The Defanging Effect of Education and Autocratic Survival

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Abstract

The modernisation theory of regime change is often perceived to be a murky paradigm, lacking theoretical or empirical foundations. In response, we clarify the links between education and regime change. More specifically, we propose that education contributes indirectly to the collapse of autocratic regimes because educated people engage in non-violent (civil) resistance that reduces the effectiveness of the security apparatus. We empirically test the validity of this 'defanging effect' of education. We indeed find that the combination of high autocracy and high education levels tends to trigger non-violent campaigns, which in turn increases the likelihood of a regime change, often associated with political liberalisation and, to a lesser degree, democratisation.

Keywords: autocracy, civil resistance, democratisation, education, modernisation, regime change.

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1

1 Introduction

Still democracy appears to be safer and less liable to revolution than oligarchy. For in oligarchies there is the double danger of the oligarchs falling out among themselves and also with the people (Aristotle, *Politics*, book V.).

Although Aristotle wrote these words thousands of years ago, they still encapsulate the basic challenges that an authoritarian regime faces: power-sharing with other elites and control of the masses (Svolik, 2012). Theories of regime changes reflect these two forms of conflict (Bunce, 2000). The transition approach argues that regime changes are mainly driven by divisions within the authoritarian regime and focuses therefore on strategic elite interactions which are believed to be much more shaped by unpredicted shocks than long-term factors (O'Donnell and Schmitter, 1986; Albertus and Menaldo, 2018; Geddes et al., 2018). In contrast to this 'from above' perspective, the structuralist approach puts forward that pre-conditions in the form of large-scale social changes matter and can play an important 'from below' role in explaining regime change (Carothers, 2002; Doorenspleet, 2004). Lipset (1959) famously articulates a modernisation paradigm in which economic development and educational attainment support democratic transitions by empowering the masses and facilitating a convergence of political and economic preferences between the people and the elites. These insights have been formally conceptualised, among others by Bourguignon and Verdier (2000), Boix (2003), Acemoglu and Robinson (2006), or Boucekkine et al. (2019). In these theoretical models, in presence of (possibly human capital-driven) economic growth and low economic inequality (possibly driven down by economic development), elites give up incurring the costs of repressing mass demands for democracy, initiate a democratic transition, and accept some income redistribution because it is simply in their net economic interests to do so. Empirically, both approaches are frequently combined and find some support to various degrees (Teorell, 2010; Treisman, 2015), although some disagreements remain, notably about the direct influence of 'modernisation'. For example, while Przeworski et al. (2000), Acemoglu et al. (2008), Teorell (2010), or Geddes et al. (2018) fail to find a link between democratisation and income or education, the opposite is true for Glaeser et al. (2007), Boix (2011), Murtin and Wacziarg (2014), Sanborn and Thyne (2014) or Alemán and Kim (2015).[1]

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[1]There is a wider consensus about the contribution of education to the stability of democratic regimes (Teorell, 2010).

Fritzsche and Vogler (2020) provide a methodological survey of the modernisation theory litera-ture and conclude that differences in results can be explained by 'design flexibility' in terms of conceptual definitions and econometric modelling, both partly resulting from not enough atten-tion paid to identifying proper causal mechanisms. Overall, to further contribute to this debate, a more sophisticated 'conditional version' of modernisation theory ought to be adopted in which clear channels of influence replace a 'black box' relationship (Rueschemeyer et al., 1992; Treis-man, 2020). In this paper, we specifically propose to clarify the links between education and regime change. Lipset (1959) single out education as one of the close-to-necessary condition for democracy and this statement is supported by substantial empirical 'reduced-form' analysis, such as Murtin and Wacziarg (2014).

While previous research has theoretically and empirically examined the notion that education fosters political engagement, enabling citizens to collectively take critical action against dictatorial regimes (e.g. Glaeser et al., 2007; Campante and Chor, 2012a), recent research has delved into how education influences a regime's control strategies. Notably, Guriev and Treisman (2019, 2022) argue that the nature of dictatorships has changed precisely because higher education levels has made crude repression methods less effective. This shift has compelled contemporary dictators to adapt by embracing more sophisticated forms of "informational" repression. A central issue in this literature is the paradox of autocracy coexisting with high levels of education. If autocrats know that educated citizens will mount resistance at the expense of the state, then they will be less inclined to invest in it. Testa (2018), Alesina et al. (2021), Paglayan (2021) have explored these motivations. However, a satisfactory modernisation theory, linking education with regime change, ought to consider that educated people are likely to be motivated to demand substantial political reforms, to possess the capacities to mobilise a large number of participants, and to adopt the strategy of non-violence, which is often an effective form of resistance in repressive regimes. Our paper integrates these elements to the literature, both conceptually and empirically.

We argue that more education makes the autocrat richer but may also threaten the auto-cratic regime by facilitating 'civil' (non-violent) resistance. Moreover, education, when channeled through non-violence, has the ability to 'defang' a repressive regime. We formally develop this idea in an illustrative theoretical model, which can be found in the Appendix, but the intuition can be easily conveyed. Authoritarian leaders face a conundrum when deciding how much to invest in education (Lindert, 2004; Sanborn and Thyne, 2014). On the one hand, more educated workers

tend to be more productive, contributing thus to economic development and larger appropriable income (Galor and Moav, 2006).[2] On the other hand, and this is our key argument, educated people have the abilities to translate any dissatisfaction with authoritarianism in modes of contestation difficult to repress, therefore undermining the efficacy of repression and increasing substantially the vulnerability of the autocratic regimes. In contrast to standard theories of political contestations putting forward education as a key determinant of coordination or monitoring costs (e.g. Glaeser et al., 2007, Eicher et al., 2009), we consider, in line with the civil resistance literature, that education has a 'defanging effect' as it decreases the efficacy of autocratic repression.[3] In our simple illustrative model, regime change then occurs because the autocrat fails to take into account that high education levels can generate the organisational abilities required to oppose and defeat the security apparatus. We also discuss the implications of full internalisation of this mechanism by the autocrat. In this case, he would choose a lower educational attainment to neutralise the threat of popular mobilisation.[4] However, the historical record suggests that authoritarian leaders have considered that the benefits associated with higher education have outweighed its drawbacks. Recent empirical works fail to find robust evidence that autocracies invest less in education than democracy (Murtin and Wacziarg, 2014; Dahlum and Knutsen, 2017; Aghion et al., 2019).

We conduct an empirical exploration of the mechanisms highlighted above in a sample of 161 countries over the period 1950-2019, using fixed effects panel models. We first show that the combination of high autocratic levels and high education levels increases the probability of a non-violent campaign (NVC) but has no effect on the occurrence of a violent campaign. We then demonstrate that a non-violent campaign increases the probability of a regime change and, most important, this is the key channel through which education operates. Among the different regime breakdowns triggered by a NVC, popular uprising and elite-led political liberalisation are not only the most likely but also those the most associated with a democratic transition. These results are robust to different measures of autocracies, and education (or autocracy) does not appear to be a proxy for other modernisation indicators such as income per capita. Our findings thus support and enrich our intuitions: there is an incompatibility between education and autocracy which manifests

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[2]Widespread education can also help to create a common national identity and be seen by the population as fulfilling a 'social contract' between them and their leader (Boli et al., 1985; Kosack, 2014; Aghion et al., 2019; Alesina et al., 2021; Palma and Reis, 2021).

[3]Of course, in doing so, we do not mean to deny that education may lower coordination costs but we insist on this alternative mechanism.

[4]Such a forward-looking behaviour has been described as the fear of political creative destruction by Acemoglu and Robinson (2012).

itself in the form of NVCs, which are more successful than violent campaigns to achieve regime change and the adoption of a more liberal political regime.

Our work makes several contributions. It is directly related to the modernisation literature. In contrast to seminal studies (Przeworski et al., 2000; Acemoglu et al., 2008) but in line with recent research (Murtin and Wacziarg, 2014; Treisman, 2020), we confirm a link between economic development, in the specific form of widespread education, and democracy. However, we make clear the mechanisms underlying this positive relationship and we consider other regime transitions than democratisation. We notably highlight how education, in presence of high autocratic levels, can increase the probability of civil resistance. This is a novel cross-country result. While Dahlum and Wig (2019) finds that the frequency of anti-governments protests increases with local levels of education in African countries, Chenoweth and Ulfelder (2017) conclude, in a larger sample of countries, that NVCs cannot be explained by structural conditions such as education. Furthermore, we provide robust evidence that NVCs are more likely than violent campaigns to induce regime change. Like Celestino and Gleditsch (2013), we achieve a stronger counterfactual investigation by considering campaign and non-campaign cases, but in addition, we control for a full range of time and country fixed effects.[5] The fact that we find that NVCs induce elite-led political liberalisations is fully compatible with the integrative economic approach of Boix (2003) Acemoglu and Robinson (2006), in the sense that change 'from above' can be triggered by pressures 'from below'. Nevertheless, our results also make clear that not all regime changes happen peacefully, under the guidance of the elites, since NVCs can also lead to popular uprisings.[6] The political events which have shaken the Arab world in the last decade immediately comes to mind. While there is now a quite abundant literature on this topic (see chapter 4 of Grinin et al., 2018 for a survey), findings from our paper suggests that the Arab spring events may ultimately be rooted in the contradiction between education and autocratic regimes.[7] Campante and Chor (2012b) and Campante and Chor (2014) have also identified education as a determinant of those events but argue that it is the lack

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[5]Dahlum (2019) also highlights that non-violent protest movements are more likely to involve educated people and to achieve their goals. However, there are key differences with our paper such as i) no consideration of the interaction between education and autocracy in triggering NVCs; ii) weak counterfactuals as the sample is restricted to a cross-section of 203 campaign events (1900-2006) and no country/region-time fixed effects are included; iii) no distinction between different types of regime breakdowns/transitions; iv) no formal theoretical model.

