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GOVERNANCE AND EFFICIENCY WITH AND WITHOUT GOVERNMENT

Francesco Angelini
University of Bologna, Italy

Guido Candela
University of Bologna, Italy

Massimiliano Castellani
University of Bologna, Italy
RCEA

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Francesco Angelini*, Guido Candela°, and Massimiliano Castellani**

University of Bologna

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Abstract

This paper explores the relationships between forms of governance and efficiency, in societies with and without State, with several specific agent behaviors. Using a theoretical framework where the private agents are, or are not, able to efficiently coordinate their actions, we study how forms of governance affect the level of welfare of each society.

JEL classification: H11, H23, H41

Keywords: Governance capacity, Public good, Public choice, Efficiency

*Department of Statistics, University of Bologna - Italy. e-mail: francesco.angelini7@unibo.it

°Department of Economics, University of Bologna, Bologna - Italy. e-mail: guido.candela@unibo.it

**Department of Statistics, University of Bologna - Italy. e-mail: m.castellani@unibo.it

1 Introduction

Can a society without governance exist? Both political philosophy and history would probably respond no. Different forms of public governance have been tested throughout history and then analyzed, primarily focusing on the role of the government in the governance of a society. What emerges is that some forms of governance without government, such as self-governance and private governance, might even be preferable to those with government. In political economy, the analysis of governance proceeds alongside investigations into the role of the State as a public agent, emphasizing the efficiency of public governance. Scholars have also focused on the stability of private and self-governance, such as Sugden (1989) and Hirshleifer (1995, 1998), and on the efficiency of anarchy (Leeson 2007*b*, Candela & Cellini 2011), but the literature lacks a comparative analysis on the efficiency of forms of governance. To bridge this gap, this paper presents such a study on the efficiency of the governance in several forms of society. We propose a static model with two private agents with two different possible behaviors, and eventually a public agent, that could either be partisan or bipartisan. In our setting, governance is seen as a pure public good and thus it incorporates all the public good characteristics, such as non-excludability and non-rivalry. For example, the advantage an individual obtains from good governance does not influence the advantage others in societies might experience, and there is no way to exclude an individual from enjoying the effects of governance.

The model we present in this paper works as a normative benchmark, useful for comparing the potential political choices, and can be used both by private agents in a position to choose the social contract and by policy makers. We explain how and why agents might be forced to make inefficient political choices, using an extended form of the Political Coase theorem, introduced by Acemoglu (2003).

The remainder of the paper is structured as follows. In Section 2, we review the literature, while in Section 3 we present our contribution. In Section 4, we set up a basic model where two private agents interact with each other in societies without State, and with each other and a public agent in societies with State. In Section 5, we present the solutions to our problems and compare the level of public and private goods in various societies. In Section 6, we compare and rank the welfare and level of public good in the societies under examination. Section 7 discusses the main results of the paper and concludes.

2 A literature review

In economics literature, the issue of governance has been covered by scholars in different strands of literature, such as the economics of anarchy, the economics of governance, and the political economy of State capacity. All three strands consider governance as a public good that influences both the static and the dynamic economic efficiency. In this Section, we present a brief critical overview of these three strands, focusing on the area of overlap, and present our contribution to the literature.

The economic analysis of anarchy studies how agents in a stateless society are able to coordinate themselves to efficiently internalize the externalities.[1] Since the end of the 1980s, a series of scholars from the fields of economics and political sciences have analyzed the concept of anarchy, as opposed to State and market, assuming that an anarchic society is characterized by the possibility of a coordination failure (Mueller 1988, Witt 1992). Sugden (1989) studies how order in a society without regulation could spontaneously emerge, as conventions forms, reciprocity rules, and self-governed choices. Hirshleifer (1995, 1998) further develops the idea from Sugden (1989), analysing the conditions under which anarchy is a stable equilibrium and when it yields a state of chaos.[2]

Recently, another strand of literature introduces self-governance to the comparison between predatory State and anarchy; Konrad & Leininger (2011) demonstrate the conditions of existence of a stateless society whose members cooperate in the collective action and do not fight, while Konrad & Skaperdas (2012) analyze the ability of the stateless society members to provide protection, seen as a public good, comparing it with the autocratic State's ability. They note, however, that a situation of self-governance is not easy to obtain or preserve; Murtazashvili & Murtazashvili (2015) analyze a case study in Afghanistan concerning self-governance in the enforcement of property rights, where State intervention may be inefficient, in an economic sense, with respect to self-governance.

Two additional strands of literature, within economics of governance and political economy,

[1] The seminal works on this topic are Tullock (1972, 1974), Nozick (1974), and Buchanan (1975). For a survey on public choice and the economic analysis of anarchy, see Powell & Stringham (2009).

[2] Since the beginning of the 2000s, several papers show how anarchy could actually be better than a State: in particular, the comparison was made between anarchy and a predatory State (Mcguire & Olson 1996, Moselle & Polak 2001, Skaperdas 2001, Powell & Coyne 2003, Leeson 2007*a*,*b*, Leeson & Williamson 2009, Baker & Bulte 2010, Vahabi 2016, Young 2016). For a survey, see Candela (2014). Buchanan (2003) suggests that the existence of politics can be seen as a "tragedy", since it destroys value that could otherwise be enjoyed under a stable anarchy of "angels".

study and analyze governance capacity and State capacity. The archetypical definition of governance as a procedure comes from Weber (1978),[3] but, since the work by North (1991), a series of modern definitions, more focused on governance capacity, have been proposed by both academic scholars and practitioners. North (1991) sees governance as institutions, defining them as "the humanly devised constraints that structure political, economic and social interaction". Frischtak (1994) defines governance capacity as "the ability to coordinate the aggregation of diverging interests and thus promote policy that can credibly be taken to represent the public interest"; she also presents a series of definitions, in which governance capacity is seen as the ability of a democratic government to allow economic rules to dominate those of politics, or as the ability to promote the government's economic policies, even using culture as a code of language that permits the development of policies to work properly. More recently, Kaufmann & Kraay (2008) consider governance to be a synonym for institutions and institutional capacity, providing other definitions, where governance is the way power is used when managing the economic and social resources of a country aimed at its development, and the traditions and institutions though which authority is exerted in a country; this last definition is also used by Holmberg et al. (2009). Fukuyama (2013) defines governance as "a government's ability to make and enforce rules, and to deliver services, regardless of whether that government is democratic or not" and the quality of governance as "a function of the interaction of capacity and autonomy".[4] Finally, Savoia & Sen (2015) define governance as the way in which power is exerted in the management of a country's economic and social resources and its development; the same authors point out that an important component of governance is the "[S]tate capacity", a concept which has been interpreted as the bureaucratic and administrative capacity (competency in spending the public budget), the legal capacity (the enforcement of laws), the infrastructural capacity ("territorial reach of the [S]tate"), the fiscal capacity (competency in collecting taxes), and the military capacity (the monopoly of violence).[5] However, this definition of governance

[3]See Fukuyama (2013, p. 352) for a discussion. Following Fukuyama (2013), the weberian bureaucracy could be more efficient than a discretionary bureaucracy, since Weber does not consider enforcement power. The author also highlights that the institutional studies are mainly focused on the institutions that limit or control power, and not on the power of the State itself, since they do not consider the economic incentives that may influence it.

[4]Government and governance are not the same concept; in fact, following Koch (2013), "the term governance in contrast to government denotes [...] modes of political steering and integration dominated by networks, overlapping roles of political and societal actors, low institutionalization, and a general blurring of bureaucratic demarcations". Some recent works focus the analysis on the transition from government to governance, for example Hysing (2009) and Koch (2013).

[5]Savoia & Sen (2015) also list the determinants of State capacity, including the length of statehood, presence

clearly implies that interpretations of State capacity are nothing other than the way in which power is exerted, so State capacity cannot be part of governance.

The concept of State capacity has been studied in depth within the political economy literature: especially from 2005, within the studies on the relationship between State capacity, development and economic growth.[6] Acemoglu (2005) studies the effect of high and low State capacity on resource allocation and growth under an optimal dynamic-efficiency approach. When introducing a theoretical and empirical model of State capacity, Besley & Persson (2009, 2010) report definitions of State capacity from both historical sociology and economics, respectively as "the power of the [S]tate to raise revenue" and the "wider range of competencies that the [S]tate acquires in the development process, which includes the power to enforce contracts and support markets through regulation or otherwise". State capacity as the military capacity has been studied by Acemoglu et al. (2010*a*), who consider the persistence of civil wars when the army may attempt a coup, and Acemoglu et al. (2010*b*), analysing the formation of military dictatorships. Acemoglu et al. (2013) analyze the limitation of State capacity due to paramilitary power, focusing on the historical case of Colombia. Using the concept of State capacity as the fiscal and administrative capacities, Acemoglu et al. (2011) study how relationships between the bureaucrats and the rich and the poor can shape the political framework in a country, including an analysis on the political equilibria in regime shifts.

3 Political Coase Theorem: an extension

As shown in the literature review, one of the long-standing debates concerns the analysis of institutions' efficiency, focusing particularly on the efficiency of the State in several configurations of society. However, a general agreement on the definitions of societies with and without State still does not exist, which clearly makes it difficult to compare their efficiency. By introducing a series of definitions, we are able to schematically analyze the efficiency issue.

We define "stateless societies" as societies where private agents, without any authority, inhabit a common environment and interact with each other: we will call the group of private agents in

of external conflicts, legal origins of the State, colonization strategy, presence of inequality, structure of the economy, ethnic and linguistic fractionalization, incentives and the type of recruitment of the bureaucracy, and political democracy.

[6]Some scholars call State capacity "the size of the State", which has also been studied in relation to the formation of the State; for a survey, see Spolaore (2006).

these societies "community".[7] Conversely, when a State exists in the society, we have a "society with State", and there will be a public agent with authority over the private agents; in this case, the community is made up of both the private agents and this public agent which we will call "extended community".[8]

In a society with State, the public agent has a certain authority and can exert its coercive power, through what we will call "public governance", whereas in a stateless society the governance is provided by the private agents either in the form of a system of private governance if the agents are selfish or a system of self-governance if they are altruistic.[9]

In order to evaluate the societies with and without State in terms of their efficiency, we use the Political Coase theorem, even if not all the potential social conflicts are considered by its original formulation.[10] In this paper, we extend the Political Coase theorem so that we are able to evaluate several types of societies and their social conflicts, starting from Acemoglu (2003) and adding a new theorem on social conflict when there is an effect of some instrumental variable on the welfare function. Recalling Acemoglu (2003), we have three possible explanations of how certain political choices $P(X)$ are made and of their effect on efficiency, given a series of economic choices X: the Political Coase theorem (PC) states that there exists a set of optimal political choices $\mathbb{P}(\cdot|X)$ that contains the political choices $P^*(X)$ that maximize the welfare function $\Theta(X, P(X))$, which states that private and public agents, through political bargaining, will choose an optimal policy in $\mathbb{P}(\cdot|X)$; the Modified Political Coase theorem (MPC), for which the economic choices are made up of two parts, a certain part X_c and an uncertain part X_u, over which the agents have a belief $\Gamma(X_u)$, so, even if two societies bargain the same *ex-ante* $X = X_c + X_u$, the presence of different beliefs could affect the political choices they make and, hence, the welfare; the Social Conflict theories (SC), for which there exists a vector Z of instrumental variables which does not directly affect the welfare function $\Theta(\cdot)$, but does change the welfare level, through X, possibly changing the optimal political choices. To consider

[7]Examples of stateless societies are not common in modern times, but several cases exist from the medieval period and in many primitive societies. Apart from the case of Somalia in recent years (Leeson 2007*a*, Leonard & Samantar 2011), we also have an example of anarchy in the Antarctic continent where the only treaty in force is the Antarctic Treaty, signed by 52 countries with no territorial claims. For further examples of self-government, see Candela & Senta (2017).

[8]All modern States where the political power of the government is limited by a social contract or a constitutional law are examples of societies with State.

[9]See Stringham (2015) and Leeson (2014) for more details on the definition of governance, and Börzel & Risse (2016) for an analysis of governance in areas without government.

[10]For a critical survey on the Political Coase theorem, see Vahabi (2011).

another case of inefficient political choices, we introduce an extension to Acemoglu (2003), the Modified Social Conflict theorem (MSC). We assume that Z can also have a direct effect on $\Theta(\cdot)$, in other words, some non-economic variables could change the welfare function, switching from $\Theta(X, P(X))$ to $\Theta_Z(X, P(X))$. The welfare function can change when the public agent exists, for example, passing from a stateless society to a society with State. Furthermore, in a society with State, the partisan Government can trigger social conflicts and modify the optimal political choices.

In addition to extending the Political Coase Theorem, our paper also contributes to the extant literature by introducing an innovative analytical framework that can be used to evaluate the efficiency of a series of institutions; our model allows policy makers to rank the levels of welfare and public good for each potential political choice, and shows that the efficiency level of a society and its governance level are not always aligned, depending on the preferences of the private agents and of Government.

