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GUARDING THE GUARDIANS*

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Good government requires some restraints on the powerful but how can those be imposed if there is no-one above them? This article studies the equilibrium allocation of power and resources established by self-interested incumbents under the threat of rebellions from inside and outside the group in power. Commitment to uphold individuals' rights can only be achieved if power is not as concentrated as incumbents would like it to be, *ex post*. Power sharing endogenously enables incumbents to commit to otherwise time-inconsistent laws by ensuring more people receive rents under the status quo and thus want to defend it.

> Princes who want to make themselves despotic have always begun by uniting all magistracies in their person.
>
> Montesquieu (1748), De l'esprit des lois

Economic development requires restrictions on the untrammelled exercise of power by incumbents. For example, a system of private property entails a commitment to respect individuals' rights at times when expropriation is physically feasible and in the interests of those in power. But how can the rule of law be upheld when there is no force above the group in the power that can control its acts? This is the classic question of 'who will guard the guardians?'

The methodological contribution of this article is a framework suitable for studying this question. Incumbents can establish an allocation of power and resources. Power can be shared, so incumbency is endogenous. There is a mechanism through which any collection of individuals (including some or all of the incumbents) can contest the existing allocation. Individuals with power may use it to defend the status quo against such attacks. The model thus determines the allocation of power and resources laid down by self-interested incumbents subject to the struggle for power – the threat that an allocation can always be contested by any

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group. The framework can be used to understand whether and how there can be protection of individual rights.[1]

In the model, there is no aspect of the allocation of power and resources that will stand outside the struggle for power: the mechanism for contesting an existing allocation is the same no matter what that allocation prescribes. Likewise, there are no individuals who inherently have either a special desire or ability to defend particular features of an allocation: everyone is *ex ante* identical. There are also no exogenous restrictions on what allocations of resources are feasible through the use of taxes or transfers.

The main result of the article is that it is possible to guard the guardians by sharing power. Credible commitment to protect individual rights – the 'rule of law' – can be achieved if and only if power is not as concentrated as incumbents would like it to be, *ex post*. Sharing power (and the rents that go with it) works as a commitment device not because power is shared with individuals who have some specific characteristics or roles but because it increases the number of individuals willing to defend the status quo against any threats coming from inside or outside the group in power. Although incumbents are free to devise any system of transfers among individuals, power sharing is a necessary and sufficient condition for commitment to otherwise time-inconsistent laws.

One implication of the model is that an increase in investment returns due to new technological discoveries spurs incumbents to share power, which gives rise to the rule of law – in the sense of protecting investors' property from expropriation. The model is thus consistent with the emergence of parliaments and independent courts as a consequence of technological progress that increases the gains from long-term investments.[2] Greater returns from investment provide an incentive for incumbents to share power more broadly in order to increase the amount of output available for them to tax, even though this will dilute the rents they receive. Another implication of the model is that the reach of the rule of law in equilibrium will fall short of what is efficient because sharing power entails sharing rents.

The 'rule of law' referred to above is a situation where laws are followed even when incumbents would like to set them aside, that is, where there is some mechanism for guarding the guardians. This ought not to be confused with democracy, which can be seen as a set of laws determining the allocation of resources in society in accordance with the results of elections. The rule of law is thus a more fundamental feature of a state and a crucial building block of any well functioning economy. In fact, an unrestrained median voter would generally not respect property rights because expropriation and redistribution would benefit the majority *ex post*.

[1] It would be possible to introduce an exogenous 'higher-level' institutional technology that directly allows for commitment to laws (perhaps at some cost) into a standard model of political economy. However, this would be as a *deus ex machina* that simply overrides the ability of incumbents to exploit their own power, failing to do justice to the question if the aim is to understand how commitment to laws is actually achieved.

[2] The implication that technological progress leads to greater power sharing is testable in principle. One challenge is that stronger protection of property rights might itself boost technological progress by raising the return to research and development. Testing the model would require disentangling these two channels, for example, through the use of an instrument for technological progress.

Section 1 describes the workings of the model and Section 2 compares it to related literature. Section 3 then presents the model of the power struggle in a simple setting where commitment issues do not arise. The fully fledged model with investment is analysed in Section 4. Finally, Section 5 draws some conclusions.

1. The Workings of the Model

The model begins with an allocation of power and resources established in the interests of incumbents (who take account of what will happen next). There are then opportunities to contest the allocation, referred to as rebellions. Rebellions can come from any subset of the population, including some or all of those in power. A successful rebellion leads to another round of this process and so on. When no rebellions occur, the prevailing allocation of resources is implemented. In equilibrium, rebellions will not occur but the threat of them is crucial in determining the nature of the allocation that will prevail.

At the heart of the model is a theory of the distribution of power and resources, which is first illustrated in a simple endowment economy where commitment issues have no bearing on output. Incentives to rebel depend on the payoffs the rebels expect to receive under a new allocation as the new incumbents. Since all individuals are *ex ante* identical and since the economic environment does not change, the equilibrium allocation is the fixed point of the constrained maximisation problem of the incumbents subject to the threat of rebellion, where subsequent incumbents would be similarly constrained by equivalent threats of rebellion. As in George Orwell's *Animal Farm*, there is no essential difference between the 'pigs' and the 'men' they replace but, in equilibrium, some individuals will be 'more equal' than others.

In the endowment economy, the equilibrium distribution of resources is tied to the distribution of power. Those with equal power receive the same payoff and those with more power receive a higher payoff. The intuition is that in comparing two individuals of equal power, one with a lower payoff would have more to gain from rebellion and would therefore be willing to exert greater effort in contesting the allocation; while comparing two individuals with the same payoff, one with more power would pose a greater danger. Since any rebellion will be launched by a subset of the population, the incumbents are concerned with the group of individuals having the greatest incentive to rebel. This means rewarding the powerful to keep them on side, while otherwise equalising payoffs to avoid concentrating disenchantment. Sharing power thus always entails sharing rents.

There is a basic trade-off in this environment that characterises the equilibrium allocation of power. On the one hand, the greater the number of individuals sharing power as the incumbent group, the greater their ability to defend the status quo against rebellions, which allows them extract more rents from those outside the group. On the other hand, the rents must then be divided more thinly among more individuals. The equilibrium size of the incumbent group maximises the payoff of each member by striking a balance between these two effects.

The fully fledged model adds an investment technology to the environment described above, which will give rise to a time-inconsistency problem. Individuals who invest incur an immediate effort cost, while the fruits of their investment are realised only after a lag. During this time, there is the ever-present opportunity for any group of individuals to launch a rebellion. Were a rebellion to occur after investments have been made, the group in power following the rebellion would have an incentive to expropriate fully investors' capital because the effort cost of investing would then be sunk.

To provide appropriate incentives for individuals to invest, the allocation of resources laid down prior to investment decisions must offer investors a higher payoff and, importantly, the allocation must survive rebellions so that what it prescribes is actually put into practice. In an endowment economy, the incumbents' principal concern is in avoiding a 'popular uprising', a rebellion of outsiders. When offering incentives to investors, the danger of this type of rebellion increases but it also becomes essential to avoid a 'coup d'état', a rebellion launched by insiders. The higher payoff enjoyed by investors is only in the interests of the incumbents *ex ante*, so *ex post* there is a time-inconsistency problem. In other words, the incumbents themselves want to rebel so they can choose a new allocation of resources that does not protect investors' property rights.

It is therefore necessary to reduce the incentive to rebel simultaneously for those inside and outside the incumbent group. This can only be done by expanding the size of the group in power – the problem cannot be solved by any alternative allocation established *ex ante* that specifies how resources will be distributed *ex post*. If higher payoffs were offered to some to reduce their willingness to rebel, resources would have to be taken away from others, increasing their incentive to rebel. Fundamentally, transfers of resources can only redistribute disgruntlement with an allocation. In contrast, enlarging the group in power reduces the attractiveness of all types of rebellions by increasing the number of individuals who will lose power if a rebellion succeeds. This increases the size of the group willing to defend the current allocation.

Simply adding the possibility of investment to the model therefore gives rise to an equilibrium with power sharing among a larger group. Sharing power is an endogenous commitment mechanism that allows the incumbents to act as a government bound to a set of laws that would otherwise be time inconsistent. The analysis thus highlights the importance of sharing power as a way of guaranteeing commitment to individuals' rights, allowing in particular for incentives to invest. This resonates with Montesquieu's doctrine of the separation of powers, now accepted and followed in well-functioning systems of government. Note that power is not shared here with those individuals who are actually investing. The additional individuals in power in no sense represent nor care about those who invest – but they do care about their own rents under the status quo. By this means, a group of self-interested individuals is able to act as a government constrained by the rule of law.

Although investors generally receive some protection against expropriation in equilibrium, power sharing and hence the reach of the rule of law fall short of what is socially optimal. Equilibrium investment is inefficiently low in the sense that total output available for consumption could be increased by having a larger group in power to reduce the proportion of investors' returns that is expropriated. The intuition comes from the inseparability of power and rents, which follows from the threat posed by powerful individuals in case of conflict. It is not possible in equilibrium for incumbents to share power with more individuals yet not grant them the same payoff as their equally strong peers. This places an endogenous and binding limit on the set of possible transfers, so some Pareto-improving deals remain unfulfilled.

2. Comparison with the Existing Literature

The idea of sharing power as a commitment device might be reminiscent of the role played by the extension of the franchise in Acemoglu and Robinson (2000) and Jack and Lagunoff (2006). As in that literature, there is too little protection of property rights in the model here. However, there are substantial differences in terms of both assumptions and results. First, in those articles, extending the franchise means choosing an intrinsically different median voter who will, in future periods, choose policies to which the current elite would like to commit.[3] That type of model assumes the existence of democratic institutions. Here, in contrast, sharing power means simply enlarging the incumbent group (all individuals are *ex ante* identical). This does not rely on exogenous differences in preferences and a world where electoral outcomes are always respected but on changes to the costs of rebellions that in turn affect the allocation of power and resources prevailing in equilibrium.

Second, protecting property rights here means protecting the interests of a minority, which is most likely true in practice: expropriation and redistribution will always benefit the majority (*ex post*) as long as the mean of the distribution of wealth is larger than the median. This suggests democracy alone will be no guarantor of property rights. In contrast, this article shows how the rule of law emerges through power sharing. By providing a mechanism for guarding the guardians, power sharing allows a minority not in power to invest even though those in power and a majority of the population would like to expropriate their capital *ex post*.

Consistent with this observation, as Acemoglu and Robinson (2000) point out, the extension of the franchise in England in the second half of the nineteenth century led to a large increase in taxes on the rich and a reduction in inequality. By then, the Industrial Revolution was well under way. The Glorious Revolution, which arguably led to the most decisive break with past government expropriations of property and greatly strengthened the rule of law in England, occurred at the end of the seventeenth century and did not coincide with any significant enfranchisement of the poor. Thus, both theoretically and empirically, it is at best unclear that enfranchisement of the poor has a positive effect on protection of property rights.

As discussed in Acemoglu (2003), if a 'political Coase theorem' were to hold, this would mean that political issues have distributional consequences but no implications for efficiency. However, Acemoglu argues that commitment problems are the major reason why a 'political Coase theorem' fails to apply in practice. This points to understanding better how commitment to rules can actually be maintained, which requires a model in which the ability to commit is not assumed but explained. Here, the breakdown of a 'political Coase theorem' is an implication of the means through

[3] Choosing a different median voter plays a similar role to delegation of monetary policy to a 'conservative' central banker in Rogoff (1985). For a related dynamic analysis of policymaking and political power, see Bai and Lagunoff (2011).

which commitment occurs. The model shows that power and rents are inseparable, which implies an endogenous and binding constraint on the set of transfers among individuals. Commitment requires sharing power, which in turn requires sharing rents, and this is a cost from the point of view of those in power.[4]

The literature has proposed a number of mechanisms through which commitment to rules can be sustained, including protection of property rights. Work building on Kydland and Prescott (1977) has studied how commitment can arise in infinitely repeated games in a variety of macroeconomic settings. Moreover, if individual preferences were aggregated through a political process in which wealthy groups have more influence, as in Benabou (2000) and Bai and Lagunoff (2013), property owners would be in a stronger position to uphold their legal rights.

This article is also related to a burgeoning literature on institutions.[5] The models in Acemoglu and Robinson (2006, 2008) also consider incumbent elites that are constrained by the threat of insurrection. In spite of this similarity, the questions addressed in those papers are very different. In particular, they do not study whether and how commitment can arise and, since they take the size of the group in power as exogenously given, there is no place for power sharing in their analysis. Furthermore, there are important differences in how those papers model conflict. The effects of institutional frictions and political turnover on investments in fiscal capacity and state capacity are studied in Besley and Persson (2009*a*, *b*, 2010) but questions about how commitments can be made and how power is shared are beyond the scope of those papers. Greif (2006) also develops game-theoretic models to shed light on political relations, with a focus on medieval history in particular.

