinson (2001) is an important paper in the democratization literature. Revolutions play a major role in the democratization of a country in the model presented in that article. This paper investigates whether that model accurately captures democratization. It does this by analyzing the paper and the model, with an emphasis on how revolutions are modelled. The model is then compared to how revolutions are portrayed in models of social conflict (Roemer, 1985)(Grossman,1991). The free-rider problem is concluded to be underdeveloped, because the model assumes that there are only public costs and benefits to revolutions. Moreover, the way that the effects of the revolution are modelled, which is an expropriation of capital, is also lacking. According to the model by Acemoglu and Robinson (2001), revolutions never directly lead to democratization, which is unrealistic.

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1. Introduction

Scientific discourse regarding democracies and democratization ranges back as far as Plato (Annas, 1981). In his book 'The Republic' he divides governments into three broad categories: dictatorships, oligarchies and democracies. Plato, however, did not have the same unbridled enthusiasm for this last category as we see in more contemporary literature and he saw the other forms of government as being at least as legitimate and efficient.

Theories regarding this subject continued to be developed in political science literature. It was not until the 20th century, however, that it became a subject in the economic school of thought. Especially the emergence of democracy became a crowded subject. The first writers in this school of thought saw economic and institutional factors as prerequisites for the start of democratization (Lipset, 1959)(Moore, 1993)(Rostow, 1956). Later on the focus shifted to modelling individual actors and how they can cause democracy to emerge (Linz, 1978) (Rustow, 1970) (Huntington, 1991).

The paper by Acemoglu and Robinson (2001) is most related to the later writers on this subject, although there are some influences from the earlier ones. They create a model in which the poor masses and the rich elite are at constant odds with each other, specifically regarding what tax rate to set. When the threat of a revolution by the masses becomes too great, the rich are forced to cede some of their power and allow a democracy to take root. It then falls to the masses to defend the democracy and prevent the rich from assuming control again.

This paper will investigate whether this model accurately captures the democratization of a country. More specifically, it will focus on mechanism of the revolution and the way it is captured in the model by Acemoglu and Robinson (2001). To do this, the paper itself will be thoroughly discussed and dissected. Moreover, two papers of the social conflict literature will be used to compare and

contrast, specifically because they too contain a model of a revolution (Grossman, 1991)(Roemer, 1985).

The main finding is that the free-rider problem that arises from revolutions is inadequately discussed in the model by Acemoglu and Robinson (2001). Because there are only public costs and benefits to a revolution in this model, it only explains why large groups in society become revolutionaries. The model could be improved by adding some analysis as to why individual agents would ever join such an undertaking. Moreover, in the model it is assumed that a successful revolution only leads to an expropriation of capital, while the possibility that democracy could follow from a successful revolution is ignored.

The paper is structured as follows: First an overview of the existing literature will be given. After this the paper will concentrate on summarizing and critiquing the paper by Acemoglu and Robinson (2001). Subsequently the focus will shift to the papers of Grossman (1991) and Roemer (1985). The next part will compare and contrast all of these papers, specifically how they model a revolution. Finally the findings will be summarized in the conclusion.

2. Literature overview

In this section, the literature surrounding 'A Theory of Political Transitions' will be discussed. First the history of the economic thought on democratization will be summarized, up to the paper of Acemoglu and Robinson (2001). After this several related areas of literature will be discussed, such as models of social conflict.

2.1 The history of the democratization literature

'A theory of political transitions' by Acemoglu and Robinson (2001) is a paper that is deeply rooted in the literature regarding the economic and political foundations of democracy. The work by Lipset (1959) can be seen as a starting point for this school of thought. In this paper, it is noted that there is a strong correlation between GDP per capita and democratization. The argument here is that democracy has certain requirements in the development of a nation, such as the existence of higher education and the rule of law. When a country has acquired a reasonable amount of 'modernization', democracy is within reach. This fits in line with the 'modernization theory', which argues that all states follow the same path of development. This development is always from a poor tyranny to a wealthy democracy. Another example of this is the work by Rostow (1956), in which he examines the 'take-off' of an economy.

A partial attack on this theory comes from Moore (1966), who does not accept that there is only one path to a developed society. He argues that there is not only a path to a developed democracy, but also a path to a developed fascist or communist state. This contrasted partially with the singular path that is proposed by the modernization theory, but it was still a very structural view, so one in which institutions and wealth play a large role and there is little room for individual agent-based theory.

Another important, but older work on democratization is that by Dahl (1971), which lists important conditions for the emergence of democracy. The interesting new part of this analysis is the fact that it delves more deeply into what democracy is: for Dahl, it is that the requests of the populace are heard and implemented.

The papers that were listed this far are called the 'structural' view, which came under attack in the 70's. Linz (1978) and Linz and Stepan (1978) maintain that there had been an overemphasis on the structural characteristics of society, such as the socioeconomic infrastructures, and an underemphasis on the actors in the political and societal arenas. The collapse of democracy was also increasingly the focus of the analysis. Some agents, they argue, are inherently pro-democratic and will attempt to shift the society towards their ideology while others will try to do the opposite. This is a much more dynamic view of society than the one proposed by Lipset or Moore, who assume static structural requirements for democracy. Rustow (1970) has a place somewhere in between these two kind of models: he asserts that before a country can become a democracy, some prerequisites have to be met, just as Lipset (1959) argues. These are different to the ones proposed by Lipset, though, with national unity and an entrenched and serious conflict being major ones. When these prerequisites are met, Rustow's analysis moves more towards the dynamic model of Linz, with a large emphasis on the agency of individuals and how their individual ideologies can influence democratization.. In the end he argues that his model abandons the search for 'functional prerequisites' for democracy in favor of a more dynamic approach.

In the 1980's research continued, most notably in the book by 'O'Donnell and Schmitter (2013). They realign the focus to democratization as opposed to the collapse of democracy. They do, however, keep using the methodology and the non-structuralism that were proposed by Linz and Stepan, as opposed to the structural approach of Lipset and Moore.

Since then, there have been other works that have attempted to combine the structural and actor approach. An example of this is the paper by Huntington (1991),

in which a complex amalgamation of factors is given that could influence democratization. However, which of these factors is important depends on the 'wave' of democratization. Different time periods are categorized into these 'waves'. Again, in this framework there are necessary conditions for democratization, but these are not enough to guarantee the emergence of it.

Another important work in the literature regarding democratization is that by Rueschemeyer, Stephens and Stephens (1992). In this book, they argue that democracy is only tenable in developed countries because there is an educated middle class that is willing to defend it. They argue that it is not the wealthy capitalist that is the greatest opponent of democracy, but rather the labor-repressive land owners that have a lot of influence in poorer countries.

The paper by Acemoglu and Robinson is a logical follow up to the increasingly complicated models that were proposed before it. According to them, it is necessary to simplify certain things in order to create a good model, especially when dealing with socially complex phenomena (Acemoglu and Robinson, 2005).

2.2 Related schools of thought

The paper by Acemoglu and Robinson (2001) is also related to models of social conflict. Examples of these are Grossman (1991) and Roemer (1985), which are also discussed in detail later on. These papers seek to model political relations between different groups in a country and are especially interested in revolutions, which makes them closely related to the analysis of democratization by Acemoglu and Robinson. Another example is the paper by Tornell and Velasco (1992), in which they model they analyze capital flight in a country by creating a model in which citizens manage their bank accounts by optimizing between different places to store their endowments. The model by Benhabib and Rustichini (1996) is also heavily related; it uses a game-theoretical approach to model conflict between different social groups over the distribution of income.

Somewhere between the models of social conflict and the paper by Acemoglu and Robinson (2001) are the papers by Usher (1989) and Usher and Engineer (1987). These articles discuss states that often switch between two modes; a despotic and an anarchic one. Acemoglu and Robinson also use this idea of a state, but in their paper it is between a dictatorship and a democracy. Usher and Engineer (1987) also discuss the degree of redistribution and its various causes.

Another close relative of this paper is the literature on the link between redistributive politics and economic outcomes. Alesina and Rodrick (1994) study this in a model in which agents have different endowments of wealth, which causes a distributive conflict. They find that greater inequality leads to greater taxation and to lower growth, which is in line with the paper by Acemoglu and Robinson that is later discussed. Another example is the paper of Meltzer and Richard (1981) which creates a model detailing the share of income that is redistributed in an economy, and finds that it depends on the voting rule and on the distribution of productivity in an economy.

3. 'A theory of political transitions' (Acemoglu and Robinson, 2001)

In this section the paper 'A theory of political transitions' will be summarized and then discussed. First the model will be presented, then the results will be listed and finally the article will be critically reviewed.

The article tries to answer the question why some nations are democracies and some are dictatorships. Moreover, historically some countries have switched from dictatorship to democracy and have remained so for over centuries, while some seem to revert back and forth every few years. The authors want to find out why this is this case.

In order to answer these questions a mathematical-analytical model is used. The focus lies on individual economic preferences. Both in democratic and

non-democratic countries a tax rate is set, but in a democratic country it is set by the masses and in a non-democratic country by the elite. The model revolves around the threat of a revolution or coup that occurs when citizens cannot agree over a tax rate.

3.1 The model: general intuition

In the model there are two groups, the rich elite and the poor masses. There can be two starting points for the model: the country can be democratic or non-democratic. In a democratic system the rich can mount a coup, while in a non-democratic system the poor can mount a revolution. The opportunity cost of these coups and revolutions change with income.

The model is infinite horizon with a proportion λ of the agents that are poor and $1-\lambda$ that are rich. There is a consumption good y and a unique asset with stock h . This stock, which can be seen as capital, can either be high or low, which is exogenously decided. With this capital the output can be produced, which can also be high or low. This way negative shocks are fitted into the model. The government budget constraint is given as:

$$(T^t - c(T^t))A^t h$$

In which T^t are the total taxes and the whole right hand term is the deadweight loss that is incurred when collecting taxes. When the society starts in nondemocracy the poor are excluded from the political process but can attempt a revolution in any time period from $t=1$. When the revolution takes part and a percentage ψ of the poor takes part, it always succeeds. The poor then expropriate fraction $\pi - \theta$ of the total assets and a fraction $1-\mu$ of the capital is destroyed. The timing of the events in a period can be summarized as follows:

- The height of output A is revealed.

- The poor receive their share of income if a revolution has taken place, tax rates are set
- In a nondemocratic regime, the rich decide what to do
- In a democratic regime, the masses decide what to do
- Consumption takes place and the period ends

A simplified visual representation of what happens in the model is given below.



3.2 Equilibrium

An important side note is that there is no free-rider problem in this model, as the masses are seen as a single player. This means the economy can be represented as a repeated game between the rich and the poor.

The state in the beginning of the game can be either (A,D), (A,E) or (A,R), where D denotes a democracy, E a dictatorship and R a country after a revolution. A is the output and it can be either A^h for a high-income year or A^l for a low income one. The strategy of the rich is denoted by $\sigma^r(S, \tau^p)$, and it is a function of the state S and the taxation decision τ^p by the poor in a democracy. Their actions are (γ, ζ, τ^r) , with γ being the decision to implement democratization and $\gamma = 0$ meaning no democratization, ζ is the decision to mount a coup, which happens only in a democracy, again with a value of 0 denoting no coup. τ^r are the taxes they set in a non-democracy. The strategy of the poor is denoted by $\sigma^p(S, \gamma, \tau^r)$. The strategy determines the actions (ρ, τ^p) , with ρ being the decision to initiate a revolution and τ^p the tax rate they set in a democracy.

