Endogenous Coalitions

Simeon D. Alder
University of Notre Dame

Guillermo L. Ordoñez
Yale University

May 2, 2010

PRELIMINARY AND INCOMPLETE – PLEASE DO NOT CITE

Abstract

Even the most cursory glance around the globe suggests that inefficient public policy is both widespread and persistent and a recent macroeconomic literature suggests that the aggregate productivity effects are sizeable (for instance, Hsieh and Klenow, 2009). However, political economics has yet to shed light on the phenomenon. This is particularly true for the incidence of inefficient policies in (relatively) democratic societies, where elections and referenda offer regular opportunities to punish incumbents politically. We hypothesize that un-informed citizens can account for these stylized facts. The paper develops a reputational model of government to derive sharp characterizations of the conditions under which inefficient policies are implemented in equilibrium. Governments balance short-term gains with reputational concerns (the probability of re-election). We consider the consequences of two information frictions. The asymmetric revelation of some of Nature's moves to the model's economic agents enables governments to implement inefficient policies and extract excessive *ego rents*. The extent to which costly signals can overcome the asymmetric information problem determines how constrained governments are in their policy choice. The prospect of a "unified political front" (coalition) when signaling is cheap dampens the government's incentives to extract rents. Secondly, a noisy "taste for redistribution" obscures the government's true motives for lump-sum transfers. The combination

of asymmetry and noise generates a rich pattern of interactions in equilibrium. In particular, the less precise the signal, the more frequently governments choose inefficient policies. In the extreme case where the signal is completely uninformative, the government can misbehave with relative impunity. In future work, we plan to identify the salient testable predictions and parametrize the model accordingly.

1 Introduction

As a matter of political economy, the role (and existence) of governments can be justified on several counts, among them (1) the implementation of transfers to satisfy social welfare objectives and (2) the regulation of economic activity in the presence of potential market failures. However, policies to address either issue are conceivably prone to abuse and in this paper we focus on governments' incentives to implement inefficient public policies. In particular, we characterize policy choices when governments balance a desire to maximize contemporaneous *ego rents* stemming from holding office with a concern for their reputation and hence their grip on power.

We develop a reputational model of government with information frictions. The state of nature is revealed asymmetrically to groups of citizens (or sectors) who are economically productive voters. Governments have an interest in selecting inefficient policies in their attempt to maximize *ego rents* associated with holding office. However, since well-informed groups can share information by way of costly signals, the prospect of facing a coalition of dissatisfied rioters muffles the government's incentive to extract excess office rents.

In an extension of the baseline model, we introduce an exogenous society-wide "taste for redistribution", denoted by θ.[1] Since groups only observe a noisy signal s of θ, the government's transfer motives become more obscure. The information content of an observed transfer (denoted by T) varies with the precision of s. In the case of a completely uninformative signal (that is, the precision goes to zero), observing T does not reveal anything about the government type. At the other extreme, precise signals prevent excessive transfers altogether.

The extended specification enables us to replicate the stylized fact that a particular public policy may be justified on more than one ground. In Switzerland, for example, direct payments to farmers – *in lieu* of input or output subsidies – are justified as an efficient means to alleviate rural poverty or to compensate them for their contribution to the conservation of the countryside (*Landschaftspflege*). Alternatively, given the farmers' disproportional influence, these transfers may also be motivated by the

[1]One may think of θ as the desire to protect members of society from destitution, for example. Countries with high poverty rates would exhibit high θs.

need to garner their political support in elections and referenda.[2] Importantly, since transfers are distributed lump-sum, there are no efficiency concerns in this dimension of the model. That is not to say that we do not care about the underlying motives for transfer payments in the model. Quite to the contrary, the extent to which citizen voters can disentangle the two rationales determines – among others – how quickly they update their beliefs about the quality of the incumbent government.

In a nutshell, the model captures the observation that few governments are unequivocally incompetent or predatory. They do, often enough it seems, respond to "legitimate" calls for government action, which insulates them somewhat from being sanctioned too harshly for inefficient policy choices.[3] Our aim is to highlight how information frictions combined with costly political actions can enable governments to misbehave with relative impunity.

Unlike Besley and Coate (1997, 1998) and Caselli and Morelli (2004) we do not model the process by which citizens declare themselves candidates and how a particular (head of) government is elected. Rather, perceptions of the incoming government's type are *ex ante* identical. *Ex post*, on the other hand, governments are perceived to vary in terms of integrity (or quality). The citizens form their beliefs about the type based on observables and noisy signals. Rather than modeling the entry margin, we focus on the exit mechanism. The *ex post* heterogeneity can drive citizens to resort to civil unrest (which we label as "riots") in order to transfer policy-making power from the incumbent to a new *ex ante* homogeneous government. While Caselli and Morelli (2004) find that low-quality citizens have a comparative advantage in elective office, our model suggests (in an extension yet to be written) that governments have incentives to be "populist" whenever unproductive agents have a comparative advantage in "producing" votes rather than final goods.[4]

This model also makes a novel contribution to the coalition literature. While Aumann and Myerson (1988); Ray and Vohra (1997, 1999); Carraro (2003); and Ray

[2]For a similar discussion about the US farm lobby the interested reader may want to refer to Acemoglu and Robinson (2001).

[3]There are, of course, examples of "degenerate" governments in places such as North Korea or the Belgian King Leopold II's *Congo Free State*. Our model, however, has nothing to say about such extreme outliers. Acemoglu (2006) discusses inefficient institutions and policies in the context of a *holdup problem*.

[4]These populist tendencies will be dampened endogenously by other features of the model.

(2007) are concerned with intra-coalitional bargaining equilibria, we focus on the non-cooperative endogenous formation of new coalitions.[5] Members self-select into a coalition if their beliefs about the government type are sufficiently synchronized, subject to the constraints imposed by costly action/membership.

To the extent that we populate a political economy with a government that is concerned with reputation our work is related to Coate and Morris (1995). Their work is concerned with efficient vs. inefficient forms of transferring resources between agents. Our focus, on the other hand, is on the extent to which (efficient) transfer payments mask other inefficient policies and hence affect how "precisely" citizens can update their beliefs about the government type (quality).