[6]Acemoglu and Robinson (2006) write that "[...] *to limit the scope of our analysis, we normally restrict our attention to situations where the creation of democracy avoids revolution. Historically, this seems to have been typical, and it means that we do not delve deeply into theories of revolution or into the modeling of post-revolutionary societies*" (p.27). However, it must be acknowledged that they briefly address the case of a revolutionary event.

[7]Devarajan and Ianchovichina (2017) and Arampatzi et al. (2018) stress the increasing public dissatisfaction in the Arab world with access to public services, corruption, and social and economic justice.

of economic opportunities for educated people which explains this relationship. We do not find evidence for such a channel of influence. We are then closer to the emancipative theory presented in Inglehart and Welzel (2005) or Welzel (2006) where the incongruence between the freedom restrictions imposed by an autocratic regime and the self-expression values of educated people lead the latter to engage in mass demands for change.

1.1 Connected literature on 'civil' (non-violent) resistance

As argued by Teorell (2010) regime change, does not just happen. In a 'from below' perspective, it is the ultimate outcome triggered, directly or indirectly, by strong social forces in the shape of the intermediary outcome of popular mobilisation. The contentious politics literature points out that citizens can engage in mass collective actions to demand and obtain political reforms (Sharp, 1973; McAdam et al., 2001; Schock, 2005; Chenoweth and Stephan, 2011; Tilly and Tarrow, 2015). Although the role of the organised working class has often been emphasised (Rueschemeyer et al., 1992; Collier, 1999; Butcher and Svensson, 2016; Dahlum et al., 2019), given its extensive social network and economic interdependence with the State, Dahlum (2019) highlights that resistance campaigns often involve educated individuals, especially when these campaigns are non-violent. Three complementary arguments can explain why educated people are likely to engage in 'civil' (non-violent) resistance, related to their motivations, capacities, and strategic behaviour.

The first argument is the motivation of educated people. They may demand political change for ideological preferences due to an incongruence between the emancipative values promoted by education and the freedom-limiting values embodied by an autocratic political regime (Inglehart and Welzel, 2005) and/or for economic aspirations resulting from an absence of economic opportunities to exploit their human capital (Campante and Chor, 2014). Numerous studies have shown a positive link at the individual level between education and political participation, e.g. Campante and Chor (2012a), intolerance for corruption, e.g. Truex (2011), preferences for democracy, e.g. (Inglehart and Welzel, 2005; Chong and Gradstein, 2015).[8] The second argument is their likely capacities and preferences for non-violent mass mobilisation. Educated people tend to have the necessary political knowledge, communication and cooperation skills, social networks, and feelings of inter-group solidarity to join, mobilise, and coordinate symbolic and non-violent campaigns

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[8]Sekkat (2018) provides a useful survey of this literature. Interestingly, Chong and Gradstein (2015) show that this result holds whatever the country-level of democracy, suggesting, in opposition to the argument developed in Lott (1990), that authoritarian regimes are not able to generate legitimacy through indoctrinating education.

(Glaeser et al., 2007; Eicher et al., 2009; Dahlum and Wig, 2019), attractive to a large number of people.[9] Educated people may also consider the use of violence incompatible with their principles (Lipset, 1959; Inglehart and Welzel, 2005) or their investment in human capital (Collier and Hoeffler, 2004; Thyne, 2006). The third argument is that educated people may be aware that non-violent resistance is, somehow paradoxically, the best strategic response to a repressive regime.[10] Authoritarian leaders may be unwilling to use violent repression against a peaceful mass movement due to a risk of backfiring taking the form of sympathy of the civilian population for the regime opponents, dissent between regime supporters, loyalty shifts of the armed forces, the strengthening of both the resolve and internal solidarity of the resistance, and intervention from the international community (Schock, 2005).[11] The empirical results of Chenoweth and Stephan (2011) and Chenoweth (2020) agree with this backfiring effect, and more broadly, indicate that non-violent mass participation campaigns, which often take place in repressive autocracies, achieve a higher success rate than violent campaigns.

The rest of the paper is organised as follows. Section 2 highlights the conceptual setting and how the defanging effect of human capital operates. Section 3 presents the data and empirical models used to test our hypotheses. Section 3 provides the empirical results and discussion. Section 4 concludes.

2 Conceptual setting

Our conceptual setting builds on a model of autocrat survival under popular revolution threats in which the interplay between education and repression is central. In this model (see all algebraic details in the Appendix), we propose a game between the autocrat and the population where the former choose the levels of education and repression in order to avert revolutions, the latter being fueled by the grievance of citizens against the autocrat maintaining a wage wedge with respect to

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[9]The professional occupations of educated people may also give them some bargaining power if their non-cooperation means the crippling of key activities in society (Dahlum et al., 2019).

[10]The civil resistance literature repeatedly makes the point that the adoption of non-violence actions has more to do with strategy than morality. For example Chenoweth (2021) writes '*Most proponents of civil resistance see this technique as a functional alternative to violence, and therefore they tend to be interested in when and whether civil resistance works— remaining agnostic about whether it is morally superior to violence*' (p.8).

[11]As pointed out by Guriev and Treisman (2019), autocratic leaders have become aware of this backfiring effect and are increasingly using the manipulation of information to improve evaluations of their leadership and remain in power. Nevertheless, a companion theoretical paper (Guriev and Treisman, 2020) emphasises that as education gets more widespread, the autocratic leader cannot control anymore the information available to the public and, in presence of incompetent leaders, democratisation ultimately occurs.

its counterpart under democracy. We assume that this wage wedge does not depend on the level of education. By doing so, we neutralize the so-called awareness effect of human capital, which has been put forward for example by Campante and Chor (2012b) in their empirical analysis of the Arab spring (see also Boucekkine et al., 2019 for a theoretical analysis enhancing the awareness effect): in our conceptual setting, being more educated does not deepen the feeling of unfairness and grievance. Human capital plays a very different role in our setting.

In the traditional modelling à la Acemoglu and Robinson (2006), the revolution decision is taken by the population when the cost they face if they revolt is lower than the gain they would get if the rebellion succeeds. Here the gain would come from raising the wages to the higher post-autocracy level. The cost faced is twofold in this traditional theory: one component depends on the vulnerability of the autocratic regime, typically on the repression forces devoted by the autocrat to stop the rebellion; the second part depends on the internal coordination costs faced by the citizens, as a revolution is by construction a collective action. In particular, one may hypothesize that a higher level of education is likely to reduce the coordination costs among the citizens. Typically, the theoretical contributions to this line of research consider either the first component (repression) or the the second (collective action). When both co-exist, education and repression are hardly specified through a direct interaction.

In our conceptual framework, consistently with our Introduction, this direct interaction between repression and education is central. Indeed, the central concept is the defanging effect of human capital. This defanging effect has been documented above essentially on the basis of the literature of non-violent rebellions, which indeed have been proved to illustrate quite well the inefficiency of repression in a variety of cases. Needless to say, as explained in the Introduction, it can be also activated by the more classical role of human capital through the coordination costs: a better coordination of the collective action due to better organizational skills can only reduce the scope and efficacy of repression.

With this conceptual frame in mind, one can devise the following game between the autocract and citizens. We consider a game between the dictator, say player N, and the population, say player M. The game lasts one period, and the following timing in three steps applies:

1. In Step 1, player N fixes the remuneration per unit of human capital, say, W^N, and the associated size of the skilled labour population by maximising their payoff, say H^*.

8

2. In Step 2, player M decides whether to challenge the autocrat, i.e. to revolt, given the decisions taken by N in Step 1, the post-revolutionary remuneration per unit of human capital, say W^D, and for the level of repression expenditures, say P, given.

3. In Step 3, N chooses their repression intensity, P, after observing the best response of M in Step 2, under own nonnegative payoff constraint.

We define the scenario characterized by the timing above in which player N is the strategic leader of the game and they choose the level of repression after observing the best response of player M, as the 'no internalisation case'. While this timing seems to correspond to a large number of experiences in autocratic regimes, we should consider an alternative timing in which player N jointly determines H and P in order to avert mass contestation, internalising the revolutionary threat as in Boucekkine et al. (2019). We define this latter scenario as the 'full internalisation case'.

In the Appendix we illustrate at a minimal algebraic cost how the defanging effect of education works. In our illustrative model, human capital reduces the efficiency of repression: it enters the revolution cost as a multiplicative factor reducing the impact of repression. The main message delivered is the following: an autocrat not (fully) anticipating the destabilising effect of education may end up educating 'too much', ultimately leading to the collapse of the political regime. This outcome emerges because the use of non-violent campaigns by educated citizens undermines the efficacy of repression and increases substantially the vulnerability of the regime. In theory, it is possible that the autocrat is fully aware of this defanging effect and invests less in education to prevent the emergency of a revolutionary threat. Nevertheless, the first timing seems to fit better with the historical experiences of many autocracies. In other words, autocrats have often not fully considered, or dismissed the possibility, that the 'good, loyal, and productive' citizens nurtured by education would eventually develop the required strategies to turn against them in an effective manner. We shall assess empirically the mechanisms enhanced in the next section.

