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Essays in Public Choice:
Public Sector Organization and Politics as Exchange

A thesis presented for the degree of Doctor of Philosophy
in the School of Economic and Business Sciences,
University of the Witwatersrand

by

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Declaration

I Aldo Alfredo Sitoe declare that this thesis is my own, unaided work. It is being submitted for the Degree of Doctor of Philosophy at the School of Economic and Business Sciences at University of the Witwatersrand. It has not been submitted before for any degree or examination at this or any other university.

Aldo Alfredo Sitoe

14th day of DECEMBER 2016 in JOHANNESBURG

Dedicated to

Aldo Alfredo Sitoe Júnior and Sheryl Aldo Sitoe, my children

Sandra Jaime Mangue, my wife

Alfredo Filipe Sitoe and Egineta Alexandre Chelengo, my parents

Abstract

Before Public Choice the state was considered simply a black box that pursues the public interest independently of individuals who compose it. A fundamental objective of Public Choice is, as James Buchanan famously phrased it in various works, to attempt to eliminate this "romanticism" from the political sphere. Thus, the ultimate primitive of Public Choice is that individuals in the political sphere (bureaucrats, politicians, public managers, etc.), just like those of the market sphere, attempt to maximize their own utilities. In line with this primitive (Chapter 1), the present thesis considers the state a public organization, namely a complex structure that individuals use to accomplish collectively their individual interests mainly through exchange. By placing greater emphasis on exchange, the thesis is able to suggest novel insights about the organization of the public sector.

Public Choice is mainly the application of economics to politics. The "economic point of view" one adopts for analysis allows one to make sense of various aspects of the organization of the public sector (e.g., why would we decentralize the state?) that may not be evident otherwise. However, one's economic point of view depends on many elements. Chapter 2 considers two of the elements that shape the economic point of view: choice and exchange. Chapter 2 uses the heuristic expedient of duality between freedom and coercion to argue that emphasis on exchange rather than choice allows one to reject what I call the syllogism of Public Choice, namely that Public Choice is in every instance a subset of neoclassical economics. By rejecting the syllogism, the chapter implies that the methods and techniques of neoclassical economics are not always applicable to politics. Thus, for instance, decentralization may produce outcomes in the political sphere (e.g., coercion) that turn out to be quite different from those one would expect in the market sphere.

By considering the problem of inter-jurisdictional externalities within the fiscal federalism literature, Chapter 3 illustrates another aspect of the state as a public organization. The literature on fiscal federalism usually starts with the implicit assumption that "in the beginning there were decentralized states". Chapter 3 instead endogenizes organizational design into fiscal federalism. Thus, whereas in fiscal federalism decentralization always fails to internalize externalities whenever there are transaction costs and centralization does better in the presence of transaction costs, Chapter 3 challenges this view on two grounds. First, centralization need not internalize externalities better than decentralization. This stems from the fact that in both organizational settings the solution to the problem of externalities requires exchange. Exchange entails interactions among parties to an externality and the number of these interactions need not be higher under decentralization than under centralization. Second, the chapter shows that, in fact, decentralization can internalize externalities, notwithstanding transaction costs. The key, Chapter 3 suggests, is to consider the state along the margin of organizational boundary design. This allows us to characterize different decentralization settings that may generate different degrees of transaction costs. Chapter 4 summarizes the main findings of the thesis and alludes to possible extensions for future work.

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Chapter 1

Introduction

1.1. Introduction

Since Duncan Black the economic theory of markets has been extended to include the political sphere. The result was the birth of Public Choice (Rowley, 2008). Public Choice has, among other things, stimulated research on the organization of the public sector. However, despite the vast research that Public Choice has stimulated, still little is known about the organization of the public sector.

The present thesis can be seen as an attempt to improve our knowledge about the organization of the public sector through the prism of Public Choice. It consists of two core chapters that are united by the view of the state as a public organization, namely as a complex structure that individuals use to accomplish collectively their individual interests mainly through exchange.[1] The thesis also includes a brief conclusion that summarizes the main findings and suggests extensions for future work.

Before we proceed, however, it is useful to explicitly point out the set of assumptions that the proposed theory of the public sector hinges on. The assumptions are three: methodological individualism, *homo economicus*, and exchange. Consider each in turn.

Decisions, whether in the market or in the political sphere, are made by individuals. Even when decisions are made within a collectivity such as the state, the individual and only the individual is the source of the decision-making calculus. That is to say that all decisions are traceable back to the individual level; or, simply, the individual is the unit of analysis.

[1] E.g., Buchanan (1987) and North, Wallis, and Weingast (2009).

Many studies have used the assumption of methodological individualism to analyse the outcome of decisions in the market sphere, but not in the political sphere. In the political sphere, the state often has been considered the unit of analysis. In this organicist or collectivist methodology the state is more than the simple sum of its members: the nature of the state (preferences and abilities) remains the same even when we remove some of its members or replace the existing members of the state with new members (Hayek, 1979; Popper, 1957).

However, if we accept methodological collectivism, then a theory of the public sector loses significance. When preferences and abilities are equal among individuals, as the collectivist methodology implies, all decision rules (from dictatorship to the unanimity rule) produce similar results. When, in maximizing his utility, a dictator for instance uses combination "*A*" of factor endowments instead of combination "*B*" to produce quantity "*a*" of public goods instead of quantity "*b*", he automatically maximizes the utility to all individuals within his state since, because of equal preferences and ability, each individual would have used combination "*A*" of factor endowments instead of combination "*B*" to produce quantity "*a*" of public goods instead of quantity "*b*" if each were free to make decisions. As a result, combination "*A*" of factor endowments and quantity "*a*" of public goods would also obtain under the unanimity rule or any other decision rule since the median voter also shares similar ability and preferences with every member of the state (Buchanan, 1971). But, to take a recent example, the recent events in the Arab world, which precipitated the demise of many dictatorships in favour of democracies, suggest that different decision rules do not produce similar results. These events provide, therefore, empirical rejection, even if indirectly, of the collectivist method as an appropriate method of modelling the state.

An assumption that is closely related to, but is different from, the assumption of methodological individualism is *homo economicus*. If individuals have positive preferences over chicken and beef, they will buy more chicken than beef if the price of beef rises relative to that of chicken, all else the same. With this in mind, producers of beef will find cheaper ways to produce beef. The outcome: producers of beef remain in business and consumers have cheaper and greater variety of goods to choose from. Thus, the desire for self-preservation causes *homo economicus*, i.e. self-interested individuals (in this example producers) to act *as if* incorporating the utility of others (consumers) in the calculations of their own utility, not benevolence as such or any other behavioural assumption. With this, I do not mean that benevolence never enters individuals' utility calculations. What I mean is that the presence or absence of benevolence in individuals' behaviour carries little weight.[2]

To clarify, suppose, with Brennan and Buchanan (1985, Ch4)), that Abel wants to build a house, and he requires Cain's services to that effect. Cain requires a large portion of the payment towards the building of the house made in advance. However, should Cain defect, Abel stands to incur a massive loss. To mitigate any potential loss, Abel embarks on an investigation of Cain's track record as a builder. But even after he is assured of Cain's excellent record, Abel still hires a lawyer to draft a formal contract between himself and Cain. In drafting the terms of the contract, Abel assumes that Cain will defect because this is the contingency he wants to protect himself against. Whether Cain is a virtuous man becomes immaterial. The drafting of the contract requires a presumption of self-interest, narrowly defined, on the part of Cain if it (the contract) is to carry meaning. The contract exists to align Cain's possibly opposing interests with those of Abel.

Before Public Choice, the possibility of opposing interests among individuals was overlooked in many studies of the political sphere. Even though studies assumed that in the market

[2] See, especially, Leeson (2006b).

sphere the self-interested individual is the proper unit of analysis, in the political sphere the state has been usually assumed to be simply a black box that pursues the public interest independently of individuals who compose it. Not being perceived as an organization for collective action which, being composed of individuals with different arguments in their utility functions, has many different innate interests and incentive problems of its own, the state is necessarily benevolent a priori. If this is the case, it is perfectly logical to consider the state exogenous because it does not create negative externalities for those who do not have a political role. In different terms, the utility calculus of the private individual can aptly take the role of the state as given because state action, if anything, improves welfare (Qian & Weingast, 1997; Weingast, 2009, 2014).

The justification one often hears adduced in defence of this position is the one of public goods. In the Samuelson-Musgrave tradition of public finance,[3] public good allocation is often not optimal: there is no market-type solution to spontaneously induce a match between the supply of and the demand for non-excludable and non-rivalrous public goods because it is in the best interest of consumer-voters to free ride rather than spontaneously reveal their preferences. The optimal solution to public good supply is therefore a role delegated to the state (Garzarelli, 2004; Oates, 2005).

An analogous logic is believed to hold in the related case of private goods with external effects. The production or consumption of some private good may generate effects that are not fully endogenized by the price system. When prices do not perform their role of sufficient statistics, it is argued that the state should take corrective action. In specific, the role of the state is to realign the divergence between private and social benefits or costs emerging from external effects: create incentives through subsidies in case of positive externalities; create disincentives through taxes in case of negative externalities (Demsetz, 1969, 2011).

[3] See Musgrave (1959) and Samuelson (1954).

But this familiar outcome is, in the main, an artefact of the assumption of motivational asymmetries between individuals in their private and political roles. Suppose that individuals are self-interested in their private and political roles. Suppose further that there is a democratic political process and individuals use majority rule, as they often do in the real world, to make collective decisions.[4] Then, in the political sphere, the winning majority will be able to shift costs disproportionately towards the losing minority while amassing most, if not all, benefits through the political process. That is, individuals in the winning majority will be able to secure benefits (costs) higher (lower) than those they would otherwise secure in their private capacity. This discrepancy between social benefits (costs) and private benefits (costs) is exactly what defines externalities in the market sphere. Thus, under the self-interest assumption, the move from the market to the political sphere does not eliminate externalities. It only changes its nature (Buchanan, 2000 [1962]).

Suppose now that individuals are benevolent in their private and political roles. Then, in the market sphere, when for example the confectioner uses a machine the noise and vibration of which impacts negatively on the ability of a doctor (a neighbour) to do her work,[5] the confectioner will include the welfare of the doctor in the calculation of his own utility because the confectioner cares about the doctor. The result is that marginal social benefits will be equal to marginal social costs and the externality effectively disappears as it does under the assumption of benevolence in the political sphere (Buchanan, 2000 [1962]).

Notwithstanding similar implications between the market and the political sphere when individuals are modelled similarly in the case of private goods with external effects, the self-interested individual remains the proper unit of analysis in both the market and the political sphere. The soundness of this proposition becomes clearer when we consider the case of

[4] E.g., Brennan (2009).
[5] See Coase (1960).

public goods. If all individuals were benevolent, then there would be no preference-revelation problem in the market sphere. Each individual would voluntarily pay the price of the benefits he derives from the consumption of the public good because only in this way the individual will not harm, by shifting costs to and thus creating negative externalities to, his fellow men and women. If there is no preference-revelation problem, there is no need for the state. But once we attribute narrow self-interest motives to each individual then, absent coercion, preference revelation would be extremely difficult, particularly in the case of a large number of individuals. Since only the state holds monopoly over coercion, then only public goods may justify a role for the state.[6] Thus, the state emerges not because individuals with political roles are benevolent à la Pigou-Samuelson-Musgrave, but because individuals are narrowly self-interested (Demsetz, 2011).

Thus far, we have considered only two of the three fundamental assumptions we will use to construct our theory of the public sector: methodological individualism and *homo economicus* or self-interest. To say that decisions are at base individualistic says nothing about the motive behind those decisions. Methodological individualism is consistent with both benevolence and narrow self-interest. An individual may rank the wellbeing of others before that of hers with the same predisposition she may rank her wellbeing before that of others. The difference between methodological individualism and narrow self-interest is clearer when one considers the opposite of each: the opposite of methodological individualism is methodological collectivism and the opposite of narrow self-interest is benevolence. Like methodological individualism, methodological collectivism may be consistent with both narrow self-interest and benevolence. However, unlike methodological individualism, methodological collectivism implies no use for a theory of the public sector because, regardless of the motives we attribute to the collectivity (benevolence or self-

[6] However see, for example, Leeson (2006a, 2012) and the literature on crowdfunding (e.g., Chovanculiak & Hudik, 2016, for a quick review).

interest), the outcome is the same for all members of the collectivity since collectivism implies equal preferences and abilities among members of the state. The upshot is that the assumption of self-interest becomes useful only when we accept methodological individualism (Buchanan, 1989).

Let us now consider our third fundamental assumption, namely exchange. In *The Wealth of Nations* Adam Smith (1981 [1776]) states that man is innately a social being. He recognizes that man belongs to a social organization, economic or political, and that man can better his position only through interaction and exchange with other men.[7] The propensity to exchange, although possibly not intentionally designed to this end, leads to the division of labour, an outcome that according to Smith is the "cause of the wealth of nations". Hence, exchange or *catallactics* highlights the purposive nature of human action. Neither economic nor political theory is concerned with the actions of isolated man because these are not distinguishable from those of animals, in that both are to a large extent predictable. Predictable actions are mechanical, not purposive.[8] This is why it is not sufficient to consider economics a *science of choice* among competing ends.[9] To understand both the market and the political sphere we need to consider exchange. With exchange, actions are not mechanical because they are not determined independently from the act of choosing. With exchange, the act of choosing creates new choices, and this leads to unpredictability and uncertainty (Kirzner, 1976; Mises, 1996 [1949]).

Consider once more the case of public goods since only this type of goods justify state intervention as per our earlier argument. Recall that because of the non-excludability property, consumer-voters can consume a public good without fully paying for it, the result of

[7] Notice the link between exchange and methodological individualism. It is the interest of the individual, even if he is placed within a group, that ultimately forms the bases of an exchange (Buchanan, 1988, 2008).
[8] See also, for example, Boettke, Coyne, and Leeson (2003) and McKenzie and Galar (2004).
[9] See Robbins (1984 [1932]).

which is free-riding. To mitigate free-riding and ensure an optimal supply of the public good, the state taxes its members. But for any voting rule other than the unanimity rule taxes need not be imposed on the marginal benefit principle, i.e. the tax-price that the state imposes on each individual need not be equal to the marginal benefit that each individual enjoys. Under a majority rule, members of the majority will enjoy higher benefits while shifting a larger portion of the tax burden to members of the minority. However, members of the minority need not accept this outcome for, through exchange, they can improve their position. Members of the minority may enter into an agreement with some members of the majority to form a new majority whose marginal benefits are higher than marginal costs. If there are no transaction costs and agreements within and among coalitions are not binding, then the result will be unpredictability and uncertainty on both the identity of the majority and the combinations of quantity of public goods and tax-prices that the majority of individuals choses (Buchanan & Tullock, 1962).[10]

Exchange may create positive as well as negative externalities for those individuals who are not directly involved in it. For instance, if through exchange members of the majority succeed in providing more of a public good without an increase in tax-price, then there are positive externalities to members of the minority since their benefits increase without a proportionate increase in costs. However, if members of the majority want the same amount of public goods with a large portion of the tax payment towards the provision of the public good made by the minority, then there are negative externalities to members of the minority since their costs increase without a proportionate increase in benefits. As obvious as this may seem, most studies have generally overlooked the fact that one has to analyse exchange in order to ascertain whether the state, as a public organization, is able to effectively perform its function (that is, match the supply of public goods with citizens' demand for public goods).

[10] See also Bernholz (2008).

1.2. Politics and Exchange: Between Freedom and Coercion

The view that pervades much of economic analysis is the one associated with Lionel Robbins (1984 [1932]) according to which economics should focus on choice rather than exchange. Chapter 2 ("Politics and Exchange: Between Freedom and Coercion") is both methodological and analytical. It uses a familiar neoclassical economics tool, namely duality, to show an instance where choice as a method to study economics assumes away how interactions between members of the state may affect the state's ability to perform its function. The alternative variables of the dual problem are freedom and coercion where coercion is the imposition of constraints on individuals' choices and freedom is the opposite of coercion (Brennan & Brooks, 2013; Hayek, 1960). When choice is the center of analysis both the problem of maximizing freedom and the problem of minimizing coercion produce no negative externalities.[11] The socio-economic implications of the two problems are equivalent: the state always meets the demands of citizens. In contrast, when exchange is the center of analysis, the problem of minimizing coercion may produce negative externalities to individuals who do not partake in the exchange activity. Under exchange, the problem of minimizing coercion is of more socio-economic relevance than the problem of maximizing freedom, because in the minimization problem the state may fail to meet the demands of citizens. Specifically, state intervention creates coercion and uncertainty.

The state may fail to meet the demands of citizens because there is no one-to-one link between action and responsibility in the political sphere. The parties to an exchange are the acting entities but the collectivity is the entity to which responsibility is imputed (Buchanan, 1954). Therefore, there is a need to identify institutions that might improve the link between

[11] Members of the state incorporate any potential externalities in the choice process. That is to say that all externalities are Pareto irrelevant (Buchanan & Stubblebine, 1962).

action and responsibility in the political sphere. Chapter 3 suggests one such institution: public sector decentralization.

1.3. A Modular Theory of the State

Many studies (e.g., Jha, 2015; Lockwood, 2006; Oates, 2005; Tommasi & Weinschelbaum, 2007; Vo, 2010) suggest that we can improve the link between action and responsibility if we assign property rights over policy decisions to local governments, that is, if we decentralize state or government functions.[12] Decentralization facilitates competition among governments and, as such, makes it easier to rein the state. Nevertheless, these studies also suggest that decentralized governments cannot autonomously internalize inter-jurisdictional externalities, the presumption of which is that the central government should intervene whenever externalities develop (see also Besley & Coate, 2003). The ambiguity in these studies can be presented succinctly.

If, with Tiebout (1956), we differentiate between local public goods and national public goods, then we can carry Buchanan's (2000 [1962]) argument in the context of private goods to the case of public goods. Local public goods are akin to private goods for local regions in the sense that the excludability and rivalry properties hold for local consumer-voters. Specifically, only local consumer-voters pay and benefit from public goods produced locally; and consumer-voters' consumption of local public goods diminish the amount of the same goods available for consumption by consumer-voters of other local regions. Thus, there are no externalities in the case of local public goods.

However, since the production or consumption of national public goods produce benefits or costs that extend beyond any single local region, national public goods produce externalities to consumer-voters of local regions. In the spirit of Buchanan, if we assume that individuals

[12] We use the words state and government interchangeably throughout the thesis.

in both local and central governments are self-interested, then the problem of externalities need not disappear when we reassign property rights over policy decisions from local governments to the central government. The problem of externality resurfaces in a different guise. The logic is simple. The central government is usually composed of local representatives who make decisions through the use of a simple majority rule.[13] Members of the majority need not include the benefits or costs to members of the minority in their policy-decision calculus. When members of the majority disregard the effect of benefits or costs of their policy decisions on members of the minority there is an inequality between national benefits or costs and the benefits or costs to members of the majority, a result we call externality.

