Social Unrest and the timing of revolution

Carmen Camacho, Waleed Hassan

PARIS SCHOOL OF ECONOMICS
ECOLE D'ECONOMIE DE PARIS

WORKING PAPER N° 2021 – 58

Social Unrest and the timing of revolution

Carmen Camacho
Waleed Hassan

JEL Codes: D74, H56, P16.
Keywords: Social unrest; Revolution dynamics; Optimal switching time.

Funded by a French government subsidy managed by the ANR under the framework of the Investissements d'avenir programme reference ANR-17-EURE-001

Social Unrest and the timing of revolution

Carmen Camacho
Paris School of Economics and CNRS (France)[*]

Waleed Hassan
Université Paris 1 Panthéon-Sorbonne[†]

October 10, 2021

Abstract

We study here whether a social movement can turn into a successful revolution, and the optimal timing for a revolution from the deprived workers perspective. To do so, the dynamics of social unrest is defined as a function of the amount of deprived workers, their organizational skills, wage inequalities, and retaliation. Then, taking the evolution of social unrest into account, we obtain the optimal time for a revolution. If unrest increases with time, then a revolution always arises independently of the initial state and the characteristics of the economy. Furthermore, whenever the gains are high enough, then a revolution arises immediately. Worth to note, even if social unrest decreases with time, a revolution arises if the initial mass of discontent is sizeable or retaliation hard.

Keywords: Social unrest; Revolution dynamics; Optimal switching time.
Journal of Economic Literature: D74, H56, P16.

1 Introduction

It took Mao Zedong thirty years for a successful revolution, while Egypt and Tunisian revolutions were able to topple the regimes within months. Some revolutions are peaceful (People Power revolution in Philippines and Velvet Revolution of Czechoslovakia) whereas others produce civil war (Libya and Syria). Some revolutions manage to get foreign support (Arab Spring and Rose revolution), whereas others fail to do so (Myanmar's 2021 protests). Some have produced democracies (Iran), whereas others have produced dictatorships. Some revolutions were suppressed by governments (Tiananmen Square), whereas others manage to overthrow strong regimes (Egypt and Mexico revolutions).

[*]Corresponding author. Paris School of Economics, 48 Boulevard Jourdan, 75014 Paris, France; e-mail: carmen.camacho@psemail.eu.

[†]e-mail: Waleed.Hassan@etu.univ-paris1.fr.

People experience grievance and consider revolting when they suffer from systematic inequality, lack of political rights, relative poverty, social injustice, poor working and living conditions, or other exclusions.[1][2] However, although a revolution may improve the deprived lives, the decision of revolt is risky since dissidents may fail to mobilize sufficiently large and efficient groups, or face violence from the regime. This paper develops a simple model to study the reasons underpinning social unrest and the optimal timing of a revolution.

Although all revolutions share their grievance origin, they differ in magnitude, length, results and consequences. Let us mention some of the earliest movements like the Athenian revolution in 508-507 BC, which established democracy in Athens; the Vietnamese revolution led by the Trung sisters in 40-43 AD against Chinese domination, or the uprising of Husayn against Umayyad caliph Yazid I in Iraq in 680AD. Closer in time, we find the American revolution in 1775-1783, the French Revolution in 1789-1799, the Haitian revolution in 1791-1804, which led by slaves established the first black republic in the modern era, or the Indian rebellion against British East India Company in 1857. Important revolutions also empted in the XXth century like the Russian revolution in 1905-1917, the Chinese revolution in 1949 and the fall of Communism in Eastern Europe after 1989.

Following Skocpol and Theda (1979), we define a revolution as a social movement of dissident individuals, which successfully modifies the productive structure, and consequently the social structure. Regarding the reasons causing social unrest, we consider income inequality as the main cause behind a revolution.