Studies more closely in line with our work can be found in Mcguire & Olson (1996) who focus on how the production of public goods in a stateless and in an autocratic society work, using a Pareto-efficiency framework, and Krasner & Risse (2014), who analyze how external interventions influence the provision of public goods, while our work concentrates on the internal production, or self-production.[11]

4 The theoretical framework

We model a basic social interaction between two private agents, A and B, which form the community (w), and eventually a public agent, the Government (G), with political and coercive power. When G exists, the extended community (ω) is formed by the community and the Government. All the agents are assumed to be perfectly informed and fully rational.[12]

In this economy there are two private goods, α and β, and a public good, γ, which is the society governance capacity; we assume that positive levels of α, β, and γ are necessary for a community to exist, while the Government only needs a positive level of γ. We further assume that α can only be produced and consumed by A and β can only be produced and consumed by B, therefore,

[11] Additionally, Moroney & Lovell (1997), Adkins et al. (2002), and Méon & Weill (2005) develop empirical models of frontier efficiency in welfare.

[12] The model explicitly considers only two private agents, which could also be two groups of agents, and one public agent.

there is no market for private goods; γ, on the other hand, is a joint production between the two private agents, and it is jointly consumed by all agents. As a result, in this framework, neither conflicts between agents nor predation on the production of private goods exist. Since the agents interactions do not involve trade and require law enforcement, the Government is an external institution that does not establish and enforce property rights or interact with other Governments and societies, but simply coordinates production and consumption of public good. The production technology of the goods uses time as its only input; in particular, each private agent decides how much time (normalized to 1) he wants to allocate to the production of the public good (t_A^γ or t_B^γ), to the production of his private good and to his unproductive time, the time available for personal activities, such as eating, sleeping, etc.: agent A chooses between the production time of α (t_A^α) and his unproductive time (t_A^ℓ), while agent B chooses between the production time of β (t_B^β) and his unproductive time (t_B^ℓ).[13]

The time constraints for A and B are the following:

$$1 = t_A^\alpha + t_A^\gamma + t_A^\ell - \pi \tag{1}$$

$$1 = t_B^\beta + t_B^\gamma + t_B^\ell + \pi \tag{2}$$

where $0 \leq \pi < 1$ is a tax on A's unproductive time and a subsidy for B's total time, who will allocate it to t_B^β, t_B^γ, and B's unproductive time t_B^ℓ. B is then the Government's favourite agent, when $\pi > 0$.

The production functions of α and β are:

$$\alpha \equiv f_A\left(t_A^\alpha\right)$$

$$\beta \equiv f_B\left(t_B^\beta\right)$$

where $f_j(\cdot)$, with $j = A, B$, has a positive first derivative and a non-positive second derivative. The production function of γ is the following:

$$\gamma \equiv k_\gamma\left(\gamma_A, \gamma_B\right)$$

[13]The subscript represents the agent and possibly the society, while the superscript indicates the good.

where γ_A and γ_B are the agents' contributions to the production of public good and $k_\gamma(\gamma_A, \gamma_B)$ has positive first partial derivatives and non-positive cross and second derivatives. In particular, the externality from public good implies that $k(0, \gamma_B) = k(\gamma_A, 0) = 0$. The production functions of γ_A and γ_B are the following:

$$\gamma_A \equiv g_A\left(t_A^\gamma\right)$$
$$\gamma_B \equiv g_B\left(t_B^\gamma\right)$$

where $g_j(\cdot)$ has a positive first derivative and a non-positive second derivative.

The preferences of the agents on α, β, γ, and unproductive time are represented by the following utility functions:

$$U_A \equiv k_A\left(\alpha, \gamma, t_A^\ell\right)$$
$$U_B \equiv k_B\left(\beta, \gamma, t_B^\ell\right)$$
$$U_G \equiv k_G\left(\gamma, U_A, U_B\right)$$

where U_A is the utility function of A, U_B is the utility function of B, and U_G is the utility function of G. All the agents' utility functions are assumed to be at least twice-differentiable and convex; we further assume that all the first derivatives are positive.

We can define the extended community welfare as:

$$\Omega \equiv \Omega\left(U_A, U_B, U_G\right) \tag{3}$$

Instead, the community welfare is given by:

$$W \equiv W\left(U_A, U_B\right) \tag{4}$$

Since $\Omega(\cdot)$ and $W(\cdot)$ are welfare functions, they are both strictly increasing in all their arguments. Following a welfare-maximizing and static-equilibrium approach to find the optimal level of governance capacity as the efficient benchmark, we have to maximize the welfare function (3) or (4), with respect to time variables, under a series of assumptions of individual and social behavior we will present below.

We define society with dictatorial Government as the society where the Government maximizes Ω with respect to all the agents' times; in particular, when $\pi = 0$, we have a society with dictatorial neutral Government (D, N), while, when $0 < \pi < 1$, we face a society with dictatorial partisan Government (D, P); in other words, the Government acts as a benevolent dictator (Olson 1993).

We assume that the agents A and B can behave either selfishly or altruistically: either the agent only cares about his own utility, or the agent cares about the social welfare of the community. Hence, we have either an individualistic society (I), in which both agents exhibit selfish behavior, or a collectivistic society (C), when both agents exhibit altruistic behavior.

In each potential society there could either be the Government (society with State) or not (stateless society, S). In a society with State, G has a certain coercive power and makes political decisions about the public good (public governance), and it can either choose a partisan policy (P), favouring by assumption agent B, or a neutral policy (N) in the governance of ω. On the other hand, the stateless society is not governed by G and the governance is provided by A and B: if they both behave selfishly, we have a system of private governance, while if they follow an altruistic path, we will have a system of self-governance. Therefore, when there is no G, we can have a stateless society with private governance (I) or self-governance (C).

Combining the agents' behaviors with the potential forms of the society, we end up with two societies with dictatorial Government, neutral and partisan, $(D, N$ and $D, P)$, two stateless societies, either individualistic or collectivistic $(I, S$ and $C, S)$, two partisan-Government societies, individualistic society with partisan Government and collectivistic society with partisan Government $(I, P$ and $C, P)$, and finally two neutral-Government societies, individualistic society with neutral Government and collectivistic society with neutral Government $(I, N$ and $C, N)$.

Summarizing, we have 8 potential societies and 12 comparisons, for which our extension of the Political Coase theorem introduced in Section 1 holds; some comparisons are explained by the theorems in Acemoglu (2003). The MPC considers the three cases in which individualistic society, conjugated either with neutral Government, partisan Government, or a stateless society, becomes a collectivistic society, and viceversa; the SC considers the three cases in which a State with neutral Government becomes a State with partisan Government, in the cases where the agents are selfish or altruistic, and in the case of a society with dictatorial Government; our extension MSC focuses on the cases in which the individualistic/collectivistic society switches to a society with dictatorial Government, in both the neutral and partisan Government cases, as well as on the cases where the stateless society becomes a society with State, with either neutral or partisan Government, for both selfish and altruistic agents, and when it becomes a society with dictatorial Government, either neutral or partisan, for both selfish and altruistic agents. The following diagram divides these comparisons according to the applicable version of the Political Coase theorem.

$$MPC: \begin{cases} I,N \leftrightarrow C,N \\ I,P \leftrightarrow C,P \\ I,S \leftrightarrow C,S \end{cases} \qquad SC: \begin{cases} I,N \leftrightarrow I,P \\ C,N \leftrightarrow C,P \\ D,N \leftrightarrow D,P \end{cases}$$

$$MSC: \begin{cases} I,S \leftrightarrow I,N & C,S \leftrightarrow C,N & I,S \leftrightarrow D,N \\ I,S \leftrightarrow I,P & C,S \leftrightarrow C,P & I,S \leftrightarrow D,P \\ I,N \leftrightarrow D,N & I,P \leftrightarrow D,P & C,S \leftrightarrow D,N \\ C,N \leftrightarrow D,N & C,P \leftrightarrow D,P & C,S \leftrightarrow D,P \end{cases}$$

In terms of the formalization of the Political Coase theorem and our extension, we have that α and β are the economic choices in X, while γ is the political choice in $P(X)$, $\Theta(\cdot)$ is $\Omega(\cdot)$, and $\Theta_Z(\cdot)$ is $W(\cdot)$. In our framework there is no uncertainty, but we can consider X_u in the MPC as a part of X over which the different agents' behavior hypotheses have an effect; in other words, our hypothesis on the collectivistic or individualistic approach behind the agents' choices is included in the belief function $\Gamma(X_u)$. Finally, the effect of Z in SC consists in the fact that $P(X)$ only modifies the value of the welfare function, and it constraints the choice on X given (1) and (2) when $0 \leq \pi < 1$, while the effect of Z in MSC consists in the switch from using W as the objective function to using Ω.

Notice that when there is a social conflict (both SC and MSC), the behavior of the agents that can change the chosen X given their different beliefs is no longer a determinant for changing the level of welfare, since the first move of the Government constraints the choice of the agents and the coordination issue is washed out.

4.1 The specification of the model

In order to find an analytic solution of the model, we assume that $f_j(\cdot)$ and $g_j(\cdot)$ are both identity functions and the production function of the public good is as follows:

$$\gamma \equiv k_\gamma (\gamma_A, \gamma_B) \equiv \gamma_A \gamma_B \tag{5}$$

Furthermore, we assume that the utility of each of the private agents is nested, as follows:

$$U_A \equiv \gamma^{\theta_A^\gamma} u_A^{1-\theta_A^\gamma}$$
$$U_B \equiv \gamma^{\theta_B^\gamma} u_B^{1-\theta_B^\gamma}$$

where $0 < \theta_j^\gamma < 1$ are weights, and u_j-s have the following form:

$$u_A \equiv \left(t_A^\alpha\right)^{\theta_A^\alpha} \left(t_A^\ell\right)^{1-\theta_A^\alpha}$$
$$u_B \equiv \left(t_B^\beta\right)^{\theta_B^\beta} \left(t_B^\ell\right)^{1-\theta_B^\beta}$$

where $0 < \theta_A^\alpha < 1$ and $0 < \theta_B^\beta < 1$ are weights.

Assuming that G can choose either a partisan policy, advantaging by assumption the agent B by fixing $\pi > 0$, or a neutral policy ($\pi = 0$) in the governance of ω, the utility function of G is the following:

$$U_G \equiv (\gamma)^{\theta_G^\gamma} (U_A)^{1-\theta_G^\gamma} (U_B)^{1-\theta_G^\gamma}$$

where $0 < \theta_G^\gamma < 1$. Notice that when $\pi > 0$, U_G is strictly increasing with respect to π, and we assume that the Government will fix π as its optimal level, π^*.

For the society as a whole (ω), we can specify (3) as:

$$\Omega = U_A^{\frac{1}{3}} U_B^{\frac{1}{3}} U_G^{\frac{1}{3}} \tag{6}$$

While, (4) can be specified as:

$$W = U_A^{\frac{1}{2}} U_B^{\frac{1}{2}} \tag{7}$$

4.2 The society with dictatorial Government

We now introduce the problems of the society with dictatorial Government, in which the Government, which can be either neutral or partisan, chooses A and B's production and unproductive times, through the maximization of (6), in the solution to the following problem:[14]

$$\max_{\left\{t^{\alpha}_{A,D,h},t^{\beta}_{B,D,h},t^{\gamma}_{A,D,h},t^{\gamma}_{B,D,h}\right\}} \Omega \;\; s.t. \;\; t^{\alpha}_{A,D,h} + t^{\gamma}_{A,D,h} + t^{\ell}_{A,D,h} = 1 + \pi \; and \qquad t^{\beta}_{B,D,h} + t^{\gamma}_{B,D,h} + t^{\ell}_{B,D,h} = 1 - \pi \wedge \alpha, \beta, \gamma > 0 \tag{8}$$

with $h = N, P$.