Chapter 3 ("A Modular Theory of the State") is theoretical and will suggest that, contrary to the common view, decentralization can simultaneously improve the link between action and responsibility in the political sphere and internalize inter-jurisdictional externalities if we consider the state in organizational terms in terms of boundary design among governments (e.g., Coase, 1937; Williamson, 1975).

Chapter 3 picks up two things. First, that what prevents autonomous internalization of inter-jurisdictional externalities is transaction costs, and transaction costs are increasing in the number of interactions between the parties to an externality (Coase, 1960). Second, once one considers the state an organization it becomes obvious that transaction costs need not be higher under decentralization than under centralization (see also Luelfesmann, Kessler, & Myers, 2015) because in both systems of organization individuals exchange in order to internalize externalities. Exchange, as shown in Chapter 2, presupposes interaction and the number of interactions increases with the number of parties to the exchange. Since

[13] E.g., Besley and Coate (2003).

transaction costs increase with the number of interactions we can reduce transaction costs by reducing the number of parties to an exchange required to internalize externalities.

One way to reduce the number of interactions among parties to an exchange required to internalize externalities is to modularize the state. Like the firm (e.g., Baldwin & Clark, 2000; Langlois, 2002), the state can be partitioned into a smaller number of connected subsystems, which we call modules, and then require that exchanges occur mostly within these subsystems.

1.4. Conclusion

The view of the state as a public organization, namely a complex structure individuals use to accomplish collectively their individual interests mainly through exchange, opens up more doors for further research on the public sector. An analysis of the public sector based on this view generates insights that clarify and even challenge widely held beliefs on, for instance, why functions should be assigned to one organizational form of the state instead of another.

Chapter 2

Politics and Exchange: Between Freedom and Coercion

2.1. Introduction

Modern economics usually analyses questions of political decision-making under the view, explicit or otherwise, that what holds in neoclassical economics also holds in Public Choice as long as the ideal-type of "economic man" matches that of "political man."[14] In "The Unity of Political and Economic Science" Black (1950) for instance argues that questions relating to economic and political decision-making have the same ideal type at their core, namely the self-interested individual. Thus, a theory of political decision-making, for example through committees, can rest on an economic theory of decision-making.[15] From this logic springs what we can call the syllogism of Public Choice (Mueller, 2003, 2015): the view that Public Choice is in every instance a proper subset of neoclassical economics. The syllogism is as follows:

- All theories based on self-interested individuals are subsets of neoclassical economics.[16]
- Public Choice is based on self-interested individuals.[17]
- Hence, Public Choice is a subset of neoclassical economics.

There seems to be some agreement on the validity of the syllogism (Boettke & López, 2002; Pitt, Salehi-Isfahani, & Eckel, 2004), one presumably based on the fact that the assumptions of the syllogism are true. I do not wish to challenge the truth of the assumptions. I want

[14] Well-known examples include Becker (1983, 1985) and Wittman (1989, 1995).
[15] See also Black (1958).
[16] E.g., Lowenberg (1990).
[17] E.g., Rowley (2008).

instead to redirect attention to some pre-analytics (Schumpeter, 1954). That is, to two views of economic science in order to suggest that the validity of the syllogism depends on which of the following two views or definitions of economics one uses:

- Economics is a *science of choice* among competing ends (Robbins, 1984 [1932]);
- Economics is a *science of exchange* among individuals (Buchanan, 1979).

To suggest that the validity of the syllogism, or, if you prefer, that the answer to whether Public Choice is a subset of neoclassical economics depends on which definition of economics one uses, I use a tool dear to neoclassical economics as a heuristic expedient: duality in individual choice. Duality is an approach within the optimization method of neoclassical economics that permits the derivation of the structure and solution of one problem from the structure and solution of another, related problem (e.g., Blume, 2008). In Public Choice spirit, in my set-up the variables of the dual problem are freedom and coercion, where coercion is the imposition of constraints on individuals' choices by other individuals, and freedom is the opposite of coercion (Brennan & Brooks, 2013; Hayek, 1960; Knight, 1939).

Since freedom is the opposite of coercion one would think that the problem of maximizing freedom is dual to the problem of minimizing coercion, namely that the outcome of choices that arise from the problem of maximizing freedom is the same as that arising from the problem of minimizing coercion. I show that this expected result from neoclassical economics need not always hold for Public Choice. Specifically, the result holds for Public Choice when one considers economics primarily a science of choice, but not when one considers economics primarily a science of exchange.

In economics as primarily a science of choice, the arguments in individuals' utility and cost functions are predetermined, in that they are unaffected by the choice action. That is, the act

of choosing does not create new choices (Buchanan & Vanberg, 2002; Marciano, 2009). Under these conditions, "the economic problem" (Robbins, 1984 [1932]) becomes one of selecting among existing arguments in the utility and cost functions that combination which would secure unanimous agreement among the choosing individuals.[18] Since under both the maximization and the minimization problem the arguments of the utility and cost functions are identical, the solution is also identical. Conversely, in economics as primarily a science of exchange, action and choice are endogenous. When Crusoe and Friday enter into an exchange relation, they influence each other's utility and cost functions. Thus, Crusoe's selection of arguments in his utility and cost functions changes the arguments in Friday's utility and costs functions, which in turn changes the arguments in Crusoe's utility and cost functions. This endogeneity creates uncertainty (Buchanan, 1979, 2001). In my set-up, the uncertainty shows up in the minimization problem but not in the maximization problem. The substantive implication: the problem of minimizing coercion is not dual to the problem of maximizing freedom under economics as a science of exchange.

The analysis of the present chapter is general. However, for concreteness, I will apply it to the context of fiscal federalism. I will suggest that some debate over the merits and demerits of public sector decentralization can be reduced to a debate over the appropriate economic "pre-analytic vision". In one sense, this application will enable us to reject one of the two definitions of economics above as an appropriate "pre-analytic vision" for Public Choice, even if only indirectly.

[18] Actually, the "economic problem", implicit in Robbins and his followers, is one of selecting among existing arguments in the utility and cost functions that combination which optimizes *social welfare*. However, to remain true to the methodological individualism assumption, Public Choice rejects the existence of a social welfare function (e.g., Vanberg, 2005).

2.2. The Elements of the Sets in Question

Because of the widespread ambiguities about what constitutes neoclassical economics (Colander, 2000) and what constitutes public choice (Mueller, 2015), it is useful to quickly consider the main similarities between the two research programs. To this end, I consider only the most pertinent aspects of the methodological foundations of the two programs as they relate to our objective.

2.2.1. Methodological individualism

Individuals may, and will typically, have different objectives in the political sphere as they do in the market sphere: in the political sphere, some individuals prefer more income redistribution than others in the same way that in the market sphere some individuals prefer more schooling years than others. Individuals use organizations such as the state, firms, and clubs to achieve individual objectives. Hence, organizations are only a means, an apparatus, to achieve individual objectives, not having a will detached from that of the individuals who compose them. Regardless of the process through which choices are made, the individual, and only the individual, is the choosing entity (Buchanan & Tullock, 1962; Holcombe, 2014; Vanberg, 2005). This holds true for both neoclassical economics and Public Choice.

2.2.2. Homo Economicus

Neoclassical economics holds that *homo economicus* populates the market sphere and Public Choice holds that *homo economicus* also populates the political sphere. Individuals are self-interested when they interact in the market sphere, and individuals are self-interested when they interact in the political sphere. When one says that an individual is self-interested, one means that the individual ranks the maximization of his objectives, however defined, above the maximization of the objectives of other individuals (Brennan, 2008; Buchanan, 2000).

Moreover, self-interest may be consistent with both altruism and egoism. The individual may rank the maximization of altruistic objectives above egoistic ones to the same extent as he may rank the maximization of egoistic objectives above altruistic ones (Engelen, 2007). Therefore, this neoclassical assumption has been extended by Public Choice to include the political sphere; and although one may reasonably argue that significant parts of neoclassical economics do not translate the egoistic aspect of self-interest to the political sphere, I will assume that neoclassical economics does not disagree with it.

2.2.3. Economics as a Science of Choice versus Economics as Exchange

Suppose that Robinson Crusoe grows crops and owns a dog. Suppose further that once Friday arrives to share the island with Crusoe, Friday rears cattle. Friday's cattle occasionally stray and destroy Crusoe's crops. Crusoe's dog occasionally frightens Friday's cattle, and, as a result, milk decreases in output (Mueller, 2003, Ch2). Suppose, further, that the present value of Crusoe's net payoff from crop production is $3000 absent damage from straying cattle but that it decreases to $2200 with damage. Also, the present value of Friday's net payoff from milk production is $2000 absent dog frights, but decreases to $1400 with dog frights. For simplicity, suppose that the only alternative available to prevent decreases in the present value of net payoffs is to build a fence at a cost of $1000. Against this backdrop, consider now the two visions that both neoclassical economics and Public Choice may be based on.

Economics as science of choice: Each individual aims to maximize the present value of net payoffs that he receives. Crop damage sets Crusoe back $800 ($3000 – $2200) whereas fence building sets him back $1000. The choice is certain and predictable: between a decrease in payoffs in the amount of $800 and an increase in costs in the amount of $1000, Crusoe chooses a decrease in payoffs in the amount of $800. Dog frightening sets Friday back $600 ($2000 – $1400), whereas fence building sets him

back $1000. The choice is again certain and predictable: between a decrease in payoffs in the amount of $600 and an increase in costs in the amount of $1000, Friday chooses a decrease in payoffs in the amount of $600.

Choices are predictable because there is no interaction between individuals. Each individual is an isolated being who, by definition, does not factor in the cost or benefit of another individual's choice in his own utility and cost calculus. Consequently, one individual's choice does not alter the choices that the other individual makes. Friday chooses not to build a fence regardless of the choice that Crusoe makes. Similarly, Crusoe chooses not to build a fence regardless of the choice that Friday makes. In sum, in economics as a science of choice, individuals' choices are defined independently of those of other individuals (Marciano, 2009).

Economics as science of exchange: Recall the problem that Crusoe and Friday face. It costs $1000 to build a fence. Without the fence, Crusoe and Friday incur an aggregate decrease in the present value of the net payoffs they receive from crop and milk production of $1400 ($800 + $600). Crusoe and Friday approach each other with the prospect of gains from trade. Crusoe and Friday agree to contribute towards fence building. Crusoe pays an amount lower than $800 and Friday pays an amount lower than $600 such that the sum total equals $1000, the amount required to build the fence. With exchange Crusoe's choice is no longer independent of Friday's choice. Although we know that Crusoe will pay an amount lower than $800, Friday will pay an amount lower than $600, and both will jointly pay $1000 towards fence building, we cannot say with certainty what each individual will contribute. Crusoe may contribute $700 if Friday contributes $300. Crusoe may contribute $500 if Friday contributes $500, and so on. The precise amount of the individual contribution is a matter of indifference for the argument here; what matters is the exchange.

Once exchange takes center stage cooperation ensues: each individual realizes that he can make himself better off through association with another individual. The mutual influence, the mutual adjustment, that exchange generates is what causes uncertainty and unpredictability (Buchanan, 1979, 2001).

2.3. Duality

In this section we develop the framework for our analysis. We assume that individuals make decisions over two sets: quantity = $\{Q_1, Q_2\}$ and price = $\{P_1, P_2\}$. For each individual there is a set containing a pair of one element of the quantity set and one element of the price set that offers optimum payoffs. Individuals decide how to pair one element in one set with an element of another set to obtain the quantity-price set that optimizes their payoffs in one of two ways:

- They may select, first, one element in the price set and ascertain what element in the quantity set, given the selected element in the price set, is consistent with optimum payoff. This is akin to selecting a budget constraint first and then shifting the utility curve until it touches the budget constraint in the familiar maximization problem in consumer theory.
- They may select, first, one element in the quantity set and ascertain what element in the price set, given the selected element in the quantity set, is consistent with optimum payoff. This is akin to selecting a utility curve first and then shifting the budget constraint until it touches the utility curve in the familiar minimization problem in consumer theory.

If the two problems yield the same result, we say that the problems are dual (Blume, 2008; Chavas & Baggio, 2010; Gravelle & Rees, 2004, Ch3). Consider a simple example. Crusoe

wants to decide on how much he should contribute towards fence building. Suppose that Crusoe's preferences over quantity-price sets are as shown in Table 2.1. In Table 2.1, a higher listed quantity-price set offers a higher payoff than a lower listed one. Hence, a higher listed quantity-price set is preferred to a lower listed one as the ranking on the first column illustrates. For instance, $\{Q_1, P_1\}$ offers a higher payoff (i.e., \$4) than $\{Q_1, P_2\}$ (i.e., \$3); hence $\{Q_1, P_1\}$ is preferred to $\{Q_1, P_2\}$.

Table 2.1: Crusoe's Preferences over Quantity-Price Sets

Crusoe			
Ranking	Payoffs	Quantity	Price
First	\$4	Q_1	P_1
Second	\$3	Q_1	P_2
Third	\$2	Q_2	P_2
Fourth	\$1	Q_2	P_1

In the maximization problem Crusoe selects, first, an element in the price set that may yield him the highest payoff, and this is P_1 in Table 2.1.[19] Once price is fixed at P_1, there are only two possible quantity-price sets: $\{Q_1, P_1\}$ and $\{Q_2, P_1\}$. Since Crusoe prefers $\{Q_1, P_1\}$ to $\{Q_2, P_1\}$ he chooses Q_1. Therefore, the solution to the maximization problem is quantity-price set $\{Q_1, P_1\}$.

In the minimization problem Crusoe selects, first, an element in the quantity set that may yield him the highest payoff. This is Q_1. Once quantity is fixed at Q_1, there are only two possible quantity-price sets: $\{Q_1, P_1\}$ and $\{Q_1, P_2\}$. Since Crusoe prefers $\{Q_1, P_1\}$ to $\{Q_1, P_2\}$

[19] Throughout the chapter, we apply the maximax principle (e.g., Congar & Merlin, 2012): individuals always choose the price or quantity that promises the quantity-price set with the highest payoff regardless of the probability of attaining such a set. This is a standard assumption in consumer theory although the assumption is seldom, if at all, made explicit.

he chooses P_1. Therefore, the solution to the minimization problem is also quantity-price set $\{Q_1, P_1\}$. Since the maximization problem and the minimization problem yield the same result, the two problems are dual to each other.

This simple and familiar example relates to the market sphere. Here, I want to consider instead the less familiar example of the political sphere. To this end, I need to introduce a decision rule that will translate individual decisions into collective decisions. Following most related literature, I will use the simple majority rule: if fifty percent of voters plus one chooses alternative X over Y, then X becomes the "collective choice". To render the simple majority rule more operational, I will consider a committee with three individuals – Crusoe, Friday, and Patrick – who want to decide over combinations of quantities of public goods and tax-prices. Also, for simplicity, I will use direct democracy throughout the chapter. I will assume further that the preferences of the three committee members over sets of quantity-tax-price are as shown in Table 2.2. Table 2.2 is fundamental for the rest of the chapter, the illustrations all derive from it.

Table 2.2: Committee Members' Preferences over Quantity-Tax-Price Sets

		Crusoe		**Friday**		**Patrick**	
Ranking	Payoffs	Quantity	Tax-price	Quantity	Tax-price	Quantity	Tax-price
First	\$4	Q_1	P_1	Q_1	P_2	Q_2	P_1
Second	\$3	Q_1	P_2	Q_2	P_2	Q_1	P_1
Third	\$2	Q_2	P_2	Q_1	P_1	Q_1	P_2
Fourth	\$1	Q_2	P_1	Q_2	P_1	Q_2	P_2

2.4. Freedom and Coercion

Individuals tend to use less than the unanimity rule, e.g., simple majority, on issues relating to ordinary or routine policy, such as the provision of public goods, because it is too onerous to secure the consent of every individual on every choice. But whereas the need to secure the

consent of every individual on every choice, under the unanimity rule, ensures that no one is left with a choice that is inconsistent with that which he would make under voluntary exchange, majority rule does not. Thus, whereas choices under the unanimity rule are never coercive, choices under majority rule may be coercive (Brennan, 2012).

As specified at the outset, we define coercion as the imposition of constraints on individuals' choices by other individuals. For the sake of our argument, coercion arises when the quantity-price set that individuals desire differs from that which results from collective choice (see also Breton, 1974). This instance is coercive in the sense of being inconsistent with the choices that individuals would make under voluntary exchange. Under voluntary exchange, individuals would want the quantity-price set that optimizes payoffs (Johnson & Pauly, 1969; Samuelson, 1954). In Table 2.1, reflecting the market sphere, the condition for voluntary exchange holds only at set $\{Q_1, P_1\}$.

However, in the political sphere individuals do not choose for themselves. They choose for the collectivity. Thus, when an individual enters an exchange relation in the political sphere, he considers *potential*, as opposed to *actual*, choices. Simply put, when an individual decides to exchange one dollar for a good in the market sphere he is assured of the good. The dollar always counts positively, i.e., it assures him the good subject to the exchange action, because there is (tacit) unanimity in the market sphere. Nevertheless, when an individual decides to exchange one vote for a preferred policy in the political sphere he is not assured of the preferred policy unless he is a member of a majority.[20] That is to say that, contrary to the case

[20] See Buchanan (1954). This also provides one, although not the only, means to differentiate between the analysis undertaken here and that undertaken in Boettke, Coyne, and Leeson (2007). In Boettke et al., the difference between the market and the political sphere lies largely on the easiness with which individuals can discover and utilize knowledge for productive ends in the market sphere compared to the political sphere. In one sense, one can consider the analysis here as suggesting that even if the political sphere was able to generate and utilize knowledge to the same extent as the market sphere can, we would still encounter differences between the two spheres. The reason for this lies in the domain of exchange. The domain of exchange in the market is a special case of the domain of exchange in the political sphere. As Wicksell pointed out long ago, the domain of

of the market sphere, exchanges need not be voluntary in the political sphere. To determine whether the condition for voluntary exchange holds in the political sphere we evaluate choices from the standpoint of the veil of uncertainty.[21]

Behind the veil of uncertainty individuals are able to determine the benefits and costs attached to collective choices. However, they are uncertain of the distribution of the benefits and costs of collective choices. Because of uncertainty, individuals in the minority and majority groups would unanimously agree to choices under majority rule. When unanimous agreement occurs there is no coercion. However, in order to secure unanimous agreement under the veil two conditions should be met. First, individuals in the minority group should expect to be members of the majority at least on some occasions (Buchanan & Tullock, 1962). We shall assume that this condition always holds. Second, the quantity-price set that individuals in the majority group choose should provide the maximum possible payoff.

As coercion decreases, freedom increases. Freedom is the absence of coercion. It "refers solely to a relation of men to other men, and the only infringement on it is coercion by men" (Hayek, 1960, p. 12). Therefore, one may think that when coercion is at a minimum, individual freedom is at its maximum (Brennan & Brooks, 2013; Hayek, 1960). The implication we are familiar with from traditional arguments in neoclassical economics is as follows: the problem of minimizing coercion and the problem of maximizing freedom are dual to each other, because one can derive the structure and solution of one problem from that of the other (Blume, 2008; Chavas & Baggio, 2010; McLaren & Wong, 2009).