The Markov equilibrium here is the combination of σ^p and σ^r that are the best responses to each other. A Markov equilibrium is one in which the actions of the players only depend on the state of the game, so there is no memory of the players that influences action. Moreover, there can be no negotiation or signaling between players. Strategies form a subgame perfect Nash equilibrium, which is an equilibrium that arises when every subgame of the whole is in a Nash equilibrium.

Both the rich and the poor face an optimization problem of present and future consumption and have to pick the optimal σ^r and σ^p in order to solve this,

respectively. They formalize the two by using two Bellman equations, which write the value of a decision problem as a value of some initial choices and the value of another decision problem that is influenced by those choices. This is necessary because the elite and the poor react to each others decisions in this model. The Bellman equation for the rich is:

$$V^r(S) = \max(C^r \sigma^p(S|\gamma, \tau^r), \sigma^r, S) + B \int V^r(S') dP(S'|\sigma^p(S|\gamma, \tau^r), \sigma^r, S) \quad (1)$$

This is a maximization problem for the elite that depends on the decisions of the poor σ^p , state of the economy S , democratization γ , tax rate τ^r , the decisions of the rich σ^r plus all of those variables discounted from the future. The idea is that the decisions of the poor σ^p can be inserted into this equation and subsequently the optimal decisions for the rich can be calculated. The same thing applies to the Bellman equation of the poor.

Analysis

The optimal tax rate for a poor agent in a democracy is derived. In the absence of a coup threat by the rich the optimal tax is simply the maximized per-period consumption of the agent. The first order condition is:

$$(\lambda - \Theta)/\lambda \quad (3)$$

Which means that the optimal tax depends on the relative amount of rich and poor agents (λ) and positively on the inequality of a country (Θ). Especially this second relationship is important later on in the paper, as it implies that the difference in optimal taxation between the rich and the poor increases with a higher inequality.

Two assumptions are added to ensure that coups and revolutions are not beneficial in periods with high income. The first one dictates that the loss incurred by the rich in a coup attempt in a high income period is always higher than the losses they incur

from redistributive taxes they pay if they choose not to revolt. Expressed mathematically:

$$(1 - B)(1 - \phi)h^r > (1 + Bs(a - 1))\delta(\theta) \quad \text{Assumption 1}$$

Where B is the discount factor, $1 - \phi$ is the amount of capital destroyed by the revolution, s is the probability of a recession, a is the income during a recession and $\delta(\theta)$ being the factor of income that is redistributed. This effectively makes it so that there is no threat of a coup in a high-income period and that it is only in a low-income period that the masses have to worry about one.

The expected utility from the poor when attempting a revolution is:

$$V^p(A, R) = (\pi\mu A^l h)/\lambda + B W^p(R) \quad (5)$$

In which the poor receive a percentage $\pi\mu$ of the economy $A^l h$ directly after the revolution and $B W^p(R)$ afterwards. π is the fraction that is expropriated, while μ is the fraction that is not destroyed by the effects of the revolution. This is modelled this way because a revolution is permanent: the poor take control of the capital and will continue doing so in the future, but have to work with a reduced income because of the turbulence of the revolution itself. λ is the proportion of the populace that is considered 'poor'. If the poor never undertake a revolution and there is no redistributive taxation, their utility is:

$$V^{*p}(A, E) = Ah^p + (B((1 - s) + sa)h^p)/1 - B$$

Where h^p is the capital of the poor, s is the probability of a recession and a is the income during a recession. In reality, their income is likely higher, since there is likely some form of redistributive taxation. The second assumption that is postulated ensures that in times of high income, the expected utility for the poor masses of not attempting a revolution is always higher than attempting one. Mathematically this is:

$$\mu < ((\pi - \theta)Bs(1 - a) + \theta - B\pi)/(1 - B)\pi \quad (\text{assumption 2})$$

Where μ is the capital that is not destroyed after a revolution and π is the amount of capital that is expropriated. This assumption ensures that there will never be a revolution attempt by the poor in a high income period and that the rich only have to worry about one in a low-income period. This also implies that there will be no distribution in times of high income, as there is no reason for the rich agents to do so.

Because there is no threat of a coup, the expected discounted value of an agent in a democracy is given as

$$h^i + \delta(\Theta) + BW^i(D) \quad (6)$$

In which the agent receives h^i from his own capital, $\delta(\Theta)$ from redistribution and $BW^i(D)$ from future incomes, where $W^i(D)$ is the future income from the next period and B is the discount value.

The income from the next period is mathematically given as:

$$W^i(D) = (1 - s) V^i(A^h, D) + sV^i(a^l, D) \quad (7)$$

Where the next period can be high income ($V^i(A^h, D)$), low income ($sV^i(a^l, D)$) and the odds of either occurring are $1-s$ and s , respectively. The value of $sV^i(a^l, D)$ partially depends on the actions of the rich, as they can choose to undertake a coup in a low-income period. The poor can then reduce the level of taxation to τ^d in order to try to prevent it. However, when they are successful, the expected value of the next period is still $W^i(D)$. This means that the taxes have reverted back to the level of before, because the rich do not pose a realistic threat during a high-income

period. This is a crucial part of the model, as it ensures that the poor cannot commit to lower taxes in the future, which the rich can do by means of democratization.

After the tax rate is made public, the rich have to decide whether or not to mount a coup, with $\zeta = 1$ meaning a coup and $\zeta = 0$ meaning no coup. This is a maximization problem, namely:

$$V^R(A^l, D) = \max[\zeta V^{*r}(A^l, E) + (1 - \zeta)V^r(A^l, D, \tau^d) \quad (9)$$

Where $V^{*r}(A^l, E)$ is the expected value in the next period, but this time in a dictatorship. Just like in a democracy, part of the expected value depends on the expected value in the period after the next one. Again, that period can be one of high income, in which the dictatorship is stable and there is no threat of a revolution, because of assumption 2. The other option is low income, in which a threat of a revolution is present. The ruling class can now choose to democratize, attempt to placate the poor by increasing redistributive taxes or to do nothing. Acemoglu and Robinson choose to focus on $\gamma = 1$, so that democratization does occur for the rest of their analysis.

The state becomes a democracy. The elite can now choose to carry out a coup, but this will not happen as long as it is a high-income period or:

$$W^r(e) - W^R(D) \leq a((1 - \phi)h^r + \Delta^r(\theta, \tau^d))/B \quad (13)$$

With $W^r(e) - W^R(D)$ being the difference in expected income between a state of democracy and a state of dictatorship. $a((1 - \phi)h^r$ is the cost of a coup in destruction of income, while $\Delta^r(\theta, \tau^d)$ is the income of the rich when they do not attempt a coup. The equation basically stipulates that the rich will only start a coup when the difference between a state of democracy and nondemocracy is bigger than the losses they incur by engaging in a coup. Using this, the critical value of the cost of a

coup $\phi(\theta, a, s)$ is derived, so that when it is at or above that level, a coup is never beneficial for the rich. It is done by solving (13) for ϕ :

$$\phi(\theta, a, s) = ((1 - B(1 - s))(h^r + \delta^r(\theta)) + B(1 - s)\delta^r(\theta)) / (1 - B(1 - s))ah^r \quad (14)$$

When $\phi < \phi(\theta, a, s)$, a coup is never beneficial for the elite and the democracy is fully consolidated. Inequality has a positive effect on this constraint, which means that less unequal democracies are more likely to be consolidated. a , which is the income during a democracy, is also positively related. This means that higher income during recession periods can make a coup more costly for the elite, which also helps with consolidation. s , which is the frequency of recessions, makes it easier for coups to be stopped, because the tax promises of the poor become more credible.

After this value of the cost of a coup $\phi'(\theta, a, s)$ is calculated. This is a situation in which the value of the cost of a coup is lower than $\phi(\theta, a, s)$, but it is still low enough for the poor to be able to stop the coup by reducing taxes. When the cost of a coup is between $\phi'(\theta, a, s)$ and $\phi(\theta, a, s)$, the democracy is semiconsolidated. The society will always remain democratic, but the threat of a coup will still influence taxes.

Lastly, there is the situation where ϕ is larger than $\phi'(\theta, a, s)$, the coup is not very costly to the rich and the poor can do nothing to prevent a coup. The democracy will then revert back to a nondemocratic society.

In the last part of the analysis, the critical value of a revolution in a nondemocratic society is calculated. The payoff when attempting a revolution for the poor was previously given as (5). However, the rich may also try to prevent a revolution by redistributing income using taxes. They will impose tax rate τ^e which gives the poor a return $v^p(A^l, E, \tau^e)$. The expected value of the average agent is given by the Bellman equation:

$$v^i(A^l, E, \tau^e) = a(h^i + \eta^i(\theta, \tau^e)) + BW^i(E) \quad (16)$$

Where a is the income in a low-income period, h^i is the capital endowment of an average agent, $\eta^i(\theta, \tau^e)$ is the redistribution, which depends on inequality θ and taxes τ^e and $BW^i(E)$, which is the expected value in the next period. As was demonstrated before, the value of $BW^i(E)$ is always the same, which means that the rich can not make credible tax promises for the future, as it is always optimal for them to renege in case of a high-income period. (5) and (16), or the expected values from a revolution and the status quo, are then combined to form the revolution constraint:

$$W^p(R) - W^p(E) \leq (a(h^p + \eta^p(\theta, \tau^e)) - \mu\pi h)/B \quad (17)$$

With μ being the fraction of the income that is not destroyed by the revolution, while π being the fraction that is expropriated by the poor. This constraint dictates that the expected value from a revolution can not be too high compared to the expected value from the status quo, because otherwise the revolution can not be stopped by lowering taxes. Mirroring what was done in the case of a democracy, the cost of a revolution during a dictatorship is then calculated. τ^m is defined as the maximum the rich can tax themselves in order to prevent a revolution. This is then substituted into equation 17 in order to get the critical value for μ denoted by $\mu'(\theta, a, s)$, such as that when $\mu > \mu'(\theta, a, s)$, the elite can never stop a revolution if $\mu > :$

$$\mu'(\theta, a, s) = ((1 - B + sB)a(h^p + \delta^p(\theta)) - (as + 1 - s)B\pi h + B(1 - s)h^p) / (1 - B)a\pi h \quad (18)$$

Just like with the coup constraint, θ has a positive effect, so inequality increases the odds of a revolution. Again a also has a positive effect, so increased income during a recession reduces the incentive to start a revolution. Finally s is also positive, which means that it becomes easier to avoid a revolution when recessions become more frequent. This can be explained by tax promises for the future becoming more credible.