Regarding the literature on social conflict, let us first put forward some general equilibrium works. In Grossman (1991), (1994) and (1995) population consists of peasants and landlords. Peasant families allocate their time between production, soldering and rebellion. Peasant's income depends on the probability of a successful revolution, and the interaction between peasants and landlords generates an equilibrium allocation of labor time. Dal Bo and Dal Bo(2011) introduce an appropriation sector in a general equilibrium model. This appropriation sector, which is the source of appropriation activities and social conflict, makes all agents of the economy worse off. They analyse how different factors such as shocks to term of trade, technology, and endowments affect the intensity of social conflict. Lichbach (1987)'s and Moore (2000)'s modeling of social conflict also use producer theory to analyze the interaction between the dissidents and the government. Like them, we also consider in the present paper that some workers, that we denote mass workers, are exploited. In our setting, even though all workers

[1]Grievance-based theories of revolution consider perceived grievance as the main cause of social unrest and rebellion. See for instance among many relevant references Davies (1962), Gurr (1968), Muller and Seligson (1987), Schock (1996), Klandermans (1997), Buechler (2004), Gurr (2015) and Boucekkine et al. (2019).

[2]Inequalities on the basis of political, economic, and social differences, are also underlined as reasons behind conflict and civil wars as in Stewart (2011) and Cederman (2011).

have similar skills and abilities, there is a wage gap among elite and mass workers, which is here the main cause of revolution.

There is also a vast literature which uses game theory to explain the complex phenomenon of social movements and revolutions. For a successful revolution, the dissidents must coordinate and organise themselves. People would rise up against the regime if they believe that movement will succeed. They want to join the protests if they believe that other people would also join. The social movement is more likely to turn into a revolution, if sufficiently many people take this collective action against the government. [3] Moreover, information has also been introduced in revolution game theoretical models. Indeed, information plays an important role in social movements and conflicts since it helps rebels to coordinate, organise and communicate effectively. In reaction to it, the regime can control this flow of information by imprisoning the revolutionary leaders,spreading the false propaganda against the movement, or banning the media outlets [4].

Taking a slightly different approach, conflict has also been treated as an evolutionary game, where the people involved in a social movement may change over time (see Ross, 2001, Arce and Sandler, 2003, and Olsson, 2012). Finally, let us mention a last branch of game theoretical models which use agent-based models and computational simulations to analyse conflicts and social movements (see Epstein, 2002, Bristow et al., 2013, or Lemos et al., 2014).

There are obviously other mathematical models of conflict and social movements, which are not game theoretical nor models in general equilibrium. For example, Lang and de Sterck (2014) develop a compartmental model for the dynamics of Arab revolution. Levy and Faria (2007) extend Ramsey's model to analyse the internal conflict among rival groups living in a same piece of a land. Worth to note, ours is also a Ramsey setup in which exploited workers maximize their lifetime utility. The novelty of our study is that workers calculate the optimal time of revolution, that is, they choose whether or not to trigger a revolution, and the optimal time to do so.

This paper proposes a simple model to describe the evolution of social unrest and how social unrest leads to a regime change at a specific date. In our economy, there are two types of workers, elites and mass workers. Although they work in the same factory, and they are perfect substitutes in production, mass workers' salary is just a fraction of the elites'. Taking into account that firm owners and governments may punish revolutioneers, we find that social unrest increases with time when mass workers are sufficiently well organized and when wage inequality is sufficiently large.

[3]See among many others Granovetter (1978), Kuran (1989), (1991), (1995), Llohmann (1993), (1994a), (1994b), (2000), Chwe (1999), and Tyson and Smith (2018).

[4]See for instance Egorov et al. (2009), de Mesquita (2010), Kricheli et al. (2011), Edmond (2013), Chen et al. (2016), Little (2016), Shadmehr et al. (2017) or Battaglini (2017)

Regarding the modeling of optimal timing, we are building on the seminal works of Tomiyama (1985), Tomiyama and Rossana (1989) and Makris (2001). This technique has traditionally been used in two stage optimal control problems to study optimal technology adoption when there is embodied technical change (Boucekkine et al., 2004) or when firms can shift from brown to green technologies (see Boucekkine et al., 2011, Acemoglu et al. 2016, among many others). Fortunate enough, our problem reduces to a static problem, so that although we keep the spirit of the optimal switching time, our problem is much simpler from a technical point of view. We find that if discrimination against mass workers is hard enough so that social unrest increases with time, then a revolution does arise immediately if the perceived gains from a revolution are high. Otherwise, if gains are not high enough at time 0, then a revolution will still arise later on when social unrest becomes sufficiently high. Worth to notice, we also show that even if social unrest decreases with time, a revolution does arise if the perceived gains from the revolution are large enough, if retaliation is strong or if deprived workers are initially in large numbers.

