Chapter Introduction

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1 Introduction

The role of government in our lives can hardly be overestimated. It is involved in many of our daily activities. We attend public schools. We drive on public roads. If we drive too fast, we can get a ticket from a police officer. We eat food that is safe because of government regulation. The prices we pay for products depend on taxes and competition policies. The list of government activities seems endless. Figure 1 presents the share of public sector employment as a share of the total workforce for 16 countries.

Economics is the study of people's choices. Economists explain behavior as the outcomes of choices. Microeconomists study the choices consumers and firms make. Macroeconomists study the economy as a whole. In both micro and macroeconomics, the government is usually studied from a normative perspective. The focus is on what governments *should* do. The government should correct market failures, promote economic growth, or stabilize fluctuations in economic outcomes. Political economists study the government from a positive perspective. They study how collectively choices are *actually* made. Often many people are involved in collective decision-making. Politicans make final decisions. Bureaucrats give advice. Lobbyists try to influence decisions. Following the economic approach, political economists explain the behavior of these people as outcomes of their choices. All these people have their own motives, which do not always align with the general interest.

In studying collective decision-making, we follow the economic approach, which emphasizes three principles. First, to explain people's choices we assume that people optimize. For example, Ann votes rather than abstains if she believes that voting

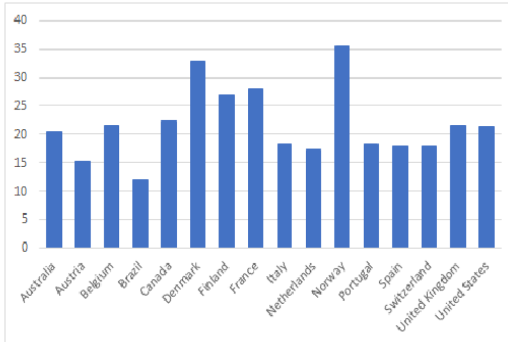

Figure 1: Public Sector Employment as a Share of the Total Workforce

makes her better off. The older literature typically assumes that agents exclusively care about their own narrow interests. Today, we take a broader perspective. Agents may care about others, about the general interest, or may want to adhere to social norms. The principle of optimization means that to explain people's choices we need to know people's opportunities and what they want. The second principle is equilibrium. This principle helps us to understand how people's choices interact. Loosely speaking, in equilibrium, citizens have no reason to change their decisions. When Ann determines the cost and benefit of voting, she takes into account that millions of citizens also cast their votes. The first two principles determine how we develop theories. The third principle is that we use data that describes people's decisions and the outcomes of their decisions. Data guides theory building. It shows what we need to explain and enables us to test the predictions of our theories.

Like other textbooks on political economics, the present one discusses a wide variety of theoretical models to help our thinking about the behavior of politicians, bureaucrats, voters, lobbyists, and other political agents. This book deviates from most other textbooks in that it extensively connects theory with empirical work. In the last decades, we have witnessed a gradual shift from theoretical to empirical research. This empirical research has shown that some theoretical concepts have a firm empirical basis while other theoretical concepts have little or no empirical basis. In this book, we use empirical research in two ways. First, we present data on topics to describe what we want to understand. For example, in the section on voter turnout in Chapter 5, we start with presenting data showing that many citizens who did not vote in an election claim to have voted after the election. Next, we discuss a model that also explains this observation. Second, we discuss empirical research after we have discussed a theoretical model. Often the data is not fully consistent with the predictions of a model. These inconsistencies form an inspiration for developing new theories.

The objective of this introductory chapter is threefold. First, we show that the government potentially plays an important role in fostering economic development. We discuss empirical literature that convincingly demonstrates that countries with governments that protect property rights and enforce contracts perform much better than countries with governments that do not perform these tasks well. This literature does not only highlight the importance of government for development. It also shows that a well-functioning government requires that politicians have the power to make decisions and to enforce their decisions. Politicians regulate. By laws, they determine what is and what is not allowed. Politicians also spend other people's money. They levy taxes to spend it on wherever they want to spend it on. Political institutions grant politicians power but also restrain their power. Political economists study how politicians use and abuse their power, how various political agents try to influence politicians' decisions, and how political institutions, such as elections and freedom of the press, influence economic and political outcomes.[1]