The modelling strategy in this article shares some features of the literature on coalition formation (Ray, 2007).[6] As in that literature, the process of establishing an allocation is non-cooperative but it is assumed that in the absence of rebellion the allocation is actually implemented.[7] Moreover, the modelling of rebellions here is related to blocking in coalitions (Ray, 2007, part III) in the sense that there is no

[4] Other aspects of power sharing have been explored in the literature, for example, Persson *et al.* (1997) and Francois *et al.* (2015).

[5] Many researchers have posited institutions as a significant determinant of economic development and the large differences found in the cross-country distribution of income (North and Weingast, 1989; North, 1990; Engerman and Sokoloff, 1997; Hall and Jones, 1999; Acemoglu *et al.*, 2005).

[6] Baron and Ferejohn (1989) analyse bargaining in legislatures using that approach, while Levy (2004) studies political parties as coalitions. Other contributions include Chwe (1994), Koray (2000), Barbera and Jackson (2004), Acemoglu *et al.* (2008), Piccione and Razin (2009) and Acemoglu *et al.* (2012).

[7] What ensures the established allocation of resources is actually implemented *ex post* if no rebellion occurs? As pointed out by Basu (2000) and Mailath *et al.* (2001), laws and institutions do not change the physical nature of the game, all they can do is affect how individuals coordinate on some pattern of behaviour. One possible interpretation of this approach is similar to the application put forward by Myerson (2009) of Schelling's (1960) notion of focal points in the organisation of society. The 'rules of the game' are self enforcing as long as society coordinates on punishing whomever deviates from the established allocation – and whomever deviates from punishing the deviator. Following this, theorising about institutions is theorising about:

(*i*) how allocations (or focal points) are chosen; and
(*ii*) how allocations can change.

For example, Myerson (2004) explores the idea of justice as a focal point influencing the allocation of resources in society. This article takes a more cynical view of our fellow human beings: those in power choose an allocation to maximise their own payoffs subject to the threat of rebellions.

explicit game-form. One important distinction is the actual modelling of power and conflict in this article. An incumbent coalition proposes an allocation but blocking requires (among other things) that an alternative coalition is willing to put in enough fighting effort to displace the current incumbents. Furthermore, while that literature focuses on characterising stable coalitions, in the sense of allocations for which there is no profitable deviation, this article studies the allocation of power and resources in the interests of an incumbent group that takes account of the threat of rebellion.

The article is also related to the literature on social conflict and predation, surveyed by Garfinkel and Skaperdas (2007).[8] It is easy to envisage how conflict could be important in a state of nature: individuals could devote their time to fighting and stealing from others. However, when there are fights, there are deadweight losses. Thus, it would be efficient if individuals could avoid conflict by agreeing and adhering to an allocation of resources. This article supposes such deals are possible. Hence, differently from the literature on conflict, individuals may fight to be part of the group that determines the allocation but not directly over what has been produced. Moreover, they fight in groups, not as isolated individuals.

Last, this article is related to work focusing on political issues that lead to inefficiencies in protecting property rights, such as Glaeser *et al.* (2003), Acemoglu (2008), Guriev and Sonin (2009) and Myerson (2010). Those papers make assumptions on institutions to study how they affect the incentives of judges, oligarchs, dictators and entrepreneurs, and how that translates into economic outcomes.[9] The objective and approach of this article are different: here, assumptions are made on the power struggle to understand whether and how commitment to protect property rights can emerge in equilibrium.

3. A Model of the Power Struggle

This Section presents an analysis of the equilibrium allocation of power and resources in a simple endowment economy where commitment issues are absent.

3.1. *Preferences, Technologies, Allocations, and Rebellions*

There is an area containing a measure-one population of ex-ante identical individuals indexed by $\imath \in \Omega$. Individuals receive utility $\mathscr{U}(C,F)$ from their own consumption C of a homogeneous good and disutility if they exert fighting effort F:

$$\mathscr{U}(C,F) = u(C) - F, \tag{1}$$

where $u(\cdot)$ is a strictly increasing and weakly concave function.

[8] See also Grossman and Kim (1995) and Hirshleifer (1995).

[9] Glaeser *et al.* (2003) focus on democratic societies and thus assume the existence of a legal system. Acemoglu (2008) compares democratic and oligarchic societies, assuming different institutions in each case. Guriev and Sonin (2009) study the interplay between a dictator and oligarchs, assuming oligarchs can choose between having a weak or a strong dictator (which can be seen as an institution that determines the set of possible actions of the dictator). Myerson (2010) assumes a dictator can choose political liberalisation, which is modelled as a probability that the dictator loses power if he expropriates capital.

In this simple economy, individuals who become workers receive an exogenous endowment of q units of goods.

There will be an allocation of power and resources that is determined endogenously through a process referred to as the power struggle. An allocation specifies the set $\mathcal{W}$ of workers and the set $\mathcal{P}$ of individuals currently in power, referred to as the incumbents. Each position of power confers an equal advantage on its holder in the event of any conflict, as described below. The term power sharing refers to a variable p, defined as the measure of the group $\mathcal{P}$. The incumbent group $\mathcal{P}$ can have any size between 0% and 50% of the population.[10] Those individuals in power cannot simultaneously be workers.[11]

An allocation also prescribes how goods are distributed across all individuals. Let $C_\mathrm{p}(\imath)$ and $C_\mathrm{w}(\imath)$ denote the individual-specific consumption levels of incumbent $\imath \in \mathcal{P}$ and worker $\imath \in \mathcal{W}$ respectively specified by an allocation. The allocation must satisfy the resource constraint:

$$\int_{\mathcal{P}} C_\mathrm{p}(\imath)\mathrm{d}\imath + \int_{\mathcal{W}} C_\mathrm{w}(\imath)\mathrm{d}\imath = \int_{\mathcal{W}} \mathrm{q}\mathrm{d}\imath, \tag{2}$$

and each individual's consumption level must be non-negative.

Formally, an allocation is a collection $\mathscr{A} = \{\mathcal{P}, \mathcal{W}, C_\mathrm{p}(\imath), C_\mathrm{w}(\imath)\}$, where the sets $\mathcal{P}$ and $\mathcal{W}$ satisfy $\mathcal{P} \cup \mathcal{W} = \Omega$, $\mathcal{P} \cap \mathcal{W} = \emptyset$, and $p < 1/2$, and where the consumption levels $C_\mathrm{p}(\imath)$ and $C_\mathrm{w}(\imath)$ are consistent with the resource constraint (2) and non-negativity constraints.

The power struggle is depicted in Figure 1. An allocation is first established. There are then opportunities for rebellions, which are described in detail below. If a rebellion succeeds, a new allocation is established, followed by more opportunities for

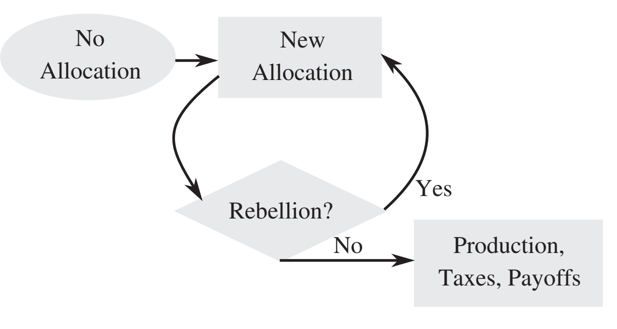

Fig. 1. *The Power Struggle*

[10] This is a simple way of modelling decreasing returns in strength with respect to the size of the group in power. The size constraint is generally not binding, but without it, it could be possible that there would be too few individuals outside the incumbent group to launch a rebellion, implying there would be increasing returns to the size of the group in power.

[11] The assumption that those in power do not receive the endowments of workers is not essential for the main results. It does mean there is an opportunity cost of individuals being in power, so strictly speaking, this is not a pure endowment economy. However, the resulting 'guns versus butter' inefficiency is not the focus of this article.

rebellions. When no rebellions occur, workers receive their endowments, resources are distributed according to the prevailing allocation and payoffs are received.

In calculating payoffs using the utility function (1), note that consumption is received only at the end of the process in Figure 1 and that any disutility from fighting effort is additively separable between different stages of the power struggle. There is no discounting of utility based on the number of iterations of the power struggle.

Rebellions are the only mechanism for changing an established allocation. A rebellion is described by a rebel army $\mathcal{R}$, an amount of (non-negative) fighting effort $F(\imath)$ for each individual $\imath \in \mathcal{R}$ who belongs to the rebel army and an incumbent army $\mathcal{D}$ that defends the current allocation. In a given rebellion, the rebel army can comprise those outside or inside the group currently in power, or a mixture of both. The incumbent army is drawn from those currently in power who do not join the rebel army. Formally, a rebellion is a collection $\{\mathcal{D}, \mathcal{R}, F(\imath)\}$, where the sets $\mathcal{D}$ and $\mathcal{R}$ satisfy $\mathcal{D} \subseteq \mathcal{P}$ and $\mathcal{D} \cap \mathcal{R} = \emptyset$.

A rebellion succeeds if:

$$\int_{\mathcal{R}} F(\imath)\mathrm{d}\imath > \int_{\mathcal{D}} \delta \mathrm{d}\imath, \tag{3}$$

which requires that the fighting strength of the rebel army exceeds the fighting strength of the incumbent army. Each army's fighting strength is the integral of the fighting strengths of its members. The fighting strength of individual $\imath \in \mathcal{R}$ in the rebel army is the amount of fighting effort $F(\imath)$ he exerts. Each individual $\imath \in \mathcal{D}$ in the incumbent army has fighting strength measured by a parameter δ (the power parameter), which is obtained at no utility cost to these individuals.[12]

Although the term rebellion is used to describe the process of changing an allocation, the formal definition encompasses 'popular uprisings' (the rebel army comprises only workers, $\mathcal{R} \subset \mathcal{W}$), 'coups d'état' (the rebel army is a subset of the incumbent group, $\mathcal{R} \subset \mathcal{P}$), 'suspensions of the constitution' (the rebel army includes all incumbents, $\mathcal{R} = \mathcal{P}$) and 'revolutions' that receive the backing of some insiders from the current regime (the rebel army includes a mixture of workers and incumbents).

3.2. *Equilibrium*

The requirements for an allocation to be an equilibrium of the power struggle described above are now stated. In what follows, let $U(\imath) = u[C(\imath)]$ denote individual $\imath$'s continuation utility under a particular allocation, and let U_{p} and U_{w} denote the average payoffs of incumbents and workers:

$$U_{\mathrm{p}} \equiv \frac{1}{p}\int_{\mathcal{P}} u[C_{\mathrm{p}}(\imath)]\mathrm{d}\imath, \text{ and } U_{\mathrm{w}} \equiv \frac{1}{1-p}\int_{\mathcal{W}} u[C_{\mathrm{w}}(\imath)]\mathrm{d}\imath. \tag{4}$$

[12] Rebellions in this model play a similar role to blocking in coalitions (Ray, 2007). One particularity of the model is that the effort rebels make in fighting is endogenous and this effort is costly. Subsection 3.4 further discusses the assumptions on the power struggle underlying the rebellion mechanism.

These payoffs assume that a given allocation prevails (with no further fighting effort incurred if there are no rebellions). The payoffs also exclude any past fighting effort.

An equilibrium allocation must be optimal in the sense of maximising the average payoff of the incumbents, taking into account the threat of rebellions. Any rebellions must be rational in the sense defined below. The notation $'$ is used to signify any aspect of the allocation that would be established following a rebellion.

DEFINITION 1. *A rebellion* $(\mathcal{D}, \mathcal{R}, F(\imath))$ *against the current allocation* $\mathscr{A}$ *is rational given the subsequent allocation* $\mathscr{A}' = \{\mathcal{P}', \mathcal{W}', C'_{\mathrm{p}}(\imath), C'_{\mathrm{w}}(\imath)\}$ *if:*

(*i*) *All individuals in the rebel army* $\mathcal{R}$ *expect a position of power under the subsequent allocation yielding a payoff no lower than what the individual would receive under the current allocation, and each individual's fighting effort* $F(\imath)$ *does not exceed his expected gain*:

$$\mathcal{R} = \{\imath \in \mathcal{P}' | U'_{\mathrm{p}} \geq U(\imath)\}, \ \textit{and} \ F(\imath) \leq U'_{\mathrm{p}} - U(\imath). \tag{5a}$$

(*ii*) *The incumbent army* $\mathcal{D}$ (*drawn from those currently holding positions of power who do not rebel*) *comprises those who would be worse off under the subsequent allocation*:

$$\mathcal{D} = \{\imath \in \mathcal{P} \backslash \mathcal{R} | U(\imath) > U'_{\mathrm{w}}\}. \tag{5b}$$

(*iii*) *Condition* (3) *for a successful rebellion holds.*

In a rational rebellion, the rebel army $\mathcal{R}$ includes only individuals who will be in power under the subsequent allocation, which is an assumption designed to capture the incentive problems in inducing individuals to fight. As discussed in subsection 3.4, this would allow for credible punishment of individuals who do not exert fighting effort, namely exclusion from the group subsequently in power. The maximum amount of fighting effort exerted by an individual in the rebel army corresponds to his utility gain from changing the allocation.[13] Analogously, an individual in power will join the incumbent army $\mathcal{D}$ to defend the current allocation if this is in his own interest. Note that restricting the rebels to those who would be in power under a subsequent allocation will actually restrict only the maximum number of rebels, not the identities or current status of those who can rebel.