3 Empirical model and data

In this Section, we test the hypotheses, in a large panel data analysis, that the combination of high autocratic levels and high education levels triggers the emergence of a non-violent campaign,

which, in turn, increases the probability of regime change. We first describe our data and then the econometric models that we use. Since the education variable is only available every five years (1950, 1955...), we adopt a five-year panel approach. Our dependent variables are binary indicators taking the value of one if at least one event occurs over a five-year period (e.g. 2000-2004). The independent variables are measured at five-year intervals (1950, 1955...). Such an approach also reduces the noise associated with yearly data and strengthens the temporal sequence causality.

3.1 Non-violent and violent campaigns

Data on non-violent campaigns (NVC) and violent campaigns (VC) come from The Nonviolent and Violent Conflict Outcomes (NAVCO) 1.3 Data Set, which builds on the original dataset associated with Stephan and Chenoweth (2008).[12] A resistance campaign is a series of observable, continuous, purposive mass tactics or events, involving at least 1000 observed participants, in pursuit of a maximalist political objective such as regime change, secession, or self-determination. Campaigns are classified as non-violent when most resistance practices do not directly threaten or harm the physical wellbeing of the regime, its agents, or its citizens, for example by relying on sit-ins, protests, boycotts, civil disobedience, strikes. Otherwise, campaigns are classified as violent when there is a manifest (threat of) use of physical force to harm the political opponent.

We define the dummy variable NVC (VC) as taking the value of one if one or several non-violent (violent) campaigns aiming at regime change have occurred during a five-year period (e.g. 2000-2004). Figure 1 shows that the last three decades have experienced a large number of campaigns aiming at regime change, with a pronounced compositional shift towards non-violent resistance methods.

3.2 Regime changes and regime breakdowns

A political regime is characterised by Djuve et al. (2019) as "the set of (formal and informal) rules that are essential for selecting political leaders and maintaining them in power" (p.2). A regime change occurs when these rules are substantially altered. Such a definition covers all regime changes, in the sense that it is not restricted, for example, to a transition from 'democracy' to 'autocracy' (or vice-versa). Djuve et al. (2019) report thirteen categories of regime breakdown

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[12]https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/ON9XND

Figure 1: Non-violent and violent campaigns aiming at regime change
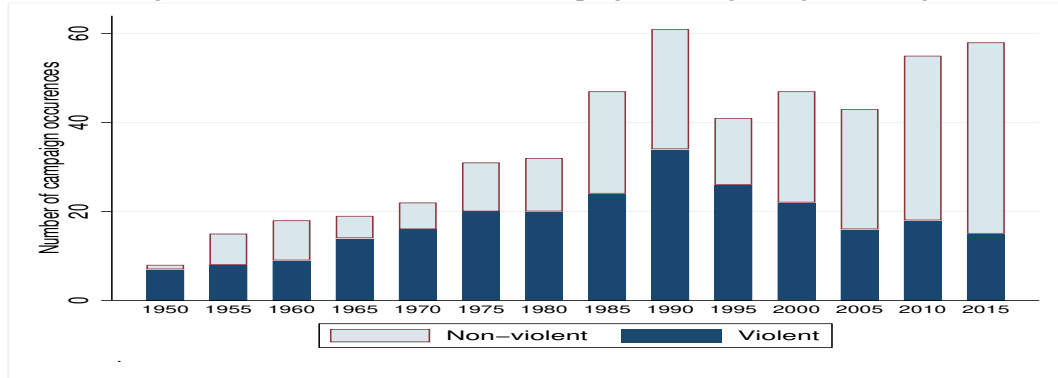
Data from NAVCO 3.1. In some country-five-year period (e.g. 1990: 1990-1994), more than one violent or non-violent campaign may have occurred (e.g. two violent campaigns) but we only count one event.

leading to a substantive regime change in the V-Dem (Varieties of Democracy) database.[13] A distinction is made between the most important and the several types of processes which led to the end of a political regime. We use the broader definition, given the fact that singling out one cause is an uncertain exercise.

Table 1 reports all types of 'five-year' regime breakdown which occurred during the period 1950-2019 in all independent countries still existing in 2019. Regime change is most often triggered by an elite: the military (MILCOUP), a political group (OTHCOUP), the incumbent (SCOUP, DINCUMB). Revolutions (POPUR) also happen although there are relatively rare events.

We define the dummy variable $REGCHANGE$ as taking the value of one if one or several regime changes have occurred during a five-year period. To look more specifically at regime transitions from autocracy to democracy, we define the dummy variable $DEMOCT$ as taking the value of one if a country was an autocracy the period before and the period during the regime change and a democracy the period after the regime change(s). The autocracy/democracy binary classification is based on the four 'regimes of the world' provided in V-Dem: closed/electoral autocracies vs. electoral/liberal democracies. Figure 2 indicates that the number of regime changes have been steady since 1990 and, while they do not necessarily result in full democratisation, they are, in comparison to pre-1990 periods, frequently associated with a move towards political liberalisation. Lastly, to understand the forms taken by regime change, we define three regime breakdown

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[13]https://www.V-Dem.net/

11

Table 1: Categories of regime breakdown

Name	Definition	Number
MILCOUP	Military coup d'état	145
OTHCOUP	Coup d'état by other groups	21
SCOUP	Self-coup to consolidate the power of incumbent leader	67
ASSASS	Assassination of sitting leader	8
NATDEATH	Natural death of sitting leader	10
CIVWL	Loss in civil war	30
INTWL	Loss in interstate war	9
FORINT	Foreign intervention	35
POPUR	Popular uprising	47
DINCUMB	Political liberalisation, guided by sitting regime	127
NODINCUMB	Directed transition without democratisation, guided by sitting regime	89
DNOINCUMB	Political liberalisation by actors outside sitting regime	17
OTHER	Other	9

Note: Data from Djuve et al. (2019) for the period 1950-2019, all independent countries still existing in 2019.
In some country-five-year period (e.g. 1990: 1990-1994), more than one specific regime may have occurred
(e.g. two military coups) but we only count one event.

binary variables: $COUP$ ($MILCOUP$ or $OTHCOUP$), self-coup $SCOUP$, popular uprising
($POPUR$), elite-led political liberalisation $POLLIB$ ($DINCUMB$ or $DNOINCUMB$).

Figure 2: Regime changes
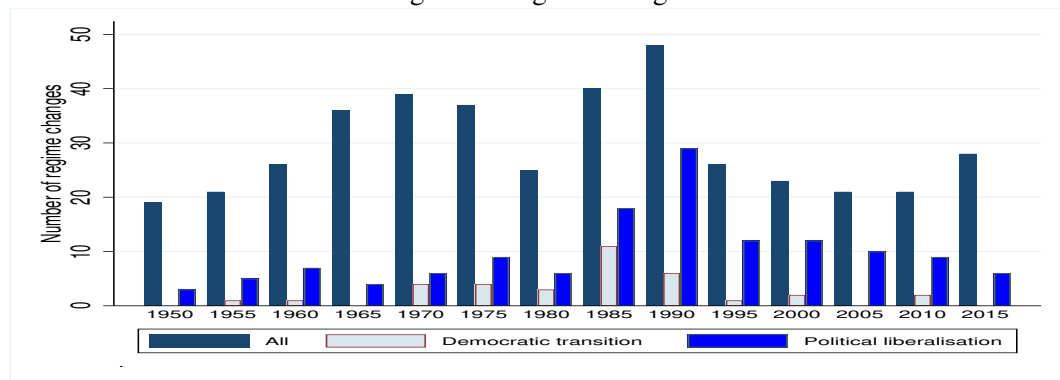
Data from V-Dem. In some country-five-year period (e.g. 1990: 1990-1994), more than one regime changes may have occurred but
we only count one event. Political liberalisation: by sitting regime or other actors.

3.3 Autocracy and education

Our measure of autocracy (AUTOC) is the neopatrimonial rule index from the V-Dem (Varieties

of Democracy) database. It attempts to capture, on the basis of sixteen indicators, the combination

of the three concepts which define together a strong autocratic regime: (i) unconstrained concentration of political power in the hands of the executive (presidentialism); ii) politics based on clientelist relationships (clientelism);[14] (iii) use of the political office by political actors for private or political gain (regime corruption). It ranges from 0 to 10 (no to very high autocratic rule). We prefer this measure to the widely used Polity score index[15]) because it encompasses regime features, beyond the absence of free and fair multiparty elections, which are unlikely to be tolerated by educated people. An autocratic regime as defined by Polity could thus score low on the autocratic scale and vice-versa (Singapore vs. Nicaragua). Figure 3 highlights that strong autocracy was initially common in all (mostly developing) regions. However, since the early nineties, it has globally declined, although at a much slower and erratic pace in the MENA and SSA regions.