Second, we study a simple political-economic model of public finance to analyze how governments make budgetary decisions. In this model, politicians have to decide how much money to spend on different policy areas, like education and agriculture. We use the model to compare alternative budgetary procedures. In one version of the model, individual ministers determine how much money is spent on their domains. In another version of the model, the prime minister ultimately makes these decisions. The other ministers may try to influence the prime minister. The model helps to compare alternative budgetary procedures. Who should make which decisions? The model also illustrates that the normative and positive approaches to the government are intertwined. The positive approach shows how alternative budgetary procedures work. Its outcomes can be used to understand how budgetary

[1] In most political-economic studies, institutions are taken as given. A small number of studies tries to explain the emergence of institutions (see, e.g. Glaeser and Schleifer, 2003, and Swank and Vullings, 2022).

procedures should be designed.

The last objective of this chapter is to introduce the game-theoretical tools that we use throughout this book. The political-economic model of public finance is interesting in itself but it is also suitable to lay down the main concepts of game theory. It is worth emphasizing that this book is not close to a substitute for a book on game theory. The models discussed in this chapter illustrate how political economists think, and provide just enough background of game theory to understand the models that are discussed in later chapters.

2 The Importance of a Well-functioning Government

In 1995, Gross Domestic Product per capita was more than 11 times higher in Chile than in Nigeria. A classical question in social sciences is why some countries are so much richer than other countries. There is a broad consensus among social scientists that protection of property rights and enforcement of contracts are two key factors for economic and social development [see, for example, North and Thomas (1973) and Hall and Jones (1999)]. To put it bluntly, if the revenues of citizens' endeavors can easily be expropriated, citizens hardly have incentives to engage in business activities. Protection of property rights is a core task of the government. Likewise, the government should enforce contracts to facilitate transactions between people, collaboration, and trade.

Figure 2 presents how well different groups of countries, divided on the basis of their income per capita, score on Rule of Law, which measures the extent to which citizens believe that their governments protect property rights and enforce contracts. Unsurprisingly, Figure 2 presents a positive correlation between Rule of Law and income per capita. It is too early to conclude that good institutions lead to high income per capita, however. We cannot rule out that richer countries choose better institutions. Moreover, there are many possible variables that affect both income per capita and institutions.

Acemoglu et al. (2002) show in a clever way that the quality of institutions does causally affect income per capita. They utilize the historical fact that many

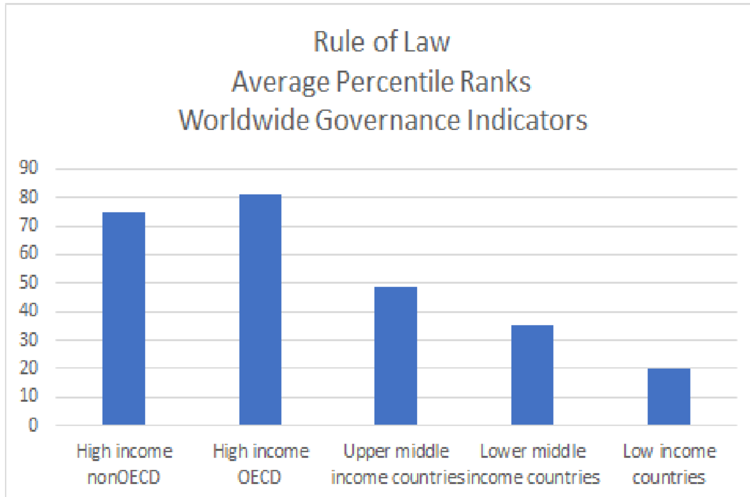

Figure 2: . Rule of Law captures perceptions to which agents have confidence in and abide with the rules of society (such as property rights and contract enforcement). Data: World Bank, 2020.

countries have different colonial histories. In some former colonies, like Australia and Canada, Europeans settled, whereas in others, like the Democratic Republic of Congo and Uganda, they did not. In countries where Europeans settled, they developed institutions with a focus on Rule of Law. Protection of property rights was in the settlers' interests. In contrast, in countries where Europeans did not settle, colonizers just "plundered" the country. The costs of developing good institutions exceeded the benefits.

Why did Europeans settle in some countries but not in others? Acemoglu et al. (2001) give a convincing answer to this question: conditions varied a lot in former colonies. The presence of malaria and yellow fever made some countries very unfavorable for Europeans to settle in.[2] In those countries, the costs of settlement were far higher than the benefits.