There is, of course, a vast literature on the age-old trade-off between redistribution and efficiency (see, for instance, Alesina and Rodrik, 1994; Persson and Tabellini, 1994, among many others). While the early literature argues that inefficiency is a necessary condition for redistribution, we find that the latter masks – and thereby enables the government to "get away" with – inefficient policies.[6]

The remainder of the paper is organized as follows. Section 2.1 sets up the environment. In particular, we specify the informational frictions and the timing of events. Section 2.2 describes how different agents Bayesian update their beliefs about the quality of the government. In section 2.3 we define and characterize the equilibrium. Moreover, we discuss some interesting comparative statics. We introduce a "taste for redistribution" in a preliminary stage of the game in section 3. Section 4 concludes and discusses future work, including the empirics to discipline the parametrization of the model.

[5]Since the coalition members' resources are not pooled we can abstract from intra-coalitional bargaining altogether.

[6]In line with assumptions in the previous literature we rule out lump-sum taxation. Otherwise there is no redistribution-efficiency trade-off.

2 Effect of Asymmetric Information on Efficiency

2.1 Environment

In the following sections, we introduce the model's three elementary ingredients, namely (1) the population, technology, and Nature's shocks, (2) the information structure, and (3) the timing assumptions.

2.1.1 Population, Technology, and Nature

At any given time, the model economy is populated by a government and by I sectors indexed by $i \in \{1, \ldots, I\}$, each populated by a measure of homogeneous agents L_i.

Without loss of generality we assume that sector 1 has access to a technology ψ to produce a single consumption good using L_i units (or fewer) of labor input. ψ is drawn from a known exogenous distribution F_ψ with support on $\Psi \subseteq \mathbb{R}^{++}$. While production takes place in sector 1, output in sectors $2, \ldots, I$ is normalized to 0.[7] Moreover, sector-1 production is subject to a sector-specific shock $\beta \in \{\beta_L, \beta_H\}$. Each period, β is drawn from an exogenous distribution with $Pr(\beta_L) = \gamma$. In the absence of government intervention, we assume that β leads to inefficiencies in the allocation of resources within sector 1.

For simplicity, we assume that $I = 2$.[8]

The government can be one of two types: G (for good, or competent) or B (for bad, or incompetent). Government "quality" is drawn from an exogenous distribution with $Pr(G) = \phi_0$.

Type-G governments implement policies that restore Pareto-optimal allocations in sector-1 production. We assume that such policies exist and are feasible on the full support of ψ. We denote them by $\alpha_H(\psi)$ and $\alpha_L(\psi)$ when $\beta = \beta_H$ and $\beta = \beta_L$, respectively.[9] Type-B governments, on the other hand, trade off short-term gains and

[7] We could, of course, assume non-zero output. Qualitatively, the results would be unaffected.
[8] We also assume, for now, that $L_i = L_j$, for all $i, j \in \{1, \ldots, I\}$.
[9] Henceforth, whenever the context allows, we drop the argument ψ in the policy $\alpha(\cdot)$.

longer-term reputation when choosing a policy response to the shock. Importantly, the policy that restores first-best allocations is always in the set of available policies. Formally, a type-B government solves:

$$\max_{\alpha} \rho(\alpha|\beta) + \Pi(\phi') \tag{1}$$

where ρ denotes short-term gains in units of the final good for a given shock β. $\phi' = (\phi'_1, \phi'_2)$ is the sectors' posterior belief about the government's quality and $\Pi(\phi')$ is the value of such a reputation ϕ'. We will show later that each sector's belief is Bayesian-updated from the prior ϕ using sector-specific observables.

2.1.2 Information Structure

The realization of the sector-1-specific shock is observed by sector 1 itself and by the government. Sector 2, on the other hand, does not observe β. This is the key information friction in the model and generates the types of coordination failures we are interested in.

The government's type is private information. Sector 1 updates its belief by observing the realization of the shock β and the government's policy α. It can issue a costly signal to sector 2 by rioting. Hence, sector 2's update relies on sector 1's decision. Keep in mind also that a riot by sector 1 alone is not sufficient to "impeach" the incumbent government. Throwing out the government requires a majority of sectors, i.e. both of them when $I = 2$.[10]

2.1.3 Timing

At the beginning of period s, the economy consists of a government – with reputation ϕ – and two sectors: sector 1 is the previous period's sector 2; the current sector 2 is a newborn cohort. [11] The timing of subsequent shocks and actions is as follows:

1. Nature moves:

[10] With $I = 2$, we need not worry about simple vs. qualified majority since in either case both sectors are required to participate in order to unseat the government.

[11] At time $s = 0$, the reputation is always given by $\phi = \phi_0$.

(a) Draws action costs (i.e. the cost of rioting) for the cohort born at time s from a known exogenous distribution with cumulative distribution function F. C_s^1 denotes the cohort-s action cost when it is in sector 1. C_s^2 is the cost of that same cohort when in sector 2. The cohort's cost draw is private information.

(b) Nature also draws sector-specific shocks β and ψ for the sector-1 cohort born at time $s-1$. Recall that this cohort's action cost was drawn in the previous period and is denoted by C_{s-1}^1.

2. The government observes the (β, ψ)-pair and chooses policy α. We denote the government's strategy by

$$\begin{aligned} \tau_G &= Pr(\alpha_H|\beta,\psi), \text{ where } \beta = \begin{pmatrix} \beta_L \\ \beta_H \end{pmatrix} \\ \tau_G &: \beta \times \psi \rightarrow [0,1] \end{aligned}$$

3. Sector 1 observes β and α. It decides whether it wishes to riot ($R_1 = 1$) or not ($R_1 = 0$), taking into account all relevant information, such as β, α, ψ and C_{s-1}^1. Again, we use the following notation to describe the decisions:

$$\begin{aligned} \tau_1 &= Pr(R_1 = 1|\beta,\alpha,\psi) \\ \tau_1 &: \beta \times \alpha \times \psi \rightarrow [0,1] \end{aligned}$$

4. Sector 2 observes R_1, α and decides whether or not to riot ($R_2 = 0$ or $R_2 = 1$):

$$\begin{aligned} \tau_2 &= Pr(R_2 = 1|R_1,\alpha) \\ \tau_2 &: \alpha \times \{0,1\} \rightarrow [0,1] \end{aligned}$$

5. (a) If $R_1 = 1$ and $R_2 = 1$, the current government pays a penalty P and is replaced with a new draw, which is of type G with the exogenous probability ϕ_0. The cost of action defaults to $C_{s-1}^1 = +\infty$ (to rule out further riots in period s). The new government chooses policy $\hat{\alpha}$ and production takes place under that policy.