This paper is structured as follows: Section 2 describes how social unrest evolves in time. Section 3 presents our economy, and the optimal time for a revolution is obtained and studied in Section 4. Finally, Section 5 presents our conclusions.

2 A simple dynamic description of social unrest

A revolution can be triggered by the stock of social unrest, that we denote by R. Social unrest is a function of some social and economic factors. First of all, social unrest is a function of M, the number of individuals out of the elite. Unrest also increases with the inequality in salaries between elites and mass workers, that we measure here by W.

Social unrest also depends on the downside of a revolution. Workers participating in a revolution may be punished. Indeed, a revolution depends on the strength of the regime, that we capture with a parameter ϕ. The more powerful the regime is, the stronger the punishment and the quieter will become mass workers.

Finally, the success of a revolution depends on its technology, that is, the effectiveness of strikes, clarity of purpose, and how organized the dissident group is against the regime. Hence, we are assuming here that R increases with the organization technology of the mass workers, B. Taking all these elements into account, we describe the evolution of social unrest by the following dynamic equation

$$\dot{R}(t) = M\left(BW - \phi\right) R(t). \tag{1}$$

According to (1), social unrest increases with the revolution technology and the wage gap between mass and elite workers. Solving (1), we obtain the evolution of R in time

$$R(t) = R_0 e^{M(BW-\phi)t}, \tag{2}$$

where R_0 is the initial stock of social unrest.[5] Obviously, if mass workers are sufficiently well organized, and if inequality in salaries is sufficiently high so as to overcome eventual punishments, i.e. if $BW - \phi > 0$, then social unrest will increase with time. It will decrease otherwise.

We consider that a revolution succeeds when it overthrows the existing regime, and that revolutions are stochastic processes, that is their outcome is a priori unknown. Here the probability that a revolution succeeds at a given time t will be a function of $R(t)$ as follows

$$P[R(t)] = 1 - \frac{1}{R(t)} = 1 - \frac{1}{R_0} e^{-M[B(1-\alpha)-\phi]t}. \tag{3}$$

Note that this probability density function has already been used in the context of civil violence in Epstein (2002) and Lemos (2014).

When the regime is strong and ϕ high, meaning that dissidents are heavily punished, then mass workers do not mobilize enough, $P(R)$ is low and revolution can hardly succeed. In this regard, note that indeed $P(R)$ tends to zero as ϕ increases.

3 The economy

At the beginning of our analysis, our economy suffers from inequality in the form of wage inequality. As a result, social unrest is generated and it can evolve with time. As we shall see, if some conditions are favorable, then a revolution will be triggered, and whatever the outcome, the economy will enter into a second phase. It is important to underline that the outcome of a revolution is a stochastic process, and that revolutioneers are uncertain about the final result. Still, if the expected gains from a revolution are high enough, then mass workers will attempt their coup.

At the initial date, our economy is made of two types of workers, elites L and mass workers M. There is one production sector where both types work, and we assume that M and L are perfect substitutes. Still, the wages of mass workers are less than the elite workers' by a factor $\alpha \in (0, 1)$. The two groups work the same number of hours and have the same set of skills; wage discrimination rests solely on the basis of class differences. Accordingly, we assume that production is described by the following function:

$$Y = A\left(\alpha M + L\right)^{\nu}, \tag{4}$$

[5] See Appendix A for all details.

where $A \in \mathbb{R}^+$ is a parameter measuring total factor productivity and $\nu \in (0, 1)$.