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exchange in the market and the political sphere coincide only when we use the unanimity rule in the political sphere.

[21] We would reach the same conclusion if we evaluate choices from the standpoint of the veil of ignorance (Rawls, 1971).

2.5. The Comparison: Choice versus Exchange

In the previous section we defined freedom and coercion. We also suggested that, from traditional arguments in neoclassical economics, the problem of maximizing freedom and the problem of minimizing coercion are dual to each other. It is now possible to dedicate attention to our main concern – namely, to examine whether Public Choice is a subset of neoclassical economics. To do this, we will examine whether the problem of maximizing freedom and the problem of minimizing coercion are equivalent, that is, if duality holds under both pre-analytic visions (economics as a science of choice and economics as a science of exchange). If the problems are equivalent in a given vision, then Public Choice is a subset of neoclassical economics under the relevant vision. However, if the problems are not equivalent in a given vision, then Public Choice is not a subset of neoclassical economics under that vision.

2.5.1. Economics as Science of Choice

Consider first the problem of minimizing coercion. There are two steps:

- First, individuals choose quantity.
- Second, individuals choose price, given the quantity chosen in the first step.

Table 2.3: Choosing Quantity

Committee members	**Highest ranked quantity-tax-price sets**	**Quantities**	
		Q_1	Q_2
Crusoe	$\{Q_1, P_1\}$	$\succ$	
Friday	$\{Q_1, P_2\}$	$\succ$	
Patrick	$\{Q_2, P_1\}$	$\prec$	
Majority		$\succ$	

To show how individuals choose quantity, it is useful to construct a new table from Table 2.2, such as Table 2.3. We consider, for such construction, what quantity allows each committee member to attain the quantity-tax-price set that he ranks most highly. For convenience, I have included the quantity-tax-price set that each committee member ranks highest on the second column of Table 2.3.

Table 2.3 shows that the majority of committee members, Crusoe and Friday, prefer quantity Q_1 to quantity Q_2 because this is the quantity that allows each to attain the quantity-tax-price set that each ranks highest. Thus, the committee "chooses" Q_1. Once quantity is fixed at Q_1, the committee moves on to the second step of the minimization problem, which is to choose price. To show how the committee "chooses" price, we derive Table 2.4 from Table 2.2. For this derivation, we consider what price allows each committee member to attain the quantity-tax-price set he ranks most highly, given that quantity is fixed at Q_1.

Table 2.4: Choosing Price when Quantity is fixed at Q_1

Committee members	**Highest ranked quantity-tax-price sets given that quantity = Q_1**	**Prices**	
		P_1	P_2
Crusoe	$\{Q_1, P_1\}$	$\succ$	
Friday	$\{Q_1, P_2\}$	$\prec$	
Patrick	$\{Q_1, P_1\}$	$\succ$	
Majority		$\succ$	

From Table 2.4, the majority of committee members, Crusoe and Patrick, prefer P_1 to P_2 because this is the price that allows each to attain the quantity-tax-price set that each ranks highest, given that quantity is fixed at Q_1. Therefore, the committee "chooses" P_1. The result is that the committee "chooses" $\{Q_1, P_1\}$ as the most preferred quantity-tax-price set.

Let us now consider the problem of maximizing freedom. There are also two steps:

- First, individuals choose price.
- Second, individuals choose quantity, given the price chosen in the first step.

To show how individuals choose price, we derive Table 2.5 from Table 2.2. Table 2.5 considers what price allows each committee member to attain the quantity-tax-price set that he ranks most highly.

Table 2.5: Choosing Price

Committee members	**Highest ranked quantity-tax-price sets**	**Prices**	
		P_1	P_2
Crusoe	$\{Q_1, P_1\}$	$\succ$	
Friday	$\{Q_1, P_2\}$	$\prec$	
Patrick	$\{Q_2, P_1\}$	$\succ$	
Majority		$\succ$	

The majority of committee members, Crusoe and Patrick, prefer price P_1 to price P_2. Hence, the committee "chooses" P_1. Once the price is fixed at P_1, the committee proceeds to "choose" quantity. To show how the committee "chooses" quantity, we consider what quantity allows each committee member to attain the quantity-tax-price set that he ranks most highly, given that price is fixed at P_1. To this end, we produce Table 2.6 from Table 2.2.

As Table 2.6 shows, the majority consisting of Crusoe and Friday prefers quantity Q_1 to quantity Q_2 because this is the quantity that allows each to attain the quantity-tax-price set that each ranks highest, given that price is fixed at P_1. Therefore, the committee "chooses" Q_1. The result is that the committee "chooses" $\{Q_1, P_1\}$ as the most preferred quantity-tax-price set.

Table 2.6: Choosing Quantity when Price is fixed at P_1

Committee members	Highest ranked quantity-tax-price sets given that price = P_1	Quantities	
		Q_1	Q_2
Crusoe	$\{Q_1, P_1\}$	$\succ$	
Friday	$\{Q_1, P_1\}$	$\succ$	
Patrick	$\{Q_2, P_1\}$	$\prec$	
Majority		$\succ$	

If and only if committee members' preferences are as shown in Table 2.2 and choice is the pre-analytic vision, there is no uncertainty in the political sphere. Absent uncertainty, it becomes irrelevant to committee members whether they maximize freedom or they minimize coercion because there is a unique and identical solution determined by the choice of the majority of committee members, namely $\{Q_1, P_1\}$. Further, under the unique solution there is no coercion because all committee members would have voluntarily chosen $\{Q_1, P_1\}$ behind the veil of uncertainty. To illustrate, suppose that a quantity-tax-price set ranked first is worth \$4, a quantity-tax-price set ranked second is worth \$3, a quantity-tax-price set ranked third is worth \$2, and a quantity-tax-price set ranked fourth is worth \$1, as the first two columns of Table 2.2 show. Then,

- $\{Q_1, P_1\}$ is worth an aggregate of \$9 (\$4 for Crusoe + \$2 for Friday + \$3 for Patrick),
- $\{Q_2, P_2\}$ is worth an aggregate of \$6 (\$2 for Crusoe + \$3 for Friday + \$1 for Patrick),
- $\{Q_2, P_1\}$ is worth an aggregate of \$6 (\$1 for Crusoe + \$1 for Friday + \$4 for Patrick), and
- $\{Q_1, P_2\}$ is worth an aggregate of \$9 (\$3 for Crusoe + \$4 for Friday + \$2 for Patrick).

Behind the veil of uncertainty, Crusoe, Friday, and Patrick would agree to set $\{Q_1, P_1\}$ because this is the set that is *at once* preferred by the majority and offers the highest

aggregate payoff so long as each individual expects to be a member of the majority, which we assume each does, on some occasions.[22] Although set $\{Q_1, P_2\}$ offers the same aggregate payoff as set $\{Q_1, P_1\}$, i.e. \$9, $\{Q_1, P_2\}$ would not be chosen behind the veil of uncertainty because it is inconsistent with the choice of the majority: the majority of committee members prefer $\{Q_1, P_1\}$ to $\{Q_1, P_2\}$, as shown above.

2.5.2. Economics as Science of Exchange

Here we also start with the minimization problem. However, unlike under the previous case of economics as a science of choice, under economics as a science of exchange we have three, instead of two, steps:

(i) Individuals choose quantity.

(ii) Individuals choose price, given the quantity chosen in (i).

(iii) Individuals enter into exchange agreements the terms of which require a change of one element in the price set for another. Quantity remains fixed at the level chosen in (i).

Since the first two steps are similar to those considered under economics as a science of choice and we know that the two steps yield $\{Q_1, P_1\}$, we can jump straight to the third step. To establish how and whether individuals would enter into exchange relations to change price in $\{Q_1, P_1\}$, holding quantity fixed at Q_1, we generate Table 2.7 from Table 2.2.

[22] Of course, no dollars need be added. This is done for the sake of convenience. We could get the same result by looking at the rankings of sets instead. Any quantity-tax-price set committee members rank highest more times provides higher benefits. For instance, Crusoe ranks $\{Q_1, P_1\}$ first and $\{Q_2, P_2\}$ third, Friday ranks $\{Q_1, P_1\}$ third and $\{Q_2, P_2\}$ second, and Patrick ranks $\{Q_1, P_1\}$ second and $\{Q_2, P_2\}$ fourth. Therefore, in a comparison between $\{Q_1, P_1\}$ and $\{Q_2, P_2\}$, $\{Q_1, P_1\}$ offers higher benefits. $\{Q_1, P_1\}$ is ranked first once, second once, and third once. $\{Q_2, P_2\}$ is ranked second once, third once, and fourth once. The same method applies to the comparison between $\{Q_1, P_1\}$ and the other quantity-tax-price sets.

Table 2.7: Exchange when Quantity is fixed at Q_1

(1) Committee Member	(2) Price	(3) Payoff when Price = P_1	(4) Price	(5) Payoff when Price = P_2	(6) Payoff from Changing P_1 into P_2, (5) – (3)	(7) Payoff from Changing P_2 into P_1, (3) – (5)
Crusoe	P_1	\$4	P_2	\$3	– \$1	\$1
Friday	P_1	\$2	P_2	\$4	\$2	– \$2
Patrick	P_1	\$3	P_2	\$2	– \$1	\$1
Total		\$9		\$9	\$0	\$0

Given Q_1, a change of P_1 into P_2 produces a negative payoff of – \$1 to both Crusoe and Patrick and a positive payoff of \$2 to Friday, as column 6 illustrates. Since Friday's payoff is higher than either Crusoe's or Patrick's payoff in absolute terms, Friday has an incentive to approach either Crusoe or Friday with the prospect of gains from exchange.[23]

1. Suppose that Friday approaches Crusoe. Friday proposes to Crusoe to change P_1 into P_2. The exchange makes both Crusoe and Friday well off: – \$1 + \$2 > 0 (see column 6). Suppose that Friday and Crusoe equally share the gains from exchange as per column 2 of Table 2.8: Crusoe receives \$0.50 and Friday receives \$0.50.
2. But Patrick and Crusoe can also gain from a change of P_2 back to P_1: \$1 + \$1 > 0 (see column 7 of Table 2.7). Suppose that Patrick and Crusoe share the gains from exchange as per column 3 of Table 2.8: Crusoe receives \$1.20 and Patrick receives \$0.80.
3. Friday can in turn break the coalition of Crusoe and Patrick by proposing a change of P_1 into P_2 and offering Patrick a share of \$0.90 while he (Friday) keeps \$0.10 as column 4 of Table 2.8 illustrates.

[23] E.g., Riker and Brams (1973).

4. Crusoe can also break the coalition of Friday and Patrick by proposing a change of P_2 into P_1 and offering Patrick a share of \$1.60 and keep \$0.40 as column 5 of Table 2.8 illustrates.
5. But Friday can once again offer better terms to Crusoe. Friday proposes a change of P_1 into P_2 and offers Crusoe a share of \$0.50 and keeps \$0.50 (see column 6 of Table 2.8).

Table 2.8: Redistribution of the Gains from Exchange

(1) Committee Member	(2) Share from Changing P_1 into P_2	(3) Share from Changing P_2 into P_1	(4) Share from Changing P_1 into P_2	(5) Share from Changing P_2 into P_1	(6) Share from Changing P_1 into P_2
Crusoe	\$0.50	\$1.20		\$0.40	\$0.50
Friday	\$0.50		\$0.10		\$0.50
Patrick		\$0.80	\$0.90	\$1.60	
Total	\$1	\$2	\$1	\$2	\$1

The upshot of this exercise is that we would be back to column 2 of Table 2.8. That is, we would have cycles and thus uncertainty. The Appendix offers a formal proof.

Cycles and uncertainty arise because the sum of the payoffs from a change of P_1 into P_2 and P_2 back into P_1 is zero (see columns 6 and 7 of Table 2.7). Thus, the gain to parties to an exchange is equal to the loss to the party outside the exchange. That is, we have a pure redistribution game. In a pure redistribution game, a previously excluded party to an exchange will want to form a new exchange with one or the other member of the old

exchange even if that means that the previously excluded party to an exchange receives a smaller share of the gains from the new exchange.[24]

Let us now consider the maximization problem. In economics as a science of exchange, the maximization problem also consists of three steps:

(i) Individuals choose price.

(ii) Individuals choose quantity, given the price chosen in (i).

(iii) Individuals enter into exchange agreements the terms of which require a change of one element in the quantity set for another. Price remains fixed at the level chosen in (i).

Again, since the first two steps are similar to those considered under the problem of maximizing freedom in economics as a science of choice and we know that the two steps yield $\{Q_1, P_1\}$, we move straight to the third step. Starting with $\{Q_1, P_1\}$, we consider whether individuals would enter into exchange relations to change quantity holding price fixed at P_1. To this end, we derive Table 2.9 from Table 2.2.

[24] It is important at this stage to differentiate between the analysis conducted here and the more familiar analyses relating to majority-voting cycles. In those analyses (e.g., Shepsle & Weingast, 2012 for a review), cycles arise because of the non-unidimensional nature of issues (here quantity-price sets) not because of choice as such. Here we are asking, in one sense, if exchange would produce cycles even if issues (quantity-price sets) were ranked such that choice did not produce cycles. As shown, the answer is in the affirmative. Hence, contra Tullock (1981) and in agreement with Shepsle and Weingast (1981), exchange is the source of, and not the solution to, instability of majority voting.

Table 2.9: Exchange when Price is fixed at P_1

(1) Committee Member	(2) Quantity	(3) Payoff when Quantity = Q_1	(4) Quantity	(5) Payoff when Quantity = Q_2	(6) Payoff from Changing Q_1 into Q_2, (5) – (3)	(7) Payoff from Changing Q_2 into Q_1, (3) – (5)
Crusoe	Q_1	\$4	Q_2	\$1	– \$3	\$3
Friday	Q_1	\$2	Q_2	\$1	– \$1	\$1
Patrick	Q_1	\$3	Q_2	\$4	\$1	– \$1
Total		\$9		\$6	– \$3	\$3

When price is fixed at P_1, a quantity of Q_1 produces the payoffs illustrated in column 3; and a quantity of Q_2 produces the payoffs illustrated in column 5. Given P_1, a change of Q_1 into Q_2 offers no gains from exchange. Any exchange between Crusoe and Friday, Crusoe and Patrick, or Friday and Patrick either offers zero payoffs or negative payoffs. From column 6 of Table 2.9:

- Exchange between Crusoe and Friday yields – \$3 – \$1 < 0.
- Exchange between Crusoe and Patrick yields – \$3 + \$1 < 0.
- Exchange between Friday and Patrick yields – \$1 + \$1 = 0.

Therefore, no committee member has an incentive to change Q_1 into Q_2 when price is fixed at P_1. That is to say that set $\{Q_1, P_1\}$ becomes the final outcome. See the Appendix for a formal proof.

The result is that the problem of minimizing coercion and the problem of maximizing freedom are not dual to each other in economics as a science of exchange because the minimization problem entails some degree of uncertainty and coercion. In the minimization problem, individuals may end up with set $\{Q_1, P_1\}$ or set $\{Q_1, P_2\}$ thus making it difficult to

calculate the expected return on purposive economic action. Further, although set $\{Q_1, P_1\}$ and set $\{Q_1, P_2\}$ provide the same aggregate payoff, i.e. \$9, set $\{Q_1, P_2\}$ is coercive in the sense that it would not secure unanimous agreement behind the veil of uncertainty since the majority strictly prefers set $\{Q_1, P_1\}$ to set $\{Q_1, P_2\}$.

In sum, since duality holds under economics as a science of choice but not under economics as a science of exchange, this suggests that Public Choice is a subset of neoclassical economics under economics as a science of choice but not under economics as a science of exchange. And all of this is in turn equivalent to asserting that the syllogism of Public Choice does not always hold: Public Choice is not in every instance a proper subset of neoclassical economics.

2.6. Application: "Failure" of Public Decentralization

Consider the following puzzle that emanates from the literature on the so-called Second Generation Theory of Fiscal Federalism (e.g., Boadway & Tremblay, 2012; Jha, 2015; Qian & Weingast, 1997; Weingast, 2009) and the related literature on yardstick competition (e.g., Belleflamme & Hindriks, 2005; Besley & Case, 1995; Besley & Smart, 2007). Both literatures share the notion that decentralization injects market-like features into the political sphere. In the market sphere consumers compare the goods that producers supply in the market. In the political sphere voters compare the goods that politicians (and bureaucrats) supply in different jurisdictions. Competition in both spheres aligns incentives. Producers in the market sphere supply goods that consumers demand lest they see consumers turn to competing suppliers. Similarly, politicians (and bureaucrats) in the political sphere supply goods that voters demand lest they see voters turn to other competing suppliers (jurisdictions). Yet, empirical evidence suggests that, unlike in the market sphere, in the political sphere voters receive goods that do not match their demands, notwithstanding

decentralization (Boettke, Coyne, & Leeson, 2011; Boffa, Piolatto, & Ponzetto, 2016; Calabrese, Epple, & Romano, 2012). That is, there is coercion. I will suggest that the apparent mismatch between theory and evidence results from the implicit view of economics as a science of choice. When we view economics as a science of exchange, the mismatch between theory and evidence disappears.

Table 2.10: Preferences under Decentralization

Panel A: Sodom

		Primo		**Secondo**		**Terzo**	
Ranking	Payoffs	Quantity	Tax-price	Quantity	Tax-price	Quantity	Tax-price
First	\$4	Q_1	P_1	Q_1	P_2	Q_2	P_1
Second	\$3	Q_2	P_1	Q_2	P_2	Q_1	P_1
Third	\$2	Q_1	P_2	Q_1	P_1	Q_1	P_2
Fourth	\$1	Q_2	P_2	Q_2	P_1	Q_2	P_2

Panel B: Gomorrah

		Alfred		**Nobel**		**Prize**	
Ranking	Payoffs	Quantity	Tax-price	Quantity	Tax-price	Quantity	Tax-price
First	\$4	Q_2	P_2	Q_2	P_2	Q_1	P_1
Second	\$3	Q_1	P_2	Q_1	P_1	Q_2	P_2
Third	\$2	Q_1	P_1	Q_1	P_2	Q_1	P_2
Fourth	\$1	Q_2	P_1	Q_2	P_1	Q_2	P_1

Consider Table 2.10 where there are two regions within the same state: Sodom and Gomorrah. Each region has a committee of three members. Each committee wants to decide among four sets of quantities of public goods and tax-prices: $\{Q_1, P_1\}$, $\{Q_1, P_2\}$, $\{Q_2, P_1\}$, and $\{Q_2, P_2\}$. Suppose that it costs \$1 to move from one region to another.[25] Suppose further that Alfred, Nobel, and Prize choose set $\{Q_2, P_2\}$. This is the set that individuals in Gomorrah would choose behind the veil of uncertainty because it also offers the highest aggregate

[25] Individuals tend to prefer to live in communities consisting of individuals of the same socio-economic class. Such miscellaneous preferences create relocation costs (Bickers, Salucci, & Stein, 2006).

payoff, i.e. \$11 (\$4 for Alfred + \$4 for Nobel + \$3 for Prize). Hence, there is no coercion in Gomorrah. How would the choice of $\{Q_2, P_2\}$ affect the choice of Primo, Secondo, and Terzo in Sodom? Consider decentralization under the two visions: economics as a science of choice and economics as a science of exchange.