From the FOCs conditions of the problem (8) when $\pi = 0$, we obtain the optimal time allocation for the society with dictatorial neutral Government, $\left\{t^{\alpha}_{A,D,N}, t^{\gamma}_{A,D,N}, t^{\beta}_{B,D,N}, t^{\gamma}_{B,D,N}\right\}$. Analytically, the result is the following quadruple:

$$\left\{\theta^{\alpha}_{A}\frac{2-\theta^{\gamma}_{A}-\theta^{\gamma}_{G}}{2+\theta^{\gamma}_{B}}, \frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G}}{2+\theta^{\gamma}_{B}}, \theta^{\beta}_{B}\frac{2-\theta^{\gamma}_{B}-\theta^{\gamma}_{G}}{2+\theta^{\gamma}_{A}}, \frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G}}{2+\theta^{\gamma}_{A}}\right\} \tag{9}$$

When G is partisan ($0 < \pi < 1$), the optimal allocation of time for A and B in the society with dictatorial partisan Government $\left\{t^{\alpha}_{A,D,P}, t^{\gamma}_{A,D,P}, t^{\beta}_{B,D,P}, t^{\gamma}_{B,D,P}\right\}$ is the following:

$$\begin{aligned}\Bigg\{&\theta^{\alpha}_{A}\frac{2-\theta^{\gamma}_{A}-\theta^{\gamma}_{G}-\pi(\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G})}{2+\theta^{\gamma}_{B}}, \frac{(\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G})(1+\pi)}{2+\theta^{\gamma}_{B}},\\ &\theta^{\beta}_{B}\frac{2-\theta^{\gamma}_{B}-\theta^{\gamma}_{G}+\pi(\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G})}{2+\theta^{\gamma}_{A}}, \frac{(\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G})(1-\pi)}{2+\theta^{\gamma}_{A}}\Bigg\}\end{aligned} \tag{10}$$

We need $t^{\alpha}_{A,D,P}$ to be positive, which is true when $\pi < \frac{2-\theta^{\gamma}_{A}-\theta^{\gamma}_{G}}{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G}}$. We also need $t^{\gamma}_{A,D,P}$ to be smaller than 1, which holds when: [15]

$$\pi < \frac{1}{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G}} - 1 \tag{11}$$

We can now rewrite the solutions from the quadruple (10) as functions of the results from the

[14] The dictator's objective function also includes the utility functions of the private agents to recognize their role in the political choices, as suggested by Gandhi & Przeworski (2006) and Desai et al. (2009). Thus, in our framework $1-\gamma^{G}$ can be seen as a measure of the private agents' weight in the policy making, while γ^{G} as a measure of the dictator's bargaining power (Desai et al. 2009).

[15] Since $\frac{1-(\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G})}{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G}} < \frac{2-\theta^{\gamma}_{A}-\theta^{\gamma}_{G}}{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G}}$, (11) is more binding. Moreover, π must be greater than 0, so the condition in (11) needs $\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G} < 1$, otherwise it will never hold.

quadruple (9):

$$
\begin{aligned}
t^{\alpha}_{A,D,P} &= t^{\alpha}_{A,D,N} - \pi\theta^{\alpha}_{A} t^{\gamma}_{A,D,N} \\
t^{\gamma}_{A,D,P} &= t^{\gamma}_{A,D,N}\left(1+\pi\right) \\
t^{\beta}_{B,D,P} &= t^{\beta}_{B,D,N} + \pi\theta^{\beta}_{B} t^{\gamma}_{B,D,N} \\
t^{\gamma}_{B,D,P} &= t^{\gamma}_{B,D,N}\left(1-\pi\right)
\end{aligned}
\tag{12}
$$

Given (9), agent A's times depends on B's preferences and viceversa, as is clear from (12). In other words, the Government internalizes the externalities coming from the public good, and this creates interdependence in the private agents' choices.

So, we have that the level of public good in the society with dictatorial neutral Government is equal to:

$$\gamma^{*}_{D,N} = \frac{\left(\theta^{\gamma}_{A} + \theta^{\gamma}_{B} + \theta^{\gamma}_{G}\right)^{2}}{\left(2+\theta^{\gamma}_{B}\right)\left(2+\theta^{\gamma}_{A}\right)}$$

Similarly, the level of public good in the society with dictatorial partisan Government is equal to:

$$\gamma^{*}_{D,P} = \frac{\left(\theta^{\gamma}_{A} + \theta^{\gamma}_{B} + \theta^{\gamma}_{G}\right)^{2}\left(1-\pi^{2}\right)}{\left(2+\theta^{\gamma}_{B}\right)\left(2+\theta^{\gamma}_{A}\right)} = \gamma^{*}_{D,N}\left(1-\pi^{2}\right) \tag{13}$$

Comparing societies with dictatorial Government, we have the following proposition:

Proposition 1 *Given our assumptions, we have that:*

$$
\begin{aligned}
t^{\alpha}_{A,D,N} &> t^{\alpha}_{A,D,P} \qquad & t^{\beta}_{B,D,N} &< t^{\beta}_{B,D,P} \\
t^{\gamma}_{A,D,N} &< t^{\gamma}_{A,D,P} \qquad & t^{\gamma}_{B,D,N} &> t^{\gamma}_{B,D,P} \\
t^{\ell}_{A,D,N} &> t^{\ell}_{A,D,P} \qquad & t^{\ell}_{B,D,N} &< t^{\ell}_{B,D,P}
\end{aligned}
$$

Proof. The proof is in Appendix A.1. ■

Corollary 1 *Given* (13)*, the public good in the society with dictatorial partisan Government is always smaller than in the society with dictatorial neutral Government:* $\gamma^{*}_{D,P} < \gamma^{*}_{D,N}$.

Proof. The proof is straightforward. ■

Comparing the society with dictatorial neutral Government to the society with dictatorial partisan Government, agent A will be forced by G to reduce his level of α and his unproductive time in order to produce more γ_A, while B will enjoy a higher level of his private good and unproductive time and will contribute less to the production of the public good. Specifically, A will reduce his private production and unproductive time by a total value of $\pi t^{\gamma}_{A,D,N}$, taking $\pi\theta^{\alpha}_{A}t^{\gamma}_{A,D,N}$ from the time allocated to the production of α and $\pi\left(1-\theta^{\alpha}_{A}\right)t^{\gamma}_{A,D,N}$ from his unproductive time, while agent B will reduce the production of γ_B by a total amount of $\pi t^{\gamma}_{B,D,N,}$ and redistribute this time to the production of his private good β with a share of θ^{β}_{B} and to his unproductive time with a share of $1-\theta^{\beta}_{B}$. However, the level of governance capacity will be reduced.

5 The governance without and with State

In this Section, we present the agents' optimization problems and analyze their solutions; in Subsection 5.1 we consider the stateless societies, with both selfish and altruistic agents, in Subsection 5.2 we focus on the neutral Government in a society with State, while in Subsection 5.3 we study the partisan Government in the same society. Subsection 5.4 contains the comparison between the public governance results coming from the choices made by neutral and partisan Government in a society with State.

5.1 Stateless societies

In the stateless individualistic society (I,S), agents A and B are selfish and maximize their utility functions separately from each other, like in a non-cooperative game. The Government G does not exist, but the two private agents can produce γ by themselves, through private governance. In this society, a coordination problem exists, which could lead to a non-optimal level of produced goods.

Agents A and B simultaneously solve the following problems:

$$\begin{aligned} &\max_{\left\{t^{\alpha}_{A,I,S},t^{\gamma}_{A,I,S}\right\}} U_A \;\; s.t.\;\; t^{\alpha}_{A}+t^{\gamma}_{A}+t^{\ell}_{A}=1\wedge\alpha,\gamma>0 \\ &\max_{\left\{t^{\beta}_{B,I,S},t^{\gamma}_{B,I,S}\right\}} U_B \;\; s.t.\;\; t^{\beta}_{B}+t^{\gamma}_{B}+t^{\ell}_{B}=1\wedge\beta,\gamma>0 \end{aligned} \tag{14}$$

The quadruple $\left\{t^{\alpha}_{A,I,S},t^{\gamma}_{A,I,S},t^{\beta}_{B,I,S},t^{\gamma}_{B,I,S}\right\}$ that solves the system in (14) is:

$$\left\{\theta^{\alpha}_{A}\left(1-\theta^{\gamma}_{A}\right),\theta^{\gamma}_{A},\theta^{\beta}_{B}\left(1-\theta^{\gamma}_{B}\right),\theta^{\gamma}_{B}\right\} \tag{15}$$

Notice that agent A's choices do not depend on agent B's preferences and viceversa, meaning that there is no internalization of the externalities in the individualistic stateless society.

In the stateless collectivistic society (C,S), private agents A and B are altruistic and jointly maximize the community welfare like in a cooperation game, providing γ through self-governance. The two agents maximize the community welfare W, solving the following problem:

$$\max_{\left\{t^{\alpha}_{A,C,S},t^{\gamma}_{A,C,S},t^{\beta}_{B,C,S},t^{\gamma}_{B,C,S}\right\}} W \;\; s.t. \;\; t^{\beta}_B + t^{\gamma}_B + t^{\ell}_B = 1 \wedge t^{\alpha}_A + t^{\gamma}_A + t^{\ell}_A = 1 \wedge \alpha, \beta, \gamma > 0 \tag{16}$$

The quadruple $\left\{t^{\alpha}_{A,C,S}, t^{\gamma}_{A,C,S}, t^{\beta}_{B,C,S}, t^{\gamma}_{B,C,S}\right\}$ that solves the problem in (16) is:

$$\left\{\theta^{\alpha}_A \frac{1-\theta^{\gamma}_A}{1+\theta^{\gamma}_B}, \frac{\theta^{\gamma}_A + \theta^{\gamma}_B}{1+\theta^{\gamma}_B}, \theta^{\beta}_B \frac{1-\theta^{\gamma}_B}{1+\theta^{\gamma}_A}, \frac{\theta^{\gamma}_A + \theta^{\gamma}_B}{1+\theta^{\gamma}_A}\right\} \tag{17}$$

In the collectivistic stateless society, agent A's choices depend on agent B's preferences and viceversa, since they internalize the externalities.

By comparing the quadruples in (15) and (17), we can see how the time the agents spend on the production of the private and the public goods changes in the two stateless societies, when the propensity of the agent to be altruistic varies. We have the following proposition:[16]

Proposition 2 *Given our assumptions, we have that:*

$$\begin{aligned} t^{\alpha}_{A,I,S} &> t^{\alpha}_{A,C,S} & t^{\beta}_{B,I,S} &> t^{\beta}_{B,C,S} \\ t^{\gamma}_{A,I,S} &< t^{\gamma}_{A,C,S} & t^{\gamma}_{B,I,S} &< t^{\gamma}_{B,C,S} \\ t^{\ell}_{A,I,S} &> t^{\ell}_{A,C,S} & t^{\ell}_{B,I,S} &> t^{\ell}_{B,C,S} \end{aligned}$$

Proof. The proof is contained in Appendix A.2. ■

Corollary 2 *Since* (5)*, the public good in the collectivistic stateless society is always higher than in the individualistic stateless society:* $\gamma^*_{C,S} > \gamma^*_{I,S}$.

Proof. The proof is straightforward. ■

In the individualistic stateless society, both the agents will find it useful to focus on the production of their own private good and on the enjoyment of their unproductive time, instead

[16]Notice that $t^{\ell}_{A,I,S}$, $t^{\ell}_{A,C,S}$, $t^{\ell}_{B,I,S}$, $t^{\ell}_{B,C,S}$ are, respectively, A's unproductive time in stateless individualistic and in stateless collectivistic societies, and B's unproductive time in stateless individualistic and in stateless collectivistic societies.

of producing the public good, since this society is characterized by a failure in the coordination in the production of γ. On the other hand, in the collectivistic stateless society, the two agents can allocate more time to the production of the public good than in the individualistic society, since coordination is possible when the agents cooperate; the non-cooperative game in the individualistic society on the production of γ is a prisoner's dilemma.

5.2 Society with neutral Government

Starting from a society with neutral Government, G makes the first move in the sequential game, maximizing U_G with respect to t_A^{γ} and t_B^{γ}, and leaving the second step to the private agents. In the case of an individualistic society, private agents will simultaneously play a non-cooperative game, while in the case of a collectivistic society, private agents will cooperate.[17]
G's move, in both the I and C societies, results from the following maximization problem:[18]

$$\begin{aligned} \max_{\{t^{\gamma}_{A,i,N}, t^{\gamma}_{B,i,N}\}} U_G \ \ s.t. \ \ & t^{\alpha}_{A,i,N} + t^{\gamma}_{A,i,N} + t^{\ell}_{A,i,N} = 1 \ \ and \\ & t^{\beta}_{B,i,N} + t^{\gamma}_{B,i,N} + t^{\ell}_{B,i,N} = 1 \wedge \alpha, \beta, \gamma > 0 \end{aligned} \tag{18}$$

with $i = I, C$. The solution of this problem is given by $t^{\gamma}_{A,i,N} = t^{\gamma}_{B,i,N} = \theta^{\gamma}_G$, hence:

$$\gamma^*_{i,N} = (\theta^{\gamma}_G)^2 \tag{19}$$

In the second step of the individualistic society case (I, N), A and B simultaneously maximize the following problems:

$$\begin{aligned} &\max_{t^{\alpha}_{A,I,N}} U_A \ \ s.t. \ t^{\gamma}_{A,I,N} = t^{\gamma}_{B,I,N} = \theta^{\gamma}_G \wedge t^{\alpha}_{A,I,N} + t^{\gamma}_{A,I,N} + t^{\ell}_{A,I,N} = 1 \wedge \alpha > 0 \\ &\max_{t^{\beta}_{B,I,N}} U_B \ \ s.t. \ t^{\gamma}_{A,I,N} = t^{\gamma}_{B,I,N} = \theta^{\gamma}_G \wedge t^{\beta}_{B,I,N} + t^{\gamma}_{B,I,N} + t^{\ell}_{B,I,N} = 1 \wedge \beta > 0 \end{aligned} \tag{20}$$

[17] In policy game models the Government is usually the leader and the private agents are the followers, but in our model we assume that the sequential game between the public and the private agents is not a Stackelberg game. See Acocella et al. (2013) for some examples of sequential game models.