(b) If $R_1 = 0$ and/or $R_2 = 0$, production takes place under the policy α.

6. Moreover, if $R_1 = 0$ and/or $R_2 = 0$, the incumbent government chooses its own consumption and distributes lump-sum rebates (if any).
7. Sector-1 cohort disappears.[12]
8. Time-s sector 2 cohort is "promoted" to sector 1 at dusk of period s. The period $s+1$ prior about the quality of the government is given by $\phi = \phi_2'$ (i.e. the posterior of the period-s sector 2). A new cohort is born; it will form sector 2 in period $s+1$ with prior ϕ_2'.

2.2 Beliefs

The decision of each sector to riot in order to unseat the government depends – in addition to all the observables – on their respective beliefs about government quality. Sector 2 observes the policy α and R_1 (sector 1's decision to riot or not) and updates its belief $Pr(G|R_1, \alpha)$, where $R_1 \in \{0,1\}$ in order to optimally choose $R_2 \in \{0,1\}$. Sector 1, in turn, anticipates the sector-2 update and forms expectations about R_2 in its own riot decision. The government, finally, forms expectations about the actions of sectors 1 and 2 in its policy choice.

Before we characterize the equilibrium by backward induction, we describe the Bayesian updating sequence in some detail. We begin with the sector-2 update of $Pr(G|R_1, \alpha)$. Since we assume that $\beta \in \{\beta_L, \beta_H\}$, we can limit ourselves to four updates, conditional on $\{R_1 = 1, \alpha_H\}$, $\{R_1 = 1, \alpha_L\}$, $\{R_1 = 0, \alpha_H\}$, and $\{R_1 = 0, \alpha_L\}$, where α_H is the policy that implements first-best allocations when $\beta = \beta_H$ and α_L does the same under β_L.[13]

We illustrate the update for $Pr(G|R_1 = 0, \alpha_H)$ in considerable detail and refer the reader to the appendix for the three remaining cases. Recall that ϕ is sector 2's prior belief about the government's quality.

$$Pr(G|R_1 = 0, \alpha_H) \quad = \quad \frac{Pr(R_1 = 0|G, \alpha_H)\, Pr(G|\alpha_H)}{Pr(R_1 = 0|G, \alpha_H)\, Pr(G|\alpha_H) + Pr(R_1 = 0|B, \alpha_H)\, Pr(B|\alpha_H)}$$

[12]This assumption allows us to eliminate higher order beliefs.

[13]If a type-B government chose $\alpha \notin \{\alpha_L, \alpha_H\}$ it would unambiguously reveal its type to all sectors and be removed from power with certainty. For that reason, there are only two policies in equilibrium, as long as there are only two possible shocks.

$$
\begin{aligned}
Pr(R_1 = 0|G, \alpha_H) &= Pr(R_1 = 0|G, \alpha_H, \beta_H)\, Pr(\beta_H|G, \alpha_H) \\
&\quad + Pr(R_1 = 0|G, \alpha_H, \beta_L)\, Pr(\beta_L|G, \alpha_H) \\
&= 1 \times 1 + (1 - \tau_1) \times 0 \\
&= 1 \\
Pr(R_1 = 0|B, \alpha_H) &= Pr(R_1 = 0|B, \alpha_H, \beta_H)\, Pr(\beta_H|B, \alpha_H) \\
&\quad + Pr(R_1 = 0|B, \alpha_H, \beta_L)\, Pr(\beta_L|B, \alpha_H) \\
&= 1 \times \frac{\gamma}{\tau_G(1-\gamma)+\gamma} + (1-\tau_1) \times \frac{\tau_G(1-\gamma)}{\tau_G(1-\gamma)+\gamma} \\
&= 1 - \frac{\tau_1\tau_G}{\tau_G(1-\gamma)+\gamma}
\end{aligned}
$$

$$
\begin{aligned}
Pr(G|\alpha_H) &= \frac{Pr(\alpha_H|G)\, Pr(G)}{Pr(\alpha_H|G)\, Pr(G) + Pr(\alpha_H|B)\, Pr(B)} \\
&= \frac{\gamma\phi}{\gamma\phi + \big[\gamma + (1-\gamma)\tau_G\big](1-\phi)} \\
&= \phi_{\alpha_H} < \phi \\
Pr(B|\alpha_H) &= 1 - \phi_{\alpha_H}
\end{aligned}
$$

Putting all the pieces back together, we have:

$$
Pr(G|R_1 = 0, \alpha_H) = \frac{\phi_{\alpha_H}}{\phi_{\alpha_H} + \left[1 - \frac{(1-\gamma)\tau_1\tau_G}{(1-\gamma)\tau_G+\gamma}\right](1-\phi_{\alpha_H})}
$$

2.3 Equilibrium

The equilibrium concept we use is Subgame Perfection. We focus on the equilibrium in a given calendar period t, where a government with reputation ϕ coexists with two sectors. Sector 1 is affected by the exogenous shock and the government's policy response; sector 2 will live in period $t+1$. For expositional simplicity we get rid of the reference to the calendar period t.

Definition 1 *A subgame perfect equilibrium consists of the government distorsion probability τ_G, riot probabilities τ_1 and τ_2 in sectors 1 and 2, respectively, and an updated government* *reputation ϕ' such that:*

(a) the government and the two sectors maximize their expected utility, and

(b) beliefs ϕ are updated using Bayes rule, whenever possible.

Given our sequential timing we can solve by backward induction in each period t.

Let payoffs to the sectors be denoted by π. At the end of the period, sector 2 observes the policy α and sector-1 rioting R_1. Its expected payoffs are:

$$\begin{array}{rl} \mathbf{I}_{(R_1=1)} E_2(\pi|\phi_0) + \mathbf{I}_{(R_1=0)} E_2(\pi|\phi'(R_1=0,\alpha)) - C_2 & \text{if} \quad \tau_2 = 1 \\ \mathbf{I}_{(R_1=1)} E_2(\pi|\phi'(R_1=1,\alpha)) + \mathbf{I}_{(R_1=0)} E_2(\pi|\phi'(R_1=0,\alpha)) & \text{if} \quad \tau_2 = 0 \end{array}$$

where $\mathbf{I}_{(\cdot)}$ is an indicator function.