2.6.1. Decentralization and Economics as a Science of Choice

In Table 2.10, Primo prefers $\{Q_1, P_1\}$ to any other quantity-tax-price set; Secondo prefers $\{Q_1, P_2\}$ to any other quantity-tax-price set; and Terzo prefers $\{Q_2, P_1\}$ to any other quantity-tax-price set. When $\{Q_1, P_1\}$, $\{Q_1, P_2\}$ and $\{Q_2, P_1\}$ are put up for a vote, the committee in Sodom "chooses" $\{Q_1, P_1\}$. Consider Table 2.11, which is derived from Table 2.10, for clarification. Primo and Terzo prefer $\{Q_1, P_1\}$ to $\{Q_1, P_2\}$; Primo and Secondo prefer $\{Q_1, P_1\}$ to $\{Q_2, P_1\}$. Hence, the majority of committee members in Sodom prefer $\{Q_1, P_1\}$ to any other quantity-tax-price set.[26]

Table 2.11: Choosing Quantity-Tax-Price Sets

Committee members	**Highest ranked quantity-tax-price sets**	**Preferences over highest ranked quantity-tax-price sets**			
		$\{Q_1, P_1\}$	$\{Q_1, P_2\}$	$\{Q_2, P_1\}$	$\{Q_1, P_1\}$
Primo	$\{Q_1, P_1\}$		$\succ$		$\prec$
Secondo	$\{Q_1, P_2\}$		$\prec$		$\prec$
Terzo	$\{Q_2, P_1\}$		$\succ$		$\succ$
Majority			$\succ$		$\prec$

Here is the crux of the matter. When economics as science of choice is the pre-analytic vision, $\{Q_1, P_1\}$ becomes the final outcome in Sodom. At $\{Q_1, P_1\}$ there is no coercion

[26] Whether the majority prefers $\{Q_1, P_2\}$ to $\{Q_2, P_1\}$ is irrelevant since both sets are dominated by $\{Q_1, P_1\}$.

because individuals in Sodom would have chosen this set behind the veil of uncertainty since it also offers the highest aggregate payoff, i.e. \$9 (\$4 for Primo + \$2 for Secondo + \$3 for Terzo) as Table 2.10 illustrates. The only way Primo, Secondo, and Terzo can receive a quantity-tax-price set other than $\{Q_1, P_1\}$ is by moving to Gomorrah.[27] In our set-up only Secondo would consider moving to Gomorrah because the gain from a change of $\{Q_1, P_1\}$ into $\{Q_2, P_2\}$ is greater than the cost of relocation. More specifically, if Secondo moved to Gomorrah to receive $\{Q_2, P_2\}$, his payoff would be \$3 minus the cost of relocating which is \$1. However, \$3 – \$1 is equal to the payoff that Secondo gets from staying in Sodom to receive $\{Q_1, P_1\}$, i.e. \$2 (see Table 2.10). The upshot is that Secondo would be indifferent between staying in Sodom and moving to Gomorrah. He would experience coercion in neither region since individuals of either region would have chosen $\{Q_1, P_1\}$ and $\{Q_2, P_2\}$ in Sodom and Gomorrah respectively behind the veil of uncertainty.

2.6.2. Decentralization and Economics as Science of Exchange

Under economics as science of exchange, $\{Q_1, P_1\}$ need not be the final outcome in Sodom. To illustrate, consider Table 2.12, which is derived from Table 2.10.

[27] See Tiebout (1956).

Table 2.12: Exchange and the Possibility of Relocation

(1) Committee Member	(2) Payoff when set = $\{Q_1, P_1\}$	(3) Payoff when set = $\{Q_1, P_2\}$	(4) Payoff when set = $\{Q_2, P_1\}$	(5) Payoff when set = $\{Q_2, P_2\}$	(6) Payoff from changing $\{Q_1, P_1\}$ into $\{Q_1, P_2\}$, (3) – (2)	(7) Payoff from Changing $\{Q_1, P_2\}$ into $\{Q_2, P_1\}$, (4) – (3)	(8) Payoff from relocating to Gomorrah to receive $\{Q_2, P_2\}$, (5) – \$1
Primo	\$4	\$2	\$3	\$1	– \$2	\$1	\$0
Secondo	\$2	\$4	\$1	\$3	\$2	– \$3	\$2
Terzo	\$3	\$2	\$4	\$1	– \$1	\$2	\$0
Total	\$9	\$8	\$8	\$5	– \$1	\$0	\$2

Note: The apparent inconsistency between the total payoff implied by the difference between the total payoff in column 5 (i.e., \$5) and relocation cost (i.e., \$1) and the vertical sum of payoffs in column 8 (i.e., \$2) disappears once we recall that there are three individuals in Sodom and that each would incur a relocation cost of \$1 when moving to Gomorrah. Thus, the total payoff in column 8 is equal to \$5 (column 5) minus 3 (the three individuals, namely Primo, Secondo, and Terzo) times \$1 (the relocation cost to each individual). The result, which is \$2, is the same as the one we obtain from vertically adding payoffs in column 8.

1. Column 6 of Table 2.12 suggests that Secondo and Terzo can gain from agreeing to vote for a change of $\{Q_1, P_1\}$ into $\{Q_1, P_2\}$. They would gain in the amount \$2 – \$1.
2. Column 6 also suggests that a change from $\{Q_1, P_1\}$ into $\{Q_1, P_2\}$ would cause Primo to incur a loss of \$2. Primo can enter into an exchange agreement with Terzo to vote for a change of $\{Q_1, P_2\}$ into $\{Q_2, P_1\}$. Primo and Terzo would gain in the amount \$1 + \$2, as column 7 suggests. Thus far, we have ignored the possibility of relocating to Gomorrah.
3. A change of $\{Q_1, P_2\}$ into $\{Q_2, P_1\}$ causes Secondo to incur a loss of \$3 (see column 7). If Secondo relocates to Gomorrah instead to receive $\{Q_2, P_2\}$, he would earn a net payoff of \$2 (\$3 which is the payoff from $\{Q_2, P_2\}$ – relocation costs of \$1), as column 8 shows.

Because "[c]ommunity decline is a bad" (Oakerson & Parks, 1988, p. 94) – for instance, it may drive property prices down, and hence property tax base, as more people sell their houses before relocating – Primo and Terzo may refrain from undertaking an exchange agreement the terms of which require them to vote for a change of set $\{Q_1, P_2\}$ into set $\{Q_2, P_1\}$.

Two conclusions follow from our illustration. First, decentralization helps align incentives and match preferences. Under decentralization individuals can compare quantity-tax-prices between regions and they can relocate with relative ease in order to avoid quantity-tax-prices they rank lowest, e.g. $\{Q_2, P_1\}$. This much is known.

Second and the important lesson from this section, when economics as science of choice is the pre-analytic vision, decentralization does not produce coercion. Set $\{Q_1, P_1\}$ is consistent with voluntary choice as is the case in the market sphere.[28] However, when economics as science of exchange is the pre-analytic vision, decentralization limits, but need not eliminate, coercion.[29] Hence, the mismatch between theory and evidence disappears: both theory and evidence show that there may be coercion under decentralization.

Unlike the market sphere, the political sphere allows for purely distributional elements in the exchange process. Behind the veil of uncertainty, no one would consent to purely distributional elements in the exchange process since these produce, at best, a zero-sum

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[28] It might be argued that the market sphere at times may produce coercive outcomes, for example when Mr *A* buys a book the content of which upsets Mrs *B*. I should point out that this argument breaks down once we evaluate the outcomes from the standpoint of the veil of uncertainty. Behind the veil of uncertainty Mrs *B* would accept actions of Mr *A* that may upset her so long as she expects to engage in actions that may also upset Mr *A* on some occasions (Brennan, 2012).

[29] Because of the possibility of relocation, residents of Sodom will never undertake exchanges that produce set $\{Q_2, P_1\}$. However, they may undertake exchanges that produce set $\{Q_1, P_2\}$. Set $\{Q_1, P_2\}$ offers an aggregate payoff of \$8 which is less than what set $\{Q_1, P_1\}$ offers, i.e. \$9 (see the last row of Table 2.12). Therefore, residents of Sodom would not choose $\{Q_1, P_2\}$ behind the veil of uncertainty. That is to say that set $\{Q_1, P_2\}$ produces coercion.

game. Absent consent behind the veil, we have coercion. This suggests that we need to limit the domain of exchanges in the political sphere.[30] To be more precise, we need to limit the possibility of purely distributional elements in the political exchange process since these are the source of coercion; not exchange as such.

2.7. Conclusion

This chapter used the heuristic expedient of duality between freedom and coercion to show an instance where the syllogism of Public Choice does not hold, or, if you prefer, an instance where Public Choice is not a subset of neoclassical economics. According to traditional arguments in neoclassical economics, we should expect equivalence between the outcome under the problem of maximizing freedom and the outcome under the problem of minimizing coercion because both problems use similar arguments in their economic calculus. However, the chapter showed that the equivalence holds when we consider economics a science of choice but not when we consider economics a science of exchange. This suggests that Public Choice is a subset of neoclassical economics when we consider economics a science of choice but not when we consider economics a science of exchange.

The analysis of the chapter serves to illustrate that the explicit or otherwise assumption that what holds in neoclassical economics also holds in Public Choice (provided that in both instances the self-interested individual is considered the unit of analysis) is not always true. Consequently, it should not be puzzling that, for example, outcomes under public decentralization may not be equivalent to outcomes under the market sphere. But the lack of equivalence between the outcomes under public decentralization and the market sphere has nothing to do with decentralization per se. The non-equivalence is an artefact of the domain of exchange in the political sphere. The domain of exchange in the political sphere

[30] E.g., Buchanan and Congleton (2003 [1998]) and Shepsle and Weingast (1981, 2012).

accommodates coercion. In the political sphere individuals may be forced to accept outcomes inconsistent with those they would voluntarily choose behind the veil of uncertainty.

In conclusion, therefore, once we make economics a science of exchange the necessity of studies of institutions, including binding contracts, follows more or less naturally. With exchange, the possibility of both uncertainty and coercion in the political sphere becomes a reality; hence the ultimate task of the political economist becomes one of investigating which institutions minimize coercion and uncertainty.

Appendix: Proof of Uncertainty or Its Absence

A grand coalition is stable – does not lead to cycles, and hence uncertainty – if it is within the core. That is to say that there is no subset of the grand coalition that offers benefits greater than the grand coalition. A coalition within the core satisfies the following conditions:[31]

(i) $Crusoe + Friday + Patrick = U(Crusoe, Friday, Patrick)$

(ii) $Crusoe \geq U(Crusoe)$, $Friday \geq U(Friday)$, $Patrick \geq U(Patrick)$

(iii) $Crusoe + Friday \geq U(Crusoe, Friday)$, $Crusoe + Patrick \geq U(Crusoe, Patrick)$, $Friday + Patrick \geq U(Friday, Patrick)$

From (iii):

(iv) $Crusoe + Friday + Patrick \geq \frac{1}{2}[U(Crusoe, Friday) + U(Crusoe, Patrick) + U(Friday, Patrick)]$

From (i) and (iv):

(v) $U(Crusoe, Friday, Patrick) \geq \frac{1}{2}[U(Crusoe, Friday) + U(Crusoe, Patrick) + U(Friday, Patrick)]$

Minimization Problem:

In Table 2.2, consider only sets that provide the highest payoff when quantity = Q_1.

$U(Crusoe, Friday, Patrick)$ = \$4 + \$2 + \$3 = \$9 from set $\{Q_1, P_1\}$ or

= \$3 + \$4 + \$2 = \$9 from set $\{Q_1, P_2\}$

$U(Crusoe, Friday)$ = \$3 + \$4 = \$7 from set $\{Q_1, P_2\}$

$U(Crusoe, Patrick)$ = \$4 + \$3 = \$7 from set $\{Q_1, P_1\}$

$U(Friday, Patrick)$ = \$4 + \$2 = \$6 from set $\{Q_1, P_2\}$

[31] See, for example, Mueller (2003, pp.30-31).

Condition (v) is violated. Therefore, the grand coalition $U(Crusoe, Friday, Patrick)$ is not within the core.

Maximization Problem:

In Table 2.2., consider only sets that provide the highest payoff when price = P_1.

$U(Crusoe, Friday, Patrick)$ = \$4 + \$2 + \$3 = \$9 from set $\{Q_1, P_1\}$

$U(Crusoe, Friday)$ = \$4 + \$2 = \$6 from set $\{Q_1, P_1\}$

$U(Crusoe, Patrick)$ = \$4 + \$3 = \$7 from set $\{Q_1, P_1\}$

$U(Friday, Patrick)$ = \$1 + \$4 = \$5 from set $\{Q_2, P_1\}$ or

= \$2 + \$3 = \$5 from set $\{Q_1, P_1\}$

All conditions are satisfied. Therefore, the grand coalition $U(Crusoe, Friday, Patrick)$ is within the core.

Chapter 3

A Modular Theory of the State

3.1. Introduction

In recent years there has been an increasing recognition that insights from organizational design are useful to study the public sector (e.g., Crémer, Estache, & Seabright, 1996; Oates, 2005; Qian & Weingast, 1997; Salmon, 2006; Weingast, 2014). In this new approach to fiscal federalism, particular attention is given to the optimal allocation of property rights over policy decisions in a fiscal federation. For example, when an interjurisdictional externality is present, what are the benefits of granting central government the right to intervene vis-à-vis the costs of removing that right from the local governments directly involved in the externality? One intriguing answer suggests that the choice to centralize or decentralize depends on the trade-off between policy coordination (reducing interjurisdictional externalities) under centralization and accountability (monitoring of politicians and bureaucrats) under decentralization (Seabright, 1996; Tommasi & Weinschelbaum, 2007).

In many ways this is the so-called assignment problem of fiscal federalism in a new guise. The problem is traceable to Musgrave's (1959) classic tome on public finance where we are introduced to the public sector 'triple' – namely the functions of allocation, distribution and stabilization. Musgrave's suggestion is that a central government should deal with distribution and stabilization and the local governments with allocation. The rationale behind the latter is intuitive: given its greater proximity to consumer-voters, it is easier for local than for central government to supply public goods according to local preferences. Of course, this intuition shares common ground with Tiebout's (1956) well-known voting with the feet model, which, in many ways, can be considered a precursor to organizational design applied

to the public sector (Garzarelli, 2004). The purpose of this chapter is to more explicitly endogenize organizational design into fiscal federalism, or, put another way, to consider the constitutional political economy of rights allocation in a fiscal federation. By doing so, I wish to specifically study a basic point of the traditional approach to fiscal federalism, which has somewhat escaped attention even in the new approach to fiscal federalism, namely the point that externalities justify central government intervention.

The implied organizational setting for both the traditional approach and the new approach to fiscal federalism is a one where (i) the organizational design of the state – levels of government, division of powers, form of the state, size of the state, etc. – is ex ante given,[32] and (ii) the transaction costs of autonomous coordination of interjurisdictional externalities are prohibitive.[33] However, (i) and (ii) are not necessarily consistent in the sense that the solution to interjurisdictional externalities, as the fiscal federalism literature conceives it, implies that the organizational design of the state is indeterminate. In advocating central intervention to internalize externalities, the fiscal federalism literature assumes that coordination costs decrease with increased centralization. However, if coordination costs decrease with increased centralization, then the higher is the level of government that internalizes externalities the better. That is to say that as the magnitude of interjurisdictional externalities increases, the degree of centralization should increase. Consequently, the optimal organizational design of the state cannot be ex ante given since levels of government would grow indefinitely so long as the magnitude of externalities increases. Since this public sector organization is not consistent with any state we know there must be some counterbalancing cost that limits the size of the state. This counterbalancing cost is, according to Breton and Scott (1978) and Tullock (1969), bureaucratic costs: setting up an

[32] E.g., Cheikbossian (2000).
[33] For an explicit statement of the setting with prohibitive transaction costs see, for example, Lockwood (2002, 2006).

additional government level introduces more noise into the process of information transmission within an organization. Differently viewed, an optimal organizational design of the state is that which minimizes transaction costs: the sum of coordination and bureaucratic costs.

This chapter is linked to Breton and Scott and Tullock in the sense that like them the chapter does not assume that the organizational design of the state is ex ante given.[34] That is, the state is not a black box. However, the chapter differs from Breton and Scott and Tullock, and, to the best of my knowledge, from any other work in the fiscal federalism literature, in that it does not assume that the transaction costs of coordinating interjurisdictional externalities increase with decentralization, mainly in consideration of the increased time it takes to reach agreement among parties to an externality.[35] The literature on fiscal federalism – Breton and Scott and Tullock included – makes no attempt to consider whether different organizations of the state can generate different degrees of coordination costs, and, by extension, whether autonomous (decentralized) internalization of externalities is possible. The missing link, I will suggest, is the theory of modularity, a theory that explicitly considers ex ante organizational design in order to minimize the transaction costs of coordination ex post.

Casual empiricism already shows that autonomous internalization of externalities is possible. Recently, the Ukraine and the European Union have entered into a bargaining relationship the terms of which required Ukraine to shut down the remaining blocks of the Chernobyl nuclear power plant in exchange for monetary compensation of almost one billion American dollars and further help towards building two new nuclear reactors (Luelfesmann et al., 2015). Another example is that of farmers in Austria who receive voluntary compensation from Alpine tourist communities for the provision of services with positive externalities, namely

[34] See also Boschken (1982) and Boffa et al. (2016).
[35] E.g., Harstad (2007).

landscape amenities (these include mowing Alpine grassland, taking care of the rural trail and road network, preserving the vegetation along the waterways, etc.). The amount of the compensation reflects the outcome of bargaining between farmers and tourist communities at the municipal council level (Hackl, Halla, & Pruckner, 2007).

I point out that what in the main raises transaction costs and ultimately prevents the autonomous solution to the problem of externalities is the number of interactions involved in a negotiation (Coase, 1960). Autonomous negotiation for internalization of externalities works up to an upper limit: as the number of parties to an externality increases, negotiation increases in difficulty, i.e. transaction costs of coordination become too high (Mueller, 2003, pp. 39-40). Therefore, the question of transaction costs minimization ultimately becomes one of minimizing the interactions tied to the negotiation. The principles of modularity are a useful guide about how to approach this organizational design question. By grouping elements of a system into smaller subsystems and then requiring that most interactions occur within subsystems, which we call modules, modularity minimizes interactions and consequently transaction costs of coordination (Langlois, 2002).