Figure 3: Changes in autocracy over time, by region
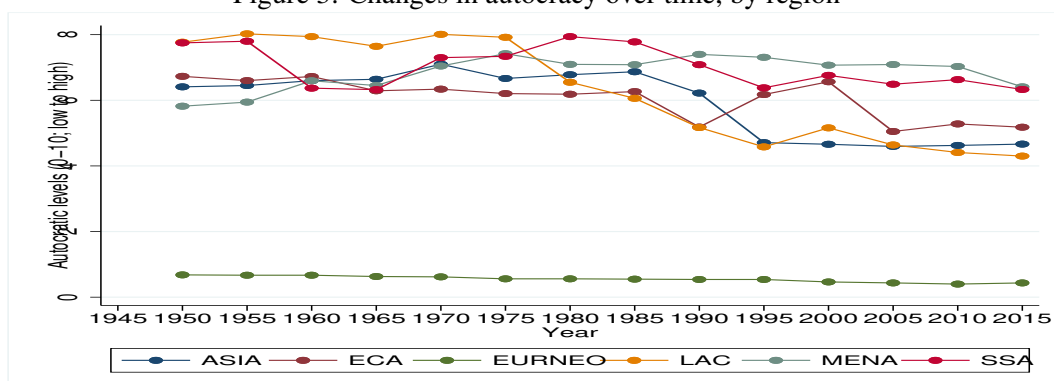
Notes: Median values. Data come from V-Dem. ASIA: South and East Asia and Pacific. ECA: Eastern Europe and Central Asia. LAC: Latin America and the Caribbean. MENA: Middle East and North Africa. NEOEUR: Western Europe and neo-Europes. SSA: Sub-Saharan Africa.

Data on the mean number of years spent in school in the population aged 15 (EDUC) and over come from the Wittgenstein Centre.[16] In comparison to the widely used Barro and Lee's dataset, this database provides a wider country coverage and, possibly, methodological improvements. Figure 4 shows that educational attainment has increased in all developing regions, with a remarkable improvement in the MENA region in the last sixty years.

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[14]More precisely, clientelism is the targeted, contingent distribution of resources (goods, services, jobs, money, etc) in exchange for political support.

[15]https://www.systemicpeace.org/polityproject.html

[16]http://dataexplorer.wittgensteincentre.org/wcde-v2/

Figure 4: Changes in educational attainment over time, by region

Notes: Median values. Data come from the Wittgenstein Centre. ASIA: South and East Asia and Pacific. ECA: Eastern Europe and Central Asia. LAC: Latin America and the Caribbean. MENA: Middle East and North Africa. NEOEUR: Western Europe and neo-Europes. SSA: Sub-Saharan Africa.
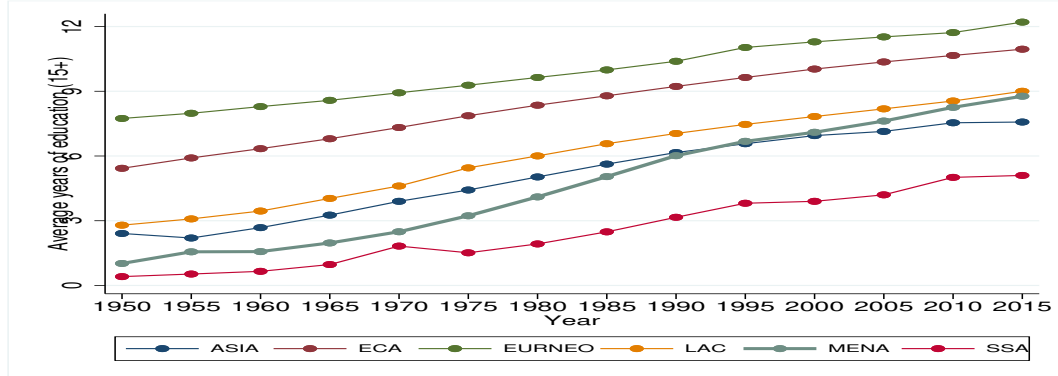
3.4 Control variables

We also include in our econometric model time-varying control variables (CVARS) which are usually considered as standard potential determinants of social conflicts (Sambanis, 2002; Fearon and Laitin, 2003; Collier and Hoeffler, 2004; Dixon, 2009; Djuve et al., 2019): natural resources abundance (NRABUND), log of income per capita (GDPPC), log of population size (POP), regime duration (DUR, DUR2, DUR3).

Natural resources abundance corresponds to total resource income (the volume of production of oil and gas times the price of these resources) per capita, expressed in 2000 US dollars. Data have been compiled by Ross & Mahdavi.[17] Given that data stop in 2014, we use the 2014 value as the 2015 value and we adopt the inverse hyperbolic transformation (IHS).[18] Log of *real income per capita* in 2011 US dollars and log of *population size* come from Fariss et al. (2022), as reported in V-Dem. Pressures for regime change may also likely to depend on regime duration. To account flexibly for this temporal dependence, we follow Carter and Signorino (2010), and we add the cubic polynomial of *regime duration*.

Table 2 provides some summary statistics. Overall, our sample covers 161 countries over the period 1950-2019.

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[17]https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/ZTPW0Y

[18]The IHS transformation behaves similarly to a log transformation but allows retaining zero-valued observations (Burbidge et al., 1988; MacKinnon and Magee, 1990).

Table 2: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.
NVC	0.14	0.34	0	1
VC	0.13	0.34	0	1
REGCHANGE	0.21	0.41	0	1
DEMOCT	0.02	0.14	0	1
AUTOC	5.11	3.06	0.06	9.93
EDUC	6.31	3.42	0	13.24
GDPPC	8.65	1.15	5.66	11.94
POP	6.80	1.62	2.40	11.89
NRABUND	2.67	3.14	0	11.76
DUR	18.21	16.47	1	71

3.5 Baseline econometric models

We estimate fixed effects linear probability models in which we investigate, firstly, whether more education in autocratic countries increases the probability of a NVC and, secondly, whether a NVC increases the probability of a regime change, which includes but is not limited to democratisation.[19]

We first estimate the following econometric model

$$NVC_{it} = \beta_1 AUTOC_{it} + \beta_2 EDUC_{it} + \beta_3 [AUTOC_{it} * EDUC_{it}] + CVARS_{it}\gamma +$$
$$\alpha_i + \alpha_t + \alpha_{rt} + \epsilon_{it} \tag{1}$$

where NVC_{it} takes the value of one (and zero otherwise) if at least one non-violent campaign (NVC) occurs in country i during the five-year period starting in t (e.g. 2000-2004), $AUTOC$ is the level of autocracy at time t (e.g. 2000), $EDUC$ is a measure of educational attainment at time t, $CVARS$ are control variables, αs are fixed effects, and ϵ is the error term. As indicated above, we adopt a five-year panel approach. We include country-specific (α_i), time-specific (α_t) and region-specific fixed effects (α_{rt}) to control for all unobserved time-invariant factors (e.g. geography or religion), global trends (e.g. a general movement towards more democracy), and the regional context such as the influence of political events in other countries of the same region

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[19]Our dependent variables are binary variables. While it may seem that limited dependent variables models would be preferable, Martin and Wooldridge (2021) show that linear probability fixed effects models perform well for estimating average marginal effects and are much less unbiased than a (fixed effects) conditional logit estimator in presence of serial correlation of the error term.

(e.g. demonstration effects of mass mobilisation in neighbouring countries).[20] Standard errors are clustered at the country level.

Our key parameters of interest are β_2 and β_3. Together, they indicate how higher education influences the probability of a NVC *conditional* on the country-specific level of autocracy since the average marginal effect of $EDUC$ on NVC is $\frac{\partial NVC}{\partial EDUC} = \beta_2 + \beta_3 AUTOC$. We expect $\beta_3 > 0$ and $(\beta_2 + \beta_3 AUTOC) > 0$ for sufficient large values of $AUTOC$. Educated people are likely to have the motivation, the capacities, and the strategic sense to engage in a NVC to challenge a regime whose autocratic values are incompatible with theirs. As a 'plausibility/placebo test', we verify that such a relationship does not exist when the dependent variable is VC, which takes the value of one if at least one non-violent campaign (NVC) occurs in country i during the five-year period starting in t.

We then estimate this second econometric model

$$
\begin{aligned}
REGCHANGE_{it} = \;\; = \;\; & \delta_1 AUTOC_{it} + \delta_2 EDUC_{it} + \delta_3 NVC_{it} + \delta_4 VC_{it} + \\
& \delta_5 [AUTOC_{it} * EDUC_{it}] + CVARS_{it}\zeta + \alpha_i + \alpha_t + \alpha_{rt} + \epsilon_{it} \quad (2)
\end{aligned}
$$

where $REGCHANGE$ takes the value of one if at least one regime change occurs in country i during the five-year period starting in t. In line with previous civil resistance works and our own theoretical model, we expect $\delta_3 > 0$ and $\delta_4 < \delta_3$. By 'defanging' autocratic regimes, education-promoted NVC is much more likely to achieve regime change than VC. Furthermore, if the presence of NVCs is the key channel of influence through which education fosters regime change, we expect that the marginal effect of $EDUC$ ($\frac{\partial REGCHANGE}{\partial EDUC} = \delta_2 + \delta_5 AUTOC$) to be equal to zero, at least in statistical terms, when controlling for NVC.[21] To understand better how this regime change takes place and the kind of regime transition it generates, we also use as dependent variables, binary indicators indicating whether the regime change was associated with a coup ($COUP$), a self-coup ($SCOUP$) popular uprising ($POPUR$), an elite-led political liberalisation ($POLLIB$) and led a democratic transition ($DEMOCT$).