If sector 1 does not riot ($R_1 = 0$), it is clearly better for sector 2 not to riot either. It cannot get rid of the government but still incurs the cost C_2. Contrarily, if sector 1 riots ($R_1 = 1$), sector 2 updates the government's reputation to $\phi'(R_1 = 1, \alpha) = 0$. Hence the strategies for sector 2 are, for all α:

$$\begin{aligned} \tau_2(R_1 = 0, \alpha) &= 0 \\ \tau_2(R_1 = 1, \alpha) &= \begin{cases} 1 & \text{if} \quad C_2 < \bar{C}_2 \equiv E_2(\pi|\phi_0) - E_2(\pi|0) \\ 0 & \text{if} \quad C_2 \geq \bar{C}_2 \end{cases} \end{aligned} \tag{2}$$

The expectation operator E_2 is over realizations of β and ψ.

Before sector 2 moves, sector 1 observes its own shock (β, ψ) and the policy α. Expected payoffs are:

$$\begin{array}{rl} F(\bar{C}_2)E_1(\pi|\phi_0) + (1 - F(\bar{C}_2))\pi(\beta, \alpha, \psi) - C_1 & \text{if} \quad \tau_1 = 1 \\ \pi(\beta, \alpha, \psi) & \text{if} \quad \tau_1 = 0 \end{array}$$

Hence, for all α and β:

$$\tau_1(\beta, \alpha, \psi) = \begin{cases} 1 & \text{if} \quad C_1 < \bar{C}_1(\beta, \alpha, \psi) \equiv F(\bar{C}_2)[E_1(\pi|\phi_0) - \pi(\beta, \alpha, \psi)] \\ 0 & \text{if} \quad C_1 \geq \bar{C}_1(\beta, \alpha, \psi) \end{cases} \tag{3}$$

Recall $\bar{C}_1(\beta_H, \alpha_H, \psi) \leq 0$, $\bar{C}_1(\beta_H, \alpha_L, \psi) \leq 0$ and $\bar{C}_1(\beta_L, \alpha_L, \psi) \leq 0$. In these three cases $\tau_1(\beta, \alpha, \psi) = 0$ since we assume rioting costs are positive. The only case in which sector 1 may find it optimal to riot is when the shock is β_L and the policy is α_H.

Finally, we need to analyze the strategies of the government. When the shock is β_H, there are no riots on the equilibrium path and the government chooses α_H. When the shock is β_L, bad governments are tempted to follow α_H. However, this distortion may unleash rioting and eventually a punishment of the government. Before we characterize the government payoffs, let us define $F_1 \equiv F\big(\bar{C}_1(\beta_L, \alpha_H, \psi)\big)$ as the probability of sector 1 rioting and $F_2 \equiv F(\bar{C}_2)$ as the probability of sector 2 joining that riot. Moreover, let $\phi'_{\alpha_H|\tau_G} \equiv \phi'(R_1 = 0, \alpha_H|\tau_G)$, $\phi'_{\alpha_L|\tau_G} \equiv \phi'(R_1 = 0, \alpha_L|\tau_G)$, and $\phi'(R_1 = 1, \alpha_H|\tau_G) = 0$.

The government's expected payoffs are:

$$\begin{aligned} &F_1[-F_2 P + (1 - F_2)(\rho(\beta_L, \alpha_H, \psi) + \Pi(0))] \\ &\quad +(1 - F_1)(\rho(\beta_L, \alpha_H, \psi) + \Pi(\phi'_{\alpha_H|\tau_G})) \quad \text{if} \quad \tau_G = 1 \\ &\quad \rho(\beta_L, \alpha_L, \psi) + \Pi(\phi'_{\alpha_L|\tau_G}) \quad \text{if} \quad \tau_G = 0 \end{aligned}$$

The government decides to distort ($\tau_G = 1$) if:

$$\begin{aligned} \rho(\beta_L, \alpha_L, \psi) + \Pi(\phi'_{\alpha_L|1}) \quad < \quad & F_1(1 - F_2)(\rho(\beta_L, \alpha_H, \psi) + \Pi(0)) - F_1 F_2 P \\ & +(1 - F_1)(\rho(\beta_L, \alpha_H, \psi) + \Pi(\phi'_{\alpha_H|1})) \end{aligned} \tag{4}$$

Since $\phi'_{\alpha_H|0} = \phi'_{\alpha_L|0} = \phi$, the government decides against distorting (i.e. $\tau_G = 0$) if

$$\begin{aligned} \rho(\beta_L, \alpha_L, \psi) + \Pi(\phi) \quad > \quad & F_1(1 - F_2)(\rho(\beta_L, \alpha_H, \psi) + \Pi(0)) - F_1 F_2 P \\ & +(1 - F_1)(\rho(\beta_L, \alpha_H, \psi) + \Pi(\phi)) \end{aligned} \tag{5}$$

Recall $\phi'_{\alpha_L|1} > \phi$ (when people believe the government is distorting, then the observational lack of distortion makes people increase the government's reputation) and $\phi'_{\alpha_H|1} < \phi$ (when people believe the government is distorting, then observed distortions lead people to decrease the government's reputation).

Given these updates, when condition (4) is fulfilled, and the government distorts, condition (5) cannot be satisfied. Similarly, when condition (5) is fulfilled, and the government does not distort, condition (5) cannot be satisfied. These are the conditions for an equilibrium in pure strategies.

Alternatively, neither of the two conditions is satisfied. In this case the equilibrium is in random strategies τ_G^* that fulfill the following condition:

$$\begin{aligned}\rho(\beta_L, \alpha_L, \psi) + \Pi(\phi'_{\alpha_L|\tau_G^*}) &= F_1(1-F_2)\big(\rho(\beta_L, \alpha_H, \psi) + \Pi(0)\big) - F_1 F_2 P \\ &\quad + (1-F_1)\big(\rho(\beta_L, \alpha_H, \psi) + \Pi(\phi'_{\alpha_H|\tau_G^*})\big), \end{aligned} \tag{6}$$

that is, the government is indifferent between distorting or not.