The four equilibria

Using these results, the authors differentiate between four types of Markov equilibria:

- A society remains undemocratic: this happens when $\mu < \mu'(\theta, a, s)$, as the revolution can be stopped by redistributive taxation.
- A society democratizes and is a consolidated democracy. This happens when $\mu > \mu'(\theta, a, s)$ and $\phi < \phi(\theta, a, s)$, because the revolution can not be stopped by the elite, but a coup is too costly for them to ever attempt afterwards. The elite no longer form a threat to the democracy.
- A society democratizes and is a semi consolidated democracy. This happens when $\mu > \mu'(\theta, a, s)$ and ϕ is between $\phi'(\theta, a, s)$ and $\phi(\theta, a, s)$. Because the elite still pose a credible threat, the taxes are still influenced by them in order to prevent a coup.
- A society democratizes and is an unconsolidated democracy, reverting back to a dictatorship. This happens when $\mu > \mu'(\theta, a, s)$ and $\phi < \phi'(\theta, a, s)$. The poor cannot avoid a coup by redistributing, as a coup is not costly enough. The society will revert back and forth from a democracy and a dictatorship.

The final section of the paper by Acemoglu and Robinson (2001) is concerned with different ways in which a democracy or a non-democracy can be consolidated, using the logic of their model. This is not pertinent to the model they present, so it will not be discussed in this paper.

Discussion

The model by Acemoglu and Robinson (2001) starts off with a game-theoretical premise that eventually produces four equilibria for the society. In what equilibrium the country resides depends on a lot of different factors, but Acemoglu and Robinson especially concentrate on θ , the inequality, a , the income during a recession and s ,

the frequency of recessions. Next we will discuss what things stand out in their model.

Firstly, the assumption that in high-income periods a revolution is impossible is a rather big one. One can understand the reasoning behind it: Acemoglu and Robinson needed a way in which promises for redistribution could be non-credible. This way, as there is no threat of a revolution in a high-income period, the regime can renege on its promise to redistribute without any fear for retribution. However, this still seems like a really large assumption in order to get this effect and one wonders if it could not have been realized without it. There should be plenty of reasons for making a revolution unfeasible in certain periods, for instance by adding the assumption that a revolution can only be attempted once in several years.

Normally, one would assume that the free-rider problem is an important factor when dealing with revolutions. Especially in the case of this paper, where the gains from a successful revolution are a country-wide redistribution of capital and income. The question of why anyone would join a revolution when they will profit anyway is not adequately answered. In this paper, people will always join a revolution because there are no private costs associated with it, only public costs in the form of destruction of output. Realistically, joining a revolution has huge potential private costs and benefits, but this is not discussed in the model. This paper will come back to this subject later on in an analysis of the free-rider problem.

The paper by Acemoglu and Robinson (2001) also chooses not to discuss what will happen after a revolution, focussing on democratization. It also sees these revolutions as redistribution of capital and income and not as other ways to democracy. The fact that democracy can only be attained through concessions by the dictator and not through force can be a major pitfall of the model. There are plenty of examples of democratic governments being established through force and not through concessions of the existing democratic governments. Examples of this are the People Power Revolution in the Philippines and the overthrow of Milosevic in

Yugoslavia. The fact that the model leaves out such an important possibility is a major weakness.

The model also does not differentiate between different forms of democracy and dictatorship. For instance, one could argue that parliamentary democracies have historically been more stable. Using the logic of the model, this could be due to the fact that in a parliamentary system, the tax rate is set after more deliberation than in a presidential system. This would mean that the promise of a tax rate being the same in the future is more credible, because it is harder to change it. This would reduce the incentive for the rich to mount a coup. The same could be said for different kinds of authoritarian regimes. A king is more credible in his promises for the future when compared to a dictator, because he expects his children to rule as well.

Finally, one of the main results of the model is that s , or the frequency of recessions, has a positive effect on both the revolution and the coup constraints. In other words, when a country experiences increased financial turmoil, it becomes easier for the government to stop either a revolution or a coup. The logic here is that it is difficult for a government to make credible tax promises for the future when it consists of mostly high-income periods. However, when the country is constantly threatened by revolutions and coups, which is the case in low-income periods, the government becomes more credible in its promises of either higher or lower taxes. But is this realistic? Normally, one could also argue that frequent recessions leave a government weak and starved for money, reducing the amount of resources it has at its disposal to fight a coup. In order to be able to defend against a coup or a revolution, it would have to raise taxes with a population that is already unhappy, which will only anger it even more. This dilemma of needing money to fight a coup or revolution attempt on the one hand, and not wanting to anger the populace on the other hand is explained more thoroughly in the paper by Grossman (1991), which is the next paper that will be discussed.

4. 'A General Equilibrium Model of Insurrections' (Grossman, 1991)

In this section 'A General Equilibrium Model of Insurrections' will be discussed. It is related to the paper of Acemoglu and Robinson (2001) by the fact that they both model social conflict between different groups in society and the revolution that can possibly result from it. This section will start by giving a small summary of the research question and method of the article. After this the model and results will be explained and finally the article will be critically reviewed.

The paper by Grossman (1991) concerns itself with the determinants of insurrections. The research question can be approximated by the following: 'What are the positive determinants of insurrections?'. In his analysis, Grossman concentrates on the economic factors, because he sees insurrection and the suppression thereof as competition of scarce resources between the ruling class and peasants.

In order to answer the research question Grossman develops a mathematical-analytical model of the situation. The two players in this game are the ruling class and the peasants of a country. These two engage in a non-cooperative one-shot game, in which labour time is divided between soldiering, production and partaking in an insurrection. This means that there can be no agreements made between the two players and the game is played only once. It emphasizes the expected private returns of the peasants/insurgents. A highly important assumption is that only peasants that participate in the insurrection get a part of the booty that is obtained from the previous ruling class. This contrasts with the majority of other theory on this matter and also with the paper by Acemoglu and Robinson (2001), where the benefits of the revolution are public. The model defines an insurrection as a forceful action against the system of taxes and property rights. This definition is a deeply economical one; an insurrection is seen as merely a redistribution of the wealth and income of a country.

The model

4.1 The ruler

In a simple economy, the time of peasant families can be distributed between production (l), soldiering (s) and partaking in an insurrection (i). The Pareto optimal option is the one in which everything is devoted to production, because soldiering and insurrections are collectively wasteful. There is a chance of an insurrection B. When there is no insurrection, the income of the ruling class is $r - Ws$, in which r is the total rent of taxes and W is the wage rate for soldiers. If there is an insurrection, their expected income is zero, because it is taken away by the masses. The ruler wants to maximize M, the expected income of the ruling class. Given the above assumptions, the ruler's objective is to maximize:

$$\begin{aligned} M &= (1 - B)(r - Ws) & (1) \\ &= (1 - B)(x\lambda L - Ws) \end{aligned}$$

In the lower part of the equation r is split up in the total production by Labour L, the tax rate x and a parameter for the technology of production, λ . The ruler has policy instruments x, w and S, where x is the rents and taxes, w is the wage rate of soldiers and S is the amount of time allocated to soldiering, so how many soldiers are hired. The ruler moves first by choosing the values of these instruments and the peasant families react to this.

4.2 Peasant families

As said earlier, the peasant families can obtain income from production l, soldiering s and insurrections i. The expected income from production is $(1-x)\lambda L$. The income from soldiering is either ws or nothing, depending on whether or not the insurrection is successful. The income from insurrection is ri/l when the insurrection is successful, or 0 when it is not. This assumes that the booty is divided according to the amount of

time each family uses for the revolution. Each family takes x (taxes), λ (a technological parameter that measures production efficiency), B (the probability of an insurrection), w (wage rate of soldiers), r (taxes and rents received by ruling class) and I (time allocated to insurrection) as a given and devotes time to l , s and i constrained to $l+s+i=1$. It maximizes its expected income, given by e :

$$e = (1 - x)\lambda l + (1 - B)ws + Bri/I \quad (2)$$

Which can be summed up as the productivity of labour λl minus the taxes, the income of soldiering ws times the chance the insurrection is not successful $((1-B)ws)$ (this is because they will not be paid if it is successful) and the income of an insurrection, which is the chance an insurrection is successful times the total capital that will be redistributed, divided by the amount of families I that get a share.

Then a few Kuhn-Tucker conditions are given. These are first order conditions which are necessary for an optimal solution. For labor, these conditions are:

$$l=0 \text{ when } (1-x)\lambda l < Y \quad (3a)$$

$$l \text{ between } 0 \text{ and } 1 \text{ when } (1-x)\lambda l = Y$$

$$l=1 \text{ when } (1-x)\lambda l > Y$$

With Y being a maximization of $(1 - B)ws, Bri/I$. This means that no time will be devoted to labour when it produces less income than soldiering and insurrections, some time when it is equal and all of the time when it is more productive than the other two options. The same Kuhn-Tucker conditions are given for soldiering and insurrections, which means that a family will never devote time to an activity whose expected return is less than any of the other activities. Moreover, when the expected return from one activity is always higher than that of the other ones, the family will devote all his time to that activity. These conditions have to be true for the optimal solution.

4.3 The insurrection

The chance of a successful insurrection is given as:

$$B = I^{1-\theta}/(S^\sigma + I^{1-\theta}) \quad (4)$$

It is here that θ and σ are introduced, which are the technologies of insurrection. They represent technologies that influence the relationship between time spent in insurrection activities and soldiering on the one hand and the odds of a successful revolution on the other hand. In this function, the chance of an insurrection increases with I , the amount of time devoted to insurrections, and decreases with S , the amount of time devoted to soldiering.

The expected return of insurrections was earlier defined as Br/I , so the chance of a insurrection succeeding B , times the total capital r , divided by the amount of families that participated in the insurrection I . From equation 4 it is then possible to derive the expected return to insurrections:

$$Br/I = x\lambda L/(I^\theta S^\sigma + I) \quad (5)$$

This implies that when the other variables are held constant, higher values for the variables of the technology of insurrection imply higher expected returns to the revolution. This is because a successful insurrection becomes more likely.

4.4 Policy choices

The ruler uses his policy instruments (x, w and S) in order to maximize M , the expected income of the ruling class. This is the same as choosing labour (L), soldiering (S) and insurrection (I) in order to maximize M , the income of the elite. Labour, soldiering and insurrection can all be either 0, between 0 and 1 and 1, with all of them together equalling 1. The optimal solution for the whole economy would

be to have an L of one, with an S and I of 0, because soldiers and insurrections are wasteful. This is, however, not the likely outcome. There are eight possible combinations of L, S and I, which reduces to seven if you leave out the option that all are 0. This means that there are seven different optimization problems to maximize M. These are formalized into seven Kuhn-Tucker conditions for optimality. Some of these can be immediately ruled out because they are unrealistic. For instance, the ruling classes would never allow L to be 0, as production would then also decrease to 0, which means no income. A more thorough analysis of this can be found in appendix 1. In the end all are discarded except for 6a and 6c:

$$(\delta M/\delta L) = (\delta M/\delta S) = (\delta M/\delta I) \quad (6a)$$

With $(L,S,I) > (0,0,0)$

And $L+S+I=1$

$$(\delta M/\delta I) \leq (\delta M/\delta L) = (\delta M/\delta S) \quad (6c)$$

With $(L,S) > (0,0)$ and $(I)=0$

And $L+S=1$

These are the two Kuhn-Tucker conditions that can apply for an optimal solution. 6c is only possible when θ , or the technology of insurrection, is zero. When it is not 0, Bri/I or the expected gains from an insurrection would become astronomically high, which would always cause the peasants to devote some time to insurrections. This means that when there is some technology of insurrection, the peasants divide their time between labour, soldiering and insurrection, while with no technology of insurrection it is also possible that they divide their time only between soldiering and labour. This displays the importance of these parameters for insurrection for this model: when the technology of insurrection θ becomes too low, it becomes possible that there is no time devoted to insurrections at all.