The firm maximizes profits at every time t by hiring the optimal amounts of workers M and L:

$$\max_{L,M} A\left(\alpha M + L\right)^{\nu} - w_L L - w_M M,$$

where w_L and w_M stand for the wages of the elite and the mass workers, respectively. Taking the first order conditions with respect to L and M we obtain that $w_M = A\alpha\nu\left[\alpha M + L\right]^{\nu-1}$ and $w_L = A\nu\left[\alpha M + L\right]^{\nu-1}$.

In order to focus on the mechanisms behind revolution, we assume that workers consume all their earnings at every period, that is, they do not save and do not make any intertemporal decision. Accordingly, consumption of mass and elite workers are $c_M = w_M$ and $c_L = w_L$, respectively.

Dividing c_M by c_L we have that

$$1 - \frac{w_M}{w_L} = 1 - \alpha, \tag{5}$$

where $1 - \alpha$ corresponds to W, the wage gap between the elite and the mass workers in equation (2).

Suppose that a revolution takes place at time T. If the revolution succeeds, then mass workers gain some additional power within the firm, that we represent by γ, with $\gamma > \alpha$. As a result, production after the revolution becomes

$$Y = A\left(\gamma M + L\right)^{\nu}.$$

Salaries obtain as in the first phase by maximizing the firm profits with respect to M and L, $w^s_M = A\nu\gamma\left(\gamma M + L\right)^{\nu-1}$ and $w^s_L = A\nu\left[\gamma M + L\right]^{\nu-1}$. The wage gap is reduced after a successful revolution since we have now that $1 - \frac{w^s_M}{w^s_L}1 - \gamma < 1 - \alpha$, and although the absolute power of the elites remain unchanged, they do lose some power in relative terms.

We say that a revolution fails if mass workers do not increase their power share after the coup. In this case, $Y = A\left(\beta M + L\right)^{\nu}$, with $\beta \leq \alpha < \gamma$. Obviously, if $\beta < \alpha$, then there is retaliation. Wages in case of failure are $w^f_M = A\nu\beta\left(\beta M + L\right)^{\nu-1}$, and $w^f_L = A\nu\left[\beta M + L\right]^{\nu-1}$.[6]

4 Optimal timing for revolution

In what follows we focus on mass workers since they will ultimately be the only responsible of a revolution. Taking into account the possibility of a revolution, mass workers maximize

[6] Appendix B presents an extension of this problem, where the mass workers' bargaining power is endogenous. In particular, we assume that their power is a function of R. Unfortunately, the problem does not have an analytical solution even using the simplest production functions.

their lifetime utility choosing whether and when to initiate a revolution, solving the following problem

$$\text{Max}_{\{T,c_M,c_M^s,c_M^f\}} \int_0^T u\left(c_M\right) e^{-\rho t} dt + P[R(T)] \int_T^\infty u\left(c_M^s\right) e^{-\rho t} dt + \left(1 - P[R(T)]\right) \int_T^\infty u(c_M^f) e^{-\rho t} dt. \tag{6}$$

c_M is the mass worker consumption before the revolution, and as such, $c_M = w_M = A\nu\alpha\left(\alpha M + L\right)^{\nu-1}$. After the revolution, c_M^s stands for the mass worker consumption if the revolution succeeds. Since all earnings are consumed also after the revolution, we have that $c_M^s = w_M^s = A\nu\gamma\left(\gamma M + L\right)^{\nu-1}$. Similarly, c_M^f is the mass worker consumption if the revolution fails, so that $c_M^f = w_M^f = A\nu\beta\left(\beta M + L\right)^{\nu-1}$, where $\beta \leq \alpha$, as already mentioned.

Since all three expressions for consumption are constant, we can write the household objective function (6) as

$$\frac{1}{\rho}\left(1 - e^{-\rho T}\right) u\left(c_M\right) + P[R(T)] u\left(c_M^s\right) \frac{e^{-\rho T}}{\rho} + \left(1 - P[R(T)]\right) u(c_M^f) \frac{e^{-\rho T}}{\rho}. \tag{7}$$

We can prove that the mass worker problem has a unique solution T:

Proposition 1. *Under the model assumptions, there exists an optimal time to trigger a revolution*

$$T = \frac{1}{M\left[B(1-\alpha) - \phi\right]} \ln\left(\frac{u(c_M^s) - u(c_M^f)}{u(c_M^s) - u(c_M)} \frac{\rho + M\left[B(1-\alpha) - \phi\right]}{\rho R_0}\right). \tag{8}$$