3.2. The Assignment Problem

The assignment problem refers to the decision to hand over property rights over tax and expenditure instruments to different levels of government. Governments use tax and expenditure instruments to establish an efficient allocation of resources, redistribute income, and keep employment and prices at stable levels (Musgrave, 1959).

Although the literature on fiscal federalism assigns the responsibility over distribution and stabilization functions to the central government and the allocation function to local governments, in practice the three functions are interrelated (e.g., tax and expenditure decisions designed to achieve optimal allocation of resources affect income redistribution and

the level of employment and price stability). Consequently, there is a need to coordinate functions and this will require coordination among governments (Musgrave, 1959; Oates, 2012). The coordination can be vertical (top-down/bottom-up) or horizontal (among governments of the same level) (Boadway & Keen, 1996).

3.2.1. Approaches to Fiscal Federalism: The State as a Black Box

Why it would matter whether property rights over policy decisions is assigned to one or the other level of government? This question forms the basis of the study of multi-level governments i.e., fiscal federalism. The answer usually is as follows. Suppose that there are two levels of government: one national jurisdiction and two local regions. Suppose further that society consists of 100 individuals of whom 51 are type A and 49 are type B. Individuals want to decide over various policies on mosquito control. Type A individuals prefer quantity A of dead mosquitoes, and type B individuals prefer quantity B of dead mosquitoes (Barzel, 1969). When property rights over policy decisions reside with the national jurisdiction, the central government supplies quantity A of dead mosquitoes because the majority (individuals of type A) prefers quantity A. Now suppose that 30 individuals of type A and 20 individuals of type B live in region 1 and the remainder of the two types of individuals (21 individuals of type A and 29 individuals of type B) live in region 2. If property rights over policy decisions reside with regions, then the local government in region 1 would supply quantity A of dead mosquitoes because the majority (individuals of type A) prefers quantity A. Similarly, the local government in region 2 would supply quantity B of dead mosquitoes because the majority (individuals of type B) prefers quantity B (Pennock, 1959; Wagner, 2001).

According to the traditional approach to fiscal federalism, the assignment of property rights over policy decisions to local regions better matches preferences. In the example above, only 41 individuals (20 individuals in region 1 plus 21 individuals in region 2) do not receive the

quantity of dead mosquitoes that matches their preferences. The assignment of property rights over policy decisions to the national jurisdiction, on the other hand, raises the number of the dissatisfied to 49 individuals (all individuals of type B). The number of the dissatisfied rises because under centralization both regions are supplied with a uniform quantity of dead mosquitoes.[36]

Hence, the cost of centralization is the neglect of the varying preferences of individuals who live in different regions. The majority of individuals who live in region 2 receive quantity A of dead mosquitoes, even though they prefer quantity B, because the majority in the national jurisdiction prefers quantity A. Decentralization, in contrast, allows each region to supply the quantity of dead mosquitoes that the majority in each region prefers. Thus, region 1 gets quantity A of dead mosquitoes and region 2 gets quantity B. The upshot is that with decentralization there is variation in the supply of dead mosquitos and variation increases preference-matching (e.g., Musgrave, 1959, 1971; Oates, 1968, 1999, 2011[1972], 2012).

Nevertheless, decentralization also imposes costs in the form of reduced externality internalization. Each region is better off when the other controls mosquitos. However, because the benefits of mosquito control are diffused among individuals of different regions while the costs are concentrated among individuals of a single region, neither region will take the positive effects of mosquito control on the other region. The outcome is underprovision of dead mosquitos, and, as a result, regional benefits will fall short of national benefits. According to the traditional approach to fiscal federalism, the central government should intervene in order to internalize externalities because by considering the national as opposed to local majority the central government considers national as opposed to regional benefits (e.g., Musgrave, 1959, 1971; Oates, 1968, 1999, 2011[1972], 2012).

[36] The fact that the number of the dissatisfied is higher under centralization than under decentralization is not specific to our example. It is general. For an elaboration see Tiebout (1956) and, especially, Pennock (1959).

The traditional approach assumes that the government pursues the public interest independently of the individuals who compose it. In other words, individuals who compose government are benevolent (Jha, 2015; Qian & Weingast, 1997; Vo, 2010; Weingast, 2009). But if that is the case then centralization should do no worse-off, and would typically do better when there are interjurisdictional externalities, than decentralization. To avoid this outcome, the traditional approach assumes that the central government provides goods uniformly either because of political constraints (e.g., regions and individuals within those regions should be treated equally) or because it costs more for the central government to obtain the information about regional preferences than it costs regions (Oates, 2005, 2008).

However, casual empiricism rejects the assumption of uniformity. For instance, in the United States federal highway spending is based on what the federal government perceives to be the differentiated needs of the various districts (Besley & Coate, 2003). Also, central governments worldwide consider differences in population, per capita income, revenue-raising ability, etc. before they disburse grants to regions (Lockwood, 2002).

According to the new approach to fiscal federalism, property rights over policy decisions should be assigned to regions not because it costs more for the central government to obtain information on regional preferences (and thus the central government ought to supply uniform policies), but because regions are more constrained than the central government to use regional information.[37]

Consider again our mosquito example. Individuals can write contracts with government the terms of which would require government to supply dead mosquitos in exchange for election. However, we know that because of cognitive limitations, contracts will be unavoidably

[37] The central government can just as easily use the mechanisms available to regions such as consultative assemblies, public hearings, and advisory boards to acquire information on regional preferences (Crémer et al., 1996).

incomplete. Therefore, although individuals can judge the effect of government's efforts on their welfare, individuals cannot verify efforts. When contracts are incomplete in this way it matters who holds property rights over policy decisions (Seabright, 1996).

By diffusing power among regions, decentralization allows for greater accountability. For instance, the probability that the preferences of type B individuals will determine who runs government is higher in region 2 than it is at the national level. Hence, a government agent who runs for election in region 2, for example, would have a higher incentive to increase effort in order to meet the preferences of type B individuals than she would have if she ran for election at the national level. However, since under decentralization only individuals within a given region can decide who will win elections in that region, government agents will not take into account the benefits of mosquito control to individuals of another region. In short, the cost of decentralization is reduced externality internalization (Seabright, 1996; Tommasi & Weinschelbaum, 2007).

Concentration of power, on the other hand, allows the central government to internalize externalities. In deciding how much effort to apply in order to be elected at the national level government agents consider the average welfare within the two regions (Seabright, 1996; Tommasi & Weinschelbaum, 2007). The upshot is that the new approach to fiscal federalism produces a result similar in spirit to the one we encounter in the traditional approach: decentralization will fail in the presence of interjurisdictional externalities, and, therefore, the central government should intervene (Besley & Coate, 2003; Oates, 2005, 2012).

The two approaches produce similar results because both assume two things. First, both consider the state a black box: both approaches assume that the organizational design of the state (e.g., the national jurisdiction and the two regions aforementioned) is ex ante given. The second assumption, which is often implicit, is that the transaction costs of autonomous

coordination of interjurisdictional externalities are prohibitive. From the second assumption follows that the higher is the number of local regions that are affected by externalities, the higher is the benefit from increased centralization since centralization economizes on coordination costs. But this result implies that the ex ante given organizational design of the state is not optimal since the result means that as the magnitude of externalities increases, the optimal degree of centralization may be a continental or even a worldwide government. In short, the optimal organizational design of the state is undefined (Breton & Scott, 1978; Tullock, 1969).

3.2.2. Opening the Black Box

In the previous subsection we learned that the literature on fiscal federalism assigns property rights over policy decisions to local governments whenever externalities are negligible because local governments are more capable to match the supply of public goods with consumer-voters preferences and increase accountability. However, as the magnitude of externalities increases, the literature recommends we assign property rights over policy decisions to the central government because the central government can economize on coordination costs. The assignment of property rights over policy decisions in this manner is predicated on the assumption that the organizational design of the state is ex ante given. However, as argued before, the assumption of ex ante given organizational design of the state is inconsistent with an 'optimal' assignment of property rights. The higher is the magnitude of interjurisdictional externalities, the higher should be the level of government that internalizes externalities in order to economize on coordination costs. The bottom line is that levels of government would have to increase indefinitely. But this is neither consistent with any state we know nor optimal. In fact, many countries e.g., France, Germany and Italy, have abolished or plan to abolish some levels of government (Boffa et al., 2016).

To make further progress we need to relax the assumption of ex ante given organizational design of the state (Breton & Scott, 1978; Tullock, 1969). With this in mind, Breton and Scott and Tullock note that there are bureaucratic costs to setting up new levels of governments. These bureaucratic costs (i.e., increased difficulty for those at the top to control actions within an organization) may rise quickly enough to trump any gains from further increases in levels of government.[38] The introduction of bureaucratic costs, therefore, allows for the design of an optimal organizational design of the state since it limits the number of levels of government. And, the optimal organization of the state will be equal to the minimum of the sum of both types of transaction costs: coordination costs and bureaucratic costs (see also Breton, 2006).[39]

In what follows, I wish to consider only the transaction costs of coordinating interjurisdictional externalities. I will isolate these transaction costs not because the other costs are unimportant but because the other transaction costs (bureaucratic costs) have been sufficiently dealt with in the literature and because the costs of externality internalization have served to slow down developments within the fiscal federalism literature. Even the work of Breton and Scott (1978), which offers perhaps the most comprehensive treatment of the assignment of property rights over policy decisions among governments, remains incomplete in that like all literature before and after it assumes that centralization is the only solution to the problem of inter-jurisdictional externalities. Would the internalization of externalities imply increased central intervention once we endogenize the costs of externality internalization into the ex ante design of the organization of the state? This is the question the rest of the chapter attempts to answer. We begin by describing the transaction costs that, according to the literature, make autonomous internalization of externalities impossible.

[38] See also Coase (1937) and Williamson (1967).
[39] Breton and Scott (1978) consider four types of transaction costs: administrative or bureaucratic costs, coordination costs, signalling costs and mobility costs. The first two relate to the state and the last two to consumer-voters.

3.3. Transaction Costs

Consider the lowest level of government for which transaction costs other than the costs of externality internalization are minimal. Let us call this level regional. Suppose that a region undertakes an activity that causes pollution to neighbouring regions. The activity benefits the polluter in the amount B and the pollution damages each neighbouring region in the amount D_i. If the polluter is not liable for the damages to neighbouring regions, then autonomous internalization of the pollution would occur provided that $\sum D_i > B$: regions would enter into a contractual exchange relation the terms of which would require the polluted regions to pay the polluter a minimum of B and a maximum of $\sum D_i$. If the polluter is liable for the damages to neighbouring regions, then autonomous internalization of the pollution would occur provided that $B > \sum D_i$: regions would enter into a contractual exchange relation the terms of which would require the polluter to pay the polluted a minimum of $\sum D_i$ and a maximum of B. The result is that regions can always contract to internalize all inefficiencies related to pollution regardless of which region holds the rights to, or is liable for, pollution. The assumption is that transaction costs, C, are zero (Coase, 1960).[40]

What happens when $C > 0$? If the polluter is not liable for damages, then autonomous internalization of the pollution would occur provided that $\sum D_i - C > B$. If the polluter is liable for damages, then autonomous internalization of the pollution would occur provided that $B - C > \sum D_i$. The magnitude of C may prevent the autonomous internalization of the pollution. Specifically, there is a critical level of transaction costs, C^*, such that for $C > C^*$ autonomous internalization of pollution is impossible (Acemoglu, 2003; Coase, 1960; Cooter, 2000, especially Ch3; Galiani, Torrens, & Yanguas, 2014; Parisi, 2003), and the literature assumes that $C > C^*$ (e.g., Lockwood, 2002, 2006).

[40] From now on we use the term transaction costs to refer to coordination costs only since these are the only costs we are interested in.

Following the definition of Dahlman (1979), transaction costs are the resources lost obtaining information on

- the identity of potential parties to a contractual exchange relation,
- the terms of the contract,
- and enforcement of the terms of the contract.

In public governance settings, the most important reason for why transaction costs may be prohibitive is the time it takes to agree on the terms of a contract. Therefore, the costs of agreement provide an approximation to the magnitude of transaction costs. For example, Harstad (2007) notes that regions would always cooperate to internalize inter-regional externalities autonomously if it were not for the transaction costs of reaching agreements on the terms of a contract. For instance, the polluter does not know the true D_i and the polluted do not know the true B. The polluter and the polluted may spend time making proposals and counterproposals in the expectation that they can induce each other to reveal the true D_i and B (Inman & Rubinfeld, 1997a, 1997b, 2014).[41]

Furthermore, as the number of parties to an externality increases, it becomes increasingly difficult to reach agreement on the terms of a contract (Inman & Rubinfeld, 1997a, 1997b, 2014). For example, as the number of polluted regions involved in a potential contractual exchange relation increases, it becomes increasingly difficult to ascertain D_i for each polluted region as polluted regions take strategic stances in order to maximize (minimize) the payment from (to) the polluter if the polluter is (not) liable for the damages from pollution.

In essence, autonomous internalization of externalities requires the minimization of transaction costs, and minimization of transaction costs requires the minimization of the

[41] The recent rounds of negotiation between Greece and the Economic and Monetary Union serve as a real illustration (http://www.dailyfx.com/forex/market_alert/2015/06/30/Greece-Misses-IMF-Payment.html).

number of interactions among parties involved in an externality. The minimization of the number of interactions among parties involved in an externality is a matter of modularization, a subject we now turn to.

3.4. Modularity

It is difficult to fully understand a complex system (e.g., galaxy, family, firm, government, university, etc.) given the number of distinct elements that the system includes and the number of interactions among the elements of the system. One way to deal with this difficulty is to minimize the number of interactions among elements. We can minimize the number of interactions among elements of a system through near-decomposition: the assignment of elements of a system to a number of subsystems that are marginally interconnected (Ethiraj & Levinthal, 2004; Ethiraj, Levinthal, & Roy, 2008; Simon, 1962, 2002, 2005).

In essence, near-decomposition hides elements of a subsystem from those of other subsystems (Langlois, 2002). Hence, in a nearly-decomposable system the rate of interaction among elements within subsystems is higher than the rate of interaction among elements of different subsystems. We call the subsystems in which the rate of interaction among elements is higher modules (Baldwin, 2015). As a result, near-decomposability is also known as modularity (e.g., Langlois & Garzarelli, 2008; Sanchez & Mahoney, 1996, 2013; Valente, 2014).

To illustrate, suppose that Ary, Barry and Carry wish to make a table. There are three sequences in the production of a table:

- Sequence 1: do task a_1 (find and cut wood to appropriate measures).
- Sequence 2: do task a_2 (construct the legs and the table top).
- Sequence 3: do task a_3 (glue and clamp the legs and the table top).

Tasks a_1, a_2, and a_3 may be non-decomposable as Figure 3.1a illustrates. In Figure 3.1a "x" represents interaction between task a_i and task a_j $(i, j = 1,2,3)$. In a non-decomposable system each task interacts with all other tasks. That is, the performance of one task requires the performance of all other tasks in the production sequence (Brusoni, Marengo, Prencipe, & Valente, 2007; Simon, 1962, 2002).

Figure 3.1: Non-decomposable, Decomposable, and Modular Systems

	a_1	a_2	a_3
a_1	x	x	x
a_2	x	x	x
a_3	x	x	x

Figure 3.1a: Non-decomposable System

	a_1	a_2	a_3
a_1	x		
a_2		x	
a_3			x

Figure 3.1b: Decomposable System

	vdr	a_1	a_2	a_3
vdr	x	x	x	x
a_1	x	x		
a_2	x		x	
a_3	x			x

Figure 3.1c: Modular System

Source: Adapted from Langlois (2006, Figure 2)

Now suppose that Ary, Barry and Carry agree that each should perform one sequence of the three sequences required to make a table. For example, Ary finds and cuts wood to appropriate measures; Barry constructs the legs and the table top; and Carry glues and clamps the legs and the table top. In this scenario, tasks are decomposable (see Figure 3.1b). In Figure 3.1b each a_i interacts only with a_i, that is, itself. In a decomposable system there is no

interaction between tasks. Specifically, the performance of one task does not require the performance of the other tasks in the production sequence (Brusoni et al., 2007; Marengo & Dosi, 2005; Simon, 1962, 2002).

The decomposition of tasks creates information hiding (Parnas, 1972, 2001). In our table example, the decomposable system requires each individual to know only one task of the production sequence. However, if there is information hiding how do Ary, Barry and Carry coordinate complementary tasks, each known to only one individual, in order to ensure that individuals together perform all the tasks of the production sequence smoothly? The answer is that individuals can modularize the tasks required to make the table. Essentially, modularity is more than the simple division of parts (tasks); individuals need to establish how parts (tasks) fit together as well (Langlois, 2006). As a result, modularity requires that individuals minimize interactions but not reduce them to zero (Frenken & Mendritzki, 2012).

In order to minimize interactions while ensuring coordination individuals divide information into visible design rules (*vdr* in Figure 3.1c) and hidden design parameters (a_i in Figure 3.1c). The visible design rules include the architecture of the system, the interface, and standards. The architecture defines the modules of the system together with the functions of modules; the interface coordinates the interactions among modules; and standards ensure conformability between the functions of modules and performance (Baldwin & Clark, 2000). In the table example, Ary, Barry, and Carry are modules. The assignment of the different tasks of the production sequence to individuals is the architecture. The criteria to determine which products can be moved on to the next production sequence are the standards. The price of products is the interface.

Visible design rules, namely the architecture, interface, and standards, are shared among modules. Hidden design parameters include the most salient aspects of each module and these

should not be shared with other modules (Baldwin & Clark, 2000; Baldwin & Henkel, 2015). To allow modules to share hidden design parameters would increase the number of interactions beyond what is manageable (Langlois, 2006). Let us return to our table example. Each task feeds into the next task of the production sequence. For example,

- the construction of the legs and the table top (task a_2) requires finding and cutting wood to appropriate measures (task a_1) first;
- gluing and clamping the legs and the table top (task a_3) requires constructing the legs and the table top (task a_2) first.

Therefore, each task interacts with the subsequent task in the production sequence: a_1 interacts with a_2 and a_2 interacts with a_3. The more sequences of production there are, the higher is the number of interactions. Consequently, if we require for instance Ary to know about all the tasks that the task under her direct supervision, namely a_1, affects matters would become unmanageable. Modularity requires that Ary should not know how a_1 affects a_2 and a_3. Nevertheless, the visible design rules are the common ground – all tasks communicate with the visible design rules (see Figure 3.1c) – that ensure that tasks fit together. In short, visible design rules ensure coordination with minimum level of interaction.