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[20]The regions are those used in Figure 3.

[21]Following Acharya et al. (2016), we are careful not to include 'post-treatment' variables to avoid creating a bias in the estimation of the direct effect of education.

4 Results

4.1 Education, non-violent contestation, regime change

Our initial results are presented in Table 3. In columns [1]-[4], we look at how the interaction of education and autocracy influences the probability of non-violent and violent mass protests while in columns [5]-[8], we examine whether these resistance movements help triggering regime change and the adoption of a democratic regime.

In column [1], we investigate the determinants of non-violent campaigns (NVCs) without considering the interaction of the nature of the political regime (AUTOC) with education levels (EDUC). AUTOC is the only variable statistically significant. Its coefficient indicates that a one point rise increases the probability of a NVC by 0.05. On the other hand education levels do not appear to play any role. In column [2], we examine whether the impact of EDUC depends on AUTOC by interacting these two variables together. The coefficient on the interaction term is positive and statistically significant. Panel A of Figure 5 shows that the average marginal effect (AME) of EDUC on the probability of a NVC is positive and statistically significant only after an autocratic level of 6 (out of 10) is exceeded. Panel B of Figure 5 provides average probabilities at different levels of AUTOC and EDUC. For example, it is estimated that for a country like Tunisia (EDUC=4, AUTOC=6, 1980; EDUC=8; AUTOC=9, 2010), the average probability of a NVC increased from 0.17 in 1980 to 0.47. In columns [3] and [4], we turn to the determinants of violent campaigns (VCs). Column [4] indicates that higher education levels do not increase the probability of a VC in autocratic regimes, providing support for a strong link between education and non-violent resistance.

In column [5], we explore whether civil resistance can trigger regime change (REGCHANGE). The coefficients on both NVC and VC are positive and statistically significant. They suggest that the occurrence of a NVC increases the probability of a regime change by 0.28 whereas the impact of a VC is 40% lower (0.17). In column [6], we test whether the interaction of EDUC with AUTOC has a direct effect beyond its indirect effect working through NVC. Although the coefficient on the interaction term is positive and statistically significant, Panel C of Figure 5 indicates that the AME of EDUC is never statistically significant, whatever autocracy levels. This suggests that education influences regime change mainly through its contribution to the emergence of civil resistance. In column [7], we turn to the determinants of democratic transition (DEMOCT). Only the coefficient

on NVC is positive and statistically significant, with an estimated effect of 0.08 on the probability of such a drastic regime change. In line with Celestino and Gleditsch (2013), nonviolence increases the willingness and incentives of autocratic elites to accept democratisation: they fear less for their lives, the may find common grounds with their opponents, and a democratic regime provides opportunities to remain politically relevant. In column [8], the coefficient on the interaction term between EDUC and AUTOC is positive but not statistically significant, highlighting again that the main effect of education is to increase, under high autocracy conditions, the likelihood of non-violent mass protests.

Table 3: Determinants of campaigns and regime change

	NVC (1)	NVC (2)	VC (3)	VC (4)	REGCHANGE (5)	REGCHANGE (6)	DEMOCT (7)	DEMOCT (8)
AUTOC	0.047***	-0.011	0.000	0.012	0.001	-0.029	0.013***	0.008
	(0.009)	(0.015)	(0.011)	(0.019)	(0.012)	(0.018)	(0.004)	(0.005)
EDUC	0.035**	-0.029	-0.006	0.007	-0.012	-0.044	-0.011**	-0.017***
	(0.016)	(0.018)	(0.023)	(0.028)	(0.022)	(0.028)	(0.005)	(0.006)
AUTOC*EDUC		0.009***		-0.002		0.005**		0.001
		(0.002)		(0.002)		(0.002)		(0.001)
NVC					0.283***	0.272***	0.077***	0.075***
					(0.040)	(0.040)	(0.018)	(0.018)
VC					0.165***	0.168***	0.017	0.017
					(0.040)	(0.040)	(0.016)	(0.016)
GDPPC	-0.016	0.004	-0.052	-0.056	-0.083**	-0.073*	0.011	0.013
	(0.034)	(0.034)	(0.044)	(0.045)	(0.039)	(0.040)	(0.010)	(0.010)
POP	0.052	-0.018	0.051	0.065	0.000	-0.036	-0.024	-0.031
	(0.075)	(0.069)	(0.083)	(0.081)	(0.073)	(0.074)	(0.021)	(0.021)
NRABUND	0.001	0.001	-0.005	-0.005	-0.004	-0.004	-0.001	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.001)	(0.001)
Observations	1,773	1,773	1,773	1,773	1,773	1,773	1,773	1,773

*Notes*: Cluster-robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. NVC: non-violent campaigns. VC: violent campaigns. DEMOCT: democratic transitions. All regressions include country and region-time fixed effects as well as the cubic polynomial of regime duration.

Overall, these results are in line with our predictions. The growing incompatibility of high education levels with high autocratic levels increases the likelihood of non-violent campaigns which, in turn, increases the probability of a regime change and, to a lower extent, the adoption of a democratic regime.

4.2 Mass campaigns, regime breakdowns, democratic transitions

Regime breakdowns come in different shapes, notably a coup (COUP), a self-coup (SCOUP), a popular uprising (REVOL), or political liberalisation guided by the leader (POLLIB). Table 4 shows that the impact of a NVC on the probability of a revolution (column [3]) or political liberalisation (column [4]) is 20-40% larger than on the probability of a coup (column [1]), and, in

Figure 5: Effect of education, conditional on autocratic levels
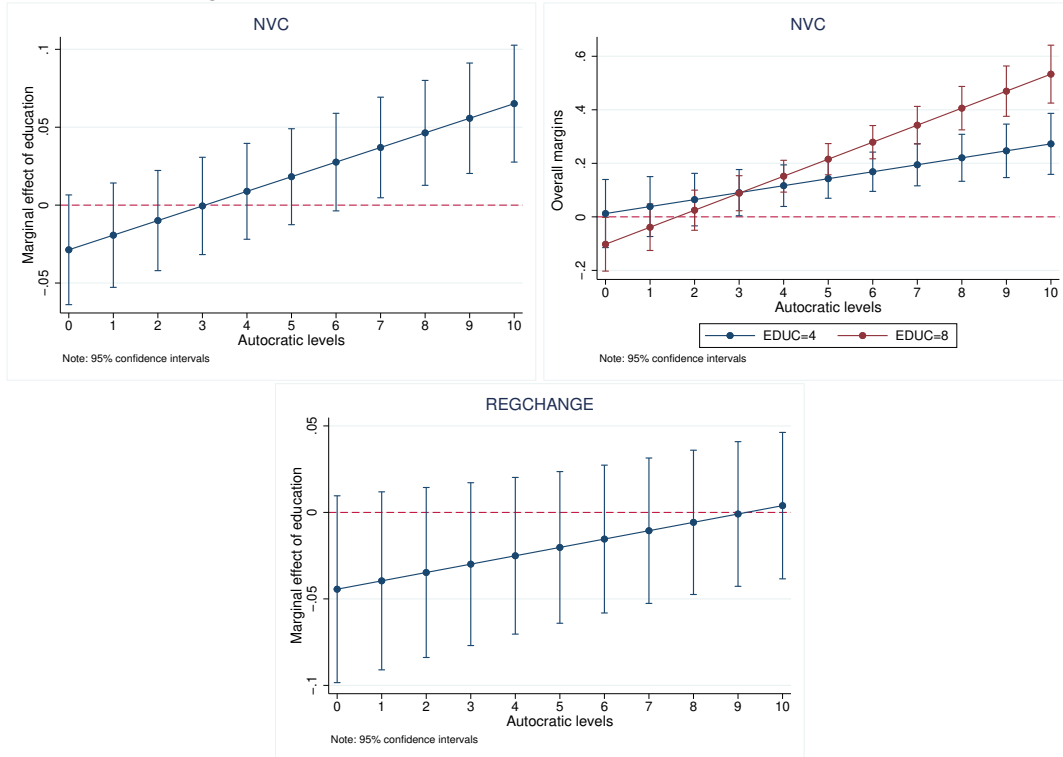
agreement with Chenoweth (2021)'s descriptive statistics, NVCs tend to be two to three times more effective than VCs at initiating a regime change. On the other hand, in column [2] we find that neither NVC or VC has an impact on the probability of a self-coup. Lastly, column [6] indicates that the regime breakdowns the most associated with a democratic transition are logically those the most associated with NVCs.

These results thus highlight that the regime changes trigged by NVCs taking place in autocracies and partly triggered by high education levels reflect well the expected nature of these resistance movements: large-scale, peaceful, relatively successful, and aiming at obtaining democratic concessions.