[18] G will maximize subject to an additional institutional commitment $(\alpha, \beta > 0)$ besides the constraint on the public good that allows the Government to exist $(\gamma > 0)$, in order to also be sure that agents A and B exist. Moreover, $\pi = 0$ since the Government is neutral.

The resulting quadruple $\left\{t_{A,I,N}^{\alpha}, t_{A,I,N}^{\gamma}, t_{B,I,N}^{\beta}, t_{B,I,N}^{\gamma}\right\}$ is then equal to:

$$\left\{\theta_A^{\alpha}\left(1-\theta_G^{\gamma}\right), \theta_G^{\gamma}, \theta_B^{\beta}\left(1-\theta_G^{\gamma}\right), \theta_G^{\gamma}\right\} \tag{21}$$

In the case where the society is collectivistic (C, N), the first step remains the same as in (18), while in the second step A and B play a cooperative game, maximizing their joint utility, which is the community welfare:

$$\begin{gathered} \max_{\left\{t_{A,C,N}^{\alpha}, t_{B,C,N}^{\beta}\right\}} W \;\; s.t. \; \theta_A^{\gamma}=\theta_B^{\gamma}=\theta_G^{\gamma} \wedge \alpha, \beta>0 \;\; and \\ t_{A,C,N}^{\alpha}+t_{A,C,N}^{\gamma}+t_{A,C,N}^{\ell}=1 \wedge t_{B,C,N}^{\beta}+t_{B,C,N}^{\gamma}+t_{B,C,N}^{\ell}=1 \end{gathered} \tag{22}$$

Since the results of this maximization problem are the same as the individualistic society, we can state the following Lemma:

Lemma 1 *Given the problem in* (18) *and the results in* (21)*, the quadruple of the results of the problems in* (20) *and* (22) *is such that*

$$\left\{t_{A,I,N}^{\alpha}=t_{A,C,N}^{\alpha}, t_{A,I,N}^{\gamma}=t_{A,C,N}^{\gamma}, t_{B,I,N}^{\beta}=t_{B,C,N}^{\beta}, t_{B,I,N}^{\gamma}=t_{B,C,N}^{\beta}\right\}.$$

Hence, in the case where the Government is neutral, the Nash-equilibrium result is equivalent to the cooperative-equilibrium result; this is due to the Government's authority, in the form of the first move in the sequential game: in its dominant position, G imposes its preferred level of public good, omitting any potential externality between the agents. As a consequence, agent A's times do not depend on B's preferences and viceversa in both the collectivistic and the individualistic society.

By comparing the solutions of the individualistic (collectivistic) society with neutral Government to the society with dictatorial neutral Government, we can state the following Claim:

Claim 1 *The times allocated by the agents to the private good, the public good, and the unproductive time are lower in the individualistic (collectivistic) society than in the society with* *dictatorial neutral Government if and only if:*

$$
\begin{aligned}
t^{\alpha}_{A,I,N} = t^{\alpha}_{A,C,N} < t^{\alpha}_{A,D,N} &\iff \theta^{\gamma}_{G} > \frac{\theta^{\gamma}_{A} + \theta^{\gamma}_{B}}{1 + \theta^{\gamma}_{B}} \\
t^{\gamma}_{A,I,N} = t^{\gamma}_{A,C,N} < t^{\gamma}_{A,D,N} &\iff \theta^{\gamma}_{G} < \frac{\theta^{\gamma}_{A} + \theta^{\gamma}_{B}}{1 + \theta^{\gamma}_{B}} \\
t^{\ell}_{A,I,N} = t^{\ell}_{A,C,N} < t^{\ell}_{A,D,N} &\iff \theta^{\gamma}_{G} > \frac{\theta^{\gamma}_{A} + \theta^{\gamma}_{B}}{1 + \theta^{\gamma}_{B}} \\
t^{\beta}_{B,I,N} = t^{\beta}_{B,C,N} < t^{\beta}_{B,D,N} &\iff \theta^{\gamma}_{G} > \frac{\theta^{\gamma}_{A} + \theta^{\gamma}_{B}}{1 + \theta^{\gamma}_{A}} \\
t^{\gamma}_{B,I,N} = t^{\gamma}_{B,C,N} < t^{\gamma}_{B,D,N} &\iff \theta^{\gamma}_{G} < \frac{\theta^{\gamma}_{A} + \theta^{\gamma}_{B}}{1 + \theta^{\gamma}_{A}} \\
t^{\ell}_{B,I,N} = t^{\ell}_{B,C,N} < t^{\ell}_{B,D,N} &\iff \theta^{\gamma}_{G} > \frac{\theta^{\gamma}_{A} + \theta^{\gamma}_{B}}{1 + \theta^{\gamma}_{A}}
\end{aligned}
$$

Remark 1 *Given* (5)*, if* $\theta^{\gamma}_{G} < \min\left\{\frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}{1+\theta^{\gamma}_{B}}, \frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}{1+\theta^{\gamma}_{A}}\right\}$*, the level of the public good in the individualistic (collectivistic) society with neutral Government is lower than in the society with dictatorial neutral Government.*

As is clear from the conditions in Claim 1, the preferences of the Government affect the way the time is allocated by the private agents in producing their private and public goods, and in enjoying their unproductive time, since their choices depend on the level of θ^{γ}_{G}, a variable which is not controlled by private agents. In particular, when the Government is not particularly selfish, $\theta^{\gamma}_{G} < \min\left\{\frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}{1+\theta^{\gamma}_{B}}, \frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}{1+\theta^{\gamma}_{A}}\right\}$, that is when the weight it gives to the public good is lower than a certain threshold that depends on the preferences of A and B, the level of γ produced in the society with dictatorial neutral Government will be higher than in the individualistic (collectivistic) society. This implies that the levels of time allocated to the private goods and to the unproductive time by A and B will be higher in the individualistic (collectivistic) society with neutral Government than in the society with dictatorial neutral Government, when the same condition on θ^{γ}_{G} holds. Conversely, the dominant position of the Government allows it to exert its political power, modifying the equilibrium allocation of agents' time, even when G is neutral.

5.3 Society with partisan Government

When G is partisan, the Government advantages B in the public choice ($\pi > 0$). In the first step, as with the neutral Government case, G will maximize U_G with respect to t_A^γ and t_B^γ. In the second step, then, A and B will choose the level of t_A^α and t_B^β, in a non-cooperative game in the individualistic society, or in a cooperative game in the collectivistic society.
The problem faced by G is the following:

$$\begin{aligned} \max_{\{t_{A,i,P}^\gamma, t_{B,i,P}^\gamma\}} U_G \;\; s.t. \;\; & t_{A,i,P}^\alpha + t_{A,i,P}^\gamma + t_{A,i,P}^\ell = 1 + \pi \;\; and \\ & t_{B,i,P}^\beta + t_{B,i,P}^\gamma + t_{B,i,P}^\ell = 1 - \pi \wedge \alpha, \beta, \gamma > 0 \end{aligned} \tag{23}$$

The solution of the problem in (23) is $\left\{\theta_G^\gamma (1+\pi), \theta_G^\gamma (1-\pi)\right\}$. We need that $t_{A,i,P}^\alpha > 0$ and that $t_{A,i,P}^\gamma < 1$, since the former may be smaller than zero and the latter may be larger than 1, and each time must lay between 0 and 1; both conditions hold if $\pi < \frac{1}{\theta_G^\gamma} - 1$. Notice that $\pi < \frac{1}{\theta_G^\gamma} - 1$ is implied by the condition in (11), hence hereafter we will consider (11) as always satisfied.[19]
In the second step of the game, the two private agents do not cooperate in choosing their levels of private goods in (I, P), while they cooperate in (C, P), taking $t_{A,i,P}^\gamma$ and $t_{B,i,P}^\gamma$ (chosen in the first step by the Government) as given. The problems A and B face in the second step of the individualistic and collectivistic societies game, (I, P) and (C, P) respectively, are the following:

$$\begin{aligned} \max_{t_{A,I,P}^\alpha} U_A \;\; s.t. \;\; & t_{A,I,P}^\gamma = \theta_G^\gamma(1+\pi) \wedge t_{B,I,P}^\gamma = \theta_G^\gamma(1-\pi) \;\; and \\ & t_{A,I,P}^\alpha + t_{A,I,P}^\gamma + t_{A,I,P}^\ell = 1 + \pi \wedge \alpha > 0 \\ \max_{t_{B,I,P}^\beta} U_B \;\; s.t. \;\; & t_{A,I,P}^\gamma = \theta_G^\gamma(1+\pi) \wedge t_{B,I,P}^\gamma = \theta_G^\gamma(1-\pi) \;\; and \\ & t_{B,I,P}^\beta + t_{B,I,P}^\gamma + t_{B,I,P}^\ell = 1 - \pi \wedge \beta > 0 \end{aligned} \tag{24}$$

$$\begin{aligned} \max_{\left\{t_{A,C,P}^\alpha, t_{B,C,P}^\beta\right\}} W \;\; s.t. \;\; & t_{A,C,P}^\gamma = \theta_G^\gamma (1+\pi) \wedge t_{B,C,P}^\gamma = \theta_G^\gamma (1-\pi) \wedge \alpha, \beta > 0 \;\; and \\ & t_{A,C,P}^\alpha + t_{A,C,P}^\gamma + t_{A,C,P}^\ell = 1 + \pi \wedge t_{B,C,P}^\beta + t_{B,C,P}^\gamma + t_{B,C,P}^\ell = 1 - \pi \end{aligned} \tag{25}$$

[19] In order to have $\pi > 0$ and (11) satisfied, we also need that $\theta_A^\gamma + \theta_B^\gamma + \theta_G^\gamma < 1$.

As in Subsection 5.2, the results of the two problems are equal in the two societies, since the way the agents choose the time allocated to their private goods and their unproductive time is still constrained by the choice of γ made by the Government; in particular, the resulting quadruple $\left\{t^{\alpha}_{A,i,P}, t^{\gamma}_{A,i,P}, t^{\beta}_{B,i,P}, t^{\gamma}_{B,i,P}\right\}$ is:

$$\left\{\theta^{\alpha}_{A}\left[1-\theta^{\gamma}_{G}(1+\pi)\right], \theta^{\gamma}_{G}(1+\pi), \theta^{\beta}_{B}\left[1-\theta^{\gamma}_{G}(1-\pi)\right], \theta^{\gamma}_{G}(1-\pi)\right\} \tag{26}$$

Given the problems in (23), (24), and (25), we can state the following Lemma:

Lemma 2 *The results of the problems in the second steps of the game, as in* (24) *and* (25)*, are such that*

$$\left\{t^{\alpha}_{A,I,P}=t^{\alpha}_{A,C,P}, t^{\gamma}_{A,I,P}=t^{\gamma}_{A,C,P}, t^{\beta}_{B,I,P}=t^{\beta}_{B,C,P}, t^{\gamma}_{B,I,P}=t^{\gamma}_{B,C,P}\right\}.$$

Notice that when the Government is partisan, there is no interdependence between A's and B's choices. This result does not depend on the coordination ability of the agents in the individualistic society, in fact it is also found in the collectivistic society, since it depends on the fact that the Government moves first.
In addition, from these results we have that:

$$\gamma_{i,P}=\left(\theta^{\gamma}_{G}\right)^{2}\left(1-\pi^{2}\right) \tag{27}$$

Comparing the results of an individualistic (collectivistic) society with partisan Government to those of the society with dictatorial partisan Government, we can state the following Claim:

Claim 2 *The times allocated by the private agents to the production of α, β, and γ, and to unproductive time are lower in the individualistic (collectivistic) society than in the society with* *dictatorial partisan Government if and only if:*

$$
\begin{aligned}
t^{\alpha}_{A,I,P} = t^{\alpha}_{A,C,P} < t^{\alpha}_{A,D,P} &\iff \theta^{\gamma}_{G} > \frac{\theta^{\gamma}_{A} + \theta^{\gamma}_{B}}{1 + \theta^{\gamma}_{B}} \\
t^{\gamma}_{A,I,P} = t^{\gamma}_{A,C,P} < t^{\gamma}_{A,D,P} &\iff \theta^{\gamma}_{G} < \frac{\theta^{\gamma}_{A} + \theta^{\gamma}_{B}}{1 + \theta^{\gamma}_{B}} \\
t^{\ell}_{A,I,P} = t^{\ell}_{A,C,P} < t^{\ell}_{A,D,P} &\iff \theta^{\gamma}_{G} > \frac{\theta^{\gamma}_{A} + \theta^{\gamma}_{B}}{1 + \theta^{\gamma}_{B}} \\
t^{\beta}_{B,I,P} = t^{\beta}_{B,C,P} < t^{\beta}_{B,D,P} &\iff \theta^{\gamma}_{G} > \frac{\theta^{\gamma}_{A} + \theta^{\gamma}_{B}}{1 + \theta^{\gamma}_{A}} \\
t^{\gamma}_{B,I,P} = t^{\gamma}_{B,C,P} < t^{\gamma}_{B,D,P} &\iff \theta^{\gamma}_{G} < \frac{\theta^{\gamma}_{A} + \theta^{\gamma}_{B}}{1 + \theta^{\gamma}_{A}} \\
t^{\ell}_{B,I,P} = t^{\ell}_{B,C,P} < t^{\ell}_{B,D,P} &\iff \theta^{\gamma}_{G} > \frac{\theta^{\gamma}_{A} + \theta^{\gamma}_{B}}{1 + \theta^{\gamma}_{A}}
\end{aligned}
$$

Remark 2 *Given* (5)*, if* $\theta^{\gamma}_{G} < \min\left\{\frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}{1+\theta^{\gamma}_{B}}, \frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}{1+\theta^{\gamma}_{A}}\right\}$*, the public good in the individualistic (collectivistic) society with partisan Government is lower than in the society with dictatorial partisan Government.*

Similar to what we observed in Subsection 5.2, when the Government is not selfish enough, the level of public governance will be lower in (I, P) and in (C, P) than in (D, P), so there would be an oversized Government in the society with dictatorial Government, a result which is independent from the level of bias toward B, π.