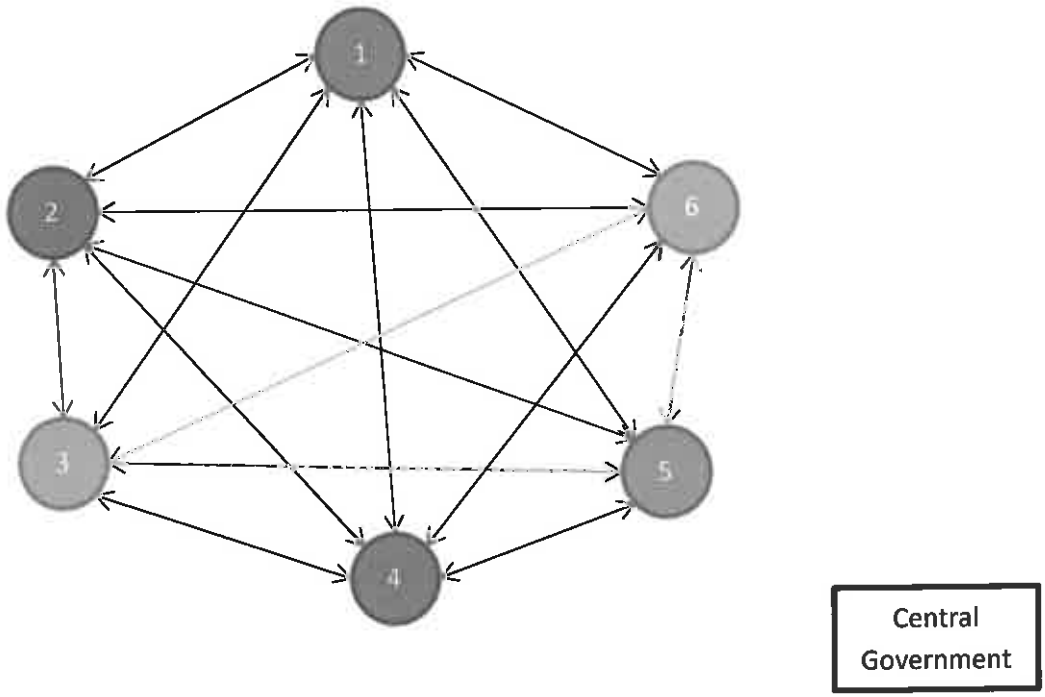
3.5. Modularity and Externalities

3.5.1. The Problem of Externalities

In the previous section we established that modularity reduces the number of interactions among elements of a system by hiding elements of a subsystem from those of other subsystems. By doing so, modularity keeps the number of interactions among elements of the system manageable (Langlois, 2002, 2006). Consider a slightly modified pollution example. There are six regions: *1*, *2*, *3*, *4*, *5*, and *6* (see Figure 3.2 below). Each region undertakes an

activity that causes pollution to all other regions. As Figure 3.2 suggests, autonomous externality internalization requires negotiation among all 6 regions (see arrows). Figure 3.2 is similar, in essence, to Figure 3.1a of Section 3.4. Each region communicates with all other regions. When one extends this example to the case of N regions, the number of interactions among regions increases exponentially. In brief, transaction costs become too high.

Figure 3.2: The State as a Non-decomposable System



The solution, traditional fiscal federalism suggests, is for the central government to intervene. The central government intervenes through top-down grants (Oates, 2005).[42] The top-down solution overlooks three important issues.

First, the central government need not use the grants to internalize externalities. For instance, the central government may use the grants as a rent-seeking instrument (Wagner, 2001).

[42] Alternatively, the central government directly provides goods the benefits or costs of which extend beyond regional boundaries (e.g., Besley & Coate, 2003). Whether the central government directly provides goods with external benefits or costs or it coordinates the provision of the goods through a system of fiscal institutions such as grants is a matter of indifference for our argument.

Empirical evidence from Sweden (Johansson, 2003), Spain (Solé-Ollé & Sorribas-Navarro, 2008), and Italy (Auteri & Cattel, 2016) shows that the central government tends to use grants to restrict competition and subsidize politically favored jurisdictions, such as jurisdictions with swing voters and jurisdictions governed by individuals of the same party as the party of individuals governing the national jurisdiction.

Second, whether regional governments internalize externalities autonomously or the central government internalizes externalities, the solution to the problem of externality remains one of negotiations or exchanges among the parties to the externality.[43] Negotiation creates transaction costs. And, transaction costs need not be higher under autonomous negotiation than under central government intermediation (Luelfesmann et al., 2015; Lulfesmann, 2002).

Third, and more importantly for the purpose of the present chapter, since the magnitude of transaction costs goes hand-in-hand with the number of interactions among parties to an externality, we can change the magnitude of transaction costs if we consider the state in organizational terms along the margin of boundary design. That is, if we redefine the boundaries of the state to conform to modularity principles.

3.5.2. An Example of Modularity Principles Applied to the State

Suppose that there are three committees, *A*, *B*, and *C*, and three issues, trade, finance, and agriculture. Let committee *A* have an interest in trade, committee *B* have an interest in finance, and committee *C* have an interest in agriculture. Suppose that committees *A* and *B* agree to support each other's issues of interest. Committee *A* agrees to support public finance of, say, tollgates in exchange for committee *B*'s support for introduction of trade barriers e.g., tariffs. What stops one committee, say, *B* to form a new coalition with committee *C* and

[43] Exchanges in order to internalize interjurisdictional externalities arise independently of the organizational setting (decentralized or centralized) because, among other things, in many countries the central government is composed of regional representatives. For instance, in France, mayors of large cities and regional council members are members of parliament, and vice versa (Salmon, 2000).

introduce a proposal to remove tariffs once committee *B*'s issue of interest, namely public financing of tollgates has been passed? The agreement between committee *A* and committee *B* may not be enforceable ex post. Hence, there are transaction costs. Weingast and Marshall (1988) suggest the following solution. Suppose that the constitution requires that (i) each committee has agenda-setting monopoly over an issue under the committee's mandate, and (ii) committees make decisions under majority rule. Let committee *A* have agenda-setting monopoly over trade, committee *B* have agenda-setting monopoly over finance, and committee *C* have agenda-setting monopoly over agriculture. Then, it would be pointless for committee *B* to form a new coalition with committee *C* to try to introduce a proposal to remove tariffs because committee *A* has agenda-setting monopoly over trade, and, as a result, only committee *A* can bring the proposal, in this case, tariff removal up for a vote.

Although Weingast and Marshall never mention modularity, their solution to the problem of enforcement of exchanges within the committee setting suggests the use of modularity principles. The assignment of mandate over issues, viz. trade, finance, and agriculture to committees is the architecture. The requirement that each committee has agenda-setting monopoly over the issue within a committee's mandate and the requirement that committees make decisions under majority rule are standards. The constitution, which embeds the standards, is the interface. The constitution coordinates the interactions among committees. It provides a means to resolve potential conflicts arising from exchanges among committees. And, the exchanges between committees are hidden design parameters.

3.5.3. Endogenizing Transaction Costs in the Design of the State

The problem of enforcement of committee exchanges is not unlike the problem of pollution among regions. Both problems exist because of high transaction costs. Thus, in the spirit of Weingast and Marshall's solution to the problem of enforcement of committees' exchanges,

we can use modularity principles to solve the problem of pollution, or any other problem of externalities, among regions.

Suppose we design the constitution (the interface) to require that the state includes three modules. Each module consists of three regions. For example, regions *1*, *2* and *3* belong to module *X*; regions *2*, *3* and *4* belong to module *Y*; and regions *4*, *5* and *6* belong to module *Z*; and all modules belong to the same state. There is overlap as Figure 3.3 illustrates. (Figure 3.3a and Figure 3.3b are alternative representations of the same information. In Figure 3.3a, the entire solid rectangle illustrates visible design rules.) Regions *2* and *3* belong to modules *X* and *Y*, and region *4* belongs to modules *Y* and *Z*. The case of overlapping regions is not novel (e.g., Casella & Frey, 1992; Eichenberger & Frey, 2006; Frey, 2001, 2005; Frey & Eichenberger, 2001). For instance, Mozambique and South Africa are members of SADC (Southern African Development Community). Portugal and Spain are members of EMU (Economic and Monetary Union). At the same time, Mozambique and Portugal are members of CPLP (Community of Portuguese Language Countries).

Figure 3.3: The State as a Modular System

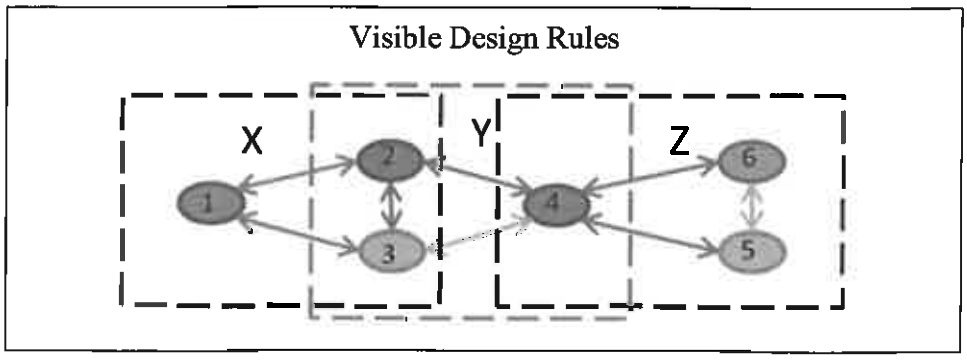


Figure 3a: Modular System

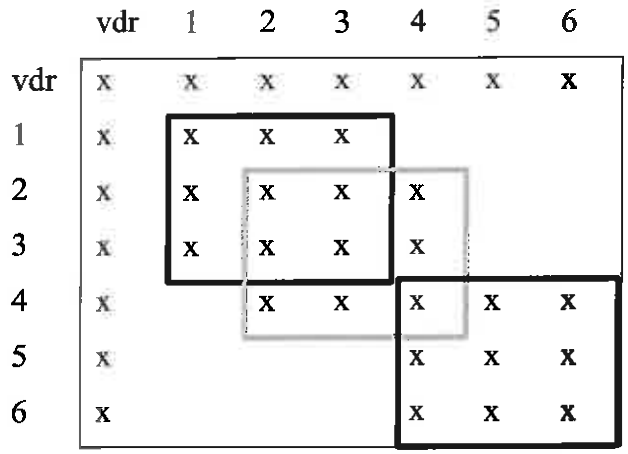


Figure 3b: Modular System

The assignment of regions to modules is the architecture. In order to internalize externalities regions do not have to interact with all other regions as in Figure 3.2. In the modular system of Figure 3.3, each region interacts only with regions of the same module: there is information hiding. For instance, even though region *1* pollutes all other regions, region *1* need not, and should not, negotiate with, say, regions *5* and *6* in order to internalize the pollution to regions *5* and *6*. Regions of module *X* (the module to which region *1* belongs) internalize the pollution to regions of other modules indirectly. Some elaboration is in order.

Suppose that the constitution defines the standards as follows: regions of each module agree on a critical level of pollution (we can think of this as the efficient level of pollution) beyond which the polluter ought to pay the polluted. In module *X* the critical level of pollution is X^*, in module *Y* the critical level is Y^*, and in module *Z* the critical level is Z^*. Suppose further that the standards require that for 1 unit increase in pollution damage, *D*, above the critical level the polluter pays the polluted an amount equal to αP. *P* is the price of 1 unit of pollution damage, *D*, and is equal to the benefit, *B*, that the polluter derives from 1 unit increase in the amount of the pollution-creating activity above the critical level; α is a parameter greater than

1. Thus, the payment for 1 unit increase in D, that is αP, is greater than B. With this in mind, consider region *1* once more. There are two possible scenarios.

In scenario I, region *1* causes pollution up to an upper limit of X^*. Since X^* is the critical level of pollution that regions of module X have agreed to, X^* (or a level of pollution below X^*) is efficient for regions of module X: there is no problem of externalities.[44] What about regions of modules Y and Z? Whether X^* is efficient for regions of modules Y and Z will depend on the difference between X^*, Y^* and Z^*. This is where the overlapping regions play a crucial role. The existence of overlapping regions will tend to create convergence among the critical levels of pollutions that regions of different modules choose. Specifically, since overlapping regions belong to more than one module, they will ensure the communication of the information about critical levels among modules.[45] Moreover, if there is convergence between the critical levels of pollution among modules, then what works for one module works for other modules. That is to say that, in the main, there is no problem of externality in modules Y and Z.[46]

In scenario II, region *1* causes pollution above X^*. Region *1* pays regions of module X for pollution damage above X^*. There is no problem of externality for regions of module X. What about regions of modules Y and Z? The standards require that for 1 unit increase in pollution

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[44] In Buchanan and Stubblebine's (1962) sense of Pareto-relevant externality.

[45] In essence, overlapping regions are *endogenous* interfaces.

[46] To understand the process of convergence, one may consider modules as if they were each a single market for the same good (pollution). The overlapping regions are buyers (of the right to pollute) who shop around among markets. The shopping around will communicate to each of the markets the price (the critical level of pollution) that equilibrates the entire "market" system (the system of modules). This equilibrating price, of course, will be approximately equal among markets; otherwise buyers (overlapping regions) will have an incentive to leave one market (module) to join another.

Alternatively, consider the critical level of pollution as representing the point where marginal cost equals marginal benefit for each module member. Then if one module chooses a critical level of pollution, say, X^* that is different from that of the other, say, Y^*, it must be the case that one of the modules has chosen a critical level of pollution for which marginal cost is not equal to marginal benefit for all members of the relevant module. The reason for this contradiction is again the presence of overlapping regions. If regions are making decisions over the same issue, in our example pollution, it cannot be the case that the point of equality between marginal benefits and costs over the same issue and for the same region, say, region *2* is one when region *2* is a member of module X and another when region *2* is a member of another module, viz. module Y.

damage, D, above X^* region *1* pays regions of module X an amount equal to αP. However, αP is greater than the benefit, B, that region *1* derives from 1 unit increase in the amount of the pollution-creating activity above X^*. Although it is possible for region *1* to cause pollution above X^*, region *1* will have a lower incentive to increase pollution above X^* because the cost of an extra unit of pollution above X^* is higher than the benefit of an extra unit of the pollution-creating activity. As a result, scenario 2 would be an exception rather than a rule. In general, scenario I will prevail. And, if scenario I prevails then there will be, in the main, no problem of externality in modules Y and Z.

The upshot is that the solution to the problem of externality is crowded out from the central government into the visible design rules: the architecture (assignment of regions to modules), the standards (critical level of pollution), and the interface (the constitution). The visible design rules free the system, namely the state from the requirement of communication among all regions in order to internalize externalities. In short, visible design rules reduce transaction costs.

3.6. Optimal Modularity

In the previous section we established that the function to internalize externalities should be assigned to regions belonging to the same module regardless of whether externalities have effects that extend beyond the relevant module. However, we still need to derive an optimal level of modularity because there are many ways in which we can modularize the state and not all of them minimize transaction costs. That is, there are nuanced scenarios: in an optimally modularized state transaction costs are not prohibitive, but in a state with a non-optimal level of modularity transaction costs may be prohibitive. The derivation of an optimal level of modularity for the state is based on Frenken and Mendritzki (2012) derivation of an optimal level of modularity for a firm with two-layered hierarchies.

Consider a non-decomposable system that consists of $i \in \{1,2,...,N\}$ regions. Each region undertakes an activity that causes a negative externality to all other regions.[47] Autonomous internalization of externalities requires negotiations among all N regions, and negotiations create transaction costs. Let the number of interactions among regions, T, be a proxy for negotiation costs. Since negotiation costs are a proxy for the magnitude of transaction costs, C, then the number of interactions among regions is a proxy for the magnitude of transaction costs. Furthermore, since each region interacts with all regions, the product of the number of interactions for each region gives us the magnitude of transaction costs in the non-decomposable system. That is,

$$C = \prod_i^N T_i \qquad i \in \{1,2,...N\} \qquad (1)$$

However, the number of possible interactions among regions decreases with modularity. A modular system groups elements of a system into a smaller number of subsystems (modules) and then requires that interactions among subsystems occur, in the main, through visible design rules (see Figure 3.1c and Figure 3.3b). For the case of a modular system,

$$C^m = \prod_i^K T_i \qquad i \in \{1,2,...,K\} \qquad K < N \qquad (2)$$

In essence, interactions within modules are hidden design parameters. Equation 2 states that the product of the number of interactions within a module, K, gives us the magnitude of transaction costs in a modular system C^m. Since K (the number of regions in a module) is smaller than N (the number of regions in the non-decomposable system), then C^m is smaller than C. Nevertheless, as will become apparent shortly, there are many ways in which we can turn a non-decomposable system into a modular system. Granted this, how do we establish an optimal level of modularity for public governance in relation to externalities? In order to establish an optimal level of modularity we make the following assumptions:

[47] The analysis also applies to the case of positive externalities, mutatis mutandis.

Assumption 1: Modules have an equal number of regions.

Since transaction costs increase with the number of interactions among regions and the number of interactions among regions increases exponentially with the number of negotiating regions (see equation 1), optimal modularity requires an appropriate grouping of regions and this occurs when modules have equal number of regions.

The rationale for Assumption 1 is based on Page's (1996) principle of cover size which states that if "subproblems are solved in parallel, then the time required to solve every subproblem is determined by the most [time] consuming subproblem" (p. 329). Since modules may face the problem of externalities at the same time and the problem may also be addressed at the same time, then the magnitude of transaction costs in the module that produces the largest magnitude of transaction costs gives us the magnitude of transaction costs in the modular system. Further, since the module that produces the largest magnitude of transaction costs is the module with the largest number of regions, then optimality requires that we equalize the number of regions among modules (see also Frenken, 2006; Frenken & Mendritzki, 2012). Thus, equation 2 becomes

$$C^m = \prod_i^K T_i = T^K \qquad \text{and} \qquad K = N/O \tag{3}$$

where K is the number of regions in a given module, N is the number of regions in the original non-decomposable system, and O is the total number of overlapping regions in the modular system.

Assumption 2: Modularity introduces the fixed costs of designing the rules that govern interactions among modules.[48] Since interactions among modules, such as communication of critical levels of pollution, occur through overlapping regions, there are costs to defining

[48] We shall further assume that these costs also include the costs of minimizing transaction costs.

appropriate overlapping regions and we assume that these costs rise exponentially with the number of overlapping regions.

Assumption 2 is required to allow for Williamson's (1999, 2010) argument, which states that in deciding whether to move from one system (e.g., non-decomposable system) to another (e.g., modular system) on efficiency grounds one ought to also consider the costs of setting up the new system. Assumption 2 suggests that modularity entails both ex ante transaction costs (these are the fixed costs of setting up the modular system) and ex post transaction costs (these are the variable costs incurred regularly after the modular system has been set up). So far we have been looking at ex post transaction costs of modularization and equation 3 illustrates these costs. When we include ex ante transaction costs equation 3 becomes

$$C^m = T^K \times T^O = T^{K+O} \qquad (4)$$

Assumption 3: There is at least one region that belongs to at most two modules. The relevant region(s) is (are) overlapping region(s).