There are two cases depending on whether social unrest increases or decreases with time:

1) If social unrest is an increasing function of time, that is, if $M\left[B(1-\alpha) - \phi\right] > 0$, then a revolution arises in finite time if and only if

$$\frac{u(c_M^s) - u(c_M)}{u(c_M^s) - u(c_M^f)} < \frac{\rho + M\left[B(1-\alpha) - \phi\right]}{\rho R_0}, \tag{9}$$

where $u(c_M^s) - u(c_M)$ is the gain in utility from the revolution if it succeeds. If condition (9) does not hold, meaning that the perceived gains are sufficiently high, then revolution is triggered immediately, that is, $T = 0$.

2) If $M\left[B(1-\alpha) - \phi\right] < 0$ and social unrest decreases with time, then a revolution is triggered in finite time, i.e. $T > 0$ if and only if

$$\frac{u(c_M^s) - u(c_M)}{u(c_M^s) - u(c_M^f)} > \frac{\rho + M\left[B(1-\alpha) - \phi\right]}{\rho R_0}. \tag{10}$$

Proof. See Appendix C. □

The second point in Proposition 1 shows that even if social unrest is calming down with time, a revolution can still arise when the relative perceived gain from revolution is high enough. If not, all the odds linked to a revolution will win over the gains, and revolution will never arise. Note that the condition for revolution in (10) is easily verified when retaliation is harder and ϕ increases.

According to the following corollary, revolutions are postponed when there is no much to gain:

Corollary 1. *Let us assume $M\left[B(1-\alpha)-\phi\right]>0$ so that social unrest increases with time. The larger R_0, that is, the initial social unrest, the sooner the revolution arises. If $u(c_M^s)$ tends to $u(c_M)$, then T tends to infinite and revolution never takes place.*

Proof. The corollary can directly be proven taking partial derivatives of T with respect to R_0 first and then taking the limit when $u(c_M^s)$ tends to $u(c_M)$. □

Corollary 1 proves that even if unrest increases steadily in time, revolutions do not always occur. In particular, revolutions do not arise if they do not bring substantial gains.

5 Conclusion

In this paper, we have built a simple and yet comprehensive model to study the optimal timing of revolutions from the perspective of mass discriminated workers. In order to do so, we first build a dynamic law to describe the evolution of social unrest as a function of wage inequality, the rule of power, dissident organization techniques as well as the number of the mass workers. We prove that if wage inequality is large enough so that social unrest increases with time, then a revolution does arise immediately if the perceived gains from a revolution are high. Otherwise, if they are not high enough at time 0, then a revolution arises later on when social unrest becomes sufficiently high.

Worth to notice, we prove that even if social unrest decreases with time, a revolution can still arise if the perceived gains from the revolution are large enough, if retaliation is strong or if deprived workers are initially in large numbers.

References

Acemoglu, D., Akcigit, U., Hanley, D., and Kerr, W. (2016), "Transition to clean technology," *Journal of Political Economy*, 124(1), 52-104.

Arce M, D. G., and Sandler, T. (2003), "An evolutionary game approach to fundamentalis and conßict," *Journal of Institutional and Theoretical Economics, 132–154.*

Battaglini, M. (2017), "Public protests and policy making," *The Quarterly Journal of Economics*, 132 (1), 485–549.

Boucekkine, R., Saglam, C., and Vallee, T. (2004), "Technology adoption under embodiment: a two-stage optimal control approach," *Macroeconomic Dynamics*, 8(2), 250-271.

Boucekkine, R., Pommeret, A., and Prieur, F. (2013), "Technological vs. ecological switch and the environmental Kuznets Curve," *American Journal of Agricultural Economics*, 95(2), 252-260.

Boucekkine, R., Desbordes, R., and Melindi-Ghidi, P. (2019), "Social divisiveness and conflicts: Grievances matter!"