We assume throughout that $\rho(\beta_L, \alpha_L, \psi)$ is constant for all ψ. $\rho(\beta_L, \alpha_H, \psi)$, on the other hand, is increasing in ψ, i.e. the higher sector-1 productivity, the greater the government's short-term gains from implementing the distortionary policy α_H. The effect of a high ψ can be seen most easily if we rearrange equation (6):

$$\begin{aligned}\Pi(\phi'_{\alpha_L|\tau_G^*}) - (1-F_1)\Pi(\phi'_{\alpha_H|\tau_G^*}) &= F_1[(1-F_2)\Pi(0) - F_2 P] \\ &= +(1-F_1)\rho(\beta_L, \alpha_H, \psi) - \rho(\beta_L, \alpha_L, \psi)\end{aligned}$$

Since we assume the productivity shocks to be i.i.d. over time, F_2 does not vary with realizations of ψ (see page 9). Moreover, assume that F_1 is held constant for now. A rise in ψ increases $\rho(\beta_L, \alpha_H, \psi) - \rho(\beta_L, \alpha_L, \psi)$ and hence the right hand side of the equality. Since $\frac{\partial \phi'_{\alpha_H|\tau_G}}{\partial \tau_G} < 0$ and $\frac{\partial \phi'_{\alpha_L|\tau_G}}{\partial \tau_G} > 0$, a rise in τ_G increases the left hand side and thus restores the equality.

Sector 1, in turn, takes the change in τ_G into account. In particular, $E_1(\pi|\phi_0)$ is increasing in τ_G. The prospect of a good government (with probability ϕ_0) is becoming more attractive – and therefore riots become a more appealing course of action – when bad governments are more likely to implement inefficient policies. Clearly, then, F_1 must rise in response to an increase in τ_G. The change in the government's and sector 1's equilibrium strategies for different realizations of ψ hinges on how sensitive sector 1's reaction is to a change in τ_G.

With this characterization we can discuss the impact of some parameters on equilibrium distortions and inefficiencies introduced by the government. For example, as $P \to \infty$, condition (5) is trivially fulfilled: governments that are afraid of punishment never adopt distortionary policies. Less extremely, since $\frac{\partial \phi'_{\alpha_H|\tau_G}}{\partial \tau_G} < 0$ and $\frac{\partial \phi'_{\alpha_L|\tau_G}}{\partial \tau_G} > 0$ an increase in P would reduce the right hand side of equation (6) and require a reduction in τ_G (the probability of distortion) to make the government indifferent again.[14]

We can also analyze what happens as the profits at stake for sector 2 increase. If sector 2's expected profits depend significantly on governments behavior and reputation, this would increase $\bar{C}_2$ and hence F_2. This rise in the probability of a sector-2 riot boosts $\bar{C}_2(\beta_L, \alpha_H, \psi)$ and thus F_1. The increase in the likelihood of a riot reduces the incentives for the government to distort sector 1, with essentially the same effect as a stiffer penalty.

We can also analyze what the effect of γ (the realization probability of β_H) is in equilibrium. When γ is low, sector 2 assigns a low probability to the need for an α_H policy. Hence, whenever α_H is observed, the reputation of the government suffers more. This deters the government from distorting when $\beta = \beta_L$. In other words, the government is more likely to distort when the policy α_H is a common occurrence.[15]

Next we dissect the effect of the reputation prior on the incentives to distort. Equation (5) is more likely to be fulfilled for high ϕ since the left hand side contains $\Pi(\phi)$ while the right hand side features $(1 - F_1)\Pi(\phi)$ with $F_1 \in [0, 1]$, of course. When ϕ increases, it raises the left hand side relatively more than the right hand side. The intuition is that high reputation governments are more afraid of being displaced and loosing the gains from that reputation.

Similarly, intermediate reputation levels widen the gap between $\phi'(\alpha_L|\tau_G)$ and $\phi'(\alpha_H|\tau_G)$, thereby strengthening the incentives against distortion. This implies that governments which are prone to distorting are those with unfavorable reputations.

[14]The intuition for $\frac{\partial \phi'_{\alpha_H|\tau_G}}{\partial \tau_G} < 0$ and $\frac{\partial \phi'_{\alpha_L|\tau_G}}{\partial \tau_G} > 0$ is as follows: the more often a government distorts, i.e. high τ_G, the less likely α_L is a bad government's policy response. As a result, its reputation improves after α_L is observed. Conversely, as τ_G rises, α_H is more and more likely to be a bad – rather than a good – government's policy response with distortions.

[15]If the policy in fact affects the possibility of the shock in the future, for example government debt is optimal in recession, but recession is affected by indebtness, then we may have a situation of recessions and debt traps. This is α_H today increases the γ to use tomorrow

3 Effect of Redistribution on Efficiency

Closer inspection of the equilibrium reveals that the government can discourage rioting by threatening to "bribe" sector 2 *ex post*, that is, once it observes that sector 1 has taken to the streets. The government can in fact preempt sector-2 rioting by transferring $T = \bar{C}_2 \equiv E_2(\pi|\phi_0) - E_2(\pi|0)$. Given this threat, sector 1 does not riot in the first place (since $F_2 = 0$, $\bar{C}_1(\beta_L, \alpha_H, \psi) = 0$ and $F_1 = 0$). This allows the government to distort with impunity, even when reputation is decreasing over time. Moreover, the mere threat of a transfer is sufficient to suppress unrest and no transfers are made on the equilibrium path. Since we grant the government an additional decision node, this result is, however, of limited relevance. More interesting is the constellation where governments decide on transfers *ex ante*.

Assume now that there is an additional stage in the game that precedes all the stages discussed so far. In this "preliminary" stage we introduce an important element: a "taste for redistribution" summarized by the function $f(\theta)$ with $f'(\theta) > 0$ and $\theta \sim \mathcal{N}(\mu, \frac{1}{\omega_\theta})$. The government observes θ and β simultaneously. One may think of θ as a summary statistic for the fraction of the population below the poverty level, for instance, or a shock that affects the welfare of sector 2. For simplicity we assume that transfers to satisfy the desire for redistribution can only take two values: 0 and T.

We assume the government observes θ and decides whether to redistribute resources or not. After the government takes action, the population observes a noisy signal of the fundamental, $s = \theta + \epsilon$, with $\epsilon \sim \mathcal{N}(0, \frac{1}{\omega_s})$. Based on observing 0 or T and the signal s the sectors update the government's reputation from the prior ϕ_0 to ϕ. This is the reputation ϕ at the start of the game discussed in the previous section.

With this additional stage the redistribution policy is determined by the "taste for redistribution" together with the opportunity set for distortions in subsequent stages.