An indicator of how favorable a former colony was to settle is settlement mortality. Acemoglu et al. (2001) show that settler mortality *120 years ago* explains countries' *current* income per capita (see Figure 3). The effect of settler mortality on income runs through the quality of institutions. Settler mortality influenced incentives to develop good institutions, which in turn affected opportunities for eco-

[2]Locals were far les sensitive to these diseases.

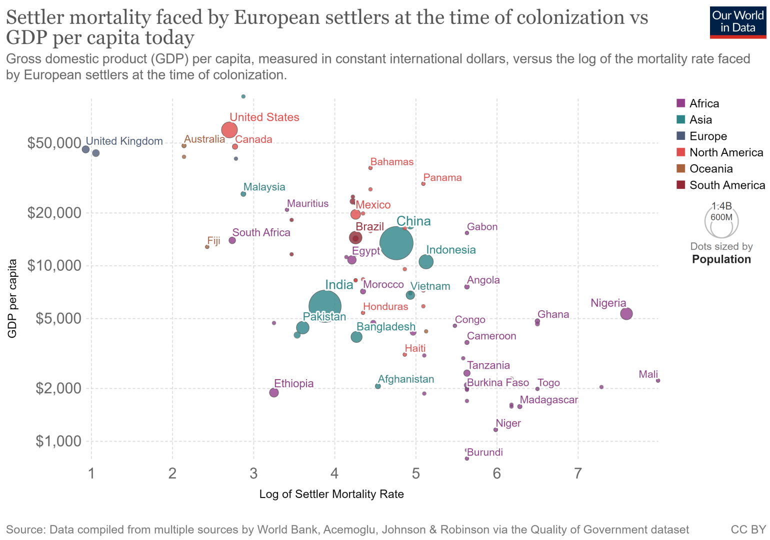

Figure 3:

nomic development. Their estimate of the effect of Rule of Law on income per capita can explain that Chile is 7 times as rich as Nigeria. As mentioned above, Chile is actually more than 11 times as rich as Nigeria.

Exercise 1 *As mentioned in Footnote 2, the local population in former colonies suffered far less than Europeans from diseases like malaria and yellow fever. Explain why this is important for the claim made by Acemoglu et al. (2002) that good institutions lead to higher income.*

Delegating Power

To protect property rights, enforce contracts, and levy taxes the government needs power. The problem with granting power to an institution or people is that power can be abused. Expropriation of property, exploitation of groups of people, discrimination, and corruption are well-known and, unfortunately, widespread examples of abuse of power by governments.

At the heart of political economics lies that the government can use its power to protect people but also to harm them. As extensively discussed in Chapter 2, a rationale for democracy is providing incentives to politicians to make decisions that are good for the people. The idea is simple and appealing. For performing its tasks, the government needs power. In democracies, power is granted to persons only temporarily, that is, until the next election. Elections enable the electorate to punish politicians who have abused their power by kicking them out of office. To keep their power, politicians should serve the public interest. Through elections, citizens can hold politicians accountable for their actions.

In political accountability models, citizens use elections for a good purpose: making the government work for the people. Citizens can use elections also for less honorable ends, for example, to redistribute income from a minority to a majority. A serious danger of dictatorship is that the dictator exploits the people. A serious danger of democracy is that a majority exploits a minority. Chapter 3 studies how elections affect redistributive policies.

In this book, we study, how policy decisions are arrived at. The main focus of the book is on democracies, countries where regular elections are held and the results of the elections are respected. The role of elections in shaping politicians' incentives is an important theme in this book (Chapters 2-5). We also pay attention to the role of the media (Chapter 7). Citizens learn about what politicians do and accomplish through the media. Without information about what politicians do and achieve, it is hard for citizens to determine whether or not politicians did a good job. But politics is much more than elections. Once elections have been held, the policy-making process starts for the elected politicians. The consequences of many policy decisions are uncertain. This uncertainty leads to asked and unasked advice. We investigate how advisors and lobbyists try to affect decisions (Chapter 6).

3 Specialization and the Problem of the Common Pool

It is impossible for a single politician to have expertise on all policy domains. The diverse tasks of the government and the wide variety of policies decisions require specialization. For this reason, governments are typically divided in departments. The government of the United Kingdom, for instance, has 23 departments, among which are the department of education and the department of agriculture.[3] The political heads of the departments, ministers, form the executive body of the government, the Cabinet.