For an allocation established at a stage of the power struggle in Figure 1 to be an equilibrium, the allocation must be optimal from the point of view of incumbents after taking account of the threat of any rational rebellions, where any allocation established following a rebellion must itself be an equilibrium (and so on for subsequent stages of the power struggle). Of those allocations satisfying these conditions, any that depend (apart from individual identities) on payoff-irrelevant histories are then deleted to leave a set of equilibrium allocations.

[13] The payoff from rebellion is the expected payoff net of fighting effort from being in the incumbent group under the subsequent allocation but with the assumption that if there is a non-degenerate distribution of consumption among those in power, individuals do not know in advance where they will be in this distribution. In equilibrium, there is a degenerate consumption distribution within the incumbent group, but this assumption simplifies the analysis.

Definition 2. *An allocation $\mathscr{A} = \{\mathcal{P}, \mathcal{W}, C_{\mathrm{p}}(\imath), C_{\mathrm{w}}(\imath)\}$ is an equilibrium of a stage of the power struggle if the following conditions are satisfied:*

(*i*) *Optimality for incumbents: The allocation $\mathscr{A}$ maximises the average utility U_{p} of incumbents when it is established, subject to:*

(*ii*) *Rationality of rebels: A rational rebellion occurs if according to Definition 1 there exists any rational rebellion against the current allocation $\mathscr{A}$ for some subsequent allocation $\mathscr{A}'$, subject to:*

(*iii*) *Threats of rebellion are credible: Any allocation $\mathscr{A}'$ established following a rebellion is itself an equilibrium of that stage of the power struggle.*

(*iv*) *Independence of irrelevant history: Allocations $\mathscr{A}$ and $\mathscr{A}'$ established at any two stages of the power struggle where fundamental (payoff-relevant) state variables are the same are identical up to a permutation of identities.*

The first equilibrium condition is that an allocation must be established in the interests of incumbents after taking account of the threat of rebellions. The second condition states that there will be a rebellion if and only if there is some rebellion in the interests of those who take part in it.[14]

It is never in the interests of incumbents to have an allocation that triggers a rational rebellion and, since there is no uncertainty in the model, no rebellions occur in equilibrium. Nevertheless, the problem of finding an allocation that maximises the average payoff of incumbents is effectively constrained by the threat of rebellions. With a slight abuse of language, the term 'no-rebellion constraint' is used below to refer to the restrictions on an allocation such that there is no rational rebellion for a particular rebel army (associated with a particular incumbent group under a subsequent allocation). The set of 'no-rebellion constraints' is the collection of these constraints for all possible compositions of the rebel army (associated with different subsequent incumbent groups).

The nature of the threat posed by rebel armies depends on what the post-rebellion allocation would be. The third equilibrium condition is that only subsequent allocations that are themselves equilibria of the power struggle can be considered when determining whether a rebellion is rational. Essentially, subsequent allocations must be in the interests of subsequent incumbents after taking account of further threats of rebellion. This excludes the possibility that rebels make a binding commitment to an allocation that is not in their interests *ex post* – for example, an allocation that would give rebels an incentive to exert more fighting effort now, but which would not be optimal once the fighting is over. Note that because there will be many subsequent equilibrium allocations with different compositions of the group in power, and as any one of these could follow a rational rebellion, the third requirement of equilibrium does not in itself restrict who can rebel.

The fourth condition is that equilibrium allocations depend only on fundamental state variables (fundamental meaning payoff relevant, for example, variables that

[14] In political-economy models (Acemoglu and Robinson, 2006; Besley and Persson, 2009*a*), it is conventional to treat groups (rather than individuals) as agents. Here, an allocation maximises the average payoff of individuals in an incumbent group but participation in a rebellion must be individually rational, and the sizes and composition of groups are not exogenously fixed.

appear in resource constraints), with the exception of individual identities. This Markovian restriction disciplines the equilibrium concept.[15] In the basic model so far, there are no fundamental state variables, therefore equilibrium allocations at any stage of the power struggle must be the same apart from changes in the identities of those in power. In the model of Section 4 below, the capital stock will be a fundamental state variable.

In summary, Definition 2 states that an equilibrium allocation must maximise incumbents' payoff (first condition) subject to avoiding any opportunity for rational rebellion (second condition), where the range of possible rational rebellions is itself limited by the set of equilibrium allocations that could be established following a rebellion (third condition). Note that the fourth (Markovian) condition does not operate as an additional constraint on the allocations that can be chosen in the interests of incumbents. Its role is in restricting which rebellions are rational (in conjunction with the third equilibrium condition) because the rationality of a rebellion depends on what allocation rebels anticipate being established following the rebellion. When any subsequent equilibrium allocation must depend only on fundamental state variables, an optimal allocation taking account of threats of rebellion need only depend on fundamental state variables.

Since individuals are *ex ante* identical, there is an essential indeterminacy in the identities of the incumbents and in the assignment of particular consumption levels to incumbents and workers in the case of non-degenerate distributions. If a certain allocation $\mathcal{A}$ is an equilibrium, otherwise identical allocations with any permutation of identities will also be equilibria. Therefore, the characterisation of the set of equilibrium allocations will determine power sharing p and the distribution of resources $C_{\mathrm{p}}(\cdot)$ and $C_{\mathrm{w}}(\cdot)$ but not specific identities. For conciseness these features of the set of equilibrium allocations are referred to as 'the' equilibrium allocation in what follows.

3.3. *Characterising the Equilibrium Allocation*

In the simple endowment-economy model, there are no fundamental state variables, so the equilibrium allocation can be determined as a fixed point of a constrained maximisation problem where the subsequent incumbents would face an identical problem following any rebellion. The equilibrium values of p^*, $C^*_{\mathrm{p}}(\cdot)$ and $C^*_{\mathrm{w}}(\cdot)$ are thus found in two steps. First, the value of p and the distributions $C_{\mathrm{p}}(\cdot)$ and $C_{\mathrm{w}}(\cdot)$ are chosen to maximise the average payoff of those in power subject to no rational rebellion, where the post-rebellion allocation p', $C'_{\mathrm{p}}(\cdot)$ and $C'_{\mathrm{w}}(\cdot)$ is taken as given. Conditional on the values of p' and U'_{p}, incumbents want to ensure that all 'no-rebellion constraints' hold, that is, there is no rational rebellion for each permutation of the identities of those in $\mathcal{P}'$. Second, the equilibrium conditions of identical power sharing $p' = p^*$ before and after rebellions and identical distributions of consumption for both groups $C'_{\mathrm{p}}(\cdot) = C^*_{\mathrm{p}}(\cdot)$ and $C'_{\mathrm{w}}(\cdot) = C^*_{\mathrm{w}}(\cdot)$ are imposed.

[15] Without this restriction, it might in principle be possible to find a sequence of different allocations associated with different stages of the power struggle that would justify different equilibrium allocations at an earlier stage of the power struggle.

The following Proposition derives some necessary features of any equilibrium allocation in this environment.

PROPOSITION 1. *Any equilibrium allocation must have the following properties:*

(*i*) *Equalisation of workers' payoffs*: $U^*_{\mathrm{w}}(\imath) = U^*_{\mathrm{w}}$ *for all* $\imath \in \mathcal{W}$ *(with measure one).*
(*ii*) *Sharing power implies sharing rents*: $U^*_{\mathrm{p}}(\imath) = U^*_{\mathrm{p}}$ *for all* $\imath \in \mathcal{P}$ *(with measure one).*
(*iii*) *Power determines rents*: $U^*_{\mathrm{p}} - U^*_{\mathrm{w}} = \delta$.
(*iv*) *The allocation maximises the payoff of incumbents subject to a single 'no-rebellion constraint' for a rebel army comprising only workers*:

$$U'_{\mathrm{p}} - U_{\mathrm{w}} \leq \delta \frac{p}{p'}, \tag{6}$$

with all other 'no-rebellion constraints' being redundant.
(*v*) *An equilibrium always exists and is unique up to permutations of identities. Equilibrium power sharing* p^* *satisfies* $0 < p^* \leq 2 - \varphi$, *where* $\varphi \equiv (1 + \sqrt{5})/2 \approx 1.618$.[16]

Proof. See on-line Appendix A.1.

The first two parts of the Proposition demonstrate that incumbents have a strong incentive to avoid inequality except where it is matched by differences in power. These results hold even when the utility function is linear in consumption, and so do not depend on strict concavity.

The intuition for the payoff-equalisation results is that the most dangerous composition of a rebel army is the one including those individuals with the greatest incentive to fight. A rebel army will always be a subset of the whole population. As a consequence, if there were payoff inequality among workers, the most dangerous rebel army would not include those workers who receive a relatively high payoff. The incumbents could then reduce the effectiveness of this rebel army by redistributing from relatively well-off workers to the worse off.[17] This slackens the set of 'no-rebellion constraints', allowing the incumbents to achieve a higher payoff. These gains are exploited to the maximum possible extent when all workers' payoffs are equalised.[18] Similarly, inequality in incumbent payoffs is undesirable because incumbents receiving a relatively low payoff can defect and join a rebel army. Equalising incumbent payoffs by redistributing consumption does not directly lower their average utility when the utility function is weakly concave, while it has the advantage of weakening the most dangerous rebel army. Since defections from the group in power weaken the incumbent army, there is no version of this argument that calls for equalisation of payoffs between workers and incumbents.

[16] The constraint $p < 1/2$ is always slack in equilibrium.
[17] Payoff equalisation implies equalisation of the maximum fighting effort workers are willing to put in.
[18] This result is different from those found in some models of electoral competition such as Myerson (1993). In the equilibrium of that model, politicians offer different payoffs to different agents. But there is a similarity with the model here because in neither case will agents' payoffs depend on their initial endowments.

Making use of the payoff-equalisation results in Proposition 1 and the resource constraint (2), the utilities of workers and incumbents are:

$$U_{\mathrm{w}} = u(C_{\mathrm{w}}), \text{ and } U_{\mathrm{p}} = u(C_{\mathrm{p}}) = u\left[\frac{(1-p)(\mathrm{q}-C_{\mathrm{w}})}{p}\right]. \tag{7}$$

As a consequence of the payoff-equalisation results, all that matters for the composition of a rebel army are the fractions σ_{w} and σ_{p} of its total numbers drawn from workers and from the group in power. The allocation must then be a solution of the problem:

$$\max_{p, C_{\mathrm{w}}} U_{\mathrm{p}} \text{ s.t. } \sigma_{\mathrm{w}} \max\{U'_{\mathrm{p}} - U_{\mathrm{w}}, 0\} + \sigma_{\mathrm{p}}(U'_{\mathrm{p}} - U_{\mathrm{p}} + \delta)\mathbb{1}[U'_{\mathrm{p}} \geq U_{\mathrm{p}}] \leq \delta \frac{p}{p'}, \tag{8}$$

for all non-negative proportions σ_{w} and σ_{p} that are feasible.[19] The first term in the constraint is the fighting effort that would be exerted by workers in a rebellion. The second term is the fighting effort exerted by any turncoat incumbents in a rebel army plus the loss of fighting strength of the incumbent army by not having these individuals in it (the term $\sigma_{\mathrm{p}}\delta$). The general form of the no-rebellion constraints stated in (8) is derived from the successful rebellion condition (3) and the participation constraints (5*a*) and (5*b*) on membership of the rebel and incumbent armies in the requirements for a rational rebellion,[20] with $\mathbb{1}[\cdot]$ denoting the indicator function.

The fourth claim in Proposition 1 states that the equilibrium allocation can be determined subject to a single no-rebellion constraint (6), which is equivalent to setting $\sigma_{\mathrm{w}} = 1$ and $\sigma_{\mathrm{p}} = 0$ in the general constraints of (8) (and noting that U'_{p} will exceed U_{w} in equilibrium). Satisfaction of (6) is clearly necessary but the Proposition shows that this single constraint is also sufficient to characterise the equilibrium allocation.[21] The constrained maximisation problem (8) thus reduces to:

$$\max_{p, C_{\mathrm{w}}} U_{\mathrm{p}} \quad \text{s.t.} \quad U'_{\mathrm{p}} - U_{\mathrm{w}} \leq \delta \frac{p}{p'}, \tag{9}$$

where U_{w} and U_{p} are as in (7), with p' and U'_{p} taken as given. In equilibrium, these are equal to the corresponding values p^* and U^*_{p} that solve the constrained maximisation problem.