The wage rate that the ruler pays for soldiers is such that it is equal to the expected return from production in equilibrium, because otherwise there would be more time devoted to production. This implies that:

$$(1 - x)\lambda = (1 - B)w \quad (7)$$

With x being the taxes, λ a technological parameter for production, B the odds of a successful insurrection and w the wage rate. With the same logic, it also implies that:

$$(1 - x)\lambda \geq Br/I \quad (8)$$

Where Br is the total capital and I are the amount of families that participate in the insurrection. An important note here is that the gains from production can also be higher here, because in situation 6c there is no insurrection and thus no gains for insurrections.

Using all these previous equations, the partial derivatives are calculated in order to derive the optimal situations.

$$\delta M / \delta L = \lambda I / (I + BL)^2 (1 - B)I - BS \quad (9)$$

$$\delta M / \delta S = (\lambda BL / (I + BL)) (\sigma (1 - B) I / (I + BL) - 1)$$

$$\delta M / \delta I \leq (\lambda BL / (I + BL)^2 (1 - B) L + S - (1 - \theta) (1 - B))$$

The most interesting result from this is that the ruler's choice is independent of λ , the productivity of labour. This is because a shift in λ will be compensated by a shift in expected insurrection gains or soldiering wage.

4.5 Equilibrium

According to Grossman, although the full implications of the Kuhn-Tucker conditions can not be solved analytically, some interesting relations are visible.

The peasants' expected share of total income E with no insurrection is derived to be:

$$E/(E + M) = (1 - x)/L \quad (13)$$

With x being the taxes and L the value of the production time put in. When the threat of an insurrection becomes greater, the ruler will probably have to raise taxes in order to hire more soldiers. However, this will also reduce the expected income of the peasants through labour, which means that they will likely devote more time to insurrections.

TABLE 1—SIMULATED EQUILIBRIA

σ	θ	L	I	S	x	β	M/λ	E/λ	$E/(M + E)$	Empirical relevance ^a
0.01	0	0.997	0	0.003	0.487	0	0.484	0.513	0.515	
0.50	0	0.856	0	0.140	0.303	0	0.163	0.693	0.810	
0.99	0	0.766	0	0.234	0.237	0	0.003	0.763	0.997	
0.01	0.1	0.941	0.056	0.0033	0.448	0.073	0.389	0.552	0.587	✓
0.50	0.1	0.780	0.114	0.107	0.326	0.302	0.105	0.675	0.865	✓
0.99	0.1	0.1229	0.838	0.039	0.877	0.955	0.0001	0.1228	0.999	**
0.01	0.5	0.744	0.254	0.0025	0.495	0.349	0.239	0.505	0.679	✓
0.50	0.5	0.524	0.407	0.070	0.523	0.707	0.047	0.477	0.910	*
0.99	0.5	0.0335	0.952	0.015	0.967	0.985	0.0000	0.0335	0.999	**
0.01	0.9	0.607	0.391	0.0021	0.567	0.492	0.174	0.433	0.173	✓
0.50	0.9	0.393	0.550	0.057	0.637	0.798	0.030	0.363	0.924	*
0.99	0.9	0.0204	0.970	0.010	0.980	0.990	0.0000	0.0204	0.999	**

Grossman then turns the analysis towards the effect of the parameters of insurrection, σ and θ . In order to analyze this, he calculates simulated solutions to the problem of maximizing M to selected values of σ and θ . The results are shown in table 1. Equation 6c is relevant for the solutions where $\theta = 0$. Here it is optimal for the ruling class to employ the amount of soldiers that will make I equal to 0, so there is no time devoted to insurrection activities. With $\theta > 0$, equation 6a is relevant. Here the ruling class also uses policies to generate a positive amount of soldiering and labour time, but it is also optimal to have time devoted to insurrections. The cost of

completely avoiding this is simply too high for the ruling class. Because θ and σ have a positive effect on the expected return of an insurrection, I becomes larger the larger they are.

What can also be seen in this table is that society comes closer to the optimal situation, namely that L is 1, when soldiering time is more efficient. This happens when σ , one of the technologies of insurrection, gets closer to 0.

As said earlier, when $\theta > 0$, there is a positive amount of insurrection activity. This is the case in the lower three blocks in the table. Here the rulers need to levy taxes in order to combat this insurrection, while also making sure that the peasants still devote a positive amount of time to production. The larger θ and σ , the technologies of insurrection get, the larger the amount of time devoted to insurrections and the smaller the amount devoted to production.

In conclusion, the ruler faces an optimization problem in which he has to trade off the recruitment and payment of soldiers on one hand, and the decrease of production income for both himself and the peasants on the other hand. When taxes get too high, peasants will also be incentivised to devote more time to the insurrection. This means that in equilibrium, this all involves a division of labour between production, soldiering and insurrection, which leads to an expected distribution of income between the peasants and the ruling class and a certain probability of a successful insurrection. The values for all these variables depend on the two technologies of insurrection.

4.6 Discussion

The model presented by Grossman results in an equilibrium in which the ruling class has to balance a need for safety in the form of soldiers on the one hand and wanting to retain a large percentage of its income and keeping the populace happy on the other hand. He will choose an optimal value of his policy instruments in order to

achieve this, while also taking into account the exogenous variables, such as the technologies of insurrection θ and σ . An important difference to the model by Acemoglu and Robinson (2001) is that recessions or fiscal volatility will worsen the position of the ruling class in this model, as their disposable income will increase and they will have less money available for soldiers. This will force them to raise taxes, which will anger the populace and reduce the rulers' income. This is, in my opinion, a more realistic depiction of what would happen to the position of a ruler during a recession. Another important difference is that the costs and benefits of the revolution fall only to insurrectionists and not to other citizens. Which means that Grossman (1991) sees an insurrection as a sort of robbery from which only a select group of citizens profit. This contrasts with the view of Acemoglu and Robinson (2001), where successful revolutionaries are Robin Hood figures that redistribute capital from the elite to the masses. A few other aspects of the model will now be discussed.

The analysis of the high probability of an insurrection that high values of σ and θ , the parameters for technology, provide, shows a weakness in the analysis. According to Grossman, these high odds are improbable, because a political system with such high odds of an insurrection is impossible to maintain. In my opinion, however, the problem here is not the high probability of a revolution, but the absence of a real change in the situation after a revolution. If the system would change apart from a redistribution of capital, then it would be possible to argue that after an insurrection the odds of another one would go down and the political system would become more stable. Another option would be to argue that since capital is redistributed, inequality decreases. With this reduced inequality there are less gains from a revolution. This all shows a fundamental weakness in using a one-shot model.

Another major deficiency in the article is that the two variables for the technology of insurrection are inadequately explained. The idea that the state of technology has a major influence on the possibility of an insurrection is an interesting one, but as it is

the two parameters θ and σ are not described very well. In the model, these two terms primarily influence the relationship between the time devoted to insurrection I and soldiering S on the one hand and the odds of a successful revolution on the other hand:

$$B = I^{1-\theta} / (S^\sigma + I^{1-\theta}) \quad (4)$$

With B being the odds of a successful revolution. A higher θ means that time devoted to insurrection becomes more effective and has a higher effect on B , while σ has the opposite effect on soldiering. However, what is truly missing is a sense of intuition as to what θ and σ represent in real-life terms. The only hint Grossman gives as to what these two could mean is 'qualitative human characteristics, geography and the quality and quantity of armaments' (Grossman, 1991, p915). One would imagine that θ is related to the ability of a populace to organise itself, so for instance it could be represented by the percentage of the populace that has access to the internet. σ Makes it harder for the soldiers to defend the ruling class, so it could for instance represent access to foreign arms dealers. Perhaps Grossman has made it purposefully vague in order to make it more widely applicable, but as it stands it is hard to imagine what is exactly meant with these parameters.

5. 'Rationalizing Revolutionary Ideology' (Roemer, 1985)

5.1 General remarks

This section will discuss the paper 'Rationalizing Revolutionary Ideology'. It is related to the papers by Acemoglu and Robinson (2001) and Grossman (1991) by the fact that it also models social conflict and a possible revolution. It differs from these other models in that it introduces two leaders that compete with each other for control of the state, while in those two other papers it is two groups that vie for power.

The paper investigates the dynamics of a revolution. It is, however, not concerned with the masses or different classes in the society, it mainly looks at revolution as a game played between two 'entrepreneurs', which it calls Lenin and the Tsar. By using the term 'entrepreneurs' the author stresses that they are utility maximizing players that seek to win a game, in this case either starting or stopping a revolution. The authors want to learn what kind of strategies would be optimal for these two players

The author uses a game-theoretical approach to answer the question what kind of strategies Lenin and the Tsar will employ. Revolution here is treated as a redistribution problem, as Lenin proposes an income distribution that is different to the one the of the Tsar's regime. Lenin wants to achieve his goal of ascending to power by recruiting a large amount of people and overthrowing the current regime, the Tsar can counter this by issuing penalties to supporters of Lenin. Both of these sides are seen as non-ideological, as they employ the strategies that are most likely to achieve their goals, which are a revolution or the prevention of one.

5. 2 The model

There is a current regime that is defined as an income distribution $\zeta = (z_1, \dots, z_n)$ in which n is the total finite population. Coalitions, which Lenin wants to recruit, are denoted as S, T , etc. He wants to overthrow ζ and replace it with his own distribution of income. His strategy is proposing an income distribution which will cause a coalition to join him. All feasible strategies are denoted by Ω :

$$\Omega = \{ \eta = (y_1, \dots, y_n) \mid \sum y_i = \sum z_i, y_i \geq 0 \} \quad (1)$$

Where η is the division of income, y_1 to y_n is the new income under this regime, and the second part is added to ensure that all citizens always get some income. The

Tsar wants to defend the status quo, his strategy is proposing different penalties for his citizens:

$$\delta = (d_1 \dots d_n), 0 \leq d_i \leq z_i \quad (2)$$

Where δ is the spread of the penalties, d_1 to d_n are the individual penalties on the citizens and penalties can never be higher than the current income of the citizen, z_i . Thus, for the whole population the penalty space is between 0 and ζ .

For each coalition S and each spread of penalties there is a probability $P_S \delta$ that it will overthrow the Tsar. The conditional probability of a revolution can be seen as:

$$P_S \delta = 2^N D(0,1) \quad (3)$$

Where 2^N is the power set of N , so it contains all possible sets of citizens. This means that whether or not a revolution can be undertaken depends on the penalty set of the Tsar.

A few assumptions are given that are necessary for the model, which are referred to later on in the analysis:

- 'Coalitional Monotonicity' (CM), as it is called in the paper, which means that when S is a subset of T , the odds of a successful revolution of T are at least as large as that of S . This is because larger coalitions have greater odds at succeeding.
- 'Penalty Monotonicity' (PM), as Roemer has named it, is added in order for the Tsar to face some trade-off when he raises penalties, so while the penalties do decrease the willingness to fight of a single person, it will increase the probability of success for a coalition.
- 'Lean and Hungry.' (LH) This term means that poorer coalitions will likely fight harder, because they hate the regime more.