Proposition 1 *Bad governments redistribute with a higher probability than good governments.*

Proof Good governments' redistribution policies are defined by $x_G(\theta)$, the probability of redistribution conditional on θ, and characterized by a simple cutoff strategy

$$x_G(\theta) = \begin{cases} 1 & \text{if} \quad \theta > \bar{\theta}_G \\ 0 & \text{if} \quad \theta \leq \bar{\theta}_G \end{cases}$$

Since good governments only redistribute when $f(\theta) > T$, the cutoff $\bar{\theta}_G$ is defined by $T = f(\bar{\theta}_G)$.

Bad governments' redistribution policies follow the strategy

$$x_B(\theta) = \begin{cases} 1 & \text{if} \quad \theta > \bar{\theta}_B \\ 0 & \text{if} \quad \theta \leq \bar{\theta}_B \end{cases}$$

where $\bar{\theta}_B$ is a cutoff that does not only consider the direct gains from the "taste for redistribution", but also the potential gains from being able to quell riots down the road. More specifically, bad governments' gains from redistribution are given by

$$f(\theta) - T + E_\beta \left[\rho(\alpha_1^*, \beta) + \Pi(\phi'|\theta, x_B = 1)\right]$$

while gains from no redistribution are given by

$$E_\beta \left[\rho(\alpha_0^*, \beta) + \Pi(\phi'|\theta, x_B = 0)\right]$$

where α_0^* and α_1^* are the equilibrium policies from the distortion stage for $x_B = 0$ and $x_B = 1$, respectively. We assume $T > \bar{C}_2$, which is sufficient to discourage sector 2 from eventually joining a riot set off by sector 1. Otherwise, a bad government would follow the same strategy as a good one in the redistribution stage since $\alpha_0^* = \alpha_1^*$.

The expected reputation in case of redistribution, $\phi'|x_B = 1$, has two expectation operators. The first considers all possible updates of the reputation from ϕ_0 in case of redistribution and conditional on θ. The second considers all possible updates in the distorsionary stage, which depends on whether an opportunity arises in the first place (that is, β_L occurs). Hence,

$$\phi'|(\theta, x_B = 1) = E_{s|\theta}\left[E_\beta\left[Pr(G|R_1 = 0, \alpha_H)|\phi(s, \bar{\theta}_G, \bar{\theta}_B, x_B = 1)\right]\right]$$

Similarly for the expected reputation in the case of no redistribution.

$$\phi'|(\theta, x_B = 0) = E_{s|\theta}\left[E_\beta\left[Pr(G|R_1, \alpha^*)|\phi(s, \bar{\theta}_G, \bar{\theta}_B, x_B = 0)\right]\right]$$

While $Pr(G|R_1, \alpha)$ has been defined in the previous section, the update after the redistribution stage is

$$\phi(s, \bar{\theta}, \bar{\theta}_B, x_B = 1) = Pr(G|T, s) = \frac{Pr(T|G, s)\phi_0}{Pr(T|G, s)\phi_0 + Pr(T|B, s)(1 - \phi_0)}$$

where

$$Pr(T|G, s) = Pr(\theta > \bar{\theta}|s) = 1 - \Phi((\bar{\theta}_G - \hat{\theta})\sqrt{\omega_\theta + \omega_s})$$

since

$$\theta|s \sim \mathcal{N}(\hat{\theta}, \frac{1}{\omega_\theta + \omega_s})$$

and

$$\hat{\theta} = \frac{\omega_\theta \mu + \omega_s s}{\omega_\theta + \omega_s}$$

Recall that, for example, if $\omega_s = \infty$, then $Pr(T|G, s) = 1$ if $s > \bar{\theta}$. This is because the signals are very precise. Any signal above $\bar{\theta}$ implies it is very likely the true fundamental is also above $\bar{\theta}$ and good governments redistribute.

Similarly,

$$Pr(T|B, s) = 1 - \Phi((\bar{\theta}_B - \hat{\theta})\sqrt{\omega_\theta + \omega_s})$$

The bad government would redistribute only if

$$T < f(\theta) + G(\phi_0, \theta)$$

where $G(\phi_0, \theta)$ represents the net gains for the government from redistributing, beyond the "taste for redistribution",

$$G(\phi_0, \theta) = E_\beta\left[\rho(\alpha_H, \beta) + \Pi(\phi'|\theta, x_B = 1)\right] - E_\beta\left[\rho(\alpha^*, \beta) + \Pi(\phi'|\theta, x_B = 0)\right]$$

There is a clear positive gain from redistribution. It is independent of θ and comes from preventing riots. The second part does depend on θ and is driven by the expected reputation update following redistribution.

Hence, the optimal cutoff for bad governments is determined by the $\theta = \bar{\theta}_B$ at which,

$$T = f(\bar{\theta}_B) + G(\phi_0, \bar{\theta}_B)$$

We show now, by contradiction, that $G(\phi_0, \bar{\theta}_B) > 0$. Then $\bar{\theta}_B \leq \bar{\theta}_G$ and $Pr(T|B,s) > Pr(T|G,s)$. Assume, to the contrary, that $\bar{\theta}_B > \bar{\theta}_G$. Since redistribution is more likely to be performed by good governments than bad ones, reputation increases at all θ after the population observes redistribution. More specifically, $G(\phi_0, \bar{\theta})$ evaluated at $\bar{\theta}_G$ is positive due to an immediate reputation gain as well as impunity in the future. However, this means that $T < f(\bar{\theta}_B) + G(\phi_0, \bar{\theta})$, and bad governments would redistribute at $\bar{\theta}_B$. This is a contradiction. Q.E.D.

This demonstrates that the only equilibrium is such that $\bar{\theta}_B \leq \bar{\theta}_G$. An interesting implication is that large gains $\rho(\cdot,\cdot)$ from distorting increase the expected frequency at which a bad government introduces inefficient redistribution (that is, they increase the gap $\bar{\theta}_G - \bar{\theta}_B$). Similarly, assume $\omega_s \to \infty$. In this case, for any $\bar{\theta}_B < \theta < \bar{\theta}_G$, $Pr(G|T,\theta) = 0$. If this reputation loss is big enough, then the equilibrium is $\bar{\theta}_B = \bar{\theta}_G$, and bad governments cannot use redistribution to generate impunity. For that reason, there is no update of the government's reputation after a transfer T has taken place. This suggests that improving the quality of the signal s would lower the incidence of inefficient redistributions that are motivated by a desire to facilitate distortions later in the game.