The equilibrium allocation of resources can be implemented by having each worker $\iota \in \mathcal{W}$ face a tax (or transfer if negative) $\tau = \mathrm{q} - C_{\mathrm{w}}$. The payoff of each incumbent is increasing in the tax τ and decreasing in power sharing p because the total tax revenue must be distributed more widely (and because there are fewer workers to tax). The indifference curves of the incumbents over τ and p and the single binding no-rebellion constraint are plotted in Figure 2.

[19] Given the size of the rebel army p' and the sizes of the groups of workers and incumbents under the current allocation, feasibility requires $\sigma_{\mathrm{w}} \leq (1-p)/p'$, $\sigma_{\mathrm{p}} \leq p/p'$, and $\sigma_{\mathrm{w}} + \sigma_{\mathrm{p}} = 1$.

[20] The condition $U_{\mathrm{p}} > U'_{\mathrm{w}}$ for those in power who do not join a rebel army being willing to belong to the incumbent army defending the current allocation is always satisfied in equilibrium.

[21] This finding is specific to the simple endowment-economy model of this Section. In the fully fledged model with investment, other no-rebellion constraints become binding. Which compositions of the rebel army are associated with binding no-rebellion constraints in equilibrium is endogenous and will depend on the situation being analysed.

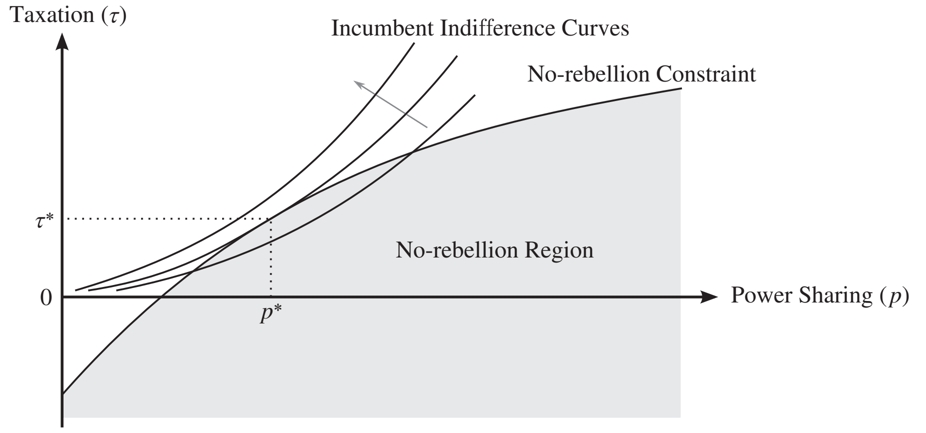

Fig. 2. *Trade-off Between Power Sharing and Taxation*

An increase in τ reduces the payoffs of workers, making them more willing to fight in a rebellion, while an increase in the size of the group in power boosts the fighting strength of the incumbent army, making rebellion less attractive to workers. The incumbents thus have two margins to avoid rebellions. They can reduce taxes τ (the 'carrot'), or increase their size p (the 'stick'). This corresponds to the upward-sloping no-rebellion constraint depicted in Figure 2.[22]

After taking into account the binding no-rebellion constraint, the key decision is how widely to share power. Incumbents face a fundamental trade-off in determining their optimal size: a larger size will make rebellions more costly and allow higher taxes to be extracted from workers but will also spread the revenue from these taxes more thinly among a larger number of individuals (and reduce the tax base). Proposition 1 shows that it is not possible in equilibrium to include extra individuals in the group in power without offering these individuals the same high payoff received by other members. Thus, sharing power entails sharing rents. The incumbents then share power with an extra individual if and only if this allows them to increase their average payoff. The allocation of power therefore reflects the interests of the incumbents, rather than the interests of society. In equilibrium, the utility value of the rents received by those in power depends only on the exogenous parameter δ.

3.4. *Discussion*

The model described above is designed to capture in a simple manner the 'power struggle' for control of the allocation of resources. An allocation of power and resources can be overthrown by rebellions and replaced by a new one. The success of a rebellion is settled by a basic 'conflict technology' that avoids going into the punches

[22] When utility is linear in consumption, the no-rebellion constraint is a straight line. The diagram shows the general case where utility is strictly concave in consumption, resulting in the constraint being a concave function.

and sword thrusts of battle. Everyone has access on the same terms to opportunities for rebellion, irrespective of their current status. Several assumptions are made for simplicity. The combatants' strengths are linear in the strengths of the individuals that make up the rebel and incumbent armies. Members of the incumbent army have a predetermined fighting strength (the power parameter δ), so this is inelastic with respect to current fighting effort. Given fighting strengths, there is no uncertainty about which side will emerge victorious.[23]

In modelling conflict, it is necessary to introduce some asymmetry between the rebel and incumbent armies for the notion of being 'in power' to be meaningful. The parameter δ represents the advantage incumbents derive from their entrenched position. It is fighting strength that is obtained at no current effort cost (though past fighting effort may have been expended in becoming an incumbent), while the rebels can only obtain fighting strength from current effort. The inelasticity of incumbent-army members' fighting strength with respect to current effort can be seen as an inessential simplification.[24] When the current allocation is established, there are several margins that can be adjusted to avoid rebellions, such as varying the number of individuals in power, or increasing the consumption allocated to those who would otherwise join a rebel army. The ability to adjust each incumbent's power δ at some cost in addition to these does not fundamentally change the problem. The rebel army, however, lacks these alternative margins, so it is essential that its fighting strength is responsive to the effort put in by its members.

One interpretation of the parameter δ is that the individuals currently in power possess some defensive fortifications, such as a castle, which place them at an immediate fighting advantage over any rebels who must breach these from outside. A broader interpretation is that δ represents the more severe coordination problems faced by rebels from outside the incumbent group. Authority depends on a chain of command, where individuals follow instructions in expectation of punishment from others if they disobey. The rebels confront the challenge of persuading enough individuals that they should fear punishment for disobeying them rather than the incumbents people are accustomed to.[25]

[23] An extension of the model where there is uncertainty about the outcome a rebellion is available upon request. This extension does not change any of the key results of the article. In many models in the political-economy literature, the threat of conflict plays an important role, but conflict does not actually occur in equilibrium. For example, see Acemoglu and Robinson (2006) and Francois *et al.* (2015). A discussion of models where conflict does occur in equilibrium is found in the survey by Blattman and Miguel (2010).

[24] An extension of the model with effort-elastic incumbent fighting strength is available upon request. This extension does not change any of the key results of the article. In some applications it might be important to consider other ways of increasing the cost of rebellions. Campante *et al.* (2013) extend the framework developed here to build a model where the cost of rebellion depends on how far a citizen is from the capital city. This means that isolating the capital city raises the cost of rebellions. Increasing military spending is another way the cost of rebellion might be raised. This is also analysed in Campante *et al.* (2013), where the finding is that military spending and isolating the capital city work as substitutes.

[25] Under this interpretation, the successful rebellion condition (3) can be seen as the rebels' effort requirement to demonstrate that they have the strength and the organisation to overcome these problems. Once the incumbents see this tipping point is reached, they surrender and no actual fighting takes place.

If a rebellion occurs and the existing allocation of power and resources is replaced by a new one, the old allocation has no effect on payoffs because consumption is assumed to occur only when an equilibrium is reached.[26] In effect, this assumption on timing disregards any short-lived effects of the old allocation after it is overthrown by a rebellion. Besides its simplicity, one advantage of this formulation for the purposes of the article is that it rules out any mechanism through which commitment to time-inconsistent laws can arise owing to the transitional dynamics that would follow a rebellion. If an allocation were to influence payoffs even though it has been overthrown then this could potentially deter (or stimulate) rebellions. It is also assumed that the occurrence of a rebellion does not destroy any of the goods available for consumption.[27]

The assumptions of the model allow for coordination among individuals in launching rebellions but subject to some restrictions. These restrictions are intended as a simple representation of the plausible constraints that ought to be placed on the set of possible deals or 'contracts' among the rebels. The fundamental contracting problem is the issue of enforceability in a world with no exogenous commitment technologies. The rebellion mechanism is intended to be as flexible as possible in allowing for 'deals' subject to the limits of enforceability.

The rebellion 'contract' implicit in the model requires a prescribed amount of fighting effort from each rebel in return for a place in the group in power under the new allocation. There is a restriction that rebel armies are open only to those who expect a place in the group subsequently in power. This rebellion contract raises two questions. Why are other forms of contract ruled out? And what suggests a contract of this form is not susceptible to enforceability concerns?

Consider a group of individuals with incentives to come together and agree to fight, enabling a new allocation to be established that offers each one of them a better payoff than what they would currently receive. The maximum fighting effort each would be willing to agree to is equal to each's expected utility gain. There are two facets of the enforceability problem for this 'deal'. First, after the success of the rebellion, will there be incentives to establish the particular allocation that was agreed beforehand? Second, will individual rebels honour their agreed levels of fighting effort?

A rebellion contract prescribing exactly what allocation is to be established faces formidable enforceability problems. Once the status quo is overthrown, there is no higher authority that can compel the group now in power to act against its interests *ex post*. This type of contract is therefore ruled out. The new allocation of power and resources must maximise the payoffs of those who are now the incumbents[28] starting afresh from the world as they find it, unconstrained by history except for fundamental

[26] This is different from the literature on dynamically stable coalitions, for example, Becker and Chakrabarti (1995) and Kalandrakis (2004) and closer to the literature on rules as self-selected fixed points, for example, Baron and Ferejohn (1989), Chwe (1994) and Koray (2000).

[27] An extension of the model where rebellions cause economic damage is available upon request. This extension does not change any of the key results of the article.

[28] In the model, an allocation being in the interests of the incumbent group is interpreted to mean maximising the average payoff of its members. Moving away from this simplifying assumption would require modelling the hierarchy and power relations within the incumbent group. See Myerson (2008) for a model which addresses that question.

state variables.[29] Any bygones will be bygones. In particular, this precludes the trigger strategies of repeated games as commitment devices.[30]

As Proposition 1 shows, incumbents have a strict preference to avoid payoff inequality except where it is matched by differences in power. It follows that the group now in power would have incentives not to honour contracts that specified either transfers to those who contributed fighting effort during the rebellion or fines for those who did not, hence such contracts cannot be written *ex ante*.

Now consider the second facet of the enforceability problem. Taking as given the payoff improvement an individual expects if a rebellion succeeds (subject to the restrictions on what can be agreed in advance regarding the new allocation), will it be possible to enforce the agreed amount of fighting effort from an individual who is party to a rebellion contract? The basic problem is that each atomistic individual (correctly) does not perceive himself as pivotal in determining whether the rebellion succeeds. Thus, left to his own devices, he would have an incentive to shirk and free-ride on others' fighting effort. To a large extent, rebel armies may be able to control individual members through internal discipline but a non-negligible enforceability problem remains when some necessary fighting is done at an individual's discretion.

To ensure that all agreed fighting effort is actually exerted, there needs to be a credible punishment that can be imposed on shirkers after the fact.[31] However, according to Proposition 1, only differences in payoffs that reflect differences in power are in the interests of incumbents *ex post*. This suggests that the offer of a position of power conditional on the requisite amount of fighting effort can provide a credible incentive not to shirk.[32] While the rebellion contract cannot determine the total number of positions of power under the new allocation, it can control the identities of those who will receive these positions.[33] But for those who anticipate becoming workers, even if they gain from the success of the rebellion, there is no worse position

[29] For simplicity, the occurrence of conflict does not itself affect any fundamental state variables. This implicitly assumes members of the rebel army can be demobilised costlessly once the fighting is over if, off the equilibrium path, there were more rebels than places in the new incumbent group. Adding a cost of demobilisation would make the size of the previous rebel army a state variable at the stage a new allocation is established, which would add a significant complication to the model without obviously delivering any new insights.

[30] Models that allow trigger strategies face the problem of multiple equilibria because there is always a range of possible punishments consistent with equilibrium.

[31] The model abstracts from imperfections of information. Taking account of less than perfect information might place additional restrictions on the range of punishments that are feasible.

[32] Suppose that a fraction ξ of an individual's agreed fighting effort (associated with some necessary tasks) cannot be directly enforced at the time through the rebel army's own discipline mechanisms but that the full amount of fighting effort F must be exerted otherwise the individual does not obtain fighting strength F. Suppose also that each individual's total fighting effort is verifiable after the rebellion. After agreeing to the rebellion contract, the individual is directly compelled to exert effort $(1-\xi)F$. If he exerts the remaining effort ξF then he subsequently receives his position of power with continuation payoff U'_{p}. If he shirks and exerts no further effort, he is demoted to worker status and receives payoff U'_{w}. Therefore, for individual $\imath$ to join the rebel army and contribute to the fighting, incentive compatibility requires $U'_{\mathrm{p}} - U'_{\mathrm{w}} \geq \xi F(\imath)$, while the maximum-effort participation constraint is $U'_{\mathrm{p}} - U(\imath) \geq F(\imath)$. If ξ is positive but sufficiently small then the incentive compatibility constraint is satisfied but not binding, while the participation constraint binds, as was implicitly assumed in the description of the rebellion mechanism.