Bristow, M., Fang, L., and Hipel, K. W. (2013), "Agent-based modeling of competitive and cooperative behavior under conßict," *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, 44 (7), 834–850.

Buechler, S. M. (2004), "The strange career of strain and breakdown theories of collective action," *The Blackwell companion to social movements*, 47–66.

Cederman, L.-E., Weidmann, N. B., and Gleditsch, K. S. (2011), "Horizontal inequalities and ethnonationalist civil war: A global comparison," *American Political Science Review*, 478–495.

Chen, H., Lu, Y. K., and Suen, W. (2016), "The power of whispers: a theory of rumor, communication, and revolution," *International economic review*, 57 (1), 89–116.

Chwe, M. S.-Y. (1999), "Structure and strategy in collective action," *American journal of sociology*, 105 (1), 128–156.

Dal Bo, E., and Dal Bo, P. (2011), "Workers, warriors, and criminals: social conßict in general equilibrium," *Journal of the European Economic Association*, 9 (4), 646–677.

Davies, J. C. (1962), "Toward a theory of revolution," *American sociological review*, 5–19.

De Mesquita, E. B. (2010), "Regime change and revolutionary entrepreneurs," *American Political Science Review*, 104 (3), 446–466.

Edmond, C. (2013), "Information manipulation, coordination, and regime change," *Review of Economic studies*, 80 (4), 1422–1458.

Egorov, G., Guriev, S., and Sonin, K. (2009), "Why resource-poor dictators allow freer media: A theory and evidence from panel data," *American political science Review*, 103 (4), 645–668.

Epstein, J. M. (2002), "Modeling civil violence: An agent-based computational approach," *Proceedings of the National Academy of Sciences*, 99 (suppl 3), 7243–7250.?

Granovetter, M. (1978), "Threshold models of collective behavior," *American journal of sociology—, 83 (6), 1420–1443.*

Grossman, H. I. (1991), "A general equilibrium model of insurrections," *The American Economic Review*, 912–921.

Grossman, H. I. (1994), "Production, appropriation, and land reform," *The American Economic Review*, 84 (3), 705–712.

Grossman, H. I. (1995), "Robin hood and the redistribution of property income," *European Journal of Political Economy*, 11 (3), 399–410.

Gurr, T. (1968), "A causal model of civil strife: A comparative analysis using new indices," *The American Political Science Review*, 62 (4), 1104–1124.

Gurr, T. R. (2015), *Why men rebel*, Routledge.

Klandermans, P. G. (1997), *The social psychology of protest.*

Kricheli, R., Livne, Y., and Magaloni, B. (2011), "Taking to the streets: Theory and evidence on protests under authoritarianism," *Apsa 2010 annual meeting papers.*

Kuran, T. (1989), "Sparks and prairie res: A theory of unanticipated political revolution," *Public choice*, 61 (1), 41–74.

Kuran, T. (1991), "Now out of never: The element of surprise in the east european revolution of 1989," *World politics*, 44 (1), 7–48.

Kuran, T. (1995), "The inevitability of future revolutionary surprises," *American Journal of Sociology*, 100 (6), 1528–1551.

Lang, J. C. and De Sterck, H. (2014), "The arab spring: A simple compartmental model for the dynamics of a revolution," *Mathematical Social Sciences*, 69 , 12–21.

Lemos, C., Lopes, R. J. and Coelho, H. (2014), "An agent-based model of civil violence with imprisonment delay and legitimacy feedback," in 2014 second world conference on complex systems (wccs) (pp. 524–529).

Levy, A. and Faria, J. R. (2007), "Ramsey in dual-population lands: internal conßict and utility-maximizing consumption," *Defence and Peace Economics*, 18 (4), 339–352.

Lichbach, M. I. (1987), "Deterrence or escalation? the puzzle of aggregate studies of repression and dissent," *Journal of Conflict Resolution*, 31 (2), 266–297.

Little, A. T. (2016), "Communication technology and protest," *The Journal of Politics*, 78 (1), 152–166.?

Lohmann, S. (1993), "A signaling model of informative and manipulative political action," *American Political Science Review,* 87(2), 319–333.