Starting from Lemmata 1 and 2, and from Remarks 1 and 2, we can now introduce a summary Claim and Remark:

Claim 3 *Given Lemmata 1 and 2, when the Government plays the first move in the choice of the public good, the selfish or altruistic behavior of agents* A *and* B *does not influence either the governance capacity or the production of the private goods.*

Remark 3 *Given Remarks 1 and 2, the level of* γ *in the society with State is lower than in the society with dictatorial Government if* $\theta^{\gamma}_{G} < \min\left\{\frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}{1+\theta^{\gamma}_{B}}, \frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}{1+\theta^{\gamma}_{A}}\right\}$*. This result is independent of the type of Government and the behavior of the agents.*

We now pass to our analysis of the comparative statics between a society with neutral Government and one with partisan Government.

5.4 Comparing Neutral Government with Partisan Government

In the case of public governance, while the effect of the Government's preferences in the agents' choices exists and has the same sign in both the societies with neutral and partisan Government, the intensity of this effect varies; therefore, we can analyze its magnitude.

Notice that we can rewrite the results in the quadruple (26) as follows:

$$\begin{aligned} t^{\alpha}_{A,i,P} &= t^{\alpha}_{A,i,N} - \pi\theta^{\alpha}_{A} t^{\gamma}_{A,i,N} \\ t^{\gamma}_{A,i,P} &= t^{\gamma}_{A,i,N}(1+\pi) \\ t^{\beta}_{B,i,P} &= t^{\beta}_{B,i,N} + \pi\theta^{\beta}_{B} t^{\gamma}_{B,i,N} \\ t^{\gamma}_{B,i,P} &= t^{\gamma}_{B,i,N}(1-\pi) \end{aligned} \tag{28}$$

By comparing the individualistic (collectivistic) society with neutral Government and the same society with partisan Government, we have the following proposition:

Proposition 3 *Given our assumptions, we have that:*

$$\begin{array}{ll} t^{\alpha}_{A,I,N} = t^{\alpha}_{A,C,N} > t^{\alpha}_{A,I,P} = t^{\alpha}_{A,C,P} & t^{\beta}_{B,I,N} = t^{\beta}_{B,C,N} < t^{\beta}_{B,I,P} = t^{\beta}_{B,C,P} \\ t^{\gamma}_{A,I,N} = t^{\gamma}_{A,C,N} < t^{\gamma}_{A,I,P} = t^{\gamma}_{A,C,P} & t^{\gamma}_{B,I,N} = t^{\gamma}_{B,C,N} > t^{\gamma}_{B,I,P} = t^{\gamma}_{B,C,P} \\ t^{\ell}_{A,I,N} = t^{\ell}_{A,C,N} > t^{\ell}_{A,I,P} = t^{\ell}_{A,C,P} & t^{\ell}_{B,I,N} = t^{\ell}_{B,C,N} < t^{\ell}_{B,I,P} = t^{\ell}_{B,I,P} \end{array}$$

Proof. The proof is in Appendix A.3. ■

Corollary 3 *In the society with partisan Government, the level of γ will always be smaller than in the society with neutral Government. This result does not depend on the behavior of the agents (selfish or altruistic).*

Proof. The proof is straightforward given (19) and (27). ■

If we compare a society with neutral Government to a society with partisan Government, we can see that agent A will be forced to reduce the time spent producing α and enjoying his unproductive time in order to increase the production of γ_A, while B will produce more of his private good and enjoy more unproductive time, contributing less to the production of the public good, but this will lead to a reduction of the total level of governance capacity. Notice that G's influence on A's choices is twofold in the society with partisan Government: there is the standard effect of the Government using its coercive power to impose its preferred level of γ; and there is the levying of the tax on A's time ($\pi > 0$). A will produce less of his private good and enjoy less unproductive time, reducing the time allocated to these two goods by a value of $\pi t^{\gamma}_{A,i,N}$, taking $\pi \theta^{\alpha}_{A} t^{\gamma}_{A,i,N}$ from the time dedicated to the production of α and $\pi \left(1 - \theta^{\alpha}_{A}\right) t^{\gamma}_{A,i,N}$ from his unproductive time; agent B will contribute less to the production of the public good, reducing the production time of γ_B by a total amount of $\pi t^{\gamma}_{B,i,N}$, redistributing this time on the production of his private good β with a share of θ^{β}_{B} and on his unproductive time with a share of $1 - \theta^{\beta}_{B}$.

6 Benchmarking on governance efficiency and capacity

In this Section, in order to compare the levels of governance efficiency and capacity in each society, we present a Theorem on the efficiency of societies based on the community and the extended community welfare levels (Subsection 6.1), and a Theorem on the comparison between the levels of governance capacity in the societies (Subsection 6.2).

6.1 Ranking the governance efficiency

We can now define a ranking of the governance efficiency, measured by the community welfare and by the extended community welfare. The Hypotheses and the Thesis that we want to demonstrate are presented in the following Theorem:

Theorem 1 *Given the Hypotheses 1.1, 1.2, 1.3, 1.4, and 1.5, a ranking of the community and the extended community equilibrium welfare levels in the societies exists as in Thesis 1.*

Hypothesis 1.1 $\Omega_{D,P} < \Omega_{D,N}$ *and* $W_{D,P} < W_{D,N}$

Hypothesis 1.2 $\Omega_{D,N} < \Omega_{i,P}$ *and* $W_{D,N} < W_{i,P}$

Hypothesis 1.3 $\Omega_{i,P} < \Omega_{i,N}$ *and* $W_{i,P} < W_{i,N}$

Hypothesis 1.4 $W_{i,N} < W_{I,S}$

Hypothesis 1.5 $W_{I,S} < W_{C,S}$

Thesis 1 $\Omega_{D,P} < \Omega_{D,N} < \Omega_{i,P} < \Omega_{i,N}$ *and* $W_{D,P} < W_{D,N} < W_{i,P} < W_{i,N} < W_{I,S} < W_{C,S}$.

Proof. The Thesis follows from Hypotheses 1.1, 1.2, 1.3, 1.4, and 1.5. ■

In the following Proposition, we show when the Hypotheses 1.1, 1.2, 1.3, 1.4, and 1.5 are verified, so that Thesis 1 is true:

Proposition 4 *Hypotheses 1.1, 1.2, 1.3, 1.4, and 1.5 are verified when the following conditions hold:*

$$\begin{aligned} &\frac{1-\theta_B^{\gamma}}{2} < \theta_A^{\gamma} < \theta_B^{\gamma} \\ &\pi > \frac{\theta_B^{\gamma}-\theta_A^{\gamma}}{\theta_A^{\gamma}+\theta_B^{\gamma}+\theta_G^{\gamma}} \\ &\theta_G^{\gamma} < \min\left\{\theta_A^{\gamma}, \frac{\theta_A^{\gamma}+\theta_B^{\gamma}}{\left(1+\theta_B^{\gamma}\right)(1+\pi)+\pi}\right\} \end{aligned} \tag{29}$$

Proof. The proof is contained in Appendix B. ■

Inside the considered subset of the parameters, as in (29), we observe that the ranking of community welfare and extended community welfare is the same for the societies with State. We can observe from the ranking of the community welfare that the level of welfare decreases as the coercive power of the Government increases, and the same result holds for the extended community welfare; this comparison falls in the Modified Social Conflict case. When the agent that benefits from the partisan Government's choice, B, is more interested in the public good than A, and when the Government is not particularly concerned with γ, the agents in the stateless societies behave better than in the societies with State (Leeson 2007*b*). The State intervention, when these conditions hold, decreases the welfare of the agents and the social welfare as well, therefore it is counterproductive, since the private agents are able to choose the levels of private and public goods to produce by themselves. In other words, the private and public agents are not able to obtain an improved efficiency in the allocation of their time, hence the Political Coase Theorem does not hold. Finally, since Hypothesis 1.5 is always true, $W_{C,S}$ is always higher than $W_{I,S}$, even though we do not consider the costs of conflicts, as in Skaperdas (2003).

6.2 Ranking the governance capacity

The governance capacity, measured by the level of the public good γ, can also be ranked, depending on the agents' preferences in each society. In the following Theorem, we present three possible governance capacity rankings.

Theorem 2 *Given Hypotheses 2.1, 2.2, 2.3, 2.4, 2.5, and 2.6, three different rankings exist for the equilibrium governance capacity levels in the societies, as in Proposition 5.*

Hypothesis 2.1 $\gamma_{D,P} < \gamma_{D,N}$

Hypothesis 2.2 $\gamma_{I,S} < \gamma_{C,S}$

Hypothesis 2.3 $\gamma_{i,P} < \gamma_{i,N}$

Hypothesis 2.4 $\gamma_{i,N} < \gamma_{I,S}$

Hypothesis 2.5 $\gamma_{i,N} < \gamma_{D,P}$

Hypothesis 2.6 $\gamma_{D,N} < \gamma_{C,S}$

Proposition 5 *Given Hypotheses 2.1, 2.2, 2.3, 2.4, 2.5, and 2.6, two threshold levels exist,* $\hat{\theta}_G^\gamma$ *and* $\hat{\pi}$*, such that:*

5.1 *When* $\theta_G^\gamma < \hat{\theta}_G^\gamma$*, we have the following ranking of the governance capacity levels:*

$$\gamma_{i,P} < \gamma_{i,N} < \gamma_{D,P} < \gamma_{D,N} < \gamma_{I,S} < \gamma_{C,S}$$

5.2 *When* $\theta_G^\gamma > \hat{\theta}_G^\gamma$ *and* $\pi > \hat{\pi}$*, we have the following ranking of the governance capacity levels:*

$$\gamma_{i,P} < \gamma_{i,N} < \gamma_{D,P} < \gamma_{I,S} < \gamma_{D,N} < \gamma_{C,S}$$

5.3 *When* $\theta_G^\gamma > \hat{\theta}_G^\gamma$ *and* $\pi < \hat{\pi}$*, we have the following ranking of the governance capacity levels:*

$$\gamma_{i,P} < \gamma_{i,N} < \gamma_{I,S} < \gamma_{D,P} < \gamma_{D,N} < \gamma_{C,S}$$

Proof. The proof is contained in Appendix C. ■

As follows from Corollaries 1 and 3, the type of Government has an effect on the level of γ: in particular, given a society with State or with a dictator, partisan Government is linked to a lower level of public good than there would be under neutral Government.

Concerning the relationship between welfare and the public good, the ranking of the two are different, as in Theorems 1 and 2. The maximum level of public good is produced in the collectivistic stateless society when agent B has a higher preference on γ than A. On the other hand, the minimum level of γ is reached by the societies where the Government chooses only the public good in the sequential game. This could result from the fact that, in the society with dictatorial Government, G is unconstrained in the choice of all time variables for the agents, but it cannot choose the objective function, which must be $\Omega(\cdot)$, whereas in the societies with State, the Government only has two choice variables, $t^{\gamma}_{A,i,h}$ and $t^{\gamma}_{B,i,h}$, but it chooses its own utility function U_G as its objective function.

While γ is higher in the societies with dictatorial Government than in the societies with State, the welfare of the extended community is higher in the societies with State than in the societies with dictatorial Government. Furthermore, the rankings of the public good and community welfare do not present the same pattern in the parameters' space set in (29). This may derive from a coordination problem in the production of γ in the individualistic stateless society, which implies that the intervention of the State may increase the level of γ, without having an effect on the ranking of welfare for the community.