[33] As the identities of the incumbent group have no effect on the maximum attainable payoffs of those in power, carrying out the punishment would not affect others in the incumbent group. Intuitively, since all individuals are *ex ante* identical, individuals in power do not care about the identities of those with whom they share power, only the total number of such people.

they can be credibly assigned if they fail to put in the agreed level of fighting effort. There is nothing to prevent such individuals from shirking,[34] which leads to the restriction that all rebels must expect a position of power.

3.5. *Example I: Utility Linear in Consumption*

There are three exogenous parameters in the model: the power parameter δ of an incumbent, the endowment q of a worker, and the utility function $u(\cdot)$ in consumption. This example illustrates the workings of the model with a linear utility function $u(C) = C$. The constrained maximisation problem (9) becomes:

$$\max_{p,C_{\mathrm{w}}} \frac{(1-p)(\mathrm{q}-C_{\mathrm{w}})}{p} \quad \text{s.t.} \quad C'_{\mathrm{p}} - C_{\mathrm{w}} \leq \delta \frac{p}{p'}, \tag{10}$$

after substituting the expressions for U_{p} and U_{w} from (7). The single no-rebellion constraint is binding, and can be used to solve explicitly for the consumption of a worker $C_{\mathrm{w}} = C'_{\mathrm{p}} - \delta p/p'$. Substituting that into the objective function yields the consumption of an incumbent:

$$C_{\mathrm{p}} = \frac{1-p}{p}\left(\mathrm{q} - C'_{\mathrm{p}} + \delta\frac{p}{p'}\right). \tag{11a}$$

The problem is now an unconstrained choice of power sharing p to maximise each incumbent's consumption, with p' and C'_{p} taken as given. The first-order condition is:

$$\frac{C^*_{\mathrm{p}}}{1-p^*} = (1-p^*)\frac{\delta}{p'}. \tag{11b}$$

The equilibrium conditions $p^* = p'$ and $C^*_{\mathrm{p}} = C'_{\mathrm{p}}$ are now imposed in (11a), which leads to $C^*_{\mathrm{p}} = (\mathrm{q} + \delta)(1 - p^*)$. Combining this with (11b) (and using $p^* = p'$ again) yields the equilibrium allocation:[35]

$$p^* = \frac{\delta}{\mathrm{q}+2\delta}, \quad C^*_{\mathrm{p}} = \frac{(\mathrm{q}+\delta)^2}{\mathrm{q}+2\delta}, \quad \text{and} \quad C^*_{\mathrm{w}} = \frac{(\mathrm{q}+\delta)^2}{\mathrm{q}+2\delta} - \delta. \tag{12}$$

Notice in this case that power sharing is a function of the ratio δ/q.

The power parameter δ affects the equilibrium in three ways. First, an increase in δ makes the incumbents stronger because the rebels have to exert greater fighting effort to defeat the incumbent army. This 'income effect' leads to a reduction in C_{w} and a

[34] The incentive compatibility constraint discussed in footnote 32 would be violated for these individuals with any positive discretionary effort fraction ξ, no matter how small. One alternative approach that could incentivise more individuals not to shirk offers a lottery in return for an agreed amount of fighting effort, where the prize is a position of power. While this mechanism could induce fighting effort from more individuals, the amount of effort each individual would agree to is lower because the lottery is less valuable than a position of power with certainty.

[35] The parameter restriction $\delta/\mathrm{q} \leq \varphi$ is assumed, where φ is as defined in Proposition 1. When the utility function is linear, this restriction is necessary and sufficient for equilibrium in which the non-negativity constraint on workers' consumption is not binding.

decrease in p. Second, the payoff that the rebels would receive once in power increases because their position will also be stronger once they have supplanted the current incumbents, making rebellion more attractive. This offsetting 'income effect' increases C_{w} and increases p. Third, an increase in δ raises the effectiveness of the marginal fighter in the incumbent army, leading to a 'substitution effect' whereby the incumbents increase their size in order to extract higher rents. As long as the non-negativity constraint on workers' consumption is not binding, the third effect dominates and power sharing is increasing in δ.

The allocation (12) can be implemented by a lump-sum tax τ on each worker given by:

$$\tau = \frac{\delta(\mathrm{q}+\delta)}{\mathrm{q}+2\delta}, \tag{13}$$

where the proceeds of the tax are shared equally among incumbents.

3.6. *Example II: Public Goods*

In the model so far, there is no scope for incumbents to do what governments are customarily supposed to do, such as provide public goods. This example extends the model by introducing a technology that allows for production of public goods. The allocation of power and resources now also specifies spending on public goods. It is then natural to ask whether resources will be efficiently allocated to public-good production.

The new technology converts units of output into public goods. If g units of goods per person are converted then everyone receives an extra $\Gamma(g)$ units of the consumption good. The function $\Gamma(\cdot)$ is strictly increasing, strictly concave, and satisfies the usual Inada conditions. The definition of an allocation $\mathscr{A}$ from subsection 3.2 is augmented to specify public-good provision g, hence $\mathscr{A} = \{\mathcal{P}, \mathcal{W}, C_{\mathrm{p}}(\imath), C_{\mathrm{w}}(\imath), g\}$. All individuals observe the choice of g and take it into account – along with all other aspects of an allocation – when considering the participation and maximum-fighting-effort conditions for a rational rebellion. There is no other change to the environment.

The consumption level C in the utility function (1) is now:

$$C = c + \Gamma(g), \tag{14}$$

which represents an individual's overall consumption, comprising private consumption c and the consumption $\Gamma(g)$ each person obtains from the public good. The resource constraint is now:

$$pC_{\mathrm{p}} + (1-p)C_{\mathrm{w}} = (1-p)\mathrm{q} - g + \Gamma(g). \tag{15}$$

A benevolent social planner would choose the first-best level of public-good provision $g = \hat{g}$, determined by $\partial\Gamma(\hat{g})/\partial g = 1$, which maximises the total amount of goods available for consumption.

In determining the equilibrium allocation, the payoff-equalisation insights of Proposition 1 continue to apply to this new environment, hence it is possible without loss of generality to focus on allocations specifying power sharing p, the consumption C_{w} of all workers, and the necessarily common public-good provision g. The resource constraint (15) can be used to find the consumption level of each incumbent under a particular allocation:

$$C_{\mathrm{p}} = \frac{(1-p)(\mathrm{q}-C_{\mathrm{w}})}{p} + \frac{\Gamma(g)-g}{p}. \tag{16}$$

The argument of Proposition 1 that the equilibrium allocation can be characterised by maximising the incumbent payoff subject only to the no-rebellion constraint for a rebel army composed entirely of workers also carries over to this new environment. Thus, the equilibrium allocation is the solution of:

$$\max_{p,C_{\mathrm{w}},g}\ u\left[\frac{(1-p)(\mathrm{q}-C_{\mathrm{w}})}{p} + \frac{\Gamma(g)-g}{p}\right] \quad \text{s.t.} \quad U'_{\mathrm{p}} - u(C_{\mathrm{w}}) \leq \delta\frac{p}{p'}, \tag{17}$$

where p' and U'_{p} are taken as given, but with $p' = p^*$, $C'_{\mathrm{w}} = C^*_{\mathrm{w}}$ and $g' = g^*$ in equilibrium. The first-order condition for public-good provision g is:

$$\frac{\partial\Gamma(g^*)}{\partial g} = 1. \tag{18}$$

This is identical to the condition for the provision $\hat{g}$ chosen by a benevolent social planner, so $g^* = \hat{g}$. The equilibrium allocation is therefore economically efficient in respect of public-good production.[36]

To understand this result, observe that the no-rebellion constraint implies incumbents cannot disregard the interests of workers, even though they do not care about them directly. Provision of the public good slackens the no-rebellion constraint, while the resources appropriated to finance it tighten the constraint. By optimally trading off the benefits of the public good against the cost of production, the incumbents effectively maximise the size of the pie, making use of transfers to ensure everyone is indifferent between rebelling or not. This efficiency result can be seen as a 'political' analogue of the Coase theorem, where the contestability of allocations through rebellion plays the role of legal property rights. The assumption that allocations are actually implemented in the absence of rebellions is important to this finding but, more importantly, the constraints imposed here by the power struggle do not interfere with the transfers that are needed for an efficient allocation of resources.

The equilibrium allocation can be implemented by a lump-sum tax on all individuals of size g^*, implicitly defined by (18), to finance the public good and a lump-sum tax τ on workers with the revenue equally distributed among incumbents. With utility linear in consumption, the tax τ on each worker would be the same as in (13).

The analysis shows that although incumbents are extracting rents from workers, this does not preclude them from acting as if they were benevolent in other contexts. Hence, the overall welfare of workers might be larger or smaller compared to a world

[36] The distribution of total output between workers and incumbents depends on the other parameters of the model, including the utility function $u(\cdot)$. In equilibrium, all individuals will receive a higher overall payoff as a result of the public-good technology being available, though in general, the benefits will not be shared equally.

in which no-one can compel others to act against their will. This reflects the ambivalent effects on ordinary people of having a ruling elite.[37]

The result found with this example can be obtained in several other settings, as discussed by Persson and Tabellini (2000) in the context of voting and elections. Here the result provides a benchmark case where the equilibrium allocation is economically efficient.

4. Investment

This Section analyses the implications of the possibility of investment for the equilibrium allocation of power and resources. Individuals can now exert effort to obtain a greater quantity of goods but there is a time lag between the effort being made and the fruits of the investment being received. During this span of time, there are opportunities for rebellion against the prevailing allocation. The model is otherwise identical to that of Section 3. In particular, there are no changes to the mechanism through which an allocation of power and resources is established and changed. However, the occurrence of investment changes incentives for rebellion, and thus affects the 'no-rebellion constraints' the equilibrium allocation must satisfy. The following analysis considers how the equilibrium allocation will be able to provide credible incentives for individuals to invest and to what extent it will be done – in particular, whether the allocation will achieve economic efficiency.

4.1. *Environment*

The sequence of events is depicted in Figure 3. Before any investment decisions are made, an allocation is first established through a process identical to that described in Section 3 (see Figure 1). The allocation specifies the group in power and the amount of consumption each individual receives, which can now be contingent on individuals' investment decisions. Once an allocation that does not immediately trigger rebellion is

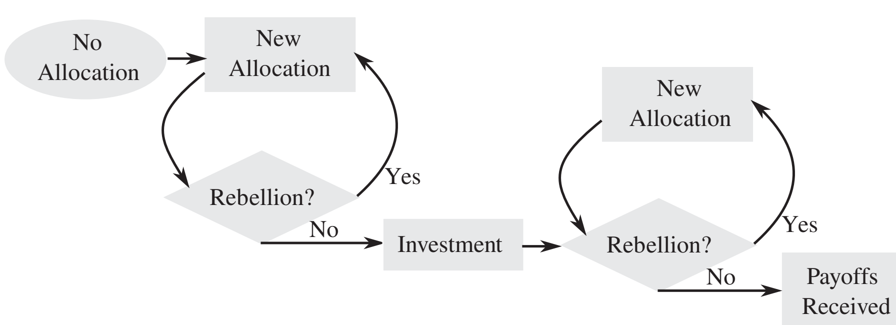

Fig. 3. *Opportunities for Investment and the Power Struggle*

[37] This trade-off is mentioned in the Bible (1 Samuel 8:10–20). The people want a king to provide public goods, despite being warned by the prophet Samuel that the king would use his power in his own interests. Many centuries later, in far too many cases, the warnings of Samuel remain as relevant as ever.

established, there are opportunities to invest. After investment decisions are made, there is another round of opportunities for rebellion, with a new allocation established if a rebellion succeeds.

Individuals who are in power (incumbents, denoted by $\iota \in \mathcal{P}$) have fighting strength δ in defence, as in the model of Section 3. Individuals not belonging to the incumbent group (denoted by $\iota \in \mathcal{N}$) at the post-investment stage receive an endowment of q units of goods.

There are μ investment opportunities, all of which arrive at the same point in the sequence of events in Figure 3. An investment opportunity is the option to produce κ units of capital in the future in return for incurring a present effort cost θ (in utility units), which is sunk by the time the capital is produced. Capital here simply means more units of the consumption good. All investment opportunities yield the same amount of capital κ but each features an effort cost that is an independent draw from the distribution:

$$\theta \sim \text{Uniform}[\psi, \kappa], \tag{19}$$

where $0 < \psi < \kappa$, with ψ being the minimum effort cost.[38] An individual's receipt of an investment opportunity, the required effort cost θ and whether the opportunity is taken are private information at the time of the investment decision, while the individual's production of capital becomes common knowledge after the investment stage.[39] Investment decisions are made rationally by individuals who are able to understand what equilibrium allocation will prevail given the sequence of events in Figure 3. It is further assumed that investment opportunities are received only by those individuals outside the incumbent group[40] and that investment opportunities are randomly assigned at the investment stage with no-one having prior knowledge of whether he will receive one, nor of the required effort cost θ if so.[41]

An individual's utility function is now:

$$\mathscr{U}(C, I, F) = C - \theta I - F, \tag{20}$$

where $I \in \{0,1\}$ is an indicator variable for whether an investment opportunity is received and taken, and F denotes any fighting effort, as in the model of Section 3. Note that utility from consumption is received at the final stage of the sequence of

[38] The uniform distribution is chosen for simplicity. The choice of distribution does not affect the qualitative results.