Political economists recognize that politicians are not angels who always serve the general interest. However, a striking feature of a Cabinet is that most of its members are *not* even supposed to serve the general interest. A minister's department reflects her mission: The minister of agriculture defends farmers not all people. Likewise, the minister of education promotes education. In fact, only the prime minister and the finance minister are supposed to defend the general interest in a Cabinet. Why do we expect from individual ministers that they promote a narrow interest instead of the general interest? An answer to this question is that for two reasons missions induce ministers to work hard. The first one is selection. If the minister of agriculture is supposed to promote the interest of farmers, politicians who especially care about the well-being of farmers find this position attractive. They are willing to do what they can for farmers. The second reason is that missions create incentives. If you are evaluated on what you have done for farmers, you have strong incentives to promote farmers' interests.[4]

In this section, we employ a model of the budgetary process to investigate the pros and cons of specialization and missions. We show that specialization is likely to lead to overspending on the one hand and better adjustments to circumstances on the other.[5] Since different countries follow different budgetary procedures, the model generates predictions about the sizes of the government across countries.

The model describes a society that consists of two groups, farmers and teachers. We denote by σ the size of the group of farmers and by $1-\sigma$ the size of the group of teachers. Three ministers form the Cabinet: the prime minister, PM, the minister of agriculture, AG, and the minister of education, ED. PM promotes the public

[3] The real name of the department of agriculture is the department for environment food and rural affairs.

[4] Dewatripont and Tirole (1999) argue that the presence of missions gives strong incentives to acquire information that helps the mission to be accomplished. Their key example is the court, where the prosecutor's main task is to find and present evidence *against* the defendant, and the advocate's task is to find and present evidence that *helps* the defendant.

[5] In Shepsle and Weingast (1981), politicians cater to the interests of different geographic groups. The model discussed here builds on Von Hagen and Harden (1995) who focus on spending ministers in a cabinet.

interest.[6] She is the politician for all citizens. By contrast, the spending ministers serve a narrow interest. AG promotes farmers' interests, and ED promotes teachers' interests. The Cabinet prepares a budget for the next year. The budget stipulates how much AG is allowed to spend on agriculture, a, and how much ED is allowed to spend on education, s. Total spending is financed by a general tax, $\tau = a + s$, of which $\sigma\tau$ is borne by the farmers and $(1-\sigma)\tau$ is borne by the teachers.

The preferences of AG and PM are described by the utility functions

$$U_{AG}(a,s) = -\frac{1}{2}\left(a - a^d\right)^2 - \sigma\tau \tag{1}$$

and

$$U_{ED}(a,s) = -\frac{1}{2}\left(s - s^d\right)^2 - (1-\sigma)\tau, \tag{2}$$

respectively. In (1), a^d denotes the desired level of spending on agriculture. AG attaches costs to deviations of a from a^d. The last term in (1) shows that AG does not want that farmers pay taxes. Equation (2) can be interpreted in the same way. The prime minister's preferences are given by

$$U_{PM}(a,s) = -\frac{1}{2}\left(a - a^d\right)^2 - \frac{1}{2}\left(s - s^d\right)^2 - \tau \tag{3}$$

PM also wants that $a = a^d$ and $s = s^d$. She dislikes both taxing teachers and farmers. We assume that (3) also measures social welfare.

3.1 Budgetary Procedures A: Games of Complete Information

A budgetary procedure stipulates how and by whom the decisions on a and s are made. In this section, we discuss three procedures. To introduce game-theoretical concepts, we formulate budgetary procedure 2 and 3 as games.

Budgetary Procedure 1: The Prime Minister Chooses a and s

[6] The literature on budgetary institutions emphasizes the role of the finance minister in the budgetary process. The usual assumption is that the finance minister attributes a higher weight to the costs of taxation. Our model with a prime minister, promoting the general interests, and spending ministers, promoting special interests, highlights the conflict between individual interests and the social interest.