- 'Symmetry' (S), as it is called in the paper, is the probability of a coalition's success depends only on its size.

The definition of when a coalition is formable against current income distribution γ at penalties δ :

$$\forall i \in S \quad P_S(\delta) y_i + 1 - (P_S(\delta))(z_i - d_i) > z_i \quad (4)$$

Which means that for all i which is a subset of S , the average of the expected income under Lenin's rule ($P_S(\delta) y_i$) and the expected income under the Tsar's rule when he has participated in the failed revolution $1 - (P_S(\delta))(z_i - d_i)$ is larger than the expected income under the Tsar's rule z_i . A coalition is formable when this is true for each of its members.

Throughout his paper, Roemer makes use of lemma's as stepping stones that need to be proven in order to advance his theories. A lemma **(2.1)** is proposed that, assuming coalitional monotonicity, that there is a unique coalition that can be formed at each given penalty scheme δ and income distribution η . This large coalition is denoted by $S^{n\delta}$. This lemma is proven by showing two η -formable coalitions at δ , S and T . η -formable means formable in a certain income distribution η . For all of the agents in both S and T , inequality (4) has to be true. This means that this is also true for union $S \cup T$. This means that $S \cup T$ is η -formable at δ . This means that the union of all η -formable coalitions is η -formable and is the biggest coalition that can be formed at δ . From this follows that:

$$\mu(\eta, \delta) = P_{S^{n\delta}}(\delta)$$

Which means that the maximum chance of a revolution occurring μ , which is a function of Lenin's income distribution η and the Tsar's penalties δ , is equal to the chance of the biggest coalition that can be formed. Lenin want to maximize μ , the Tsar wants to minimize it. As said earlier, Lenin does this by choosing the optimal

income distribution, the Tsar by using penalties. Thus the eventual solution will consist of a pair of μ and η and a revolutionary coalition $S^{\eta\delta}$. Now we have a 2-person zero sum game with payoff to Lenin of $\mu(\eta, \delta)$. The Tsar, knowing that Lenin will react this way will choose the penalty scheme to minimize this probability:

$$\text{Min}_{D} \text{Max}_{\Omega} \mu(\eta, \delta) = \mu^*(\zeta) \quad (2.0)$$

Because there will be no minimax solution to the game when the players move simultaneously, Roemer decides to let the Tsar move first, so Lenin reacts to his penalties.

It is then necessary to explain when a coalition S is formable. This is the case when Lenin can promise every member in the coalition a higher expected income than is expected under the tsar's rule. This means that people that are outside a coalition most likely will not be rooting for Lenin, as he needs to promise to hand out a lot of money to people inside of coalitions in order for them to rally behind him. This leaves little for the rest of the population.

5.3 The existence of a solution

A lemma is proposed that gives the necessary and sufficient condition for an $\eta \in \Omega$, so a part of the income distribution proposed by Lenin, to form an S . The Tsar's income distribution ζ , penalty scheme δ and coalition S are held constant. The necessary and sufficient condition for S to be η -formable is:

$$P_S(\delta) > d_S / (d_S + (n - z_S)), \quad (3.1)$$

$$d^S = \sum_{i \in S} d^i \quad z^S = \sum_{i \in S} z^i$$

Which means that the probability of success $P_s(\delta)$ has to be greater than a combination of total penalties d^s and current income of members z^s . In order to prove this, η has to be determined. The income y_i' which renders members of S indifferent to fighting can be taken from equation (4) and is:

$$P_s(\delta)y_i' + 1 - (P_s(\delta))(z_i - d_i) = z_i \quad (3.2)$$

Or, when rewritten:

$$y_i' = (1 - P_s/P_s)d_i + z_i \quad (3.3)$$

Which says that a person is indifferent to fighting when the income under Lenin's regime equals the possibility $(1 - P_s/P_s)$ of Lenin failing, times the penalty the Tsar will impose on him d_i plus his income under the Tsar z_i . This means that Lenin can organise S at δ when he can give everyone in the coalition slightly more than y_i' . Formalized this is when:

$$\sum_{i \in S} ((1/B)/d_i + z_i) < n \quad (3.5)$$

The variable n here is the total income agents in the state. Recall that n was earlier defined as the total populace, but because average income is 1, it is also the total income. Where B is the odds of success of S at δ , which can be derived as being:

$$B = B_s(\delta) = (P(\delta))/(1 - P(\delta)) \quad (3.4)$$

(3.5) can be rearranged as the lemma (3.1), which proves it. Using the odds function (3.4), (3.1) can be rewritten as:

$$(P_s/1 - P_s) > (d_s/n - z_s) \quad (3.6')$$

This makes (3.1) a bit clearer. With a chance of P_S , the coalition S will take control and will increase its income by $n - z_S$, z_S being its current income. With a chance of $1 - P_S$, it will lose and pay ds . Only when a revolution is profitable will a coalition be formable. Roemer then adds the theorem, of which proof is given in appendix 2.1:

Theorem 3.1: A solution (μ^*, δ^*) to the minimax problem of the Tsar exists, along with an associated revolutionary coalition $S^* = S^{\mu^* \delta^*}$

With it being proven that there is a solution to the optimization problem of the Tsar, can now we given by program T A δ is chosen to minimize $B_S^*(\delta)$ subject to three constraints:

$$\begin{aligned} -B_S^*(\delta) &> (ds^*/n - z_S^*) && \text{Program \{T\}} \\ -B_S(\delta) &\leq (ds/n - z_S) && \forall S \subseteq N \text{ such that } B_S(\delta) > B_S^*(\delta) \\ -0 &\leq \delta \leq \zeta \end{aligned}$$

The first is added to ensure that S^* is formable at δ and the second assumption assures that there is no coalition formable with greater odds than S , which makes S^* MPF at δ for the Tsar. The third constraint was postulated earlier, it simply says that punishments must be between 0 and the income of the citizens. At the optimal solution there will most likely be several coalitions for which the second constraint is binding. When the tsar increases the penalties further, these coalitions suddenly become formable because their z_S has decreased too much. Roemer calls them 'critical coalitions', and they block the Tsar from endlessly increasing penalties.

5.4 Tyranny of the Tsar

Roemer assumes penalty monotonicity (PM) here, which was explained earlier. It is defined that a Tsar is tyrannical if his optimal penalties δ^* equal income ζ . Normally the Tsar would be able to raise penalties up to income ζ with no real trade-off, but with penalty monotonicity the coalitions get a higher chance of succeeding with

higher penalties. If the probability functions of the revolution are completely insensitive to δ , however, the regime will always have a tyrannical solution. In this section Roemer shows that when the probability functions are very slightly sensitive to δ , the optimal solution for the Tsar will not be tyrannical. It is defined that a solution is sensitive when at the optimal (S^*, δ^*) , the derivative of the odds of the revolution succeeding $B_{S^*}(\delta)$ is larger than 0. The assumption URA is then added that there is a unique richest agent in ζ , the income distribution of the Tsar, as well as previously explained assumptions LH and PM. A new lemma is added:

Lemma 4.2: If the solution is sensitive and $d^{*i} > 0$, then i is a member of some critical coalition.

Here d^{*i} is a part of the penalty schedule δ . Critical coalitions were previously explained as being coalitions for which the second constraint in program T is binding. To prove this lemma, reduce d^{*i} very slightly, leaving the other penalties the same. The new penalty scheme is δ' . Because the solution is sensitive, so increasing penalties has a positive effect on the odds of a revolution, $B_{S^*}(\delta') < B_{S^*}(\delta^*)$. Because δ^* is optimal, the second constraint of program T is violated by δ' . Some critical coalition S' becomes formable at δ' . However, the only way it becomes formable is when i is an element of S' , because $B_{S^*}(\delta') \leq B_{S^*}(\delta^*)$. Only when i is a part of coalition S' can that coalition not be bound by constraint 1 in programme T. This means Lemma 4.2 has been proven. The next lemma is given as:

Lemma 4.3: Let $i \in S'$, S' is a critical coalition, and $(d^{*j}, z_j) \leq (d^{*i}, z_i)$, then $j \in S'$.

This means that if a richer citizen i is part of a critical coalition, poorer agent j is also. To prove this, if j is not a part of S' , form $\tilde{S}' = (S' \setminus \{i\}) \cup \{j\}$, which is S' without i but with j . The odds of this coalition to succeed must be higher, because of LH. However the inequality in the lemma implies that the gains minus the losses from a revolution $((d^{*s}) / (n - z^s))$ must be lower than the critical coalition \tilde{S}' . This means the penalties δ

must be higher and the odds of succeeding is greater for S^{\sim} than for critical coalition S' , which violates the second assumption. This means j must be a part of S' , because otherwise it would be able to join another coalition, whose odds of winning would be greater than the current optimum.

Finally the proof of the theorem that the Tsar is not tyrannical with a sensitive solution: When i is the URA and the optimal penalty δ^* is ζ , the income of the citizens. This means that his penalty $d^{*i} > 0$, since his income must also be larger than 0. Lemma 4.2 has proven that there is a critical coalition containing i . However, lemma 4.3 has proven that a poorer agent j must also be part of that critical coalition. Because i is the richest agent, everyone must be a part of that critical coalition. However, critical coalitions are proper sub-coalitions of N , so $\delta = \zeta$ must be impossible. This means that the Tsar cannot be tyrannical when the odds of a revolution are sensitive to δ .

5.5 The progressiveness of Lenin

In the following section, Roemer wants to investigate when Lenin is progressive, that is in what situation will he redistribute from the rich to the poor. An income distribution as proposed by Lenin is progressive when there is an income level z where:

$$z_i \geq z \Rightarrow y_i \leq z_i$$

$$z_i \leq z \Rightarrow y_i \geq z_i$$

So when a person's income z_i under the Tsar's regime is higher than z , it follows that it will be lower in Lenin's regime, with the reverse being true for a value lower than z . It is defined that:

A coalition is δ -formable when there is a progressive redistribution η for which S is η -formable. A new lemma (5.1) is proposed, which is the necessary and sufficient condition for a coalition to be δ -formable at δ :

Lemma (5.1): $Bs(\delta) > d^s / (n - (z^s + z^{s^0}))$

Where $Bs(\delta)$ are the odds of a revolution to be successful, d^s the penalty of the Tsar, n the money that can be redistributed by Lenin, z^s is the income in the Tsar's regime and S^0 can be defined as:

$$\{i \in S \mid z_i \leq \max_{j \in S} z_j\}$$

So an i which is part of S , given that its income is smaller than that of agent j . The proof for Lemma (5.1) is given in appendix 2.2.

Roemer then defines a coalition S as being poor-connected when it contains all agent whose income is below some given income. **Theorem 5.2:** If a revolutionary coalition is poor connected, Lenin can choose an optimal strategy that is progressive. This is because lemma (3.1) and (5.1), the conditions for the optimal coalition and a progressive coalition, are the same, as there is no S^0 .