[39] Since investment opportunities are private information when taken, it is not feasible to have a 'command economy' allocation where individuals perform investments by decree.

[40] Allowing those in power to invest adds extra complications to the model. It might be thought important to have investors inside the incumbent group to provide appropriate incentives. As will be seen, this is not the case, and moreover, the advantage of having investors in power most likely applies to the case where they are brought into the incumbent group conditional on taking an investment opportunity. From the incumbents' perspective, the incentive to do this disappears once investments have come to fruition. But given the information restrictions, which represent the not implausible difficulties of identifying talented investors in advance, bringing in individuals conditional on investment at an earlier stage would not be feasible.

[41] This modelling device places individuals behind a 'veil of ignorance' about their talents as investors when the pre-investment stage allocation is determined. Doing this avoids having to track whether talented investors are disproportionately inside or outside the group in power, which would add a (relevant) state variable to the problem of determining the pre-investment stage allocation, significantly complicating the analysis. However, it will turn out that the 'no-rebellion constraints' are slack at the pre-investment stage, so this assumption need not significantly affect the results.

events in Figure 3, disutility from any fighting effort is additively separable between different stages of the power struggle and there is no discounting of payoffs based on the number of rounds of the power struggle that occur. At the pre-investment stage, since those outside the incumbent group do not know their type yet (whether they will be workers or investors), their payoffs are to be interpreted as expected payoffs. At the post-investment stage, continuation payoffs are independent of any earlier effort (this is the sense in which effort costs are sunk). The utility function is assumed to be linear in consumption for analytical tractability.

The following parameter restrictions are imposed:

$$\frac{\delta}{\mathrm{q}} \leq \varphi \equiv \frac{1+\sqrt{5}}{2}, \quad \mu < \frac{\mathrm{q}}{2(\mathrm{q}+2\delta)}, \quad \text{and} \quad \kappa < \delta. \tag{21}$$

The first restriction is the bound from subsection 3.5 needed to ensure non-negativity constraints are always slack in equilibrium. The second restriction states that the measure μ of individuals who receive an investment opportunity is not too large, which ensures there is never a shortage of workers to fill a rebel army after investments have occurred.[42] The third restriction places a physical limit on the economy's maximum capital stock.

In this environment, an allocation is formally defined as $\mathscr{A} = \{\mathcal{P}, \mathcal{N}, C_{\mathrm{p}}(\imath), C_{\mathrm{w}}(\imath), C_{\mathrm{k}}(\imath)\}$, where $\mathcal{P}$ is the set of incumbents and $\mathcal{N}$ is the set of all other individuals. The consumption allocation of the incumbents is denoted by $C_{\mathrm{p}}(\imath)$. For an individual $\imath \in \mathcal{N}$ outside the incumbent group, the consumption allocation is potentially contingent on whether the individual has produced capital. The term worker now refers to an individual outside the incumbent group who did not produce any capital ($\imath \in \mathcal{W}$), in which case the consumption allocation is $C_{\mathrm{w}}(\imath)$. Those who did produce capital ($\imath \in \mathcal{K}$), the capitalists, receive consumption allocation $C_{\mathrm{k}}(\imath)$.

Investment decisions are required to be individually rational, taking account of the equilibrium allocation that will emerge from the power struggle. The equilibrium concept is unchanged from that introduced in Definition 2. An equilibrium allocation must be in the interests of incumbents taking into account threats of rebellion, where a rebellion occurs if and only if one is rational. Any allocation established following a rebellion must itself be an equilibrium, and equilibrium allocations are restricted to those that depend only on fundamental state variables (apart from individual identities). Note that since the aggregate capital stock is a fundamental state variable at the post-investment stage, any aspect of an equilibrium allocation of power and resources established following a rebellion after investments have been made is permitted to depend on the capital stock.

Since any equilibrium allocation would remain so after a permutation of identities, the relevant variables characterising 'the' equilibrium allocation are power sharing p, and the distributions $C_{\mathrm{p}}(\cdot)$, $C_{\mathrm{w}}(\cdot)$, and $C_{\mathrm{k}}(\cdot)$ of consumption for incumbents, workers, and capitalists respectively.

[42] If investors were to become the predominant group then the nature of the binding constraints might change and a general analysis would be significantly more convoluted. This extension would not invalidate the main result of the article that commitment can be achieved through power sharing.

4.2. *Characterising the Equilibrium Allocation*

Characterising the equilibrium allocation requires working backwards, determining the new equilibrium allocation if a rebellion were to occur at the post-investment stage and then analysing what allocation will be established at the pre-investment stage. Incumbents want the established allocation to survive threats of rebellion so that they remain in power. In this environment, an allocation established at the pre-investment stage must now avoid rebellions both before and after the investment stage.

4.2.1. *Post-investment stage allocation after a rebellion*

Suppose that a rebellion occurs at some point after investment decisions have been made, which is necessarily off the equilibrium path. Let K denote the predetermined stock of capital that has been produced. In what follows, the superscript † is used to distinguish a new consumption allocation established at the post-investment stage from one established earlier.

The effort costs θ of investing are sunk at the post-investment stage, so the continuation utility function $\mathscr{U}(C,F) = C - F$ is the same for both a capitalist and any other individual. The resource constraint at this stage is:

$$\int_{\mathcal{P}^\dagger} C_{\mathrm{p}}^\dagger(\imath)\,\mathrm{d}\imath + \int_{\mathcal{W}^\dagger} C_{\mathrm{w}}^\dagger(\imath)\,\mathrm{d}\imath + \int_{\mathcal{K}^\dagger} C_{\mathrm{k}}^\dagger(\imath)\,\mathrm{d}\imath = (1-p^\dagger)\mathrm{q} + K,$$

where the sets of workers $\mathcal{W}^\dagger$ and capitalists $\mathcal{K}^\dagger$ partition on the basis of past investment decisions the set $\mathcal{N}^\dagger$ of those now outside the incumbent group.

An argument similar to Proposition 1 shows that the new equilibrium allocation would equalise continuation payoffs for all individuals outside the incumbent group ($\imath \in \mathcal{N}^\dagger$). This means that any notional claims to capital will be set aside and individuals' payoffs will be determined according to their power, with capital redistributed according to a new allocation. Capitalists are not compensated for any past efforts because those effort costs are sunk. Let $C_{\mathrm{n}}^\dagger = C_{\mathrm{w}}^\dagger(\imath) = C_{\mathrm{k}}^\dagger(\imath)$ denote the common consumption level of all individuals outside the incumbent group (workers and expropriated capitalists). Also as in Proposition 1, payoffs of incumbents will be equalised, with $C_{\mathrm{p}}^\dagger = C_{\mathrm{p}}^\dagger(\imath)$ denoting this common payoff. The resource constraint implies the incumbents' payoff is:

$$U_{\mathrm{p}}^\dagger = C_{\mathrm{p}}^\dagger = \frac{(1-p^\dagger)(\mathrm{q} - C_{\mathrm{n}}^\dagger) + K}{p^\dagger}. \tag{22}$$

Using the argument of Proposition 1, the equilibrium allocation following a rebellion at the post-investment stage can be characterised by maximising the payoff of incumbents in (22) subject to a single 'no-rebellion constraint':

$$U_{\mathrm{n}}^\dagger \leq U_{\mathrm{p}}'(K) - \delta \frac{p^\dagger}{p'(K)},$$

where $p'(K)$ and $U'_{\mathrm{p}}(K)$ are features of the equilibrium allocation that would follow a further rebellion.[43] In equilibrium, p' and U'_{p} may be functions of the aggregate capital stock K, which is a fundamental state variable at this stage. Given payoff equalisation and the resource constraint, the variables to be determined in the constrained maximisation problem are power sharing $p^{\dagger}$ and the consumption $C_{\mathrm{n}}^{\dagger}$ of those outside the incumbent group.

The equilibrium allocation is found by solving the constrained maximisation problem and then imposing the equilibrium conditions $p^{\dagger}(K) = p'(K)$ and $U_{\mathrm{p}}^{\dagger}(K) = U'_{\mathrm{p}}(K)$. The unique equilibrium values of each variable are as follows:

$$p^{\dagger} = \frac{\delta}{\mathrm{q}+2\delta}, \quad U_{\mathrm{p}}^{\dagger}(K) = \frac{(\mathrm{q}+\delta)^2}{\mathrm{q}+2\delta} + K, \quad \text{and} \quad U_{\mathrm{w}}^{\dagger}(K) = \frac{(\mathrm{q}+\delta)^2}{\mathrm{q}+2\delta} - \delta + K. \tag{23}$$

The equilibrium allocation is such that everyone outside the incumbent group receives utility $U_{\mathrm{w}}^{\dagger}(K)$. Equilibrium power sharing $p^{\dagger}$ is independent of K and is the same as that found in the endowment-economy model with linear utility from subsection 3.5.[44] The results show that were a rebellion to occur at the post-investment stage, the entire capital stock would be expropriated and equally distributed among the whole population. This is because the presence of capital increases incentives for further rebellions.

The allocation (23) can be implemented by taxing all non-incumbents an amount τ given in (13) and distributing the proceeds equally among incumbents (as in subsection 3.5), and by a 100% tax on holdings of capital with the proceeds divided equally among all individuals.

4.2.2. *Pre-investment stage allocation*

The equilibrium allocation will avoid rebellions at both the pre and post-investment stages. Potential rebellions at these stages need to be considered separately owing to the change in the environment as a result of accumulation of capital and the revelation of information after the investment stage.

Given that there will be no rebellion against the allocation in equilibrium, an individual with an investment opportunity will decide to take it or not on the basis of the prevailing investment-contingent consumption allocation. An investor is an individual who receives and takes an investment opportunity (and who will be referred to as a capitalist at the post-investment stage). If individual $\imath$ receives an investment opportunity with effort cost θ then he obtains utility $U_{\mathrm{i}}(\imath;\theta) = C_{\mathrm{k}}(\imath) - \theta$ by taking the opportunity. If he chooses not to take it, he becomes a worker and obtains utility $U_{\mathrm{w}}(\imath) = C_{\mathrm{w}}(\imath)$. This gives rise to an incentive compatibility constraint (conditional on the realisation of θ) that must hold if individual $\imath$ is to invest:

$$C_{\mathrm{k}}(\imath) - C_{\mathrm{w}}(\imath) \geq \theta.$$

[43] Under the parameter restrictions in (21), in equilibrium, all non-negativity constraints on consumption are slack, the bound $p^{\dagger} < 1/2$ is respected and the condition $U_{\mathrm{p}}^{\dagger}(K) > U_{\mathrm{w}}^{\dagger}(K)$ for those in power to belong to the incumbent army is satisfied.

[44] This analytically convenient finding is owing to the linearity of utility in consumption.

Let s denote the proportion of those receiving an investment opportunity for whom the incentive constraint is satisfied. The resource constraint is then:

$$\int_{\mathcal{P}} C_{\mathrm{p}}(\imath)\mathrm{d}\imath + \int_{\mathcal{W}} C_{\mathrm{w}}(\imath)\mathrm{d}\imath + \int_{\mathcal{K}} C_{\mathrm{k}}(\imath)\mathrm{d}\imath = (1-p)\mathrm{q} + \mu\kappa s,$$

and the post-investment capital stock K is:

$$K = \mu\kappa s.$$

The expected utility of individual $\imath \in \mathcal{N}$ outside the incumbent group (who does not yet know whether he will become a worker or an investor) is:

$$U_{\mathrm{n}}(\imath) = (1-\alpha)C_{\mathrm{w}}(\imath) + \alpha\mathbb{E}_{\theta}\max\{C_{\mathrm{k}}(\imath)-\theta, C_{\mathrm{w}}(\imath)\}, \text{ where } \alpha = \frac{\mu}{1-p}. \tag{24}$$

In this expression, α is the probability of any individual outside the incumbent group receiving an investment opportunity, which is the total measure of such opportunities divided by the measure of those individuals.[45]

The following Proposition presents the key features of the equilibrium allocation.

PROPOSITION 2. *Any equilibrium allocation with $s > 0$ must have the following features:*

(*i*) *Payoff equalisation among all workers, and payoff equalisation among all incumbents*: $U_{\mathrm{w}} = U_{\mathrm{w}}(\imath)$, $U_{\mathrm{p}} = U_{\mathrm{p}}(\imath)$.