7 Conclusions and policy implications

Every society needs governance, but several forms of governance exist, depending on the role of the State and on the behavior of the agents. A community of rational agents may be able to choose the institution which maximizes efficiency, between public, self-, and private governance, but they would need a normative framework to make their choice.

In this paper, we set a basic model that can be used as a benchmark for comparison among potential political choices, which could be helpful to both policy makers and citizens who are in the position to choose between governance forms.

With our Theorems 1 and 2, we contribute to the economics literature on the comparison between anarchy and predatory State, confirming that a stateless society could indeed be better than a society with State.

We find that governance efficiency and capacity in the societies with State are lower in cases where the Government is partisan rather than when it is neutral. Furthermore, the partisan

Government coerces the non-preferred agent to produce more public good, by levying a tax and a subsidy on the agents' available time, but, surprisingly, this will reduce the total amount of governance capacity. On the other hand, in an anarchic society, the governance capacity will always be higher in cases where the agents are altruistic than when they are selfish, and this is the only type of society where the behavior of the private agents influences the public choice. Finally, our model leads to policy implications on the desirability of State intervention; in particular, when the private and public agents' preferences respect certain conditions, self-governance dominates both private and public governance, in both governance capacity and efficiency.

Our paper considers an autarchic society without markets and prices, and without the need to define property rights, since every private agent consumes what he produces; however, a potential extension of our model consists in introducing the market and demonstrating that the optimal allocation of resources in a system with market prices is equivalent to one in a system with shadow prices. An additional extension to our model would be to consider the formation and accumulation of capital, making it dynamic, and to study how this affects efficiency; furthermore, additional positive or negative externalities can be added to the model, for example in sympathy for other members of the community, or in the presence of envy or relative deprivation.

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A Proofs of Propositions 1, 2, and 3

A.1 Proof of Proposition 1

Given (12), $t^{\alpha}_{A,D,N} > t^{\alpha}_{A,D,P}$ is true since $\pi\theta^{\alpha}_{A}t^{\gamma}_{A,D,N}$ is positive. $t^{\gamma}_{A,D,N} < t^{\gamma}_{A,D,P}$ is true given (12) and since $\pi > 0$ in the society with partisan Government. $t^{\ell}_{A,D,N} > t^{\ell}_{A,D,P}$ can be rewritten as $1 - t^{\alpha}_{A,D,N} - t^{\gamma}_{A,D,N} > 1 - t^{\alpha}_{A,D,P} - t^{\gamma}_{A,D,P}$; using (12), we have that $1 - t^{\alpha}_{A,D,N} - t^{\gamma}_{A,D,N} > 1 - t^{\alpha}_{A,D,N} + \pi\theta^{\alpha}_{A}t^{\gamma}_{A,D,N} - (1+\pi)t^{\gamma}_{A,D,N}$, which is always true since $0 > \theta^{\alpha}_{A} - 1$ is always true. Given (12), $t^{\beta}_{B,D,N} < t^{\beta}_{B,D,P}$ is true since $\pi\theta^{\beta}_{B}t^{\gamma}_{B,D,N}$ is positive. $t^{\gamma}_{B,D,N} > t^{\gamma}_{B,D,P}$ is true given (12) and since $\pi > 0$ in P. $t^{\ell}_{B,D,N} < t^{\ell}_{B,D,P}$ can be rewritten as $1 - t^{\beta}_{B,D,N} - t^{\gamma}_{B,D,N} < 1 - t^{\beta}_{B,D,P} - t^{\gamma}_{B,D,P}$; substituting (12), we obtain the following inequality: $1 - t^{\beta}_{B,D,N} - t^{\gamma}_{B,D,N} < 1 - t^{\beta}_{B,D,N} - \pi\theta^{\beta}_{B}t^{\gamma}_{B,D,N} - (1-\pi)t^{\gamma}_{B,D,N}$, which is always true since $0 < 1 - \theta^{\beta}_{B}$ is always true. This completes the proof of Proposition 1.

A.2 Proof of Proposition 2

$t^{\alpha}_{A,I,S} > t^{\alpha}_{A,C,S}$ is true when $\theta^{\alpha}_{A}\left(1-\theta^{\gamma}_{A}\right) > \frac{\theta^{\alpha}_{A}\left(1-\theta^{\gamma}_{A}\right)}{1+\theta^{\gamma}_{B}}$, that is, when $\theta^{\gamma}_{B} > 0$, which is always true. $t^{\gamma}_{A,I,S} < t^{\gamma}_{A,C,S}$ is verified when $\theta^{\gamma}_{A} < \frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}{1+\theta^{\gamma}_{B}}$, which is always true since $\theta^{\gamma}_{A} < 1$ by assumption. $t^{\ell}_{A,I,S} > t^{\ell}_{A,C,S}$ can be rewritten as $1-\theta^{\alpha}_{A}\left(1-\theta^{\gamma}_{A}\right)-\theta^{\gamma}_{A} > 1-\frac{\theta^{\alpha}_{A}\left(1-\theta^{\gamma}_{A}\right)}{1+\theta^{\gamma}_{B}}-\frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}{1+\theta^{\gamma}_{B}}$, which is verified when $\theta^{\gamma}_{B}\left(1-\theta^{\gamma}_{A}\right)\left(1-\theta^{\alpha}_{A}\right) > 0$, whose parts are always between 0 and 1 by assumption and, hence, it is always true. $t^{\beta}_{B,I,S} > t^{\beta}_{B,C,S}$ is verified when $\theta^{\beta}_{B}\left(1-\theta^{\gamma}_{B}\right) > \frac{\theta^{\beta}_{B}\left(1-\theta^{\gamma}_{B}\right)}{1+\theta^{\gamma}_{A}}$, that is, when $\theta^{\gamma}_{A} > 0$ by assumption. $t^{\gamma}_{B,I,S} < t^{\gamma}_{B,C,S}$ is true when $\theta^{\gamma}_{B} < \frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}{1+\theta^{\gamma}_{A}}$, which is always verified since $\theta^{\gamma}_{B} < 1$ by assumption. $t^{\ell}_{B,I,S} > t^{\ell}_{B,C,S}$ can be rewritten as $1-\theta^{\beta}_{B}\left(1-\theta^{\gamma}_{B}\right)-\theta^{\gamma}_{B} > 1-\frac{\theta^{\beta}_{B}\left(1-\theta^{\gamma}_{B}\right)}{1+\theta^{\gamma}_{A}}-\frac{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}{1+\theta^{\gamma}_{A}}$, which is verified when $\theta^{\gamma}_{A}\left(1-\theta^{\gamma}_{B}\right)\left(1-\theta^{\beta}_{B}\right) > 0$, whose parts are always between 0 and 1 by assumption and, hence, it is always true.

This completes the proof of Proposition 2.

A.3 Proof of Proposition 3

As for (28), $t^{\alpha}_{A,i,N} > t^{\alpha}_{A,i,P}$ is true since $\pi\theta^{\alpha}_{A} > 0$. Since (28) and $\pi > 0$, $t^{\gamma}_{A,i,N} < t^{\gamma}_{A,i,P}$ is true. $t^{\ell}_{A,i,N} > t^{\ell}_{A,i,P}$ is verified when $1-t^{\alpha}_{A,i,N}-t^{\gamma}_{A,i,N} > 1-t^{\alpha}_{A,i,P}-t^{\gamma}_{A,i,P}$, that is, when $1-t^{\alpha}_{A,i,N}-t^{\gamma}_{A,i,N} > 1-t^{\alpha}_{A,i,N}+\pi\theta^{\alpha}_{A}t^{\gamma}_{A,i,N}-t^{\gamma}_{A,i,N}(1+\pi)$, which is verified when $0 > \pi t^{\gamma}_{A,i,N}\left(\theta^{\alpha}_{A}-1\right)$, always true since $\theta^{\alpha}_{A}-1 < 0$.

Given (28), $t^{\beta}_{B,i,N} < t^{\beta}_{B,i,P}$ is always verified since $\pi\theta^{\beta}_{B} > 0$. Given (28), $t^{\gamma}_{B,i,N} > t^{\gamma}_{B,i,P}$ is true since $-\pi < 0$. $t^{\ell}_{B,i,N} < t^{\ell}_{B,i,P}$ is verified in case $1-t^{\beta}_{B,i,N}-t^{\gamma}_{B,i,N} < 1-t^{\beta}_{B,i,N}-\pi\theta^{\beta}_{B}t^{\gamma}_{B,i,N}-t^{\gamma}_{B,i,N}(1-\pi)$, which is equivalent to $0 < \pi t^{\gamma}_{B,i,N}\left(1-\theta^{\beta}_{B}\right)$, always true since $1-\theta^{\beta}_{B} > 0$ is true by assumption.

This completes the proof of Proposition 3.

B Proof of Proposition 4

The proof of Proposition 4 consists of 5 parts, one for each of the Hypotheses in Theorem 1.

B.1 Sufficient conditions for which Hypothesis 1.1 is verified

We first present the conditions for which $\Omega_{D,P} < \Omega_{D,N}$; replacing the equilibrium values (12) in $\Omega_{D,N}$ and $\Omega_{D,P}$, dividing $\Omega_{D,P}$ by $\Omega_{D,N}$, and simplifying, we obtain:

$$1 > \left[\left(1 - \frac{\pi t^{\gamma}_{A,D,N}}{1 - t^{\gamma}_{A,D,N}}\right)\right]^{\left(2-\theta^{\gamma}_{G}\right)\left(1-\theta^{\gamma}_{A}\right)} \left[\left(1 + \frac{\pi t^{\gamma}_{B,D,N}}{1 - t^{\gamma}_{B,D,N}}\right)\right]^{\left(2-\theta^{\gamma}_{G}\right)\left(1-\theta^{\gamma}_{B}\right)} \left(1-\pi^2\right)^{\left(2-\theta^{\gamma}_{G}\right)\left(\theta^{\gamma}_{A}+\theta^{\gamma}_{B}\right)+\theta^{\gamma}_{G}} \tag{B.1}$$

Replacing in (B.1) the equilibrium values of (9) and rewriting it by using the logarithms, we have:

$$\begin{aligned}&\left(2-\theta^{\gamma}_{G}\right)\left(1-\theta^{\gamma}_{A}\right)\left[\log\left(1-t^{\gamma}_{A,D,N}-\pi t^{\gamma}_{A,D,N}\right)-\log\left(1-t^{\gamma}_{A,D,N}\right)\right]+\\ &+\left(2-\theta^{\gamma}_{G}\right)\left(1-\theta^{\gamma}_{B}\right)\left[\log\left(1-t^{\gamma}_{B,D,N}+\pi t^{\gamma}_{B,D,N}\right)-\log\left(1-t^{\gamma}_{B,D,N}\right)\right]+\\ &+\left[\left(2-\theta^{\gamma}_{G}\right)\left(\theta^{\gamma}_{A}+\theta^{\gamma}_{B}\right)+\theta^{\gamma}_{G}\right]\log\left(1-\pi^2\right)<0\end{aligned} \tag{B.2}$$

The sum of the first and the second lines of (B.2) is negative if $\theta^{\gamma}_{A} < \theta^{\gamma}_{B}$ and $\pi > \frac{\theta^{\gamma}_{B}-\theta^{\gamma}_{A}}{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}+\theta^{\gamma}_{G}}$. The third line of (B.2) is always smaller than 0.

For what concerns the conditions for which $W_{D,P} < W_{D,N}$, we proceed in a way similar to the one used above. Replacing the values from (12) in $W_{D,N}$ and $W_{D,P}$, we can write $\frac{W_{D,P}}{W_{D,N}} < 1$, after some simplifications, as:

$$1 > \left[\left(1 - \frac{\pi t^{\gamma}_{A,D,N}}{1 - t^{\gamma}_{A,D,N}}\right)\right]^{1-\theta^{\gamma}_{A}} \left[\left(1 + \frac{\pi t^{\gamma}_{B,D,N}}{1 - t^{\gamma}_{B,D,N}}\right)\right]^{1-\theta^{\gamma}_{B}} \left(1-\pi^2\right)^{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}} \tag{B.3}$$

Replacing in the (B.3) the equilibrium values of (9) and rewriting it by using the logarithms, we obtain:

$$\begin{aligned}&(1-\theta^{\gamma}_{A})\left[\log\left(1-t^{\gamma}_{A,D,N}-\pi t^{\gamma}_{A,D,N}\right)-\log\left(1-t^{\gamma}_{A,D,N}\right)\right]+\\ &+(1-\theta^{\gamma}_{B})\left[\log\left(1-t^{\gamma}_{B,D,N}+\pi t^{\gamma}_{B,D,N}\right)-\log\left(1-t^{\gamma}_{B,D,N}\right)\right]+\\ &+\left(\theta^{\gamma}_{A}+\theta^{\gamma}_{B}\right)\log(1-\pi^2)<0\end{aligned} \tag{B.4}$$

Notice that the first and the second lines of (B.4) are both negative if $\theta^{\gamma}_{A} < \theta^{\gamma}_{B}$ and $\pi >$

$\frac{\theta_B^\gamma-\theta_A^\gamma}{\theta_A^\gamma+\theta_B^\gamma+\theta_G^\gamma}$. The third line of (B.4) is always smaller than 0.