Proposition 2 *A higher precision of the population signals ω_s reduces the probability of inefficient redistributions and distortions.*

The proposition spells out a novel explanation of ”populism”. The larger the government's direct gains from distortion the stronger the incentives to redistribute inefficiently. Similarly, the easier it is to prevent riots (for example, thanks to low income of sector 2 or high costs of rioting) and the murkier the motivation for redistribution (due to noisy signals about the fundamentals that justify redistribution), the more governments are inclined to redistribute.

The previous literature on the redistribution-efficiency trade-off emphasized the role of inefficient (distortionary) taxation as a necessary condition for redistribution. In our model, redistribution plays a more subtle role. Bad governments redistribute more often since some of the resources can later be used to suppress riots against excessively distortionary policy choices. In essence, redistribution motives mask rent-seeking motives and thereby offer the government more scope for inefficient behavior.

4 Conclusion & Future Work

Our model features a government with murky motives for redistribution, strong incentives to control resources, and a concern for its political survival (for which the reputation ϕ is a sufficient statistic). In addition, the citizens have asymmetric knowledge of the economic environment and political action (rioting) is costly. In this setup, governments have incentives to implement inefficient policies that boost their *ego rents* as long as these policies do not undermine the future of their political careers. The extent to which inefficiencies occur along the equilibrium path depends on whether the symmetric information problem can be overcome: governments are more circumspect in their policy choice when they are more likely to be challenged by a large enough coalition of rioters.

When, in addition, we introduce a stochastic exogenous "taste for redistribution", the government's motives become obscure. Transfers may be (a) designed to satisfy the genuine desire for redistribution or (b) they are an attempt to pre-empt the removal from power. The ambiguity of transfer motives can insulate incumbents from the political consequences of an inefficient choice in the α-dimension of the model. Precise taste signals preclude excessive transfers altogether. On the other hand, when the signal is uninformative, governments can act inefficiently with relative impunity.

In future work, we focus on a theoretical extension of the model and on empirically testable predictions.[16]

[16] In appendix B we present a variation of the current model featuring a continuum of sectors.

In a variation of the model presented thus far, we can show that relatively unproductive sectors have a comparative advantage in "producing" votes. Clearly then, in an environment with large (small) inter-sectoral productivity differences governments have stronger (weaker) incentives to propose populist policies. For productive sectors, on the other hand, sending costly signals is comparatively less onerous and that allows them to share information about government quality more easily and frequently. Anticipating the publicization of their type, governments become more circumspect in their policy choices and soften their populist stance. In equilibrium, the incentives driven by comparative advantage balance the effects of low-cost communication. Clearly, initial conditions in terms of cross-sectoral inequality affect the trade-off, which is why not all governments are "populist". Our model can characterize this policy variation crisply.

Finally, we're planning to make progress on the empirical front by identifying salient testable predictions in the model and taking them to the times series and/or cross-sectional data.

A Bayesian Updates

In addition to the update conditional on $R_1 = 0$ and α_H described in section 2.2, this appendix details sector 2's Bayesian update in the remaining three cases of interest. Recall that ϕ denotes the prior belief about the government's quality.

$$
\begin{aligned}
Pr(G|R_1 = 0, \alpha_L) &= \frac{Pr(R_1 = 0|G, \alpha_L)\, Pr(G|\alpha_L)}{Pr(R_1 = 0|G, \alpha_L)\, Pr(G|\alpha_L) + Pr(R_1 = 0|B, \alpha_L)\, Pr(B|\alpha_L)} \\
Pr(R_1 = 0|G, \alpha_L) &= 1 \\
Pr(R_1 = 0|B, \alpha_L) &= 1 \\
Pr(G|\alpha_L) &= \frac{Pr(\alpha_L|G)\, Pr(G)}{Pr(\alpha_L|G)\, Pr(G) + Pr(\alpha_L|B)\, Pr(B)} \\
&= \frac{(1-\gamma)\phi}{(1-\gamma)\phi + (1-\gamma)(1-\tau_G)(1-\phi)} \\
&= \phi_{\alpha_L} > \phi \\
Pr(B|\alpha_L) &= 1 - \phi_{\alpha_L}
\end{aligned}
$$

Putting all the pieces back together, we obtain:

$$
Pr(G|R_1 = 0, \alpha_L) = \frac{\phi_{\alpha_L}}{\phi_{\alpha_L} + (1 - \phi_{\alpha_L})} = \phi_{\alpha_L} \tag{7}
$$

Given that sector 1 has access to more information than sector 2, $R_1 = 1$ sends an unambiguous signal to sector 2 that the government is bad. Clearly then,

$$
Pr(G|R_1 = 1, \alpha_L) = 0 \tag{8}
$$

$$
Pr(G|R_1 = 1, \alpha_H) = 0 \tag{9}
$$

B *Kitty Genovese* Extension

Instead of assuming $I = 2$ as in section 2.1, assume $I \in \mathbb{Z}^{++}$. Assume also that $1 \leq I_1 < I$ sectors are subject to a realization of β and policy α; $I_2 = I - I_1$ is the size of the new-born cohort and each of its sector's outputs is normalized to zero. For the time being, let all the sectors subject to β and α be identical in terms of their action costs and productivities ($C^i = C^j = C_1$ and $\psi^i = \psi^j$ for $i, j \in [1, I_1]$). Lastly, let $C^i = C^j = C_2$ for $i, j \in (I_1, I]$ be the symmetric action cost of all sectors in the new-born cohort.

Let $I^1_{\beta_L}$ ($I^1_{\beta_H}$) denote the number of sectors subject to β_L (β_H). As in the baseline model, the (endogenous) policy for all sectors subject to β_H is α_H. Among those subject to β_L, the government may pick α_L for some and α_H for others: $I^1_{\beta_L,\alpha_L} + I^1_{\beta_L,\alpha_H} = I^1_{\beta_L}$.

We are interested in the behavior of the $I^1_{\beta_L,\alpha_H}$ sectors subject to β_L and α_H. Since they are homogeneous with regard to ψ, the expected gains from getting rid of a bad government are identical, ignoring the cost C_1. In the game, a single signal is sufficient to inform the rest of the economy about the quality of government and thereby trigger the formation of a coalition with the aim to remove the incumbent. Sending a signal, however, is costly and this is where the *Kitty Genovese* problem arises.

For simplicity, assume that $I_2 + 1$ participating sectors are sufficient to unseat the incumbent government. Let $\hat{\pi}_i$ denote sector i's gross expected gain from getting rid of the incumbent:

$$\hat{\pi} = F(\bar{C}_2)\big[E_1(\pi|\phi_0) - \pi(\beta, \alpha, \psi)\big]$$

where $F(\bar{C}_2)$ is defined analogously to equations (2) and (3).