Lohmann, S. (1994a), "The dynamics of informational cascades: The Monday demonstrations in Leipzig, East Germany, 1989–91," *World politics*, 47(1), 42–101.

Lohmann, S. (1994b), "Information aggregation through costly political action," *The American Economic Review*, 518–530.

Lohmann, S. (2000), "Collective action cascades: An informational rationale for the power in numbers," *Journal of Economic Surveys*, 14(5), 655–684.

Makris, M. (2001), "Necessary conditions for infinite horizon discounted two-stage optimal control problems", *Journal of Economic Dynamics and Control* 25, 19351950.

Moore, W. H. (2000), "The repression of dissent: A substitution model of government coercion," *Journal of conßict resolution*, 44(1), 107–127.

Muller, E. N. and Seligson, M. A. (1987), "Inequality and insurgency," *The American Political Science Review*, 425–451.

Olsson-Yaouzis, N. (2012), "An evolutionary dynamic of revolutions," *Public Choice*, 151(3), 497–515.

Ross, M. H. (2001), "Contributions of evolutionary thinking to theories of ethnic," *Evolutionary theory and ethnic conßict*, 71.

Schock, K. (1996), "A conjunctural model of political conßict: The impact of political opportunities on the relationship between economic inequality and violent political conßict," *Journal of Conßict resolution*, 40(1), 98–133.

Shadmehr, M. and Bernhardt, D. (2017), "When can citizen communication hinder successful revolution?", *Quarterly Journal of Political Science*, 12(3), 301-323.

Skocpol, T. and Theda, S. (1979), *States and social revolutions: A comparative analysis of France, Russia and China.* Cambridge University Press.

Stewart, F. (2011), "Horizontal inequalities as a cause of conflict: A review of crise ndings".

Tomiyama, K. (1985), "Two-stage optimal control problems and optimality conditions," *Journal of Economic Dynamics and Control* 9, 317337.

Tomiyama, K. and R. Rossana (1989), "Two-stage optimal control problems with an explicit switch point dependence: Optimality criteria and an example of delivery lags and investment," *Journal of Economic Dynamics and Control* 13, 319337.

Tyson, S. A. and Smith, A. (2018), "Dual-layered coordination and political instability: Repression, co-optation, and the role of information," *The Journal of Politics*, 80(1), 44–58.

Appendices

A Solving for R

Equation (1) can be rewritten as

$$\frac{\dot{R}(t)}{R(t)} = M[B(1-\alpha) - \phi].$$

Integrating both sides with respect to t

$$\int \frac{\dot{R}(t)}{R(t)} dt = \int M[B(1-\alpha) - \phi] dt,$$

we obtain that

$$\ln R(t) = M[B(1-\alpha) - \phi]t + c,$$

with $c \in \mathbb{R}$. Then, $R(t) = e^{M[B(1-\alpha)-\phi]t} e^c$. Since $R(0) = R_0$ is known, (2) obtains.

B Endogenous bargaining power of the mass workers

As an alternative to our assumption, we could have instead assumed that after the revolution, the mass workers bargaining power

$$Y = A\left(P[R(T)]M + L\right)^{\nu}.$$

In this case, the objective function of a mass worker is

$$\frac{1}{\rho}\left[1 - e^{-\rho T}\right] u\left(c_M\right) + P[R(T)]u\left(c_M^s\right)\frac{e^{-\rho T}}{\rho} + \left(1 - P[R(T)]\right)u(c_M^f)\frac{e^{-\rho T}}{\rho}, \tag{11}$$

where c_M and c_M^f are as in the main text, and c_M^s is now $c_M^s = A\nu P[R(T)]\left(P[R(T)]M + L\right)^{\nu-1}$.
Maximizing (11) is a hard problem. Assuming that both production and utility are linear functions, we have that $u(c_M) = A\alpha$, $u\left(c_M^s\right) = AR(T)$ and $u(c_M^f) = A\beta$. Let $x = M\left[B(1-\alpha) - \phi\right]$.
The first order condition of (11) with respect to T is

$$1 + \alpha + R_0 e^{xT}\left(\frac{x}{\rho} - 1\right) - \frac{\beta}{R_0}e^{-xT}\left(\frac{x}{\rho} + 1\right) = 0, \tag{12}$$

which cannot be solved analytically, although it can be proven that a solution exists.