(*ii*) *Consumption equality among capitalists* $[C_{\mathrm{k}} = C_{\mathrm{k}}(\imath)]$ *is consistent with equilibrium without loss of generality and all no-rebellion constraints for rebel armies with a positive measure of capitalists are slack. In equilibrium, there is a binding incentive compatibility constraint for capitalists that can be expressed as a threshold condition* $\theta \leq \tilde{\theta}$ *for investment. The effort cost threshold* $\tilde{\theta}$ *and the implied fraction* $s = \mathbb{P}_{\theta}[\theta \leq \tilde{\theta}]$ *of investment opportunities that are taken are given by*:

$$\tilde{\theta} = C_{\mathrm{k}} - C_{\mathrm{w}}, \textit{ and } \quad s = \frac{\tilde{\theta}-\psi}{\kappa-\psi}. \tag{25a}$$

(*iii*) *All no-rebellion constraints at the pre-investment stage are slack. The equilibrium allocation can be characterised by only two binding no-rebellion constraints at the post-investment stage, one for rebellions including only workers and one for rebellions including only incumbents*:

$$U_{\mathrm{w}} \geq U_{\mathrm{p}}^{\dagger}(K) - \delta\frac{p}{p^{\dagger}}, \textit{ and } U_{\mathrm{p}} \geq U_{\mathrm{p}}^{\dagger}(K) - \delta\frac{(p-p^{\dagger})}{p^{\dagger}}, \tag{25b}$$

or equivalently, any two linearly independent combinations of these no-rebellion constraints.

(*iv*) *The binding incentive-compatibility constraint* (25*a*) *and the binding no-rebellion constraints* (25*b*) *imply that power sharing* p *must satisfy*

[45] Note that the parameter restrictions in (21) imply $\mu < 1/2$, and since $p < 1/2$, individuals outside the group in power are always more than 50% of the population, and hence there are more of them than investment opportunities.

$$p = p^{\dagger} + \frac{\mu\tilde{\theta}s}{\delta}. \tag{25c}$$

Credible incentives for investment ($s > 0$) thus require that power is not as concentrated as incumbents would like it to be, ex post ($p > p^{\dagger}$).

(v) *Given the power-sharing constraint (25c), the payoff of an incumbent in terms of s is*

$$U_{\mathrm{p}} = \frac{(\mathrm{q}+\delta)^2}{\mathrm{q}+2\delta} + \mu\left\{\kappa - \left(\frac{\mathrm{q}+2\delta}{\delta}\right)[\psi + (\kappa-\psi)s]\right\}s. \tag{25d}$$

Proof. See on-line Appendix A.2.

Conditional on the fraction s of investment opportunities that are taken, which is still to be determined, the equilibrium allocation is completely characterised by the results of Proposition 2. It can be implemented by a lump-sum tax τ_{q} on both workers and capitalists with the proceeds distributed equally among incumbents (as in subsection 3.5), combined with a tax on capitalists τ_{k} with the proceeds divided equally among everyone (including the capitalists themselves). The required values of τ_{q} and τ_{k} are:

$$\tau_{\mathrm{q}} = \frac{\delta(\mathrm{q}+\delta)}{\mathrm{q}+2\delta} + \frac{\mu(\mathrm{q}+\delta)[\psi+(\kappa-\psi)s]s}{\delta}, \text{ and } \tau_{\mathrm{k}} = (\kappa-\psi)(1-s).$$

The equilibrium allocation is such that the marginal investor receives no surplus from investing, while the most efficient investor keeps a fraction s of the whole surplus. Although capital is not fully expropriated, it is still taxed.

The intuition for the equalisation of payoffs in equilibrium among workers and among incumbents is the same as in Proposition 1. The second part of Proposition 2 shows that no investor belongs to a rebel army associated with a binding no-rebellion constraint. The basic reason is that providing incentives to investors means granting them higher consumption than workers and thus higher utility *ex post* once the sunk effort cost of investing has already been incurred (*ex ante*, the marginal investor has the same utility as a worker). The analysis of subsection 4.2.1 shows that the new equilibrium allocation established following a rebellion at the post-investment stage would not respect individuals' holdings of capital prior to the rebellion. Thus, what investors stand to receive by participating in a rebellion (net of fighting costs) is no different from that of workers who rebel (their power is identical), while what they lose is superior if they currently hold capital. Accordingly, they are less willing to fight to replace the current allocation. This implies the distribution of income needed to provide incentives to invest is not one that investors themselves could enforce by a credible threat to participate in rebellions now or at some future stage.

The fundamental problem lying behind the results of Proposition 2 is that the distribution of income needed to encourage investment diverges from that consistent with the distribution of power and so there are incentives for groups to rebel against allocations granting property rights to investors. As usual, the no-rebellion constraint for workers is binding because incumbents gain by extracting as much as possible from them. What is novel here is that discouraging rebellion by workers is no longer sufficient for an allocation to survive when investment opportunities are taken: the incumbents must also worry about rebellion from within their own ranks. *Ex ante*, incumbents would like to establish an allocation encouraging investment by allowing investors to keep a large part of the capital they produce but there is also the temptation *ex post* for them to participate in a rebellion that will allow for a new allocation specifying full expropriation. The fact that the effort cost of investment is sunk gives rise to a time-inconsistency problem, which is reflected in the threat of rebellion coming from inside as well as outside the group in power.[46]

Given this time-inconsistency problem, it might be thought impossible to sustain any investment in equilibrium because individuals cannot commit not to rebel. Since the defence of the current allocation relies on those with power, a rebellion backed by all incumbents succeeds without requiring any fighting effort. Were the size p of the group in power equal to its equilibrium size $p^{\dagger}$ following a rebellion, those in power would be able to change the current allocation through a costless 'suspension of the constitution'. A new allocation could be established that leaves all the current incumbents in power, essentially granting them full discretion *ex post* to change the allocation of resources. However, when power is shared more broadly and thus $p > p^{\dagger}$, costless suspension of the constitution is not possible. The equilibrium size of the group in power after the rebellion is smaller than beforehand, so some incumbents must lose their positions. The rebellion launched by insiders is now necessarily a 'coup d'état' that shrinks the incumbent group. Conflict with those incumbents who would lose their positions of power makes this a costly course of action.

The analysis in Proposition 2 confirms that satisfaction of the no-rebellion constraints for both workers and incumbents is equivalent to ensuring power sharing p at the pre-investment stage is large in relation to $p^{\dagger}$, the equilibrium power sharing after a rebellion at the post-investment stage. The claim in (25*c*) is that credible limits on expropriation require more power sharing than what would be optimal for incumbents after investment decisions have actually been made. Furthermore, as the proportion s of investors rises, the amount of power sharing p that is needed increases. Given the incentive constraint, a higher value of s requires that investors keep more of the capital they produce, which worsens the time-inconsistency problem for incumbents.

The Proposition shows that not only is this increase in power sharing sufficient for credible protection of property rights; it is also necessary. There is no other allocation of power and resources that can both establish credible incentives for investors and survive the power struggle. In particular, it might be thought possible to solve the problem by setting up a different allocation of resources, essentially 'buying off' those who would otherwise rebel. But discouraging rebellion by workers would require transferring resources from incumbents to workers, while discouraging rebellion by incumbents would require transfers in the opposite direction. Transfers away from investors would of course destroy the very incentives that must be preserved. The only way to discourage rebellion simultaneously from both inside and outside the group in

[46] The no-rebellion constraint for the incumbents places a lower bound on their payoff U_{p} even though the equilibrium allocation is set up to maximise U_{p} *ex ante*. The constraint then represents the absence of incentives to deviate from the initial allocation of power and resources through rebellion *ex post*.

power is an increase in power sharing. Fundamentally, transfers are a zero-sum game, and can only redistribute disgruntlement with an allocation.[47]

Sharing power among a wider group thus allows incumbents to act as a government committed to rules that would otherwise be time inconsistent. Even though all individuals have the discretion to participate in a rebellion against the allocation of power and resources, overcoming the time-inconsistency problem is feasible. Sharing power thus emerges endogenously as a commitment device. It provides a solution to the classic problem of 'who will guard the guardians?': time-inconsistent rules can be protected from those who hold power (the 'rule of law') when some incumbents fear losing their privileged status if the rules are changed from within.[48]

Broadly speaking, the extra individuals in power required to sustain property rights (the difference between p and $p^{\dagger}$) might be interpreted as a 'parliament', or an 'independent judiciary', or any other group with the power to resist attempts to change the allocation of power and resources, coming especially from others in power. In the model, these extra individuals in power are in no way intrinsically different from other incumbents and do not have access to any special technology directly protecting property rights.[49] Power sharing enables commitment to otherwise time-inconsistent rules because it makes it costlier for incumbents to replace the current allocation with a new one – with potential differences in how resources and power are distributed. Once power is too concentrated, rules become subject to the whims of those in power, as noted by Montesquieu.

The essence of the argument is that while the model presupposes that an investment-contingent allocation of resources can be established, for any property rights specified by that allocation to be 'rules' in the sense that is commonly understood, they must survive in a world where allocations can always be contested by rebellions. The result here is that property rights can be a feature of the equilibrium allocation only if power is shared among a larger group. The model does not allow potential rebels to commit to creating a new allocation that is not an equilibrium, in particular, one which is not in their interests after the rebellion. Once individuals have incurred the sunk effort costs of investing, those in power would like to sign a 'rebellion contract' where they agree to change the allocation to expropriate capital but bind themselves not to change the allocation when it comes to the distribution of

[47] On the other hand, the notion of being in power is essentially an ability when fighting occurs to impose costs on others at a lower cost to oneself.

[48] One early historical example that resonates with the finding of a connection between power sharing and the rule of law is provided by Malmendier (2009), who studies the Roman *societas publicanorum*. These were groups (precursors of the modern business corporation) to which the government contracted functions such as tax collection and public works. Their demise occurred with the transition from the Roman Republic to the Roman Empire. Why? According to Malmendier (2009), one possible explanation is that 'the Roman Republic was a system of checks and balances. But the emperors centralised power and could, in principle, bend law and enforcement in their favor' (p. 1092). In other words, while power was decentralised, it was possible to have rules that guaranteed the government's adherence to its contract with the *societas publicanorum* and their property rights, presumably because changing the allocation of power and resources would result in some of the individuals in power coming into conflict with their peers, which would be costly. Once power was centralised, protection against expropriation was not possible any longer.

[49] In practice, the roles of these extra individuals in power are specific (legislative, judicial etc.) but the model suggests that commitment to time-inconsistent rules relies not only on the actual functions of the additional incumbents but also on power being distributed among a larger group in itself.

power. However, each has an incentive to reduce the extent of power sharing (imposing the loss of status on others within the former incumbent group), so this contract could only be enforced by some exogenous higher authority. In the absence of such a thing, rebels may contest the existing allocation but cannot commit to what they will then do next.[50]

4.3. *The Equilibrium Allocation and Economic Efficiency*

Economic development ultimately requires rewarding the productive rather than just the strong and, for this to happen, there must be credible protection of investors' property rights. It is an endogenous feature of the model that broader power sharing can sustain such a commitment but is establishing such an allocation in the interests of those in power?[51]

Proposition 2 shows that the equilibrium allocation can be found by maximising the incumbent payoff subject to two binding no-rebellion constraints and a binding incentive constraint.[52] The allocation is characterised by power sharing p and, given payoff equalisation, the consumption levels C_{p}, C_{w} and C_{k} of incumbents, workers and capitalists, respectively. Using the resource constraint and the power-sharing constraint (which combines the two binding no-rebellion constraints), the payoff of incumbents can be written in terms of the fraction s of investment opportunities that are taken, which is linked to consumption levels via the incentive constraint. This payoff is given in (25*d*), which is maximised by the following choice of s:

$$s^{*} = \max\left\{0, \frac{\delta\kappa - (\mathrm{q} + 2\delta)\psi}{2(\mathrm{q} + 2\delta)(\kappa - \psi)}\right\}. \tag{26}$$

As confirmed below in Proposition 3, this characterises the unique equilibrium of the model.[53] But does s^{*} correspond to the efficient level of investment?

To study the question of efficiency, the payoffs of all individuals are derived given the measure p of incumbents and the fraction s of investment opportunities that are taken. The values of p and s imply that there are $1 - p - \mu s$ workers, and μs investors with utility $U_{\mathrm{i}}(\theta) = C_{\mathrm{k}} - \theta$ (those for whom the realisation of θ is no more than $\tilde{\theta}$).

[50] If it were possible for rebels to commit to restrict reoptimisation to certain areas following a rebellion then paradoxically this makes it harder to establish an allocation that gives rise to commitment to time-inconsistent rules. For example, suppose the distribution of power is defined on the first page of the constitution, and limits on expropriation of private property are specified on the second page. If it were feasible somehow to prevent a successful rebellion from rewriting page one of the constitution then this would annihilate the credibility of page two.