This means that in order to answer the question when Lenin can be progressive and still optimal, one has to answer the question when a coalition will be poor-connected. Roemer first studies it in the case of an insensitive regime, so one in which the Tsar is tyrannical. In order to do this the assumption Discrete Income (DI) is added, which states that no two agents have the same income in ζ , the Tsar's income regime. Penalties are defined to be monotonic when a higher income during the Tsar's regime z_i leads to higher penalties d_i .

Lemma 5.3: If DI and LH are assumed, when optimal penalties δ^* are monotonic, there is a revolutionary coalition S^* that is poor-connected.

If i is the richest agent in S^* and S^* is not poor-connected, so there is a j that is not part of S^* with lower income than i . Because of monotonicity:

$$(d_j, z_j) < (d_i, z_i) \quad (5.4)$$

Just like with the previous section, S^{\sim} is formed which is coalition S^* without i but with j . Because of LH the odds of coalition S^{\sim} must be larger than or equal to the odds of coalition S^* . Because of (5.4):

$$(d^{\sim} / (n - z^{\sim})) < (d^{S^*} / (n - z^{S^*}))$$

Which means that the gains from the revolution are larger relative to the losses in the case of S^{\sim} , which means that it is formable. If the odds of S^{\sim} are then larger than that of S^* , there is a contradiction, because S^* is supposed to be the largest formable coalition or MPF. That means that the odds of S^* have to be equal to the odds of S^{\sim} . This means that lemma 5.3 is proven, as there is an optimal revolutionary coalition that is poor-connected. In the previous section, Roemer has shown that monotonic penalties are not optimal in sensitive regimes. However, in insensitive regimes the Tsar will raise penalties as high as income, which makes them monotonic. This means that in a tyrannical and insensitive regime, Lenin has an optimal strategy that is progressive.

In the last part of this section Roemer compares two tyrannical regimes which have the same population N and probability functions P_s . The only difference is in the inequality of the two countries: the income distribution ζ_1 of one country is more unequal than that of another country ζ_2 .

Theorem 5.5: ζ_1 is at least as unstable as ζ_2 $\mu^*(\zeta_1) \geq \mu^*(\zeta_2)$

Where μ is the optimal chance of a successful revolution for the Tsar, which is the lowest possible percentage. It follows from lemma (5.3) that a poor-connected coalition can be formed in both of these tyrannical regimes. Because of the Lorenz curve assumption the income of the poor-connected coalition is higher in country 2.

Because the regime of the Tsar is insensitive, this means the penalties are higher in country 2 as well. Roemer shows that this makes it possible for a sub-optimal coalition to be formed in country 1 that has the same odds of victory as the optimal coalition in country 2. This means that the odds of victory of the optimal coalition of a more unequal country are larger. This means more unequal countries are more unstable.

5.6 Sensitive regimes

Roemer now returns to situations where the regime is sensitive to changes in penalties δ , so the odds of a coalition succeeding do change when penalties change. People become less happy as the penalties increase and will fight harder. A penalty severity function is added to this, to reflect people's perception of how agent i is penalized. It is denoted by $\sigma(di, zi)$. If i 's σ is larger than that of j , people will be more incensed by an increase in the penalty of i . This function can show, for instance, that the general populace will become angrier when a person that has already been punished a lot gets punished even more. This is formalized in the assumption of Relative Severity (RS), which states that there is a differentiable function $\sigma(d, z)$ where d lies somewhere between 0 and z . The first derivative is larger than 0, while the second one is smaller than 0. This means it is a parabolic function and it is defined to reach its maximum at the same spot as maximum penalties, where $d=z$. If the σ of i is larger than that of j , the chance of a coalition with i succeeding is higher than one with j . This is basically a different way to model the trade-off the Tsar faces when issuing penalties, the other way being Penalty Monotonicity (PM), which was explained earlier.

Lemma 6.1: When i and j are two agents with $\sigma(dj, zj) > \sigma(di, zi)$ at the optimal penalties. Then there is a critical coalition S which 'separates' i and j with $j \in S$ and i not a part of S .

The proof for this is given in appendix 2.3. This leads to theorem 6.2:

Theorem 6.2: If $\sigma(d_j, z_j) > \sigma(d_i, z_i)$, $z_i > z_j$

Suppose $z_j > z_i$, then the first order behavior, which is positive, of σ implies that $d_j > d_i$. This means $(d_i, z_i) \leq (d_j, z_j)$. According to lemma 4.3 every critical coalition that contains j contains i . This is because it is easier to 'buy' i into a coalition. Lemma 6.1 is a direct contradiction to this. This means $z_i > z_j$, which proves theorem 6.2. What this means is that it is optimal for the Tsar to let the poor suffer more from the penalties he issues than the rich.

5.7 The coalition in the general case

In this section Roemer discusses whether Lenin will still choose a progressive income distribution when the Tsar is not tyrannical. Symmetry (S) is assumed, so the odds of a revolution succeeding B_S depend only on the size of coalition S for any penalty scheme δ . When δ is the optimal penalty scheme and S^* the revolutionary coalition that follows from this, Lenin must offer agent i that is a part of S^* more than:

$$\tilde{y} = z_i + (1/b_S)d_i \quad (7.1)$$

Where \tilde{y} is income distribution of Lenin where i does not care whether he joins the revolution or not, which Roemer calls the reservation income, z_i is the income distribution of the Tsar and d_i is the penalty i receives. This equation is basically a reformulated version of (3.3). A figure is used to explain that any agent can be represented as a pair of (d_i, z_i) above the 45 degree line, because d can never be higher than z . The agent k has the highest reservation income of all agents in the coalition S^* . All the other agents in the coalition must be below line CB , because of the symmetry assumption. Because only the size of the coalition has an effect on its odds, it is optimal for Lenin to recruit people with the lowest reservation income, in other words with the lowest d and z . (See equation 7.1). In this figure, every person that is both above line OA and below line CB is in the coalition.

Roemer then advances the theory that there are three income classes, of which the poor are surely in the coalition, the rich certainly not and the middle class is undecided. These three income classes are mathematically:

$$I1 = \{i | z_i \leq P_s * z_k + (1 - P_s)dk\} \quad \text{(Theorem 7.1)}$$

$$I2 = \{i | P_s * z_k + (1 - P_s)dk < z_i \leq z_k + (1/B_s)dk\}$$

$$I3 = \{i | z_i > z_k + (1/B_s)dk\}$$

Where $I1$ is the lowest income class and $I3$ is the highest. z_i is the income in the Tsar's regime, P_s the chance of a successful revolution occurring, B_s the odds of a successful revolution occurring, k an agent of maximum reservation income in coalition S^* and dk the penalty agent k has to pay. The proof is given in appendix 2.4.

If P_s is sufficiently high, $I2$ will be close to empty. This means that the coalition will probably be poor-connected. This means that highly probable revolutions are very likely to have a progressive coalition that is optimal. He makes this argument precise in corollary 7.2:

Corollary 7.2: Assume S and DI . For any regime ζ there is a number $q(\zeta)$ that when $P_s > q(\zeta)$, S^* is poor-connected and progressive. We can choose $q(\zeta) = z_{\max} / (z_{\max} + \Delta)$ where $z_{\max} = \max z_i$ and $\Delta = \min |z_i - z_j|$. This means $q(\zeta)$ is independent of functions $\{P_s\}$.

The proof for this is given in appendix 2.5

Theorem 7.3: Assume RS , PM and S . Then all agents in I_i suffer identical severity of penalties.

Where PM and S are explained in the beginning and RS is relative severity, or the assumption that people get angered more when certain people are punished in comparison to others. Proof : if $i, j \in I_1$ but they do not suffer the same penalties, and $z_i > z_j$. Because of theorem 6.2, $\sigma(d_i, z_i) < \sigma(d_j, z_j)$, where σ is the relative severity of the penalty. By lemma 6.1 there is a critical coalition that has j but not i . In figure 1 j must lie somewhere directly below i . This critical coalition must then be smaller than the maximally formable coalition S . By symmetry (S) this means that it is also less likely to win a revolution, which is impossible. This means that i and j must suffer the same penalty severity. This proves theorem 7.3.

Theorem 7.4: Suppose I_1 is not empty. Then S^* is poor-connected and all members of S^* suffer the same penalty severity σ .

Proof: Let S^* be poor-connected and i the poorest agent in S^* whose penalty severity is less than the maximum penalty severity in S^* . i must be in I_2 because of theorem 2, because otherwise he would be equally penalized. There is a critical coalition of which j is a part but i is not because of lemma 6.1. i has a higher income than j . This means that his penalty must be more severe, in order to get the same relative penalty severity. However, this contradicts theorem 6.2, which states that income and the severity of penalties are inversely related. This means S^* must be income connected, which makes the penalties also the same for everyone in the coalition. This proves theorem 7.4.

This chapter proves that, when assuming Symmetry (S), the citizens can be divided into different income groups, of which the poor groups are more likely to join Lenin. Moreover, Lenin's optimal strategy is more likely to be progressive when the regime is unstable and that people of the poorest class are treated identically and most severely, which makes them more angry and allows Lenin to create a progressive coalition.

5.8 Results

In section 5.3 Roemer finds that there is a solution to the sequential game when the Tsar moves first. In section 5.4 he examines the Tsar and finds that he is tyrannical when the probability of revolutions is insensitive to penalties. In section 5.5 it is concluded that Lenin is certainly progressive when the Tsar is tyrannical and that under symmetry the instability of regimes increases with inequality. In section 5.6 Roemer concludes that the Tsar is incentivised to punish the poor more harshly relative to the rich. Finally, in section 5.7 he concludes that agents can be divided into different income groups and that under the symmetry assumption Lenin will recruit the poorer agents. Moreover, the members of the poorest class are punished most severely and equally by the Tsar, which will make them even more likely to join Lenin.

5.9 Discussion

In this model Lenin and the Tsar play a game for control of the state. Roemer wants to demonstrate that certain qualities that might seem ideological, such as Lenin's progressiveness and the Tsar's tyranny or severity to the poor, can actually be logically deduced to be rational decisions that are made in order to win the game. Lenin is progressive, for instance, because the poor can be recruited for the smallest cost in his model. However, in order to prove this, he relies on large assumptions. The assumption of Symmetry (S) is required in order to prove that Lenin will recruit poor agents. This assumption says that the odds of a revolution succeeding only relies on how large the revolutionary coalition is. However, it seems more realistic to say that some agents do have a larger effect on the odds of a revolution than others do. Having a large industrialist on your side, for instance, is a lot more helpful than one poor factory worker, as he can supply you with capital. In this section we will discuss some other aspects that stand out from the model.

A definition that Roemer gives in section (4) of his paper is that a strategy for the Tsar is tyrannical when optimal penalties δ^* are equal to income ζ . At first sight, this is a rather strange definition of tyranny.. A tyranny would normally be defined as a

state that is under cruel or oppressive rule by a tyrant or perhaps a military regime. Roemer, however, sees it as a state in which the ruler faces no trade-off when punishing his citizens and will choose to punish them as severely as possible. This is a very extreme version of tyranny, which is true in very few countries if it is ever true at all. It implies that the ruler can take away every last breadcrumb away from its citizens and still face no increase in opposition from them. An example that springs to mind is North-Korea, where the general population regularly faces famine, yet outwardly never seems to lose faith in the regime. However, according to Roemer's definition an average military junta will not be truly tyrannical, as it will most likely not deal with a populace that will never fight back.