Hence, the conditions for which $\Omega_{D,P} < \Omega_{D,N}$ and $W_{D,P} < W_{D,N}$ are the same, that is, $\theta_A^\gamma < \theta_B^\gamma$ and $\pi > \frac{\theta_B^\gamma-\theta_A^\gamma}{\theta_A^\gamma+\theta_B^\gamma+\theta_G^\gamma}$.

B.2 Sufficient conditions for which Hypothesis 1.2 is verified

Defining X and Y as auxiliary variables and assuming $\theta_G^\gamma < \min\left\{\frac{\theta_A^\gamma+\theta_B^\gamma}{(1+\theta_A^\gamma)(1-\pi)-\pi}, \frac{\theta_A^\gamma+\theta_B^\gamma}{(1+\theta_B^\gamma)(1+\pi)+\pi}\right\}$, we have:

$$\begin{aligned} X &\equiv \theta_A^\alpha \frac{\theta_G^\gamma\left[\left(1+\theta_B^\gamma\right)(1+\pi)+\pi\right]-\theta_A^\gamma-\theta_B^\gamma}{2+\theta_B^\gamma} < 0 \\ Y &\equiv \theta_B^\beta \frac{\theta_G^\gamma\left[\left(1+\theta_A^\gamma\right)(1-\pi)-\pi\right]-\theta_A^\gamma-\theta_B^\gamma}{2+\theta_A^\gamma} < 0 \end{aligned} \tag{B.5}$$

Given (B.5), we can rewrite the equilibrium times of the society with dictatorial neutral Government as:

$$\begin{aligned} t_{A,D,N}^\alpha &= t_{A,i,P}^\alpha + X \\ t_{A,D,N}^\gamma &= t_{A,i,P}^\gamma - \frac{X}{\theta_A^\alpha} \\ t_{B,D,N}^\beta &= t_{B,i,P}^\beta + Y \\ t_{B,D,N}^\gamma &= t_{B,i,P}^\gamma - \frac{Y}{\theta_B^\beta} \end{aligned} \tag{B.6}$$

We first present the sufficient conditions for which $\Omega_{D,N} < \Omega_{i,P}$.

Given (B.6), we can rewrite $\frac{\Omega_{D,N}}{\Omega_{i,P}}$ as follows:

$$\left(1+\frac{\frac{X}{\theta_A^\alpha}}{1-t_{A,i,P}^\gamma}\right)^{\left(2-\theta_G^\gamma\right)\left(1-\theta_A^\gamma\right)} \left(1-\frac{\frac{X}{\theta_A^\alpha}}{t_{A,i,P}^\gamma}\right)^{\left(2-\theta_G^\gamma\right)\left(\theta_A^\gamma+\theta_B^\gamma\right)+\theta_G^\gamma}$$
$$\left(1+\frac{\frac{Y}{\theta_B^\beta}}{1-t_{B,i,P}^\gamma}\right)^{\left(2-\theta_G^\gamma\right)\left(1-\theta_B^\gamma\right)} \left(1-\frac{\frac{Y}{\theta_B^\beta}}{t_{B,i,P}^\gamma}\right)^{\left(2-\theta_G^\gamma\right)\left(\theta_A^\gamma+\theta_B^\gamma\right)+\theta_G^\gamma} < 1$$

Rearranging, we have:

$$\left[\frac{1+\frac{\frac{X}{\theta_A^\alpha}}{1-t_{A,i,P}^\gamma}}{1-\frac{\frac{X}{\theta_A^\alpha}}{t_{A,i,P}^\gamma}}\right]^{\left(2-\theta_G^\gamma\right)\left(1-\theta_A^\gamma\right)}\left(1-\frac{\frac{X}{\theta_A^\alpha}}{t_{A,i,P}^\gamma}\right)^{\theta_G^\gamma-\left[\left(2-\theta_G^\gamma\right)\left(1-\theta_B^\gamma\right)\right]}$$
$$\left[\frac{1+\frac{\frac{Y}{\theta_B^\beta}}{1-t_{B,i,P}^\gamma}}{1-\frac{\frac{Y}{\theta_B^\beta}}{t_{B,i,P}^\gamma}}\right]^{\left(2-\theta_G^\gamma\right)\left(1-\theta_B^\gamma\right)}\left(1-\frac{\frac{Y}{\theta_B^\beta}}{t_{B,i,P}^\gamma}\right)^{\theta_G^\gamma-\left[\left(2-\theta_G^\gamma\right)\left(1-\theta_A^\gamma\right)\right]}<1 \tag{B.7}$$

$\left[\frac{1+\frac{\frac{X}{\theta_A^\alpha}}{1-t_{A,i,P}^\gamma}}{1-\frac{\frac{X}{\theta_A^\alpha}}{t_{A,i,P}^\gamma}}\right]$ and $\left[\frac{1+\frac{\frac{Y}{\theta_B^\beta}}{1-t_{B,i,P}^\gamma}}{1-\frac{\frac{Y}{\theta_B^\beta}}{t_{B,i,P}^\gamma}}\right]$ are both smaller than 1 when $X, Y < 0$, and their exponents are positive, hence these two parts are smaller than 1. Conversely, $1-\frac{\frac{X}{\theta_A^\alpha}}{t_{A,i,P}^\gamma}$ and $1-\frac{\frac{Y}{\theta_B^\beta}}{t_{B,i,P}^\gamma}$ are both larger than 1 when $X, Y < 0$, but their exponents are negative given what we said in footnote 19, hence also these two parts are smaller than 1. So, when $X, Y < 0$, that is, when $\theta_G^\gamma < \min\left\{\frac{\theta_A^\gamma+\theta_B^\gamma}{\left(1+\theta_A^\gamma\right)(1-\pi)-\pi}, \frac{\theta_A^\gamma+\theta_B^\gamma}{\left(1+\theta_B^\gamma\right)(1+\pi)+\pi}\right\}$, then $\Omega_{D,N} < \Omega_{i,P}$.

We now present the sufficient conditions to have $W_{D,N} < W_{C,P}$; following a similar approach to the one above, we can rewrite $\frac{W_{D,N}}{W_{C,P}} < 1$ as follows:

$$\left[\frac{1+\frac{\frac{X}{\theta_A^\alpha}}{1-t_{A,i,P}^\gamma}}{1-\frac{\frac{X}{\theta_A^\alpha}}{t_{A,i,P}^\gamma}}\right]^{1-\theta_A^\gamma}\left(1-\frac{\frac{X}{\theta_A^\alpha}}{t_{A,i,P}^\gamma}\right)^{\theta_B^\gamma-1}$$
$$\left[\frac{1+\frac{\frac{Y}{\theta_B^\beta}}{1-t_{B,i,P}^\gamma}}{1-\frac{\frac{Y}{\theta_B^\beta}}{t_{B,i,P}^\gamma}}\right]^{1-\theta_B^\gamma}\left(1-\frac{\frac{Y}{\theta_B^\beta}}{t_{B,i,P}^\gamma}\right)^{\theta_A^\gamma-1}<1$$

As for (B.7), the parts in square brackets are smaller than 1 when $X, Y < 0$, and their exponents are larger than one, while the ones in the parentheses are larger than 1 when $X, Y < 0$, but their exponents are always negative. Hence, $W_{D,N} < W_{i,P}$ when $X, Y < 0$, that is, when $\theta_G^\gamma < \min\left\{\frac{\theta_A^\gamma+\theta_B^\gamma}{\left(1+\theta_A^\gamma\right)(1-\pi)-\pi}, \frac{\theta_A^\gamma+\theta_B^\gamma}{\left(1+\theta_B^\gamma\right)(1+\pi)+\pi}\right\}$.

B.3 Sufficient conditions for which Hypothesis 1.3 is verified

We now present the sufficient conditions for which Hypothesis 1.3 is verified, starting from $\Omega_{i,P} < \Omega_{i,N}$. Recalling (28) and the equilibrium times $t^{\gamma}_{A,i,N}$ and $t^{\gamma}_{B,i,N}$ from (21), we can write $\frac{\Omega_{i,P}}{\Omega_{i,N}} < 1$ as follows:

$$\left(1 - \frac{\theta^{\gamma}_{G}\pi}{1-\theta^{\gamma}_{G}}\right)^{\left(2-\theta^{\gamma}_{G}\right)\left(1-\theta^{\gamma}_{A}\right)} \left(1 + \frac{\theta^{\gamma}_{G}\pi}{1-\theta^{\gamma}_{G}}\right)^{\left(2-\theta^{\gamma}_{G}\right)\left(1-\theta^{\gamma}_{B}\right)} \left(1-\pi^2\right)^{\left(2-\theta^{\gamma}_{G}\right)\left(\theta^{\gamma}_{A}+\theta^{\gamma}_{B}\right)+\theta^{\gamma}_{G}} < 1 \tag{B.8}$$

We can rewrite (B.8) as follows:

$$\begin{aligned} &\left(\frac{\left[1-\theta^{\gamma}_{G}(1+\pi)\right]\left[1-\theta^{\gamma}_{G}(1-\pi)\right]}{(1-\theta^{\gamma}_{G})^2}\right)^{\left(2-\theta^{\gamma}_{G}\right)\left(1-\theta^{\gamma}_{A}\right)} \\ &\left(\frac{1-\theta^{\gamma}_{G}(1-\pi)}{1-\theta^{\gamma}_{G}}\right)^{\left(2-\theta^{\gamma}_{G}\right)\left(\theta^{\gamma}_{A}-\theta^{\gamma}_{B}\right)} \\ &\left(1-\pi^2\right)^{\left(2-\theta^{\gamma}_{G}\right)\left(\theta^{\gamma}_{A}+\theta^{\gamma}_{B}\right)+\theta^{\gamma}_{G}} < 1 \end{aligned} \tag{B.9}$$

The first line of (B.9) is smaller than 1 since the numerator of the base is always smaller than its denominator and its exponent is positive. The second line of (B.9) is smaller than one if $\theta^{\gamma}_{B} > \theta^{\gamma}_{A}$, since the base is larger than 1. The third line is always smaller than 1, since the base is smaller than 1 by definition and the exponent is positive.
Hence, when $\theta^{\gamma}_{B} > \theta^{\gamma}_{A}$, $\Omega_{i,N} > \Omega_{i,P}$.

We now pass to the conditions for which $W_{i,N} > W_{i,P}$, using a similar approach. We can rewrite $\frac{W_{i,P}}{W_{i,N}} < 1$ as:

$$\begin{aligned} &\left(\frac{\left[1-\theta^{\gamma}_{G}(1+\pi)\right]\left[1-\theta^{\gamma}_{G}(1-\pi)\right]}{(1-\theta^{\gamma}_{G})^2}\right)^{1-\theta^{\gamma}_{A}} \\ &\left(\frac{1-\theta^{\gamma}_{G}(1-\pi)}{1-\theta^{\gamma}_{G}}\right)^{\theta^{\gamma}_{A}-\theta^{\gamma}_{B}} \\ &\left(1-\pi^2\right)^{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}} < 1 \end{aligned} \tag{B.10}$$

With the same reasoning we applied above for (B.9), we have that (B.10) is smaller than 1 when $\theta^{\gamma}_{B} > \theta^{\gamma}_{A}$, so $W_{i,P} < W_{i,N}$ when this condition holds.