Assumption 3 suggests that optimal modularity requires a minimum of 3 regions (e.g., $N \geq 3$) with each module having at least 2 regions (e.g., $K \geq 2$).

Assumption 4: The number of interactions for the overlapping regions should be lower in the modular system than in the original non-decomposable system.

This assumption is required to ensure that all regions are strictly better off in the modular system than in the non-decomposable system, in terms of transaction costs. Assumption 4 modifies Assumption 3 since it requires that $N > 3$.

In light of our assumptions, optimal modularity requires solving the following:

Minimize T^{K+O}

Subject to $K = N/O$

$K \geq 2$

There are two possible solutions to the problem (see the appendix),

Solution 1: $K_1^* = \sqrt{N}$ and $O_1^* = \sqrt{N}$;

Solution 2: $O_2^* = N/2$ and $K_2^* = 2$, provided that $\sqrt{N}$ and $N/2$ are integers.

When $\sqrt{N}$ and $N/2$ are not integers, we need to make few further assumptions in order to establish optimality:

Assumption 5: When $\sqrt{N}$ and $N/2$ are not integers, optimal modularity is given by the smallest integer greater than $\sqrt{N}$ and $N/2$.

Assumption 6: Because of Assumption 5 there will be instances where it will be impossible to design a modular system with $K_1^* = O_1^* = \sqrt{N}$. Since the idea is to reduce transaction costs to facilitate autonomous externality internalization, and in the spirit of Assumption 1, the value of K^* should take precedence over the value of O^*.

Assumption 7: Because of Assumption 6 there will be instances where it may not be apparent which solution between O_1^* and O_2^* is better. Again, since the idea is to reduce transaction costs, and in the spirit of Assumption 2, the solution with the smallest number of overlapping regions, O^*, is to be preferred.

There are many ways in which a non-modular state may be modularized. To establish the optimal level of modularity we made seven assumptions. The next step is to illustrate how these seven assumptions work to establish the optimal level of modularity.

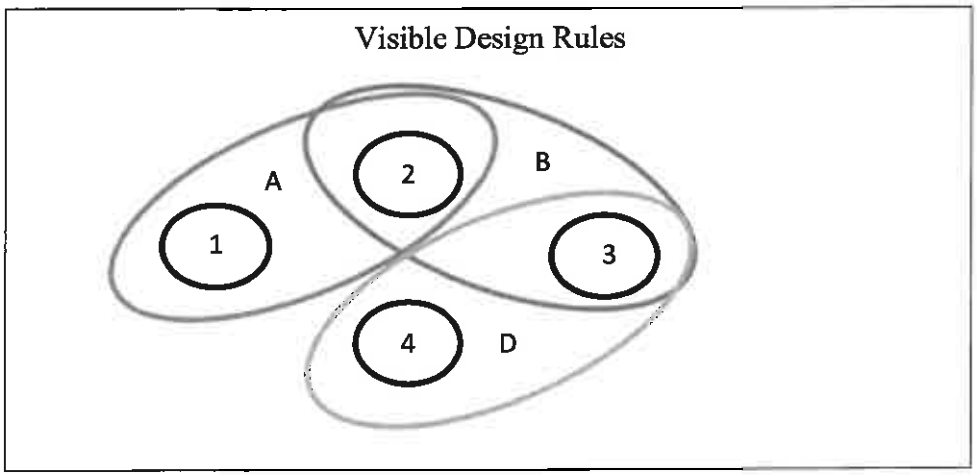
3.6.1. Illustrations

Assumption 4 requires N, the number of regions in the non-decomposable system, to be strictly greater than 3. Thus, we consider only cases where $N > 3$.

Illustration 1: $N = 4$

When $N = 4$, $K_1^* = K_2^* = 2$ and $O_1^* = O_2^* = 2$. The modular system will look like Figure 3.4.

Figure 3.4: N = 4, K = 2, and O = 2



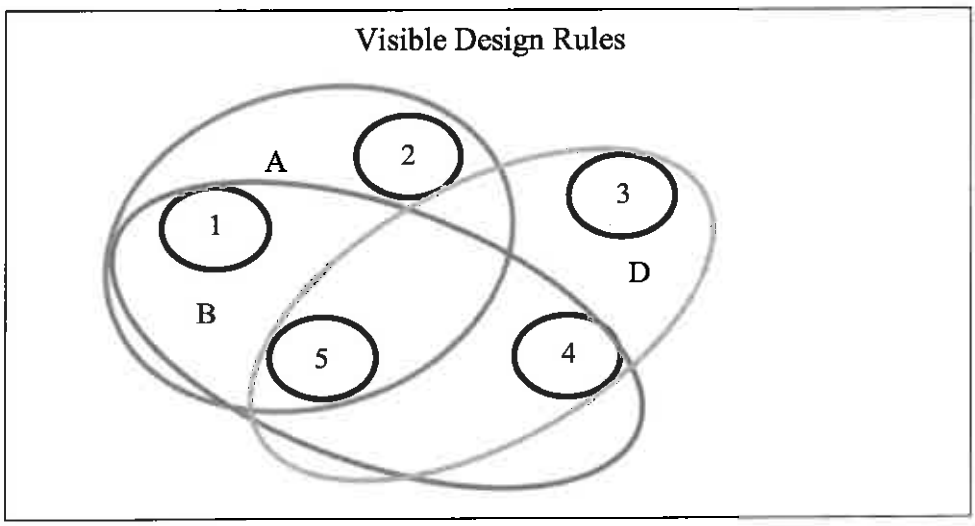
Numbers denote regions and letters denote modules throughout this section. For easiness of exposition, we present the modular systems in this section similarly to Figure 3.3a. We also removed arrows for the sake of neatness. In Figure 3.4, regions 2 and 3 are overlapping regions.

Illustration 2: $N = 5$

Solution 1: $K_1^* = O_1^* = 2.24$. Since K_1^* and O_1^* are not integers, Assumption 5 requires that we consider the smallest integer greater than 2.24, that is 3. Figure 3.5.1 illustrates the resulting modular system. As Figure 3.5.1 illustrates, when $N = 5$ it is impossible to design a modular

system with $K_1^* = O_1^* = 3$ without violating assumptions 3 and 4. Region 5 belongs to three modules (violation of Assumption 3) and it interacts with the same number of regions as it would absent modularity (violation of Assumption 4). Hence, we consider the second solution.

Figure 3.5.1: N = 5, K = 3, and O = 3



Solution 2: $K_2^* = 2$ and $O_2^* = 2.5$. Assumption 5 requires that $O_2^* = 3$. Figure 3.5.2 illustrates the modular system that ensues. As Figure 3.5.2 illustrates, this solution satisfies all the assumptions put forward in Section 6.

Figure 3.5.2: N = 5, K = 2, and O = 3

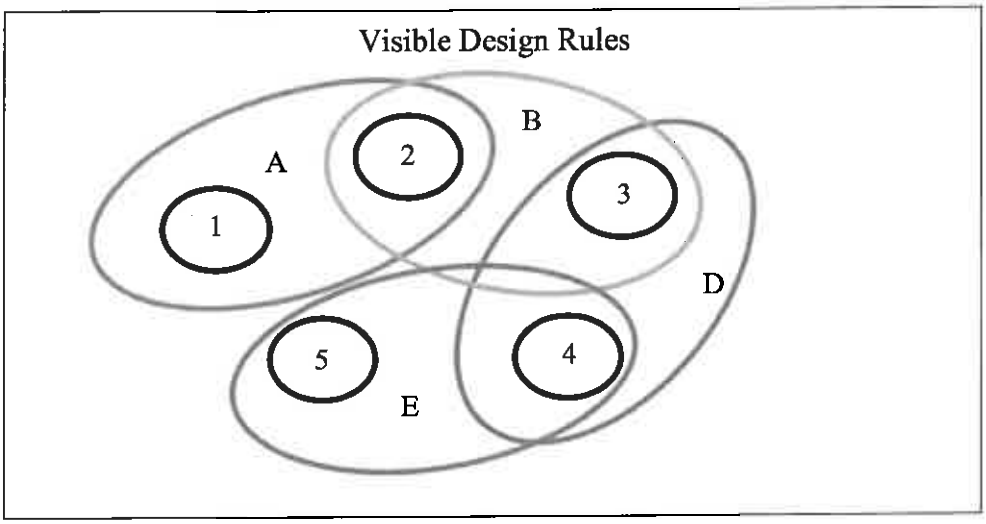


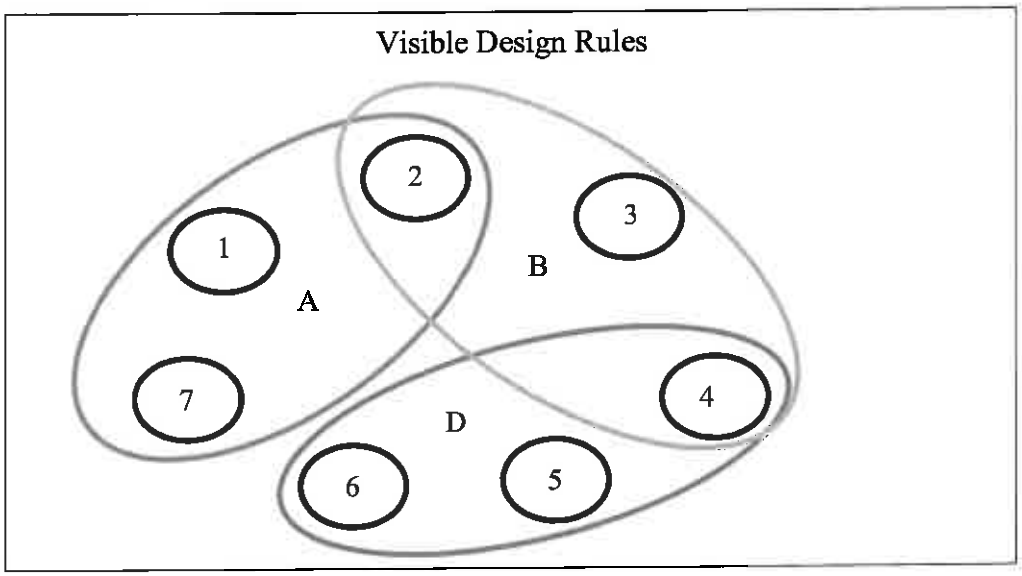
Illustration 3: $N = 6$

Solution 1: $K_1^* = O_1^* = 2.45$. Solution 2: $K_2^* = 2$ and $O_2^* = 3$. It is straightforward to show that solution 2 cannot be implemented since O_2^* will be greater than 3 if $K_2^* = 2$ (cf. Figure 3.6.2 below). Figure 3.3 illustrates solution 1 and we shall not repeat it here.

Illustration 4: $N = 7$

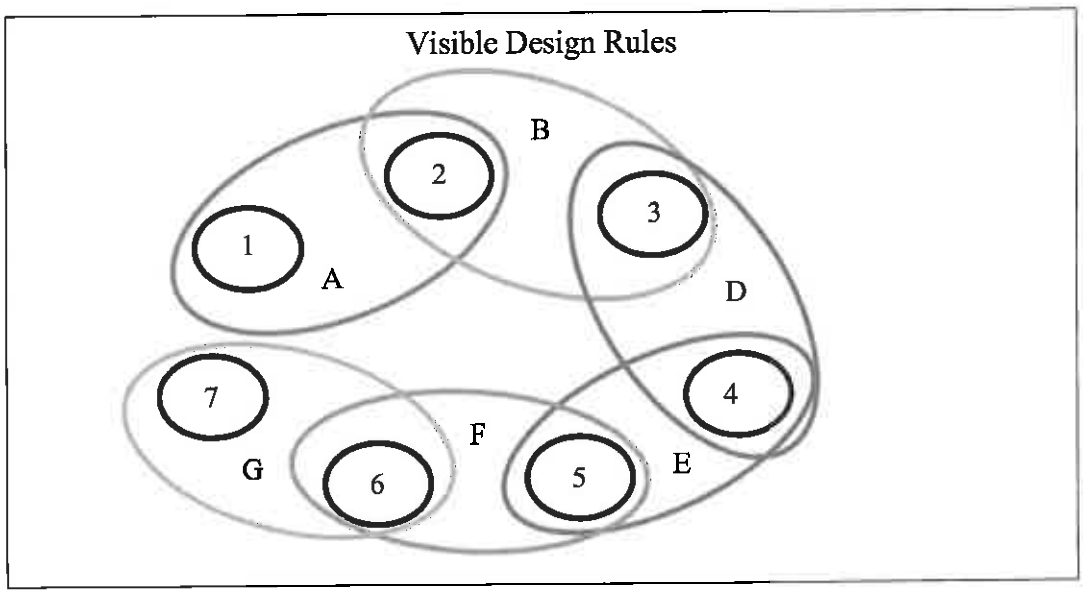
Solution 1: $K_1^* = O_1^* = 2.65$. From Assumption 5 we have $K_1^* = O_1^* = 3$. Figure 3.6.1 illustrates the resulting modular system. As Figure 3.6.1 suggests, for $N = 7$ we cannot design a modular system with $K_1^* = O_1^* = 3$. Thus, we consider solution 2.

Figure 3.6.1: N = 7, K = 3, and O = 3



Solution 2: $K_2^* = 2$ and $O_2^* = 3.5$. From Assumption 5 we have $O_2^* = 4$. Figure 3.6.2 illustrates the resulting modular system. As Figure 3.6.2 suggests, for $N = 7$ and $K_2^* = 2$ we cannot design a modular system with $O_2^* = 4$.

Figure 3.6.2: N = 7, K = 2, and O = 4



In Figure 3.6.1, we have one overlapping region less than what is optimal and in Figure 3.6.2 we have one overlapping region more than what is optimal. In this case we choose the solution with the lowest number of overlapping regions (see Assumption 7). Assumption 7 also provides the rationale for not considering a modular system with $O_1^* > 3$, whereas Assumption 6 provides the rationale for considering only $K_1^* = 3$ in Figure 3.6.1.

We have provided four illustrations of how to design an optimal modular state. In some cases, where the number of regions in the original non-decomposable system is greater than 4, it is impossible to design an optimal modular state without violating Assumption 3 (regions should belong to at most two modules) and Assumption 4 (the number of interactions for the overlapping regions should be lower in the modular system than in the original non-decomposable system). To address these issues, we had to approach the problem sequentially: first we minimized the number of regions within a given module (Assumption 6) and then we minimized the number of overlapping regions (Assumption 7). Also, these illustrations characterize nuanced scenarios: for a given number of parties involved in an externality, transaction costs may (e.g., Figure 3.2 and Figure 3.5.1) or may not (e.g. Figure 3.3, Figure 3.5.2, and Figure 3.6.1) be prohibitive for autonomous internalization of externalities.

3.6.2. Modularity and Negotiation: An Extension

Regions may feel that overlapping regions hold leadership positions and thus disproportionate power within modules. This feeling of unfairness may increase the costs of designing a modular system since such feeling would increase the costs of negotiation (e.g., Bolton & Ockenfels, 2000; Charness & Rabin, 2002; Croson, Boles, & Murnigham, 2003). In order to mitigate this issue, we include the requirement of rotation on the position of overlapping region within modules. For example, In Figure 3.3 regions *2* and *3* would be the overlapping regions of module *X* for a period of, say, two years. In the subsequent two years

regions *1* and *2* would be the new overlapping regions, and regions *1* and *3* would be the new overlapping regions two years later, and so on. Of course, the same type of rotations would occur within other modules.[49]

However that may be, it is usually argued that except, perhaps, for the case of two negotiating parties (e.g., Harris, 1985; Rubinstein, 1982), negotiation may fail even if transaction costs are sufficiently reduced. At the heart of the problem are tussles arising over the optimal distribution of benefits once agreement on cooperation has been reached (e.g., Cooter, 1982; Inman & Rubinfeld, 2014). Therefore, it is necessary to extend the previous analysis to accommodate this possibility.

We assume that there are two stages to negotiation or exchange.[50] In the first stage, regions in the non-decomposable system use unanimity rule to define the design rules of the modular system: the architecture (number of regions and their functions within modules, number of modules), the interface (the constitution and overlapping regions), and the standards (the critical level of inter-regional externalities above which the externality-creating region ought to compensate the other regions of the same module).

Once regions define design rules, the second stage requires only that regions ascertain whether the agreed-on critical level of inter-regional externalities has been exceeded or not. This is where the central government would play a crucial role, not to internalize externalities as suggested in most of the fiscal federalism literature but, to adjudicate disagreements regarding compensation over inter-regional externalities. In the spirit of Cooter, Marks, and Mnookin (1982), in order to minimize tussles over negotiation on compensation, the region(s) that lose(s) in the adjudication process should pay the costs of the adjudication process to the

[49] Rotation of leadership positions is commonplace especially in international organizations such as the African Union and the European Union. However, I should point out that rotation is conceptual, not physical. For instance, the recent exit of the United Kingdom from the European Union was not accompanied by a change of the United Kingdom's geographical (as opposed to politico-economic) position in the European continent.
[50] See Buchanan's (1975) discussions of pre- and post-constitutional stages.

winner(s) in addition to compensation for inter-regional externalities should such compensation for inter-regional externalities be applicable. This requirement should enhance cooperation.

3.7. Application: The Case of the Economic and Monetary Union (EMU)

The Stability and Growth Pact requires all EMU members to maintain a public deficit to GDP ratio not exceeding 3%.[51] However, given different circumstances that each country faces at any given point in time such a policy is both inflexible and difficult to police. For example, at any given point in time some countries face high unemployment rates and strict adherence to the Stability Pact may require further austerity measures which may not sit well with the citizens of the relevant countries. Given this trade-off, the rule may be subject to non-compliance and the need for ex-post negotiations which may run counter to the spirit of the Pact (Alves & Afonso, 2007; Buiter, 2006; Eichengreen, 2004; Lindbeck & Niepelt, 2006).

There has been a call for a more flexible policy which would take the different circumstances of countries into account. Such policy should reduce the costs of inspecting compliance. Tradable permits, the argument goes, is such a policy. The European Central Bank could allocate a predetermined number of permits and let the market determine the appropriate prices. Countries would be required to keep an amount of permits that are not inferior to the amount required to cover the existing deficit to GDP ratio. Three advantages immediately follow: (i) flexibility, since countries can hold any percentage of deficit to GDP ratio subject to the amount of permits held; (ii) good behaviour is compensated for, since countries need hold only the amount required to cover their existing deficit to GDP ratio they may save or sell excess amounts of permits; and (iii) low costs of policing, since the market would

[51] In fact, the Stability and Growth Pact also requires each EMU member to maintain a debt to GDP ratio not exceeding 60% (Alves & Afonso, 2007; Buiter, 2006; Eichengreen, 2004). However, we consider the case of deficit to GDP ratio for both easiness of exposition and conform to most of the literature. Nevertheless, the analysis can be easily transplanted to debt to GDP ratio discussion without loss of generality.

determine the optimal price and quantity of permits distributed given the total quantity of permits in circulation (Casella, 1999). However, the tradable permits policy is not without its own problems.