In this model, Lenin is also implicitly assumed to be unconstrained by unconstrained by any opposition except for the Tsar and his penalties. Recall:

$$\sum_{i \in S} ((1/B)/d_i + z_i) < n \quad (3.5)$$

Which implies that Lenin can form his coalition when he can promise each member a part of total income n that is greater than the expected costs they face from a revolution $(1/B)/d_i + z_i$. However, this assumes that Lenin can promise all of the country's income n to the revolutionary coalition, without any real consequences. It would be more realistic to say that when Lenin proposes an income distribution that gives too much to his revolutionary coalition, the resistance to him by the general populace increases. This could perhaps be represented as a function for Lenin similar to the one the Tsar has in his penalty monotonicity (PM), where the odds of a successful revolution would decrease as the income distribution would become more skewed towards his revolutionary coalition.

It is also said in the introduction that the free-rider problem, which arises from the fact that people can profit from a revolution without helping to start it, is ignored with this model. Lenin will propose an income distribution which makes certain agents better off, even when factoring in penalties. These agents will join him in the

revolutionary coalition. However, there is no real reason for the agent to join the revolutionary coalition, as he will still profit from the redistribution of income when it is successful. Roemer argues that it is Lenin's charisma that convinces people to join him, by assuring them that they will be better off when they will participate. He argues that Lenin could also change the income distribution ex-post to make sure only the agents that joined him will profit. This is similar to the way in which Grossman (1991) models insurrections in that there will only be gains for active revolutionaries. Roemer, however, thinks this is not realistic and thinks the free-rider problem is best modelled as being overcome by some force of charisma.

Roemer (1985) also proposes the same relation between inequality and volatility of the regime as Acemoglu and Robinson (2001). According to Roemer, who investigates this relationship in section (5), in two tyrannical regimes the one with higher inequality is more unstable. This is because citizens of states with higher inequality have a lower reservation income, so they are more quickly have something to gain from joining Lenin. In the model of Acemoglu and Robinson (2001), inequality increases the volatility of regimes by widening the gap between the optimal tax rates of the poor and the rich. This improves the possible gains from either a revolution or a coup. Hence, both of these papers basically propose the same mechanism in this situation.

6. Analysis

6.1. The free-rider problem

This section will discuss the free-rider problem that is inherent to revolutions and how it is dealt with by Acemoglu and Robinson (2001) and to a smaller degree by the two papers by Grossman (1991) and Roemer (1985). Whether or not a model of a

revolution deals with the free-rider problem depends on how it factors in public and private costs and benefits. This section will first examine how the paper by Acemoglu and Robinson (2001) discusses the free rider problem, followed by the papers by Grossman (1991) and Roemer (1985). The section ends by returning to the first of these papers and discussing what improvements could be made to the model.

I argue that the free-rider problem is one that is strongly related to the problem of organising revolutions and coups. Often the potential wealth gains from a revolution are public, for instance an increase in the tax rate of the rich which improves the situation of the poor. When he receives the potential rent irrespective of his actions, why would a poor agent take such a large risk as participating in an insurrection, especially when the negative consequences could be prison or expropriation of his capital?

In the paper by Acemoglu and Robinson (2001), the free-rider problem is largely avoided. The poor do all reap the benefits of a successful revolution, which is an expropriation of the capital of the rich or a change in the tax rate in the case of democratization. Logically, this would point to a potential free-rider problem. However, there are only public costs associated with a revolution and no private ones. Only the income of either total economy or a very large group of people is partially destroyed by a revolution, so when the expected gains from a revolution are higher than the status quo, the poor agent has no reason to refrain from joining the revolution. This is because his decision to join has no influence on the potential costs that he faces. When enough poor agents participate in the revolution in order for it to succeed, the other poor agents can choose to not-participate. However, there is no real reason for him to do so, as again there are no private costs associated with participating. The same is true for the rich during a democracy, as the only costs he faces is a destruction of a part of the capital of the rich. This means that there is no free-rider problem, but is that a realistic outcome?

The assumption that the gains from a revolution are public is one that can be reasonably defended. The new government is one that is likely composed of the

poorer part of the society and it is logical that they would increase the redistribution of capital. From this all of the poorer masses would benefit. However, what happens to the capital of the small group of elite that ruled the country is harder to predict. It is perfectly reasonable to assume that it will go to a select group of revolutionaries. However, in other situations it can also be defended that it will most likely be divided amongst the masses. In the most realistic situation, the answer probably lies somewhere in the middle. Revolutionaries will come through on their promise to redistribute capital, but the leaders of the revolution will probably profit a bit more, for instance by funneling capital to offshore accounts. However, the public redistribution of capital can be argued to be by far the larger effect of the two. So while other options likely exist, modelling public gains from a revolution is not completely without a foundation. On the other hand, assuming that there are no private costs to a revolution seems like an unrealistic situation. Revolutions are costly and dangerous things to participate in. At the very least, participating in a revolution should lead to the loss of some private income, as some time is spent on revolutions that could be spent on production. Moreover, insurgent behavior could also lead to imprisonment, which should be modelled as even more costly. The fact that Acemoglu and Robinson (2001) choose to completely ignore the private costs to a revolution is in my view something that is lacking in their analysis. In the following section we will examine how Grossman (1991) and Roemer (1985) deal with the costs and returns from a revolution.

In Grossman's (1991) paper there are both private returns and private costs. Here only active insurgents benefit from a successful insurrection. They take a part of the ruling class' capital and divide it amongst the families that spent time helping the insurrection. The costs are also private, as an agent sacrifices time he could also have spent on production or soldiering for the ruling class, which would have provided him with income. Because of the fact that both costs and returns are modelled as being private, there is no free-rider problem. However, this is with the assumption that there are no public gains of the revolution, which implies that these are very predatory revolutionaries. There is no room for ideology in the model of Grossman (1991), as the insurrectionists are only in it for private gain. Of course this

is true for some real-life insurrections, however one could argue that most revolutionaries want to permanently change something in their country. They see something wrong in the way the current regime rules and want to do something about it. This kind of revolution can not be fully captured by a model that assumes that there are only private gains.

Roemer (1985), in his model, assumes that there are mostly public gains from a revolution, as the distribution of income is altered in comparison to the one in the Tsar's regime. Lenin proposes a change in this distribution of income and will choose it so that certain agents will have a higher expected income when the revolution succeeds than when it does not. He will then expect these agents to join his revolutionary coalition. However, there is nothing in the model that stops the agents from observing the proposed redistribution of income in which they profit and choosing not to join the coalition. This is because Lenin has no way of excluding agents from the proposed income redistribution ex-post. This causes a free-rider problem, which Roemer addresses by adding that it is Lenin's inherent skill to convince people to join his coalition, because when everyone does they will all be better off. He makes it explicit in the paper that he thinks that modelling only private gains to a revolution would also solve this free-rider problem, but that it is unrealistic. The costs of a revolution are purely private here, as agents face penalties from the Tsar if they choose to join Lenin. This seems like a realistic way of modelling the private costs of a revolution, as it is logical that a dictator or tyrant would retaliate against individuals that want to overthrow him. There are no public costs associated with the revolution, which means that agents assume that there will be no real changes in the economy of the country after the revolution. Agent i bases his decision of joining the revolution on:

$$y_i' = (1 - P_s/P_s) d_i + z_i \quad (3.3)$$

Where y_i' is the reservation income of agent i , P_s is the probability of the revolution succeeding, d_i is the penalty imposed by the Tsar and z_i is their income in the Tsar's regime. There is no term for the possible public destruction of capital or income due

to the revolution. This is something Acemoglu and Robinson (2001) do very differently, as the poor and the rich assume that their income and capital, respectively, will decrease after a revolution or coup. Both can be defended as being realistic. In the case of the model by Roemer (1985), it depends on whether agents that are part of the coalition still believe that he can make them better off, even when he has less income to distribute after the revolution. If you argue that Lenin can make them believe this, there is no real reason to model public costs to the revolution. This is because they will then join his coalition regardless of damage done to the economy by the revolution.

With this information, how can the model by Acemoglu and Robinson (2001) be improved? As we have seen, the free-rider problem was avoided by not incorporating any private costs or private benefits for undertaking a revolution. However, this can be argued to be an unrealistic assumption. The model basically gives reasons for the rich and the poor classes to undertake a coup or a revolution, but gives no real reasons why an individual would join such an undertaking. It is implicitly assumed that when one of these large groups of citizens would benefit from a revolution or coup, they will immediately be able to organize one. The model could be extended by adding a private cost to participating in a revolution. This could either be modelled as a penalty from the current ruler like in model by Roemer (1985) or by adding other activities as an opportunity cost, as Grossman (1991) does. This would create a free-rider problem in the model, as there is now a reason to refrain from helping a revolution, while there are still public benefits. There would need to be a way to overcome this free-rider problem, because otherwise the revolution would never occur. One option would be to allow the revolutionaries to exclude outsiders from at least a part of the gains of a revolution. Roemer (1985) calls this unrealistic, probably because in his model the gains from a revolution are mostly a change in the tax rate. It is difficult to make exceptions in the tax rate for individuals. In models where the gains from a successful revolution are for a large part the expropriation of capital, such as in Acemoglu and Robinson (2001) and Grossman (1991), this is a much more realistic addition. The individual agent would have to weigh the penalties or opportunity costs he faces against the capital he receives when he joins the

revolution. Another option to overcome the free-rider problem would be to model some form of class-consciousness. Roemer (1985) argues that when penalties against a certain group in society become too high, the social cohesion of this group increases. This class-consciousness could be modelled as a rewards function that can offset the losses from joining the revolutionaries

In this section we have seen that Acemoglu and Robinson (2001) choose to ignore the prisoner's dilemma of revolutions by only modelling public costs and public benefits. This means that the model only shows why groups of people would undertake a revolution or coup, and not why individuals would join. The fact that individuals face no private costs in joining a revolution is an unrealistic assumption. When they do face private costs but still receive public benefits, there is a prisoner's dilemma. In order to overcome this problem, agents would need to receive some private benefit from a revolution, which can be tangible or intangible.

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6.2 The effects of the revolution

In their paper, Acemoglu and Robinson (2001) consider a revolution to be a constant threat to the ruling class which can force it to increase the degree of democracy in a country. In a revolution, capital is redistributed from the ruling class to the lower masses. When this event becomes too likely to occur, the ruling class will implement more democracy to appease the masses. In the model it is actually impossible for a revolution to occur, as the ruling class will always prefer switching to a democracy. This, however, leaves out an important part of the analysis: what happens to a country after a revolution occurs?

Grossman's (1991) model sees a successful insurrection as a redistribution from capital from the rich to the insurrectionists. It is a one-shot game in which peasant families can choose to devote time to helping with an insurrection, which, if it is successful, will give them a part of the capital of the ruling class. This means that the effects of the revolution are purely economical and will only benefit active

insurrectionists. Grossman (1991) models a successful revolution as a robbery that enriches the robbers and impoverishes the ruling class.