4.3 Various features of autocracy

Our key measure of autocracy is a 'neopatrimonial rule' index, which is the aggregation of three components related to clientelism (CLIENT), presidentialism (PRES), and regime corruption (CORR). This begs the questions of which dimension drives our results and whether this index performs bet-

Table 4: Various regime breakdowns

	COUP (1)	SCOUP (2)	POPUR (3)	POLLIB (4)	OTHER (5)	DEMOCT (6)
NVC	0.106***	-0.001	0.130***	0.152***	0.006	
	(0.028)	(0.017)	(0.025)	(0.032)	(0.008)	
VC	0.069**	0.025	0.048**	0.051**	0.025**	
	(0.032)	(0.022)	(0.019)	(0.025)	(0.011)	
AUTOC	-0.022**	0.012*	0.008**	0.008	-0.001	
	(0.009)	(0.007)	(0.004)	(0.008)	(0.002)	
EDUC	-0.004	-0.010	-0.013	-0.013	0.002	
	(0.020)	(0.011)	(0.008)	(0.013)	(0.003)	
COUP						0.018
						(0.020)
SCOUP						-0.000
						(0.019)
POPUR						0.146**
						(0.063)
POLLIB						0.133***
						(0.034)
OTHCH						0.063
						(0.084)
Observations	1,773	1,773	1,773	1,773	1,773	1,773

Notes: Cluster-robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. NVC: non-violent campaigns. VC: violent campaigns. COUP: military or other coups. SCOUP: self-coup. POPUR: popular uprising. POLLIB: political liberalisation/ OTHER: other regime breakdowns. DEMOCT: democratic transitions. All regressions include country and region-time fixed effects as well as all control variables.

ter than the traditional measure of autocracy used in the literature, the Polity index (POLITY).[22]

Columns [1]-[3] of Table 5 indicate that all components may be relevant to explain the occurrence of NVCs as, in all cases, the interaction term is positive and statistically significant while the marginal effect of education associated with a one point rise in each autocratic dimension (0-10, best to worse) is relatively similar (0.05 for an autocratic value of 8), with a slightly larger magnitude for presidentialism. A 'horse race' in column [4] suggests that the most important dimensions may be presidentialism and corruption. In column [5], using the Polity index as a measure of autocratic levels yields very similar results. However, column [6] reports that when including our preferred measure of autocracy, the autocratic rule index, with Polity, the former dominates: only coefficients associated with AUTOC are positive and statistically significant. Turning to determinants of VCs in columns [7]-[12], as in our initial findings, we fail to find that education in autocracies, whichever the measure employed, raised the probability of violent mass protests.

Given that regime corruption is the variable the less correlated with Polity 2 ($r \simeq 0.46$), these results suggest that the non-violent mass protests triggered by high education levels in autocracies are likely to find their roots in corruption, which is facilitated by the lack of political and judicial constraints in presidentialist regimes.

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[22] We re-scale the variable such as it ranges from 0 (democracy) to 10 (autocracy).

Table 5: Various autocracy measures

	NVC (1)	NVC (2)	NVC (3)	NVC (4)	NVC (5)	NVC (6)	VC (7)	VC (8)	VC (9)	VC (10)	VC (11)	VC (12)
EDUC	-0.003	-0.013	-0.030*	-0.036*	0.005	-0.027	0.000	-0.004	0.002	0.003	0.006	0.014
	(0.019)	(0.016)	(0.018)	(0.018)	(0.017)	(0.019)	(0.027)	(0.027)	(0.027)	(0.029)	(0.023)	(0.027)
CLIENT	-0.011			0.011			0.012			0.010		
	(0.014)			(0.017)			(0.019)			(0.021)		
CLIENT*EDUC	0.006***			-0.003			-0.001			-0.000		
	(0.002)			(0.003)			(0.002)			(0.003)		
PRES		-0.014		-0.005				-0.002		-0.007		
		(0.011)		(0.011)				(0.016)		(0.018)		
PRES*EDUC		0.008***		0.005***				-0.000		0.000		
		(0.002)		(0.002)				(0.002)		(0.002)		
CORR			-0.017	-0.021					0.007	0.006		
			(0.012)	(0.014)					(0.016)	(0.018)		
CORR*EDUC			0.009***	0.008***					-0.001	-0.002		
			(0.002)	(0.003)					(0.002)	(0.003)		
POLITY					-0.008	0.004					0.004	-0.001
					(0.008)	(0.009)					(0.009)	(0.011)
POLITY*EDUC					0.005***	0.000					-0.001	-0.000
					(0.001)	(0.002)					(0.001)	(0.002)
AUTOC						-0.012						0.016
						(0.018)						(0.022)
AUTOC*EDUC						0.009***						-0.002
						(0.002)						(0.003)
Observations	1,776	1,776	1,776	1,776	1,721	1,718	1,776	1,776	1,776	1,776	1,721	1,718

Notes: Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. NVC: non-violent campaigns. VC: violent campaigns. CLIENT: clientelism. PRES: presidentialism. CORR: regime corruption. All regressions include country and region-time fixed effects as well as all control variables.

4.4 Interactions with income per capita

Education is highly correlated with economic development ($r \simeq 0.78$), raising concerns that the former is a proxy for another variable associated with 'modernisation'. Starting with NVC as our dependent variable, column |1] of Table 6 includes, in addition to the interaction term between EDUC and AUTOC, an interaction term between EDUC and GDPPC. Only the coefficient on the first interaction term is statistically significant. In column [2], we adopt a development accounting perspective, by decomposing the log of income per capita (ypc) into the log of two components, human capital input (HC) and the rest (GDDPCwoHC), based on the following (and admittedly overly simple) equation: $ypc = TFP * (Y/K)^{\frac{\alpha}{1-\alpha}} e^{\phi EDUC}$, where Y is income, K is the capital stock, $\phi = 0.09$. Only the coefficient on the interaction term involving HC is positive and statistically significant. iIn unreported regressions, we also verified that our results are robust to the inclusion of the interaction between EDUC and the urban rate or the log of manufacturing value added. Large concentration of people or workers can be expected to facilitate mass mobilisation (Rueschemeyer et al., 1992; Butcher and Svensson, 2016; Dahlum et al., 2019).

Campante and Chor (2014) propose, and empirically show, that the combination of a well-educated population (more likely to engage in political activities) and weak macroeconomic conditions (which reduce the opportunity costs of engaging in political activities) tends to increase the

probability of a change in the executive.[23] Given that AUTOC and income per capita are negatively correlated (r≃ -0.46), it is then possible that our interaction term acts as a proxy for the interaction between education and income per capita suggested by Campante and Chor (2014). However, column [3] shows that the coefficient on this additional interaction term is not statistically significant. Similar results are obtained in column [4], when interacting EDUC with economic growth over the last five years (Δ GDPPC). AUTOC thus does not appear to be a simple proxy for weak macroeconomic, or labour market, conditions. In related works, Bratton and Van de Walle (1997) and Dahlum and Wig (2019) find that political protests in Africa do not seem to have been motivated by economic factors.

In columns [5]-[8], when using VC as the dependent variable, we find, as before and across columns, an absence of influence of EDUC on violent mass protests.

Taken all together, these results suggest that our interaction term, involving EDUC and AUTOC, is not a proxy for other factors correlated with one of these two variables.

Table 6: Various incompatibility measures

	NVC (1)	NVC (2)	NVC (3)	NVC (4)	VC (5)	VC (6)	VC (7)	VC (8)
AUTOC*EDUC	0.006* (0.003)	0.007*** (0.003)	0.009*** (0.002)	0.010*** (0.002)	0.003 (0.003)	0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)
AUTOC*GDPPC	0.014 (0.010)				-0.022** (0.008)			
AUTOC*GDPPCwpHC		0.014 (0.010)				-0.022** (0.008)		
EDUC*GDPPC			-0.005 (0.006)				0.005 (0.009)	
EDUC*Δ GDPPC			0.021	(0.015)				0.013 (0.025)
Observations	1,773	1,773	1,773	1,691	1,773	1,773	1,773	1,691

Notes: Cluster-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. NVC: non-violent campaigns. VC: violent campaigns. GDPPCwoHC: GDPPC without human capital contribution. All regressions include country and region-time fixed effects as well as all control variables. The independent components of the interaction terms are always included.

5   Conclusion

In this paper, we have contributed to opening the 'black box' of modernisation theory by clarifying the links between education and regime change. Autocrats, when they invest in education may also involuntary reduce the effectiveness of their security apparatus because educated people adopt

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[23]An executive change can happen without it being associated to a regime change as long as the institutional rules are not substantially changed; e.g. the nomination of a new Prime Minister in the United Kingdom.

non-violent modes of contestation difficult to repress. Higher educational attainment can thus lead indirectly to the collapse of an apparently powerful autocratic regime. We empirically verify the validity of this 'defanging effect' of education. We indeed find that, in presence of high autocratic levels, higher education increases the probability of a non-violent mass campaign, which in turn, increases the likelihood of a regime change, often associated with political liberalisation, and, to a lesser extent, democratisation. These results highlight the relevance of structural factors to understand why political change occurs.

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A Appendix: a simple model of the defanging effect of education

We provide hereafter a very simple model illustrating the logic of the defanging effect of education. In particular, we highlight the implications of partial/full internalisation of this mechanism by the autocratic leader for their optimal education decision as well as the likelihood of a possible regime breakdown.

A.1 The no internalisation case

We now detail the computations at each step of the game introduced in Section 2. In Step 1, player N maximises their payoff with respect to H, the size of the skilled labour population needed subject to the autocratic wage, W^N. The payoff function is:

$$\Pi(N) = AF(H) - W^N H - P \tag{A1}$$

$AF(H)$ is the production function with A the technological level (proxy of economic development and/or the size of the economy) and $F(.)$ is a standard increasing and concave function with $H(0) = 0$ and satisfying the Inada conditions (see related remark below). P is the size of self-preservation expenditures by the autocratic ruler. We interpret P more tightly as repression expenditures. Clearly, just like in Acemoglu and Robinson (2006), self-preservation expenditures may also include redistribution. We focus here on repression as this is by far the most salient characteristic of autocratic regimes. Four remarks are in order here.