For example, although the market determines the price of permits, the central government, specifically the European Central Bank, determines the number of permits available at any given time.[52] As a result, it becomes often the case that the total number of permits in circulation is either less or more than what member countries require. In essence, the ascertainment of the optimal total quantity of permits in circulation requires local knowledge that the European Central Bank does not possess.[53]

Furthermore, in the form currently suggested, the tradable permits policy creates unequal treatment among parties to trade for permits. For instance, some effort is placed on designing mechanisms to punish a country that issues a debt for which a permit does not exist. What about the purchaser (Buiter, 2003)?

Also, in order for the tradable permits policy to work effectively, the market has to be thick in order to avoid excessive influence by big players such as Germany (Lindbeck & Niepelt, 2006).

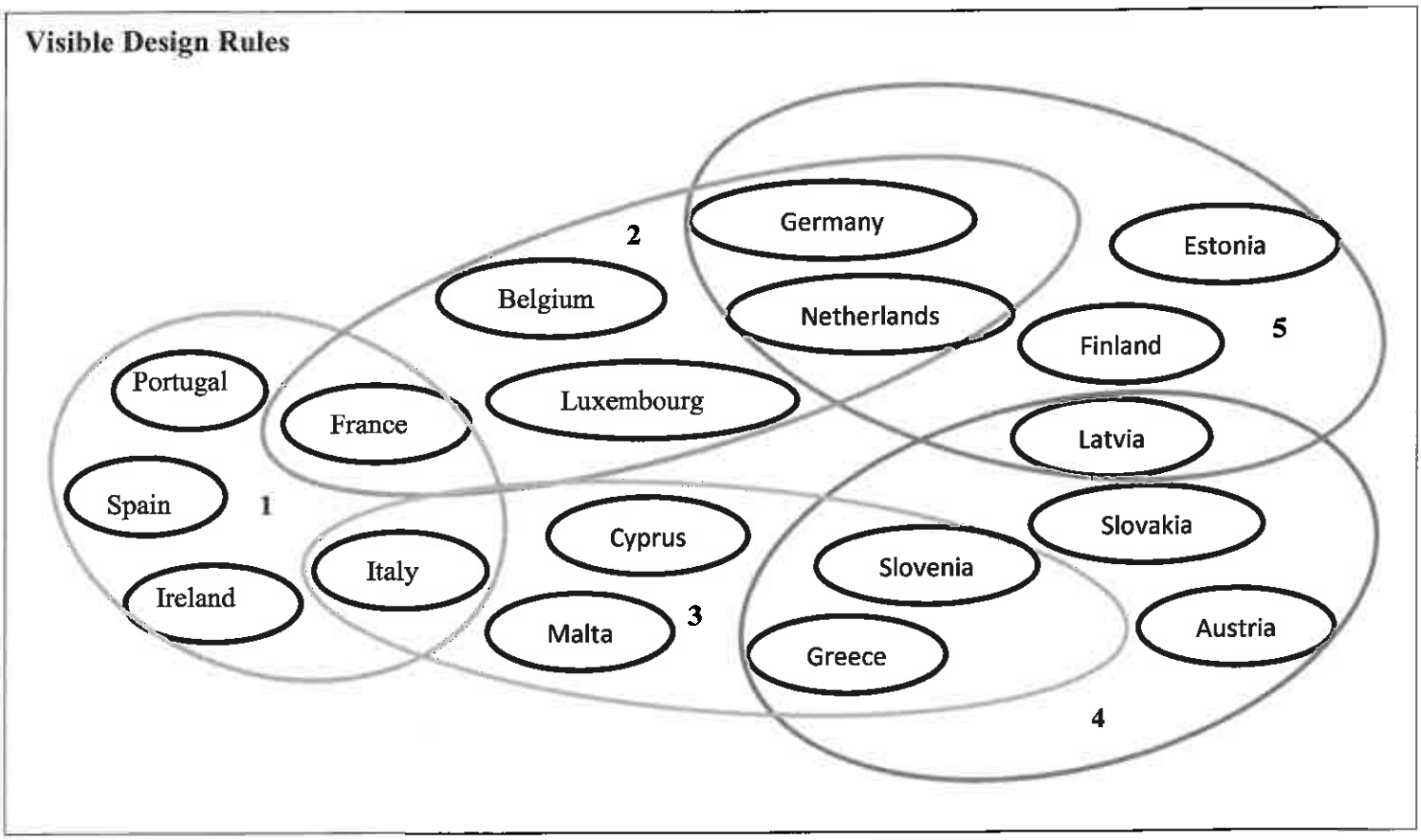
Perhaps more importantly, countries may hoard permits at the time when other countries may need them the most (Ellerman et al., 2000).

Thus, I offer an alternative policy that retains the benefits of the tradable permits policy while ridding itself from the aforementioned problems. This alternative policy is the restructuring of EMU to conform to modularity principles. At the time of writing, the EMU had 18

[52] Since we are here considering national and supranational governments, the European Central Bank is akin to the central government and the national governments are akin to local regions in this context.
[53] See Hayek (1945).

member states.[54] In terms of the illustrations of modularity in Section 3.6.1 this would entail the division of the EMU into 5 modules with 5 member states each and 7 overlapping states as Figure 3.7 illustrates.

Figure 3.7: The Economic and Monetary Union as a Modular System



Once EMU members establish the optimal level of modularity, they would use unanimity rule to determine the members of each module. Although module members need not be chosen on the basis of geographical proximity to one another (for example, a rule based on average GDP of modules would work as well), let Portugal, Spain, France, Italy, and Ireland constitute Module *1*; France, Luxembourg, Belgium, Netherlands, and Germany constitute Module *2*; Italy, Malta, Greece, Cyprus, and Slovenia constitute Module *3*; Greece, Slovenia, Austria, Slovakia, and Latvia constitute Module *4*; Netherlands, Germany, Latvia, Estonia,

[54] https://www.ecb.europa.eu/ecb/educational/facts/euint/html/ei_006.en.html

and Finland constitute Module *5*. Each module has at least one member that belongs to at most one other module. These are overlapping member states.

In order to pre-empt haggles that may arise because of perceived issues of unfairness, the position of overlapping member state ought to be rotated within modules. For example, France and Italy belong to Module *1* and one other module. In the following period, say two years, Portugal and Spain may replace France and Italy as overlapping member states.

With the architecture (modules and the attendant members) already determined, members of each module would again use unanimity rule to establish the critical level of deficit to GDP ratio such that should any member exceed the ratio that member would have to pay the remaining members of the module(s) to which the member belongs an amount that is proportional to the excess. These are the standards. The critical level of deficit to GDP ratio need not be the same across modules. For example,

- members of Module *1* may agree on a 3% deficit to GDP ratio as the critical level of deficit;
- members of Module *2* may agree on a 2% deficit to GDP ratio as the critical level of deficit;
- members of Module *3* may agree on a 3.5% deficit to GDP ratio as the critical level of deficit;
- members of Module *4* may agree on a 3% deficit to GDP ratio as the critical level of deficit; and so on.

Nevertheless, the critical levels will be close to each other. As an example, consider France. France is a member of Modules *1* and *2*. The amount that France would have to pay members of Modules *1* and *2* should France exceed the critical level of deficit to GDP ratio would depend on the critical level of deficit to GDP ratio that members of Modules *1* and *2* choose.

As a result, it would be possible for France to meet the critical level of deficit to GDP ratio in one module e.g., Module *2* while failing to meet the critical level of deficit to GDP ratio in the other module, viz. Module *1*. In order to minimize this possibility, France (and other overlapping member states) would push for convergence of critical levels of deficit to GDP ratio among modules. The requirement of rotation on the position of overlapping member states would increase the probability of agreement on convergence of critical levels of deficit to GDP ratio among modules.

Modularizing the EMU creates flexibility in the sense that member states can, if there is a need, exceed the critical level of deficit to GDP ratio provided they compensate module members. The externality is internalized without direct central intervention. Autonomous internalization of externality becomes easy because compensation requires only the determination of whether the critical level of deficit to GDP ratio has been exceeded. In the spirit of Cooter et al. (1982), should there be any disagreement on whether a given member has exceeded the critical level of deficit to GDP ratio the member(s) that lose(s) in the adjudication process should pay the costs of the adjudication process to the winner(s) in addition to compensation for externalities should such compensation for externalities be applicable. This should facilitate cooperation and reduce the transaction costs of autonomous externality internalization even more.

Nevertheless, an issue that we have not yet tackled need to be considered. Specifically, how should the compensation arrangement among overlapping states such as Greece and Slovenia be handled should the two modules to which they belong, namely Module 3 and Module 4, have different critical levels of deficit to GDP ratio? There are two possibilities: (i) Greece and Slovenia may enter into another negotiation in order to address the impasse, or (ii) they may choose one of the critical levels of deficit to GDP ratio as binding. Possibility (i) introduces new costs and it may also undermine the legitimacy of the negotiations entered

into together with the other members belonging to each of the two modules: Module 3 and Module 4. Possibility (ii) appears more satisfactory since it does not meaningfully change costs and it has no adverse legal effects. Therefore, a simple rule that establishes one of the critical levels of deficit to GDP ratio as binding suffices. However, in order to reduce negative externalities, a rule that establishes the lowest of the critical levels of deficit to GDP ratio between the modules of interest, Module 3 and Module 4, as the default policy is better.

3.8. Conclusion

The purpose of the present chapter is to show that transaction costs need not be prohibitive for autonomous internalization of interjurisdictional externalities. The key to this is the relaxation of the literature's view of the state as a black box where the organizational design of the state is ex ante given. By endogenizing the organizational design of the state, the chapter shows that different decentralization settings may generate different degrees of transaction costs. Differently put, there are nuanced scenarios: transaction costs may or may not be prohibitive for autonomous internalization of interjurisdictional externalities if we define the organizational boundaries of the state to conform to modularity principles. The implication, different from the fiscal federalism literature, is that externalities need not be a prohibitive cost to decentralization. And, by extension, the trade-off between preference-matching/accountability under decentralization and internalization of interjurisdictional externalities under centralization, which is at the heart of discussions within the fiscal federalism literature, need not always hold.

Appendix: Derivation of Optimal Modularity

Minimize T^{K+O}

Subject to $K = N/O$

$K \geq 2$

The Lagrangian function is

$$L = T^{K+O} - \alpha(\frac{N}{O} - K) - \gamma(2 - K)$$

And the Kuhn-Tucker conditions are

(i) $L_K = (\ln T)T^{K+O} + \alpha + \gamma = 0$

(ii) $L_O = (\ln T)T^{K+O} + \alpha NO^{-2} = 0$

(iii) $\alpha \geq 0$

(iv) $\gamma \geq 0$ (= 0 if $K > 2$)

To find a solution, examine the following cases

Case 1: $K = \frac{N}{O}$ ($\alpha \geq 0$)

1.1 $K > 2$ ($\gamma = 0$)

1.2 $K = 2$ ($\gamma \geq 0$)

From (i) and (ii), and 1.1 we get the first solution

$$\frac{\alpha NO^{-2}}{\alpha + \gamma} = 1$$

$O_1^* = \sqrt{N}$, and since $K = \frac{N}{O}$ we have $K_1^* = \frac{N}{\sqrt{N}} = \sqrt{N}$

From 1.2 we get the second solution

$K_2^* = 2$, and since $K = \frac{N}{O}$ we have $O_2^* = \frac{N}{2}$

Chapter 4

Conclusion

4.1. Introduction

The present thesis considers the organization of the public sector. To this end, it develops a theory of the public sector based on the following three assumptions:

- Methodological individualism: the individual, not the collectivity, is the ultimate decision maker;
- *Homo economicus*: individuals rank their preferences above those of others. In short, individuals are self-interested;
- Economics is a science of exchange: exchange, not choice among competing ends, explains the purposive nature of individuals' actions.

Of the three assumptions, economics as a science of exchange represents the most important departure from most traditional theories of the public sector.[55] Naturally, this assumption also provides the rationale for the departure of the theory of the public sector that the present thesis has developed from traditional theories of the public sector. Once we consider economics a science of exchange many ambiguities that have escaped attention in traditional theories of the public sector were more or less automatically exposed and clarified in our topics of interest: Chapter 2 on "Politics and Exchange: Between Freedom and Coercion" and Chapter 3 on "A Modular Theory of the State".

4.2. Politics and Exchange: Between Freedom and Coercion

The state is an organization composed of individuals with different arguments in their utility functions. In order to secure gains individuals exchange. Although exchange is beneficial to

[55] The lifetime work of James Buchanan deserves a special mention among notable exceptions.

the parties directly involved, say, *A* and *B*, it need not be beneficial to parties outside it, say, *C*. That is to say that exchange may create negative externalities to parties not directly involved, hence the possibility of a negative-sum game.

The negative-sum game arises because *C*, who suffers from a negative externality that the exchange between *A* and *B* creates, has an incentive to undertake an exchange with at least one of the parties to the original exchange, say, *A* in order to reduce the negative externality to herself. But the exchange between *A* and *C* may in turn produce a negative externality to *B*.[56] Thus *B* would also have an incentive to enter into an exchange relation with either *A* or *C* in order to improve upon his position. The ultimate result is uncertainty and a loss to all members of the state, in this case *A*, *B* and *C*. Two implications immediately follow.

First, since uncertainty arises because individuals take turns breaking up previous agreements or contracts to form new ones in order to secure gains from exchange and/or mitigate negative externalities that others impose on them, the necessity of institutionalizing binding contracts follows more or less naturally. Uncertainty, as we know from, e.g., Mises (1996 [1949]), decreases the ability to calculate the expected return on purposive economic action.

Second, if all members of the state lose as they take turns imposing negative externalities on one another, they would not unanimously acquiesce to exchange that only produce negative externalities behind the veil of ignorance (Rawls, 1971) or uncertainty (Buchanan & Tullock, 1962). Absent unanimous acquiescence behind the veil of ignorance or uncertainty we have coercion (Brennan, 2012). This suggests that we need to limit the domain of exchange in the political sphere. In specific, we need to limit the possibility of some types of exchange,

[56] This is the familiar reciprocity problem (Coase, 1960).

namely exchange that increases negative externalities and hence coercion, not exchange as such.[57]

This important insight, namely the need to comparatively analyze institutions that minimize uncertainty and coercion, is lost or does not follow logically when one considers economics a science of choice.

In economics as a science of choice, all information (e.g., about cost and utility functions) is given in advance. All information is given because individuals do not interact with one another, and, as a result, the act of choosing does not create new choices. The upshot is that choices and the outcomes of those choices are predetermined. That is to say that there is no uncertainty (Marciano, 2009). With no uncertainty, the need for institutions such as binding contracts becomes less obvious, at best.

Further, and relatedly, since individuals can foresee all possible outcomes in advance, they factor in all potential externalities as they choose among outcomes. Hence, Pareto-relevant externalities,[58] and, by extension, coercion are eliminated by assumption. Consequently, and contrary to what traditional theories of the public sector would have us believe, even if we assume methodological individualism and *homo economicus*, the inquiry into the organizational form of the state (e.g., decentralized/centralized, democratic/authoritarian, liberal/totalitarian, etc.) most likely to carry its assigned function effectively becomes pointless so long as we view economics as a science of choice. Essentially, since under the view of economics as a science of choice there may be no coercion, all states would, by

[57] See also, for example, Buchanan and Congleton (2003 [1998]) and Shepsle and Weingast (1981, 2012).
[58] See Buchanan and Stubblebine (1962).

definition, be liberal (in the classical sense).[59] But this is not representative of the world we live in.

4.3. A Modular Theory of the State

We have established that binding contracts mitigate the problem of uncertainty.[60] One organizational form of the state that limits the possibility of exchange that increases coercion, and, as a result, is most likely to enhance efficiency, is decentralization: the assignment of property rights over policy decisions to local governments. Decentralization may reduce the possibility of coercion because it allows for relative performance evaluation. Individuals can compare performances among local regions and they may either deny re-election to a local government whose performance is poorer or they may decide to relocate in a local region whose performance is better (Eichenberger & Frey, 2006; Hirschman, 1970; Oakerson & Parks, 1988; Salmon, 2006). In short, decentralization allows for better preference-matching and improved accountability. However, decentralization also entails a cost: this cost is the inability to internalize externalities (Oates, 2005).

Once more, we have a seemingly puzzling result. Decentralization can address the problem of externalities among individuals of the same local region, but it cannot address the problem of externalities among individuals of different local regions. The presumption of the puzzle is that centralization can solve the latter problem, namely the problem of externalities among individuals of different local regions. The often adduced justification in favour of centralization is that there are transaction costs to exchange among individuals of different local regions. But this justification is at best weak for two reasons. First, why similar transaction costs do not show up in the case of exchange among individuals of the same local region? Second and most importantly, as we suggested in Chapter 2, the inquiry into the form

[59] Liberalism "is concerned mainly with limiting the coercive powers of all government, whether democratic or not [to this we may add whether decentralized or not]" (Hayek, 1960, p. 103).
[60] See also, for example, Bernholz (2008) and Mueller (2003, Ch2).

of the state that allows for an effective performance of functions becomes meaningful only once we consider exchange as the explanation of the purposive nature of individuals' actions.

The state, whether centralized or decentralized, remains an organization. As such, the internalization of externalities requires exchange. Exchange entails interactions among the parties to the externality and the number of these interactions need not be higher under decentralization than under centralization. Consequently, and differently from the fiscal federalism literature, the internalization of externalities need not improve with centralization.

Also, and perhaps most importantly, a decentralized state can effectively internalize externalities if the state is organized to conform to modularity principles: if we group local governments into smaller number of minimally connected subsystems, which we call modules, and then require that exchanges occur mostly within these subsystems. A natural corollary of this is that we do not have to assume away transaction costs in the political sphere, à la, e.g. Parisi (2003), in order to render the Coase theorem applicable to the political sphere because modularity reduces transaction costs.

4.4. The Way Ahead

In pursuing our objective, we have left out some important elements that may influence the ability of the state to carry out its assigned functions.

- We have not considered, at least not in detail, the political democratic process. For instance, we overlooked how different electoral systems influence the ability of the state to match the supply of public goods with demand. Would voters' ability to deny re-election to poorly performing governments remain the same regardless of the electoral system? If not, which electoral system allows voters to control the state better, and, as a result, increase the probability that the state performs its assigned

functions effectively? These are questions that I have particular interest in and I intend to answer in future research.

- We have also disregarded the role of bureaucrats. The actions of bureaucrats may, to a large degree, influence the state's ability to perform its function. Like politicians who may have interests that are misaligned with those of voters, bureaucrats may have interests that are misaligned with those of politicians as well as voters. Thus, future research would have to also consider mechanisms that align the interests of bureaucrats with those of voters. Fortunately, some attempts have been made in this direction (see, for example, Breton & Wintrobe, 1982, who use an approach similar to ours, that is, exchange as a method to study economics).

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