Roemer (1985) models a successful revolution as a permanent redistribution of income. Lenin can implement the plans that he promised to his revolutionaries, which are purely economical in the model. The revolution here does have lasting effects, as the distribution of income is permanently changed. Moreover, the effects are public, as a person does not have to be a member of the revolutionary coalition in order to profit from the new distribution of income. Nothing is said, however, about the political implications of a successful coup. The outcome seems to be that there is another dictator in place that distributes income in a different way.

To sum up, these models see a revolution as either a momentary or temporary redistribution of income. The type of government, however, remains the same or is not discussed. But is this really a realistic depiction? As said earlier, there have been multiple revolutions in the past that have led to a (temporary) democratization of a country, such as the overthrow of Milosevic in Yugoslavia and the People Power Revolution in the Philippines. Moreover, a revolution could also lead to a state of anarchy, in which agents can seize and defend resources without regulation from above (Hirshleifer, 1995).

I argue that it would make more sense for the model of Acemoglu and Robinson (2001) to have a successful revolution modelled the way it is done by Roemer (1985), with a more formal redistribution of income, instead of a permanent expropriation. It would be even better to have several types of possible revolutions, with some resulting in a democratization, while others just end in a redistribution of income. Others still could lead to a state of anarchy.

7. Conclusion

This paper has discussed and compared three separate papers. The main paper used was 'A theory of political transitions' by Acemoglu and Robinson (2001), with

the other ones being written by Grossman (1991) and Roemer (1985). This thesis started out with a review of the existing economics literature on democratization and revolutions. After this the three main papers were discussed. Finally they were compared and contrasted, with an emphasis on how revolutions were modelled.

The main conclusion is that the free-rider problem in revolutions can be expanded on in the model by Acemoglu and Robinson (2001). It was shown that the free rider problem is ignored in their model by making both the costs and benefits of a revolution public. Because of this, the model only answers the question why large groups in society would start a revolution. The question of why an individual agent would join such an undertaking is largely ignored. This paper has demonstrated how it is possible to add private costs in the model, referring to the papers by Roemer (1985) and Grossman (1991). This then creates a free-rider problem in the model, which has to be overcome by giving the agent some form of private gain from joining the revolution.

Another central issue discussed is that of what happens after the revolution. Acemoglu and Robinson (2001) assume that a revolution is a redistribution of income from the ruling class to the lower masses through expropriation. Roemer (1985) and Grossman (1991) also model a successful revolution as some form of redistribution of income. This paper asserted that this might be too narrow of a view, as revolutions have led to democratization or anarchy in the past.

Future research could focus on finding some way to find model the mechanisms of why groups in society would start a revolution and of why individuals would join such a group, instead of free-riding on their success. These are both important questions, but as of now they are often answered in separate papers. Only with the answers on both questions can it be explained why revolutions succeed or why they do not.

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Appendix 1

The possible Kuhn-Tucker conditions are given as:

$$(\delta M/\delta L) = (\delta M/\delta S) = (\delta M/\delta I) \quad 6a$$

With $(L, S, I) > (0, 0, 0)$

And $L+S+I=1$

$$(\delta M/\delta L) \leq (\delta M/\delta S) = (\delta M/\delta I) \quad 6b$$

With $L=0$, $(S,I) > (0,0)$

And $S+I=1$

$$(\delta M/\delta I) \leq (\delta M/\delta L) = (\delta M/\delta S) \quad 6c$$

With $(I)=0$, $(L,S) > (0,0)$

And $L+S=1$

$$(\delta M/\delta S) \leq (\delta M/\delta L) = (\delta M/\delta I) \quad 6d$$

With $S=0$, $(L,I) > (0,0)$

And $L+I=1$

$$(\delta M/\delta S) \leq (\delta M/\delta L) \geq (\delta M/\delta I) \quad 6e$$

With $I=S=0$ and $L=1$

$$(\delta M/\delta L) \leq (\delta M/\delta I) \geq (\delta M/\delta S) \quad 6f$$

With $L=S=0$ and $I=1$

$$(\delta M/\delta L) \leq (\delta M/\delta S) \geq (\delta M/\delta I) \quad 6g$$

With $L=I=0$ and $S=1$

These are the seven combinations of I , L and S that are possible. However, since the ruling class would never let L be reduced to 0, since that means that their expected income is also 0. This means that 6b, 6f and 6g are unrealistic and are thus ruled out. 6e can be ruled out because if peasants would devote all their time to production, their expected income from an insurrection would be higher, so it would be advantageous for them to switch. Finally, 6d is unrealistic because when peasants devote positive time to mounting an insurrection, the ruling class will hire soldiers to defend themselves. This means that only 6a and 6c are relevant options and are the situations that are used in the calculations that follow.

Appendix 2.1

$S^* = S^{\mu\delta^*}$ means that the coalition will be the maximally formable coalition (MPF), which means that it has larger odds of victory than any other coalition that can be formed at that penalty scheme. To prove theorem 3.1, Roemer first lists the subset of D for each S :

$$D(S) = \{ \delta \in D \mid S \text{ is MPF at } \delta \}$$

Which means that the penalty δ scheme is a part of D if S is the maximally formable coalition at δ . When the Tsar announces δ , Lenin responds by assembling the coalition that is MPF at δ . After this the Tsar announces a penalty schedule that minimizes the odds of victory of this coalition. Now suppose that the odds of victory are not minimized at $\delta \in D$. There has to be a coalition S^* such that:

$$(\forall (S, \delta) \text{ with } \delta \in D(S)) (\exists \delta' \in D(S^*)) (B_{S^*}(\delta') < B_S(\delta)) \quad (3.8)$$

Because there are a finite number of coalitions. Which means that for all combinations of (S, δ) with δ being an element of $D(S)$, there exists a penalty scheme and coalition there exists an odds of success $B_{S^*}(\delta')$ that is more optimal for the Tsar, because the odds of success are lower. The Tsar then chooses $\delta \in D(S^*)$ to minimize $B_{S^*}(\delta)$. If there is a B^* which is the minimum of $B_{S^*}(\delta)$, in D there is $\delta^* \in D$ such that B^* is achieved. There is a coalition T that is MPF at δ^* . T is formable for δ if it is close to δ^* and thus also for $\delta \in D(S^*)$. This means:

$$B_T(\delta^*) \leq B^* \quad (3.9)$$

Since otherwise when there is a δ which is a part of the penalty scheme of the optimal coalition, there is a T formable whose odds of succeeding are higher than the optimal coalition. However, (3.9) contradicts (3.8), because B^* is the minimum of B_{S^*} over $D(S^*)$, so there can be no $\delta' \in D(S^*)$ which makes $B_S(\delta') < B_T(\delta^*)$. Which

means that there is some minimum that can be found by the Tsar when a coalition is chosen, which proves theorem 3.1.

Appendix 2.2

S is *-formable only when there is enough money to pay each member y where $y > \tilde{y}$ and

$$\tilde{y} = (1/B_S)d^i + z^i \quad (5.1)$$

Which is the same as equation (3.3) and \tilde{y} is the income that is promised by Lenin where the members of the coalition are indifferent to fighting. Moreover, to be *-formable the coalition also has to pay y_i each poor member $i \in S^0$ where y_i has to be higher than the income they receive in the Tsar's regime. This is because otherwise the redistribution would not be progressive. Putting these two requirements together, we can say that S is *-formable when:

$$\sum_{i \in S} ((1/B_S)d_i + z_i) + \sum_{i \in S^0} z_i < n \quad (5.3)$$

Which means that for all agents i that are part of S equation (5.1) must be true, plus there must be enough money n to make sure every poor agent i gets more than he would have gotten in the Tsar's regime z_i . This equation can be rewritten to lemma 5.1, which proves that lemma.

Appendix 2.3

Because $\sigma(d_j, z_j) > \sigma(d_i, z_i)$, it is possible to infer that $d_i < z_i$ and $d_j > 0$ from the previous assumptions. d_i and d_j can be moved to $d_i + \varepsilon$ and $d_j - \varepsilon$, with ε being a

certain value. For a sufficiently small ε , the formability of existing coalitions remains and their odds fall according to RS. Since Bs^* , the optimal odds of a revolution, have decreased, a critical coalition has to become formable. It can only become formable when $(ds/(n - zs))$ has decreased, but this only happens when the critical coalition contains j but not i , because the penalties of i have increased. This proves lemma 6.1.

Appendix 2.4

from figure 1 you can conclude that $z_i \leq z'$ because i lies somewhere in ΔOBC . z' must be $ps * zk + (1 - Ps)dk$ because BC is the line $z + (1/Bs *)d = yk$ and OA is the line $z=d$. Now $I1$ is defined. Any person with an income greater than intercept C is surely not in the triangle and must not be in the coalition. The value of this point is $zk + (1/b_s)dk$. This defines $I3$. The area between the two previous ones is $I2$, here it is not certain whether a person is in the coalition. This proves theorem 7.1.

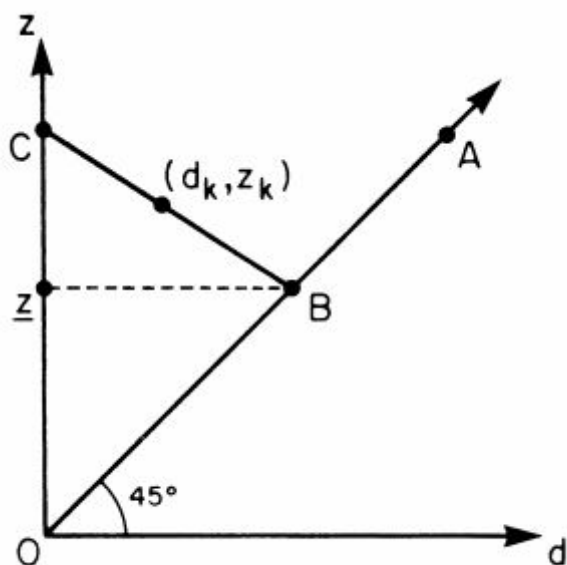


FIGURE 1

Appendix 2.5

Proof assume DI, so no two agents have the same income. This means $\Delta > 0$. The interval of incomes characterizing I2 is, for convenience, (Ps^*yk', yk') , which has the length $(1-Ps)yk'$. When

$$(1-Ps^*)yk' < \Delta \quad (7.2)$$

Where yk' is the reservation income of an agent. Then I2 contains at most one member, because $q(\zeta)$ becomes very small, which makes Ps larger than it. In this case S^* is poor-connected. Rewritten, inequality (7.2) is true when:

$$Ps^* > 1 - (\Delta/yk') \quad (7.3)$$

The reservation income depends on Ps , Roemer eliminates this by observing that:

$$yk' = zk + (1/Bs^*)dk \leq zk(1 + 1/Bs) < zmax/Ps^* \quad (7.4)$$

Where the second term is the definition for the reservation income that was discussed in a previous section, which must be smaller or equal to itself times dk , because dk can not be higher than 1. This term again must be lower than $zmax/Ps$, because Ps is the inverse of Bs and $zmax$ is higher than zk by necessity. From this it follows that:

$$ps^* > 1 - (ps^* \Delta)/zmax \quad (7.5)$$

For S^* to be poor-connected. Solving this gives us corollary (7.2). This result means that in more volatile regimes, where Ps is higher, $Ps > q(\zeta)$ will most likely hold and Lenin is more likely to choose for a progressive revolutionary strategy.