- First of all, our modelling of the education effort of the ruler N is simplified. Instead of relying on a two-sector Lucas-Uzawa-like model like in Boucekkine et al. (2019) with an explicit and separate education sector, we use the simple trick of the textbook one-sector model where the same good is employed for any type of investment (see (Barro and Sala-i Martin, 1998), chapter 5). This does not imply any generality loss as the ruler N exercises an exclusive control on education. Another assumption worth mentioning is that education is essential to production (as $H(0) = 0$); the Inada conditions reinforce the incentives to invest in education. This is in line with the role of mass education in the development policies of newly independent states.

- Second, there is room for adding natural resource windfalls in the payoff equation without

changing the main results of the paper. Of course, this ingredient would be relevant given the role of natural resources in the institutional shape and dynamics of many autocratic regimes. That said, taking into account windfalls would simply add an exogenous term to the payoff function and would not alter the essential outcomes of this analysis.

- Third, one should notice that only the education effort is chosen at this stage. The repression effort is chosen in the final Step 3. This is to give the player N a strategic advantage: player N is the strategic leader of the game and they choose the level of repression after observing the best response of player M. We relax this assumption at the end of this section and allow the player N to jointly determine H and P in order to avert mass contestation, internalising the revolutionary threat as in Boucekkine et al. (2019).

- W^N is an arbitrary non-walrasian wage. We measure the degree of autocracy as the wedge between W^N and W^D. More precisely, we posit:

$$W^N = (1 - b) W^D = 1 - b, \tag{A2}$$

once W^D normalised to 1, with $0 \leq b < 1$. The larger b, the larger the autocratic preemption on human capital income, the larger the dissatisfaction of the population with the current political regime.[24]

In Step 2, player M has to decide whether they revolt. In line with the literature (Acemoglu and Robinson, 2006; Caselli and Tesei, 2016; Boucekkine et al., 2016), we assume that player M faces a revolution cost, which consists in the coordination costs involved in organising a collective action, taking into account the degree of contestability of the regime. In our setting, contestability is captured by the level of repression expenditures, P. We crucially argue that the larger the size of the educated population, H, the less effective the repression expenditures. As discussed in the Introduction and in section 2, educated people are more likely to adopt non-violent forms of collective resistance, which often cannot be repressed violently by the autocrat without causing a destabilising backfiring effect. Said differently, education, through non-violence, can 'defang' a

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[24]In alternative settings (e.g. (Boucekkine et al., 2019)), income aspirations would increase with education and the *perceived* level of autocracy, here constant and equal to b, would depend on human capital H. In this paper, we shut down this grievance channel and focus on the repression channel outlined in the Introduction and formalised in this Section.

repressive regime. We therefore specify the mass mobilisation cost function perceived by player M as a function $C(P, H)$ which is increasing in P and decreasing in H. We set the following i assumptions for function $C(.,.)$:

Assumption 1. *Function $C(P, H)$ satisfies the following properties:*

(i) $C_P(.) > 0$, $C_{PP}(.) > 0$

(ii) $C_H(.) < 0$, $C_{PH}(.) < 0$

Note that we do require that the cost function is strictly convex with respect to P. As we shall see, it is the 'degree' of convexity (in a sense that we clarify later) which determines the level of contestability of the regime, more so than the level of expenditures P. We do not make any convexity/concavity assumption with respect to H but we do require the negativity of the second-order cross derivative, that is the inhibiting effect of an additional unit of repression expenditures declines with the level of human capital. Therefore, in our setting, the cost function is non-separable.[25]

Player M will not revolt provided the following *No Revolution Condition* [NRC] is checked:

$$C(P, H^*) \geq (W^D - W^N) H^* = b H^* \tag{A3}$$

In Step 3, player N chooses the level of repression P in order to enforce the [NRC]. But they have to do it without incurring negative payoffs. With the level of education chosen in Step 1, the maximal level of repression under nonnegative payoff is given by $\bar{P}$, such that:

$$\bar{P} = AF(H^*) - (1 - b) H^* \tag{A4}$$

Because the cost function $C(P, H)$ is strictly increasing in P, we can conclude that revolutions are averted if and only if the following condition holds:

$$C(\bar{P}, H^*) \geq b H^* \tag{A5}$$

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[25]If the cost function were separable but still satisfying the three remaining assumptions in Assumption 1, then a strict convexity assumption with respect to H has to be added to preserve the essential outcomes of our theoretical analysis. We believe the negativity of the second-order cross derivative is the most relevant second-order assumption involving H we can make, and we develop our arguments with it.

In the next section, we will show that when b increases (that is as autocratism becomes less bearable from the point view of player M), [NRC] cannot hold under certain mild conditions, and revolutions occur. At first glance, the reader might think that this outcome is trivial. However, this is not the case. When b goes to 1, H^* goes to infinity as the autocratic leader preempts nearly all the human capital income and production increases strictly with H; therefore, both the right-hand and left-hand sides of [NRC] go to infinity. The nature of the revolution cost function, which is the key distinctive feature of our theory, is decisive: education is a major determinant of citizens' capacities to contest effectively the autocratic regime by facilitating the emergence of collective resistance actions difficult to repress. Conversely, the polar case, when b goes to zero, is trivial: in such a case, the wage wedge driving revolutions (that is the right-hand of [NRC]) goes to zero as H^* remains finite when b goes to 0. Hence, [NRC] can only fail to hold for b large enough. In other words, revolutions cannot occur in our model when the degree of autocracy is low enough. The propositions displayed below are therefore formulated accordingly, and focus on cases related to clearly identified autocratic regimes.

From now on, we work with the following functional forms which satisfy the set of assumptions made above:

$$F(H) = H^\alpha \ , \ C(P,H) = P^\beta H^{-\gamma},$$

with $0 < \alpha < 1$, $\beta > 1$ and $\gamma > 0$. We start with the extreme case where γ tends to 0. An alternative specification of the cost function is discussed in the last subsection.

A.1.1 Case where the revolution cost is independent of human capital

We simply assume $\gamma = 0$ in this special case. We can then study explicitly whether the [NRC] is fulfilled in this case. The main results are given in the proposition below.

Proposition 1. *The following cases emerge:*

i) There exists $\bar{b} \in]0\ 1[$ such that [NRC] holds for $b \geq \bar{b}$ provided $\beta > \frac{1}{\alpha}$. Moreover, if A is large enough, [NRC] holds $\forall b$ whenever $\beta > \frac{1}{\alpha}$.

ii) If $\beta < \frac{1}{\alpha}$, then there exists $\bar{b} > 0$, such that [NRC] does not hold for $b \geq \bar{b}$.

iii) If $\beta = \frac{1}{\alpha}$, then [NRC] holds $\forall b$, provided A is large enough.

The proof is easy, we sketch it briefly. In Step 1, the level of education is determined by maximisation of the payoff $\Pi(N)$ with respect to H yielding

$$H^* = \left(\frac{\alpha A}{1 - b} \right)^{\frac{1}{1-\alpha}}. \tag{A6}$$

Therefore, not surprisingly, H^* goes to infinity when b goes to 1. Denote by $G(b)$ the left-hand side of [NRC], which depends on b too; we have

$$G(b) = C(\bar{P}) = C\left(AF(H^*) - (1 - b)\, H^*\right) = (\alpha\, A)^{\frac{\beta}{1-\alpha}} \left(\frac{1}{\alpha} - 1 \right)^{\beta} (1 - b)^{\frac{-\alpha\beta}{1-\alpha}}.$$

Taking the ratio of the left-hand to the right-hand sides of [NRC] yields:

$$\Delta(b) \equiv \frac{G(b)}{bH^*} = \frac{K}{b}\ (1 - b)^{\frac{1-\alpha\beta}{1-\alpha}}, \tag{A7}$$

where K is a well-defined constant, independent of b and increasing in A. Proposition 1 derives immediately from the expression above. As β increases, the (perceived) contestability of the regime, which is inversely related to the size of $C(\bar{P})$, goes down *ceteris paribus*. The larger β, the more effective repression is and the less contestable the dictator is, and [NRC] is more likely to hold. Moreover, for given β and given b, the larger $\bar{P}$, the more resources can be available for repression. In particular, as the constant K in equation (A7) is increasing in A, the larger A, the more [NRC] is likely to hold.