Under the identity assumptions about costs and productivities, only the case $C_1 < \hat{\pi}$ generates interesting insights.

We are looking for a symmetric mixed strategy equilibrium, where p denotes the probability for each player to send a signal. If a sector sends a signal, the expected net gain is $\hat{\pi} - C_1$. If it does not, it realizes a net gain of zero with probability $(1-p)^{I_1-1}$ (no one else sends a signal) or $\hat{\pi}$ with probability $1 - (1-p)^{I_1-1}$ (at least one sector sends a signal).

A particular sector is indifferent whenever:

$$\hat{\pi} - C_1 = \hat{\pi}\big((1-p)^{I_1-1}\big)$$

The (symmetric) probability for each sector is:

$$p = 1 - \left(\frac{C_1}{\hat{\pi}}\right)^{\frac{1}{I_1-1}}$$

The probability of at least one sector sending a signal is:

$$1-(1-p)^{I_1} = 1 - \left(\frac{C_1}{\hat{\pi}}\right)^{\frac{I_1}{I_1-1}}$$

In the limit with $I \to \infty$ and $I_1 \to \infty$ the corresponding probabilities are:

$$\begin{aligned} p &= 0 \\ 1-(1-p)^{I_1} &= 1 - \frac{C_1}{\hat{\pi}} > 0, \\ &\quad \text{since } \frac{I_1}{I_1-1} \to 1 \text{ as } I_1 \to \infty \end{aligned}$$

That is, while the probability of any individual sending a signal goes to zero, the probability of at least one signal is strictly positive, as long as $\hat{\pi} > C_1$. Put differently, in the model with a continuum of sectors, the uncertainty is **not** completely resolved *ex ante* and this is reflected in the government's strategy τ_G.

References

ACEMOGLU, D. (2006): "Modeling Inefficient Institutions," in *Advances in Economics and Econometrics: Theory and Applications*, ed. by R. Blundell, W. K. Newey, and T. Persson, Cambridge University Press, vol. 1, 341–380.

ACEMOGLU, D. AND J. A. ROBINSON (2001): "Inefficient Redistribution," *American Political Science Review*, 95, 649–661.

ALDER, S. D. (2010): "In the Wrong Hands: Complementarities, Resource Allocation, and Aggregate TFP," Working Paper.

ALESINA, A. AND D. RODRIK (1994): "Distributive Politics and Economic Growth," *The Quarterly Journal of Economics*, 109, 465–490.

ALSTON, L. J., G. D. LIBECAP, AND B. MUELLER (2010): "Interest Groups, Information Manipulation in the Media, and Public Policy: The Case of the Landless Peasants Movement in Brazil," *NBER Working Paper*.

AUMANN, R. J. AND R. B. MYERSON (1988): "Endogenous formation of links between players and of coalitions: An application of the Shapley value," in *The Shapley value : The Shapley value: essays in honor of Lloyd S. Shapley*, ed. by A. E. Roth, Cambridge University Press.

BECKER, G. S. (1985): "Public policies, pressure groups, and dead weight costs," *Journal of Public Economics*, 28, 329–347.

BESLEY, T. AND S. COATE (1997): "An Economic Model of Representative Democracy," *Quarterly Journal of Economics*, 112, 85–114.

——— (1998): "Sources of inefficiency in a representative democracy: a dynamic analysis," *American Economic Review*, 88, 139–156.

BESLEY, T. AND T. PERSSON (2010): "State Capacity, Conflict and Development," *Econometrica*, 78, 1–34.

CARRARO, C., ed. (2003): *The endogenous formation of economic coalitions*, Fondazione Eni Enrico Mattei.

CASELLI, F. AND N. GENNAIOLI (2008): "Economics and Politics of Alternative Institutional Reforms*," *Quarterly Journal of Economics*, 123, 1197–1250.

CASELLI, F. AND M. MORELLI (2004): "Bad politicians," *Journal of Public Economics*, 88, 759–782.

COATE, S. AND S. MORRIS (1995): "On the Form of Transfers to Special Interests," *The Journal of Political Economy*, 103, 1210–1235.

HALL, R. AND C. JONES (1999): "Why Do Some Countries Produce So Much More Output Per Worker Than Others?" *The Quarterly Journal of Economics*, 114, 83–116.

HART, S. AND M. KURZ (1983): "Endogenous formation of coalitions," *Econometrica*, 51, 1047–1064.

HSIEH, C.-T. AND P. J. KLENOW (2009): "Misallocation and Manufacturing TFP in China and India*," *Quarterly Journal of Economics*, 124, 1403–1448.

KRUSELL, P. AND J.-V. RIOS-RULL (1996): "Vested interests in a positive theory of stagnation and growth," *The Review of Economic Studies*, 63, 301–329.

LIZZERI, A. AND N. PERSICO (2001): "The provision of public goods under alternative electoral incentives," *The American Economic Review*, 91, 225–239.

ORDOÑEZ, G. L. (2010a): "Fragility of Reputation and Clustering of Risk-Taking," Working Paper.

——— (2010b): "Reputation from Nested Activities," Working Paper.

PEROTTI, R. (1993): "Political Equilibrium, Income Distribution, and Growth," *The Review of Economic Studies*, 60, 755–776.

PERSSON, T. AND G. TABELLINI (1994): "Is Inequality Harmful for Growth?" *The American Economic Review*, 84, 600–621.

——— (2009): "Democratic Capital: The Nexus of Political and Economic Change," *American Economic Journal: Macroeconomics*, 1, 88–126.

RAJAN, R. G. (2009): "Rent preservation and the persistence of underdevelopment," *American Economic Journal: Macroeconomics*, 1, 178–218.

RAY, D. (2007): *A game-theoretic perspective on coalition formation*, The Lipsey Lectures, Oxford University Press.

RAY, D. AND R. VOHRA (1997): "Equilibrium binding agreements," *Journal of Economic Theory*, 73, 30–78.

——— (1999): "A theory of endogenous coalition structures," *Games and Economic Behavior*, 26, 286–336.

RESTUCCIA, D. AND R. ROGERSON (2008): "Policy distortions and aggregate productivity with heterogeneous establishments," *Review of Economic Dynamics*, 11, 707–720.