B.4 Sufficient conditions for which Hypothesis 1.4 is verified

Given the equilibrium times in (15) and (21), we can write:

$$
\begin{aligned}
t^{\alpha}_{A,i,N} =& t^{\alpha}_{A,I,S} + \theta^{\alpha}_{A}\left(\theta^{\gamma}_{A} - \theta^{\gamma}_{G}\right) \equiv t^{\alpha}_{A,I,S} + X \\
t^{\gamma}_{A,i,N} =& t^{\gamma}_{A,I,S} - \frac{X}{\theta^{\alpha}_{A}} \\
t^{\beta}_{B,i,N} =& t^{\beta}_{B,I,S} + \theta^{\beta}_{B}\left(\theta^{\gamma}_{B} - \theta^{\gamma}_{G}\right) \equiv t^{\beta}_{B,I,S} + Y \\
t^{\gamma}_{B,i,N} =& t^{\gamma}_{B,I,S} - \frac{Y}{\theta^{\beta}_{B}}
\end{aligned}
\tag{B.11}
$$

Given (B.11) and the equilibrium levels in (15), we can write $\frac{W_{i,N}}{W_{I,S}} < 1$ as follows:

$$
\left(1 + \frac{\frac{X}{\theta^{\alpha}_{A}}}{1-\theta^{\gamma}_{A}}\right)^{1-\theta^{\gamma}_{A}} \left(1 - \frac{\frac{X}{\theta^{\alpha}_{A}}}{\theta^{\gamma}_{A}}\right)^{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}}
\left(1 + \frac{\frac{Y}{\theta^{\beta}_{B}}}{1-\theta^{\gamma}_{B}}\right)^{1-\theta^{\gamma}_{B}} \left(1 - \frac{\frac{Y}{\theta^{\beta}_{B}}}{\theta^{\gamma}_{B}}\right)^{\theta^{\gamma}_{A}+\theta^{\gamma}_{B}} < 1
$$

Passing to logarithms, we obtain:

$$
\begin{aligned}
&\left(1-\theta^{\gamma}_{A}\right)\left[\log\left(1-\theta^{\gamma}_{A} + \frac{X}{\theta^{\alpha}_{A}}\right) - \log\left(1-\theta^{\gamma}_{A}\right)\right] + \\
&+ \left(\theta^{\gamma}_{A}+\theta^{\gamma}_{B}\right)\left[\log\left(\theta^{\gamma}_{A} - \frac{X}{\theta^{\alpha}_{A}}\right) - \log\left(\theta^{\gamma}_{A}\right)\right] + \\
&+ \left(1-\theta^{\gamma}_{B}\right)\left[\log\left(1-\theta^{\gamma}_{B} + \frac{Y}{\theta^{\beta}_{B}}\right) - \log\left(1-\theta^{\gamma}_{B}\right)\right] + \\
&+ \left(\theta^{\gamma}_{A}+\theta^{\gamma}_{B}\right)\left[\log\left(\theta^{\gamma}_{B} - \frac{Y}{\theta^{\beta}_{B}}\right) - \log\left(\theta^{\gamma}_{B}\right)\right] < 0
\end{aligned}
\tag{B.12}
$$

The part in square brackets in the first line of (B.12) is positive when $X > 0$, while the one in square brackets in the second line is negative; the latter is larger, in absolute value, of the former, hence a sufficient condition to have the first two lines of (B.12) to be negative is to have $\theta^{\gamma}_{A} > \frac{1-\theta^{\gamma}_{B}}{2}$.

A similar reasoning applies to the third and the fourth line of (B.12): the part in square brackets in the third line is positive when $Y > 0$, while the one in square brackets in the fourth line is negative; the latter is larger than the former in absolute value. Thus, a sufficient condition to have the third and the fourth line of (B.12) to be negative is to have $\theta^{\gamma}_{B} > \frac{1-\theta^{\gamma}_{A}}{2}$.

We have, then, that $W_{i,N} < W_{I,S}$ when $\theta_A^\gamma > \frac{1-\theta_B^\gamma}{2}$, $\theta_B^\gamma > \frac{1-\theta_A^\gamma}{2}$, and $X, Y > 0$, that is, $\theta_A^\gamma > \theta_G^\gamma$ and $\theta_B^\gamma > \theta_G^\gamma$.[20]

B.5 Proof that Hypothesis 1.5 always holds

The proof is made up of two parts: we first prove that $U_{A,I,S} < U_{A,C,S}$ and that $U_{B,I,S} < U_{B,C,S}$, and then we see how these two results imply $W_{C,S} > W_{I,S}$.

Given $t^\alpha_{A,C,S} = \frac{t^\alpha_{A,I,S}}{1+\theta_B^\gamma}$, $t^\beta_{B,C,S} = \frac{t^\beta_{B,I,S}}{1+\theta_A^\gamma}$, $t^\gamma_{A,C,S} = t^\gamma_{A,I,S} + \frac{\theta_B^\gamma(1-\theta_A^\gamma)}{1+\theta_B^\gamma}$, and $t^\gamma_{B,C,S} = t^\gamma_{B,I,S} + \frac{\theta_A^\gamma(1-\theta_B^\gamma)}{1+\theta_A^\gamma}$, we can rewrite $U_{A,I,S}$ and $U_{A,C,S}$ as:

$$U_{A,I,S} = \left(t^\alpha_{A,I,S}\right)^{\theta_A^\alpha} \left(t^\gamma_{A,I,S}\right)^{\theta_A^\gamma} \left(1 - t^\alpha_{A,I,S} - t^\gamma_{A,I,S}\right)^{1-\theta_A^\alpha-\theta_A^\gamma} \left(t^\gamma_{B,I,S}\right)^{\theta_A^\gamma} \left(\frac{1-t^\gamma_{A,I,S}}{t^\alpha_{A,I,S}} - 1\right)^{\theta_A^\gamma \theta_A^\alpha}$$

$$U_{A,C,S} = \left(\frac{t^\alpha_{A,I,S}}{1+\theta_B^\gamma}\right)^{\theta_A^\alpha} \left(t^\gamma_{A,I,S} + \frac{\theta_B^\gamma(1-\theta_A^\gamma)}{1+\theta_B^\gamma}\right)^{\theta_A^\gamma} \left(\frac{1-t^\alpha_{A,I,S}-t^\gamma_{A,I,S}}{1+\theta_B^\gamma}\right)^{1-\theta_A^\alpha-\theta_A^\gamma} \left(t^\gamma_{B,I,S} + \frac{\theta_A^\gamma(1-\theta_B^\gamma)}{1+\theta_A^\gamma}\right)^{\theta_A^\gamma} \left(\frac{1-t^\gamma_{A,I,S}}{t^\alpha_{A,I,S}} - 1\right)^{\theta_A^\gamma \theta_A^\alpha}$$

$U_{A,I,S} < U_{A,C,S}$ is then true when:

$$\left(1+\theta_B^\gamma\right) < \left(\frac{t^\gamma_{A,I,S}\left(1+\theta_B^\gamma\right) + \theta_B^\gamma(1-\theta_A^\gamma)}{t^\gamma_{A,I,S}}\right)^{\theta_A^\gamma} \left(\frac{t^\gamma_{B,I,S}\left(1+\theta_A^\gamma\right) + \theta_A^\gamma(1-\theta_B^\gamma)}{t^\gamma_{B,I,S}(1+\theta_A^\gamma)}\right)^{\theta_A^\gamma}$$

Substituting $t^\gamma_{A,I,S}$ with θ_A^γ and $t^\gamma_{B,I,S}$ with θ_B^γ, as for (15), we obtain:

$$\left(1+\theta_B^\gamma\right) < \left(\frac{\theta_A^\gamma + \theta_B^\gamma}{\theta_A^\gamma}\right)^{\theta_A^\gamma} \left(\frac{\theta_A^\gamma + \theta_B^\gamma)}{\theta_B^\gamma(1+\theta_A^\gamma)}\right)^{\theta_A^\gamma}$$

Simplifying, we obtain:

$$\left(1 + \frac{\theta_A^\gamma}{\theta_B^\gamma} + \frac{\theta_B^\gamma}{\theta_A^\gamma} - \theta_A^\gamma\right) \frac{1}{1+\theta_A^\gamma} > \left(\theta_B^\gamma\right)^{\frac{1}{\theta_A^\gamma}}$$

Since the right-hand side is always smaller than 1, while the left-hand side is always greater than 1, $U_{A,I,S} < U_{A,C,S}$ is always verified.

The demonstration of $U_{B,I,S} < U_{B,C,S}$ proceeds in the same way as the just-presented proof for

[20] We would also need that $\theta_G^\gamma < \frac{1}{2}$ and $\theta_A^\gamma < \frac{1}{2}$, but $\theta_A^\gamma < \frac{1}{2}$ is already implied by what we said in footnote 19 and $\theta_A^\gamma < \theta_B^\gamma$, and consequently $\theta_G^\gamma < \frac{1}{2}$ is always verified.

$U_{A,I,S} < U_{A,C,S}$, since the utility functions are homologous, so we will not present it here.

Recalling the form of W as in (7), we have that $W_{I,S} < W_{C,S}$ when $U_{A,I,S}^{\frac{1}{2}} U_{B,I,S}^{\frac{1}{2}} < U_{A,C,S}^{\frac{1}{2}} U_{B,C,S}^{\frac{1}{2}}$, which is always verified given what we presented in the first part of the proof. This completes the proof.

B.6 Summary of the conditions for Proposition 4

The condition $\theta_A^\gamma < \theta_B^\gamma$, from Appendix B.1 and B.3, implies that $\frac{\theta_A^\gamma+\theta_B^\gamma}{(1+\theta_A^\gamma)(1-\pi)-\pi} > \frac{\theta_A^\gamma+\theta_B^\gamma}{(1+\theta_B^\gamma)(1+\pi)+\pi}$, so the condition $\theta_G^\gamma < \min\left\{\frac{\theta_A^\gamma+\theta_B^\gamma}{(1+\theta_A^\gamma)(1-\pi)-\pi}, \frac{\theta_A^\gamma+\theta_B^\gamma}{(1+\theta_B^\gamma)(1+\pi)+\pi}\right\}$ becomes $\theta_G^\gamma < \frac{\theta_A^\gamma+\theta_B^\gamma}{(1+\theta_B^\gamma)(1+\pi)+\pi}$; given the same condition, $\theta_A^\gamma > \frac{1-\theta_B^\gamma}{2}$ implies $\theta_B^\gamma > \frac{1-\theta_A^\gamma}{2}$, and $\theta_A^\gamma > \theta_G^\gamma$ implies $\theta_B^\gamma > \theta_G^\gamma$. So, the conditions for which Hypotheses 1.1, 1.2, 1.3, 1.4, and 1.5 will hold simultaneously are:

$$\frac{1-\theta_B^\gamma}{2} < \theta_A^\gamma < \theta_B^\gamma$$
$$\pi > \frac{\theta_B^\gamma - \theta_A^\gamma}{\theta_A^\gamma + \theta_B^\gamma + \theta_G^\gamma}$$
$$\theta_G^\gamma < \min\left\{\theta_A^\gamma, \frac{\theta_A^\gamma + \theta_B^\gamma}{\left(1+\theta_B^\gamma\right)(1+\pi)+\pi}\right\}$$

This completes the proof of Proposition 4.

C Proof of Proposition 5

We first show when the Hypotheses from Theorem 2 hold, before passing to the proof of the Proposition 5.

Hypothesis 2.1 comes from Corollary 1, Hypothesis 2.2 comes from Corollary 2, and Hypothesis 2.3 comes from Corollary 3; all three Hypotheses always hold.

Hypothesis 2.4, Hypothesis 2.5, and Hypothesis 2.6 are always verified when $\theta_B^\gamma > \theta_A^\gamma > \frac{1-\theta_B^\gamma}{2}$. Thus, the 6 Hypotheses are jointly satisfied when $\theta_B^\gamma > \theta_A^\gamma > \frac{1-\theta_B^\gamma}{2}$.

We now present the proof of Proposition 5, which is divided in three parts.

Given that $\gamma_{I,S} > \gamma_{D,N}$ when $\theta_G^\gamma > \sqrt{\theta_A^\gamma \theta_B^\gamma \left(2+\theta_A^\gamma\right)\left(2+\theta_B^\gamma\right)} - \theta_A^\gamma - \theta_B^\gamma \equiv \hat{\theta}_G^\gamma$, when Hypotheses 2.1, 2.2, 2.3, and 2.5 hold, that is, when $\frac{1-\theta_B^\gamma}{2} < \theta_A^\gamma < \theta_B^\gamma$, and $\theta_G^\gamma > \hat{\theta}_G^\gamma$, Subproposition 5.1 is verified.

This completes the proof of Subproposition 5.1.

Given that $\gamma_{I,S} < \gamma_{D,N}$ when $\theta_G^\gamma < \hat{\theta}_G^\gamma$ and $\gamma_{D,P} < \gamma_{I,S}$ when $\pi > \sqrt{1 - \frac{\theta_A^\gamma \theta_B^\gamma (2+\theta_A^\gamma)(2+\theta_B^\gamma)}{(\theta_A^\gamma + \theta_B^\gamma + \theta_G^\gamma)^2}} \equiv \hat{\pi}$, when Hypotheses 2.2, 2.3, and 2.5 hold, that is, when $\frac{1-\theta_B^\gamma}{2} < \theta_A^\gamma < \theta_B^\gamma$, $\theta_G^\gamma < \hat{\theta}_G^\gamma$ and $\pi > \hat{\pi}$, Subproposition 5.2 is verified.

This completes the proof of Subproposition 5.2.

Given that $\gamma_{I,S} < \gamma_{D,N}$ when $\theta_G^\gamma < \hat{\theta}_G^\gamma$ and that $\gamma_{D,P} > \gamma_{I,S}$ when $\pi < \hat{\pi}$, when Hypotheses 2.1, 2.2, 2.4, and 2.6 hold, that is, when $\frac{1-\theta_B^\gamma}{2} < \theta_A^\gamma < \theta_B^\gamma$, $\theta_G^\gamma < \hat{\theta}_G^\gamma$ and $\pi < \hat{\pi}$, Subproposition 5.3 is verified.

This completes the proof of Subproposition 5.3 and the proof of Proposition 5.