Indeed, two aspects are critical in the decision of citizens to revolt: the capacity of the autocrat to repress, that is the magnitude of $\bar{P}$, which is intricately related to the scale of the economy A,[26] and the perceived degree of contestability of the regime as captured by parameter β. Proposition 1 shows clearly that the latter aspect dominates in the revolutionary outbursts. It turns out that if β is not large enough, here if $\beta < \frac{1}{\alpha}$, [NRC] is impossible to hold for b large enough as $\Delta(b)$ goes to 0 when b goes to 1. The reverse occurs when β is above the threshold $\frac{1}{\alpha}$ since $\Delta(b)$ goes to infinity when b goes to 1. In the latter case, [NRC] can hold for all $b \in [0; 1]$ provided A is large enough. If we interpret A as the level of development of the autocratic economy or, more basically, its scale, it results that revolutions are more easily averted in the biggest and most developed autocratic

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[26]The capacity to repress is also determined by the size of resource windfalls (typically, the amount of revenues from natural resources exports), see Boucekkine et al. (2016).

countries provided the regime is fierce enough.[27]

A.1.2   The defanging effect of education

We now consider the case where $\gamma > 0$. Note that in this scenario, using trivially multiplicative separability, we can reformulate [NRC] as follows:

$$G(b) \geq b \ (H^*)^{1+\gamma} \tag{A8}$$

where $G(b)$ is given just above. Let us consider the case i) of Proposition 1 where β being bigger than $\frac{1}{\alpha}$, player N can always block revolutions whatever the degree of autocracy, b (for A large enough). The following results can be then readily derived from the previous computations.

Proposition 2. *Suppose $\beta > \frac{1}{\alpha}$. The following cases emerge:*

  i) [NRC] holds $\forall b, 0 < b \leq 1$ provided $\gamma < \alpha\beta - 1$, and A is large enough.

  ii) If $\gamma > \alpha\beta - 1$, then there exist $\bar{b} > 0$, such that [NRC] does not hold for $b \geq \bar{b}$.

  iii) If $\gamma = \alpha\beta - 1$, then [NRC] holds $\forall b, 0 < b \leq 1$ provided A is large enough.

As announced, when adding the human capital effect on perceived contestability, (non-violent) protest campaigns are more likely in autocratic regimes. Notice that by Property ii) of Proposition 2, the elasticity of the cost function with respect to human capital needs not be large (relative to the elasticity with respect to repression) to increase contestability. In particular, as β gets closer to the cutoff value $\frac{1}{\alpha}$, the value of γ needed to trigger revolutionary outbursts when autocracy worsens goes to zero. That is to say the defanging effect of education is powerful, thanks to the use of non-violent resistance.

A.2   The full internalisation case

While the timing considered so far seems to correspond to a large number of experiences in autocratic regimes, one could object that our theoretical results are essentially driven by the assumed sequence of events. We study hereafter an alternative problem where player N chooses P and H

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[27]An edge-of-knife case occurs in the cutoff case $\beta = \frac{1}{\alpha}$. It is easy to see that this cutoff value is exactly the parametric case where the impact of b through H^* is nullified in $\Delta(b)$: at this cutoff value, the effect through H^* on the wage wedge in [NRC] is totally offset by its counterpart on the cost of revolution (increasing resources for repression). In such a case, the main determinant of [NRC] to hold for b close enough to 1 is the size of the economy.

simultaneously. In such a configuration, player N would probably choose a much lower level of education to prevent the subsequent impact on regime contestability. This is in line with one of the results put forward by Boucekkine et al. (2019) who outline the emergence of optimal solutions with zero investment in education and no political regime change. We prove here a similar result as, under some parametric conditions, an optimal solution emerges with [NRC] fulfilled when b goes to 1 with finite education, while in the sequential game above optimal education is infinite when b increases to 1. We later discuss the admissibility of the two alternative timings.

Consider that player N maximises their payoff $\Pi(N)$ simultaneously in P and H under the joint constraints [NRC] and payoff nonnegativity

$$C(P,H) \geq bH \tag{A9}$$

$$AF(H) - (1-b)H \geq P, \tag{A10}$$

The following proposition can then be proved:

Proposition 3. *The first-order conditions of the joint optimisation one-step problem yield:*

i) *The [NRC] is always binding.*

ii) *Provided $\gamma > \alpha\beta - 1$, and for b large enough, there exists a unique solution $\left(\tilde{H}(b), \tilde{P}(b)\right)$, the limits of both are finite when b goes to 1. The limit education increases with A, and it is decreasing in γ (for A large enough).*

iii) *For b large enough, the solution $\left(\tilde{H}(b), \tilde{P}(b)\right)$ is optimal if $\gamma \geq \beta - 1$ (second-order conditions met).*

The detailed proof is given below. Property i) ultimately means, beside the binding nature of the [NRC] at the optimum, that if an optimal solution exists, it ensures that revolutions are averted for a given level of autocracy, b. This is a substantial difference with respect to the previous cases without internalisation. We focus on the case the most favourable for a revolution to occur: b large enough (as exemplified in the non-internalisation cases studied above).

Property ii) is key. For b large enough, such optimal solutions averting revolutions indeed

exist, and can be characterized precisely (see below). In particular, when b tends to 1, one gets:

$$\tilde{H}(1) = \left[\frac{\beta\alpha A}{1+\gamma}\right]^{\frac{\beta}{1+\gamma-\alpha\beta}}.$$

Clearly, education increases with A provided $\gamma > \alpha\beta - 1$. Notice that the latter condition covers the case where [NRC] fails to hold (for b large enough) in Proposition 2 due to the destabilising effect of education in the sequential game studied before. In the alternative timing, if the dictator internalises this destabilising effect, then they invest less in education and may ultimately avert revolutions. Note also that the education chosen is generally decreasing in γ: the larger the destabilising effect of education (through γ), the lower the level of education chosen.

The simple model presented above illustrates at a minimal algebraic cost how the defanging effect of education works. We could have obtained the same outcome by endogenising β as a decreasing function of H. Our alternative modelling allows for a complete analysis with minimal algebra.

A.2.1 Proof of Proposition 3

N maximises their payoff $\Pi(N)$ in P and H under the [NRC] and payoff nonnegativity constraint:

$$
\begin{aligned}
C(P,H) &\geq bH \\
AF(H) - (1-b)H &\geq P.
\end{aligned}
$$

The latter conditions can be rewritten with our specifications as the equivalent set of constraints

$$
\begin{aligned}
P^\beta - bH^{1+\gamma} &\geq 0 \\
\Pi(N) \equiv AH^\alpha - (1-b)H - P &\geq 0.
\end{aligned}
$$

The corresponding augmented Lagrangian is

$$L = \Pi(N) + \mu_1\left(P^\beta - bH^{1+\gamma}\right) + \mu_2\left(AF(H) - (1-b)H - P\right),$$

with μ_i, $i = 1, 2$ the corresponding Kunh-Tucker multipliers. The necessary first-order conditions with respect to P and H respectively, are:

$$-1 + \mu_1 \ \beta P^{\beta-1} - \mu_2 \ = \ 0 \qquad (A11)$$

$$\left(\alpha A H^{\alpha-1} - (1 - b)\right)(1 + \mu_2) - \mu_1(1 + \gamma)b \ H^\gamma \ = \ 0, \qquad (A12)$$

with the usual slackness conditions:

$$\mu_1 \ \left(P^\beta - bH^{1+\gamma}\right) = 0, \mu_1 \geq 0,$$

and

$$\mu_2 \ (AF(H) - (1 - b)H - P) = 0, \mu_2 \geq 0.$$

We now show how to derive the solution of the optimisation problem above. At first, one has to observe that [NRC] can only bind. If it does not bind, then by the first slackness condition, $\mu_1 = 0$, leading to $\mu_2 = -1$ by the necessary condition (A1), which is impossible. This proves Property i) of Proposition 3. Additionally, one gets from the binding [NRC]:

$$P = b^{\frac{1}{\beta}} \ H^{\frac{1+\gamma}{\beta}}. \qquad (A13)$$

Property (iii) about the second-order conditions can be readily extracted using the classical bordered Hessian matrix argument given that the [NRC] is always binding. If $\gamma > \beta - 1$, these conditions are met.

Property (ii) requires more algebra as it has to do with computing the optimal [NRC] solutions if any. To find these optimal solutions $\left(\tilde{H}(b), \tilde{P}(b)\right)$, consider equations (A1)-(A2). One can observe that both equations allow to express the same ratio $\frac{1+\mu_2}{\mu_1}$ in terms of P and H respectively. Identifying the two expressions yields another equation involving P and H, to be combined with equation (A3), and ultimately allowing to solve for the joint decision (P, H). When b goes to 1, the second equation in (P, H) can be written as:

$$\beta P^{\beta-1} = \frac{1 + \gamma}{\alpha A} \ H^{\gamma-\alpha+1}. \qquad (A14)$$

Solving (A3)-(A4) with $b = 1$ yields:

$$\tilde{H}(1) = \left[\frac{\beta\alpha A}{1+\gamma}\right]^{\frac{\beta}{1+\gamma-\alpha\beta}}. \tag{A15}$$

It is then possible to come out with the remaining optimality conditions, showing in particular that the payoff non-negativity constraint is not binding at the optimum. Indeed, when b goes to 1 and given that [NRC] is binding, a non-binding payoff non-negativity constraint is equivalent to $AH^\alpha > H^{\frac{1+\gamma}{\beta}}$ or to $H < A^d$ with $d = \frac{\beta}{1+\gamma-\alpha\beta}$, $d > 0$ as we assume $\gamma > \alpha\beta - 1$. Once we substitute for H using equation (A5), we get the equivalent inequality: $\left(\frac{\alpha\beta}{1+\gamma}\right)^d < 1$, which obviously holds as $\alpha\beta < 1+\gamma$. So the payoff non-negativity constraint is not binding and $\mu_2 = 0$. We can then observe that $\mu_1 > 0$ by (A1). $\square$