[51] Guimaraes and Sheedy (2015) extend the framework here to a world of open economies where the possibility of trade affects the relative price of two goods, which adds an international dimension to the question of whether property rights will be protected. For the reasons highlighted here, production of an investment good requires power sharing, while the other good is modelled as an endowment. The model predicts that trade generates divergence as production of the investment good becomes concentrated in a subset of economies where power is shared broadly, so trade benefits some economies, but harms others.

[52] It is verified in Proposition 3 that the non-negativity constraint $C_{\mathrm{w}} \geq 0$, the bound $p < 1/2$, and the conditions $U_{\mathrm{p}} > U_{\mathrm{n}}'$ and $U_{\mathrm{p}} > U_{\mathrm{w}}^{\dagger}(K)$ ensuring that incumbents who do not rebel will belong to the incumbent army are all satisfied in equilibrium.

[53] Since s is typically small and the fraction of the surplus received by investors lies between 0 and s, investors do not keep much of the proceeds of investment above and beyond what is required to compensate them for their efforts.

The average utility $\bar{U}$ over all individuals is:

$$\bar{U} \equiv \int_{\Omega} U(\iota)\mathrm{d}\iota = pU_{\mathrm{p}} + (1-p-\mu s)U_{\mathrm{w}} + \mu s\mathbb{E}_{\theta}[U_{\mathrm{i}}(\theta)|\theta \leq \tilde{\theta}].$$

Average utility can be written in terms of the expected surplus $\mathcal{S}_{\mathrm{i}}(\tilde{\theta})$ from receiving an investment opportunity:

$$\bar{U} = pU_{\mathrm{p}} + (1-p)U_{\mathrm{w}} + \mu\mathcal{S}_{\mathrm{i}}(\tilde{\theta}),\ \text{where}\ \mathcal{S}_{\mathrm{i}}(\tilde{\theta}) \equiv \mathbb{E}_{\theta}\max\{\tilde{\theta}-\theta, 0\}. \tag{27}$$

Since the distribution of θ lies between ψ and κ, it is easy to see that the surplus $\mathcal{S}_{\mathrm{i}}(\tilde{\theta})$ is maximised when $\hat{\tilde{\theta}} = \kappa$, that is, when all investment opportunities are taken ($\hat{s} = 1$). With no restrictions on the distribution of resources, this choice maximises $\bar{U}$ and is hence the first-best level of investment. It also follows from the resource constraint that the first-best size of the incumbent group is zero ($\hat{p} = 0$) because those in power do not receive the endowment q.

However, the first best is not the most interesting welfare benchmark. A key lesson of the model is that the property rights necessary to provide incentives to invest only survive the power struggle if power is shared among a sufficiently large group. Therefore, in a world where a social planner must respect the constraints imposed by the power struggle and cannot freely choose all aspects of an allocation of power and resources, an increase in power sharing has the benefit of raising investment. This must be set against the opportunity cost of having more individuals in power who are diverted from directly productive occupations.

Taking that trade-off into account, consider the following notion of constrained efficiency. Suppose that it were possible for a social planner to choose some level of investment (and thus the variable s) at all pre-investment stages of the power struggle when a new allocation is established. But all other aspects of an allocation are determined endogenously as before, which means they must ensure s is consistent with investors' incentive-compatibility constraints and the no-rebellion constraints arising from the power struggle. The constrained-efficient level of s is what would then be chosen by a benevolent social planner who takes into account the environment in which the equilibrium allocation is determined. The social planner would appreciate that more investment requires greater protection of property rights and, thus, more power sharing. The concept of constrained efficiency requires weighing the benefit of more investment against the resource cost of the necessary increase in power sharing.[54] In the public-good example considered in subsection 3.6, a social planner could not improve upon the efficiency of the allocation by imposing a level of public-good provision different from what prevails in equilibrium. Here, the issue is whether the equilibrium amount of investment coincides with its constrained-efficient level.

To find the constrained-efficient level of investment, the social planner maximises the average utility $\bar{U}$ of all individuals subject to the binding constraints identified in Proposition 2 (the configuration of binding constraints is the same even with an exogenously imposed level of $s > 0$). As a consequence of (25b), workers' and

[54] If there were no resource cost of increasing the size of the group in power then the constrained-efficient level of investment would coincide with the first best. Note that in the model with the public-good technology from subsection 3.6, the first-best and constrained-efficient levels of public-good provision are the same.

incumbents' payoffs are tied together by $U_{\mathrm{w}} = U_{\mathrm{p}} - \delta$. Since the social planner takes such constraints into account, this relationship is substituted into the expression for $\bar{U}$:

$$\bar{U} = U_{\mathrm{p}} - \delta(1-p) + \mu\mathcal{S}_{\mathrm{i}}(\tilde{\theta}). \tag{28}$$

There are thus two differences between the expressions for average utility $\bar{U}$ and the incumbents' utility U_{p}. The second term on the right-hand side is related to the distribution of resources between individuals with different levels of power and the third term reflects the investors' surplus.

The expression for $\bar{U}$ is maximised by noting that the binding constraints imply U_{p} is given by (25*d*), and that these constraints are equivalent to the power-sharing constraint (25*c*) linking p and s, and by making use of the expression for the investors' surplus from (27).

Proposition 3.

(*i*) *The unique equilibrium* s^* *is given by the expression in* (26).

(*ii*) *The constrained-efficient level of* s (*denoted by* $s^\diamond$), *which maximises* $\bar{U}$ *in* (28), *is given by the following expression* (*if the non-negativity constraint on workers' consumption does not bind*):

$$s^\diamond = \max\left\{0, \frac{\delta\kappa - (\mathrm{q}+\delta)\psi}{(2\mathrm{q}+\delta)(\kappa-\psi)}\right\}. \tag{29}$$

(*iii*) s^* *is positive when* $\kappa/\psi - 1 > 1 + q/\delta$, *while* $\kappa/\psi - 1 > q/\delta$ *is necessary for* $s^\diamond > 0$. *Whenever* $s^\diamond > 0$, *it must be the case that* $s^* < s^\diamond$.

Proof. See on-line Appendix A.3.

The constrained-efficient level of s is positive ($s^\diamond > 0$) only if the return to investment $\kappa/\psi - 1$ for the most efficient investor is larger than the resource cost q/δ of the increase in power sharing needed to protect that investor's property rights. To understand this expression, the power-sharing constraint (25*c*) implies that protecting the most efficient investor from expropriation requires increasing the size of the incumbent group by ψ/δ. For each worker who becomes an incumbent, q units less of output are produced, so the resource cost of protecting the most efficient investor is $\mathrm{q}\psi/\delta$, which corresponds to the required return on investment q/δ.

The condition for investment to occur in equilibrium ($s^* > 0$) is that the return to investment for the most efficient investor is larger than $1 + \mathrm{q}/\delta$. This required return is greater than that for a positive level of investment to be constrained efficient. The reason for the difference is that incumbents take into account the dilution of rents that follows from power sharing in addition to the resource cost. As before, (25*c*) shows that power sharing must increase by ψ/δ to protect the most efficient investor. Since incumbent and worker payoffs need to satisfy $U_{\mathrm{p}} = U_{\mathrm{w}} + \delta$ in equilibrium, each extra incumbent is able to lay claim to rents of δ. Therefore, the cost to other incumbents of protecting the first investor is the resource cost plus $\delta\psi/\delta = \psi$, which adds 100% to the required return on investment.

More generally, although the equilibrium level of investment is positive for a range of parameters, the constrained-efficient level of investment is larger because of the presence of two distortions. The first (and more interesting) distortion follows from the distributional consequences of protection against expropriation described above, which appear in the second term on the right-hand side of (28). Credible commitment to property rights requires sharing power, which in turn requires sharing rents because incumbents are more powerful than other individuals. Incumbents have access to an endogenous commitment device through power sharing that can in principle implement the constrained-efficient level of investment but the need to avoid rebellions means this entails sharing rents. The cost to incumbents of expanding their number is not simply the lost output from diverting individuals away from directly productive activities.

In contrast to the public-good example of subsection 3.6, in an environment with investment, the power struggle imposes an endogenous and binding constraint on the set of possible transfers among individuals. This leads to the breakdown of the political analogue of the Coase theorem. Power sharing can give rise to credible commitment but the association between power and rents places a lower bound on the consumption of each individual in power. The impossibility of sharing power without sharing rents thus drives a wedge between maximising total output and maximising an incumbent's payoff.[55]

The second distortion that results in investment being too low is that the equilibrium allocation does not take account of investors' surplus, which corresponds to the third term on the right-hand side of (28). Since investors' effort costs θ are not public information, it is impossible for an allocation to specify individual consumption levels that are contingent on this information. The no-rebellion constraints for rebel armies including non-marginal investors will therefore be slack, so no benefit accrues to incumbents from increases in such investors' payoffs. This increases the wedge between total output and the payoff of incumbents.[56]

Acemoglu *et al.* (2005) present evidence that institutional failures in providing adequate protection of property rights are especially damaging to economic performance. But why should property rights be so susceptible to political failures compared to other aspects of institutions? The model here sheds light on this question by explaining why there is often tenacious opposition by incumbents to institutions that would effectively 'guard the guardians', allowing for credible property rights. For example, in seventeenth-century England, the Glorious Revolution led to power sharing between king and parliament. By accepting the Bill of Rights, King William III conceded that power would be shared. North and Weingast (1989) argue that the Glorious Revolution began an era of secure property rights and put an end to

[55] The welfare implications of the power parameter δ are non-trivial here. In the public-good example of subsection 3.6, a larger δ can only be harmful to workers because it allows more rents to be extracted, resulting in a more unequal distribution of income. In contrast, in an economy with a very small value of δ, there would not be any investment in equilibrium. A larger δ makes it easier for incumbents to remain in power, which directly benefits them, but might also allow them to offer some protection of property rights.

[56] The first and second distortions correspond respectively to the second and third terms in the expression for $\bar{U}$ in (28). The effects of each of them on the first-order condition determining s^* are thus seen to operate independently of the other distortion.

confiscatory government. As a result, the English government was able to borrow much more and at substantially lower rates. This was certainly in the interests of the king, yet the earlier Stuart kings had staunchly resisted sharing power with parliament. According to the model, secure property rights require just such power sharing to make it costly for the king to rewrite the rules *ex post*. However, the existence of a parliament with real power implies that rents have to be shared, so even if the total pie becomes larger, with a smaller share, the amount received by the king might end up being lower.

This raises the question of why the calculus of the ruling elite shifted over time from keeping power highly concentrated to broader power sharing between king and parliament (and the separation of powers more generally). The comparative statics of the model provide a tentative answer. The equilibrium level of power sharing p^* is an increasing function of s^*, which in turn depends positively on κ and negatively on q and ψ. If, for example, the technological progress leading up to the Industrial Revolution can be interpreted as a higher return to investment (captured in the model by a larger κ), this would spur incumbents to share power where previously this had been resisted. The model is thus consistent with the emergence of parliaments and independent courts as a response to new technologies that open up profitable opportunities for investment.

5. Concluding Remarks

Research in economics has frequently progressed by focusing on the behaviour of individuals subject to some fundamental constraints or frictions and deriving the resulting implications for the economy. For example, it is often claimed that unemployment, credit rationing and missing markets ought not to be directly assumed but instead derived from the likes of search frictions, limited pledgeability, or asymmetric information. This article proposes a model of the allocation of power and resources that emerges from the power struggle which we think of as an attempt to model politics in that tradition. The building blocks of the model are the basics of preferences, technologies and a single rebellion mechanism that allows individuals to form groups and fight for power. Those in power establish an allocation and have an advantage in defending the status quo but the option of rebelling against an allocation is open to everyone on the same terms.

The modelling of conflict abides by the principle that the mechanism for contesting any allocation does not depend on what that allocation prescribes. This is important to ensure results are not due to individuals having access to different mechanisms to change or resist changes to the various aspects of an allocation. In particular, credible commitment does not arise because of an assumption that some aspects of an allocation cannot ever be changed, nor does commitment fail to arise because some aspects of an allocation can always be changed without a contest. The model also adopts the principle of imposing no exogenous restrictions on the transfers that an allocation can prescribe. This is important to ensure commitment neither arises nor fails to arise owing to assumptions on the functional forms of feasible tax or transfer schedules.

The model is used to study an environment where investment is possible but can be expropriated. In order to 'guard the guardians', that is, ensure those in power adhere to time-inconsistent rules, the incumbent group is endogenously enlarged. But the same conflict mechanism that explains how power sharing gives rise to the 'rule of law' also implies that sharing power cannot be done without sharing rents. This imposes endogenous limits on the set of possible allocations and leads to a breakdown of the political analogue of the Coase theorem. In equilibrium, while there is commitment to some protection of individual rights, there is too little power sharing to achieve economic efficiency.

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Additional Supporting Information may be found in the online version of this article:

Appendix A. Proofs.

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