C Proof of Proposition 1

Taking the first order condition of (7) with respect to T we obtain:

$$u(c_M)e^{-\rho T} + P'[R(T)]R'(T)u(c_M^s)\frac{e^{-\rho T}}{\rho} - P[R(T)]u(c_M^s)e^{-\rho T} = 0,$$

or

$$-P'[R(T)]R'(T)u(c_M^f)\frac{e^{-\rho t}}{\rho} - (1 - P[R(T)])u(c_M^f)e^{-\rho T} = 0.$$

Taking $e^{-\rho T}$ common, and re-arranging terms:

$$u(c_M) - u(c_M^f) - P[R(T)]\left[u(c_M^s) - u(c_M^f)\right] + \frac{1}{\rho}P'[R(T)]R'(T)\left[u(c_M^s) - u(c_M^f)\right] = 0.$$

Dividing both sides by $u(c_M^s) - u(c_M^f)$

$$P[R(T)] = \frac{1}{\rho}P'[R(T)]R'(T) + \frac{u(c_M) - u(c_M^f)}{u(c_M^s) - u(c_M^f)}.$$

Substituting $R(T)$, $P[R(T)]$ and $P'[R(T)]$ by their expressions, that is $R(T) = R_0 e^{M[B(1-\alpha)-\phi]T}$, $P[R(T)] = 1 - \frac{1}{R_0}e^{-M[B(1-\alpha)-\phi]T}$ and $P'[R(T)] = \frac{1}{R(T)^2} = \frac{1}{R_0^2}e^{-2M[B(1-\alpha)-\phi]T}$:

$$1 - \frac{1}{R_0}e^{-M[B(1-\alpha)-\phi]T} = \frac{1}{\rho}\frac{1}{R_0}e^{-M[B(1-\alpha)-\phi]T}M\left[B(1-\alpha) - \phi\right] + \frac{u(c_M) - u(c_M^f)}{u(c_M^s) - u(c_M^f)}$$

We can write

$$e^{-M[B(1-\alpha)-\phi]T} = R_0\frac{u(c_M^s) - u(c_M)}{u(c_M^s) - u(c_M^f)}\frac{\rho}{\rho + M\left[B(1-\alpha) - \phi\right]},$$

so that

$$e^{M[B(1-\alpha)-\phi]T} = \frac{u(c_M^s) - u(c_M^f)}{u(c_M^s) - u(c_M)} \frac{\rho + M\left[B(1-\alpha) - \phi\right]}{\rho R_0},$$

and

$$T = \frac{1}{M\left[B(1-\alpha) - \phi\right]} \ln\left(\frac{u(c_M^s) - u(c_M^f)}{u(c_M^s) - u(c_M)} \frac{\rho + M\left[B(1-\alpha) - \phi\right]}{\rho R_0} \right).$$

Then the two cases arise:

1. If $M\left[B(1-\alpha) - \phi\right] > 0$, then T is a positive number if and only if

$$\frac{u(c_M^s) - u(c_M^f)}{u(c_M^s) - u(c_M)} \frac{\rho + M\left[B(1-\alpha) - \phi\right]}{\rho R_0} > 1,$$

   or equivalently, if and only if

$$\frac{\rho + M\left[B(1-\alpha) - \phi\right]}{\rho R_0} > \frac{u(c_M^s) - u(c_M)}{u(c_M^s) - u(c_M^f)},$$

   If $\frac{u(c_M^s)-u(c_M)}{u(c_M^s)-u(c_M^f)} > 1$, then $T = 0$.

2. If $M\left[B(1-\alpha) - \phi\right] < 0$, then revolution can still arise if the logarithm is negative, which arises if and only if

$$\frac{u(c_M^s) - u(c_M^f)}{u(c_M^s) - u(c_M)} \frac{\rho + M\left[B(1-\alpha) - \phi\right]}{\rho R_0} < 1.$$