In the first budgetary procedure, the prime minister chooses a and s. Maximizing (3) with respect to a and s, using that $\tau = a + s$, yields

$$\begin{aligned} a &= a^d - 1 \text{ if } a^d > 1 \text{ and } a = 0 \text{ if } a^d \leq 1 \\ s &= s^d - 1 \text{ if } s^d > 1 \text{ and } s = 0 \text{ if } s^d \leq 1. \end{aligned}$$

PM allocates a positive amount of money to a budget item if the desired level of spending of that item is higher than the marginal cost of taxation, which equals one. From now on, we assume that $a^d > 1$ and $s^d > 1$. In the present setting, $a^d - 1$ and $s^d - 1$ are the socially optimal levels of spending on a and s, respectively.

Budgetary Procedure 2: The Spending Ministers Choose a and s

In the second budgetary procedure, AG chooses a and ED chooses s, simultaneously. We now formulate the resulting model as a *static game of complete information*. A game has players. In the Spending Game, the players are AG and ED. A game also describes what the players can do: their possible strategies. In the Spending Game, the strategies available to AG are the possible values of a she might choose, $S_{AG} = [0, \infty)$, where S_{AG} is called AG's strategy space. It shows that AG might choose any non-negative value of a, $a \in S_{AG}$. ED's strategy space is $S_{ED} = [0, \infty)$, with $s \in S_{ED}$. Finally, a game specifies how players' strategies, here their choices of a and s, affect their utilities or payoffs [see (1) and (2), with $\tau = a + s$]. This book often uses tables to present a game in a concise manner. The next table presents the Spending Game.

Table 1 The Spending Game - The Static Version

Players: AG and ED.

What players do:

- AG chooses $a \in [0, \infty)$. ED chooses $s \in [0, \infty)$.

Utility functions:

AG: $U_{AG}(a, s) = -\frac{1}{2}\left(a - a^d\right)^2 - \sigma (a + s)$.

ED: $U_{ED}(a, s) = -\frac{1}{2}\left(s - s^d\right)^2 - (1 - \sigma)(a + s)$.

The Spending Game is a *static* game, because AG and ED choose their strategies simultaneously. It is a game of *complete information* because how the possible combinations of a and s affect the players' utility functions is common knowledge among the players.

To determine the outcomes of a static game of complete information, we solve it by identifying its *Nash equilibria*. In the context of our game, a strategy pair (a^*, s^*) forms a Nash equilibrium if

$$U_{AG}(a^*, s^*) \geq U_{AG}(a, s^*) \text{ and } U_{ED}(a^*, s^*) \geq U_{ED}(a^*, s) \tag{4}$$

The first (in)equality in (4) ensures that AG's equilibrium strategy is a best response to ED's equilibrium strategy: given s^*, a^* yields a higher or equal utility than any other $a \in S_{AG}$. The second (in)equality in (4) ensures that ED's equilibrium strategy is a best response to AG's equilibrium strategy. Note that if a player's strategy is a best response, she has no reason to deviate. If a person had an incentive to deviate in equilibrium, her strategy would not be a best response!

Let us now determine the Nash equilibrium for the Spending Game. For AG, a^* must maximize

$$\begin{aligned} U_{AG}(a, s^*) &= -\frac{1}{2}\left(a - a^d\right)^2 - \sigma(a + s^*), \text{ implying} \\ a^* &= a^d - \sigma. \end{aligned}$$

Exercise 2 *Explain in your own words why determining AG's best response amounts to maximizing* $U_{AG}(a, s^*)$.

Analogously, for ED, s^* must maximize

$$\begin{aligned} U_{ED}(a^*, s) &= -\frac{1}{2}\left(s - s^d\right)^2 - (1-\sigma)(a^* + s), \text{ implying} \\ s^* &= s^d - (1-\sigma). \end{aligned}$$

Another feature of this book is that we present main theoretical results in propositions. A proposition is a statement (or statements) that can be proven mathematically. Proposition 1, which is proven above, presents the Nash equilibrium of the Spending Game.

Proposition 1 *In the unique Nash equilibrium of the static version of the Spending Game, AG chooses* $a^* = a^d - \sigma$ *and ED chooses* $s = s^d - (1 - \sigma)$.

Proposition 1 shows that when the spending ministers determine their budgets they spend more than what is socially optimal, $a^* > a^d - 1$ and $s^* > s^d - 1$. The reason for overspending is that because the spending minister only cares about *her* group, she does not take the taxes paid by the other group into account. For instance, AG ignores the tax borne by teachers. Note that the spending minister, promoting the smaller group, particularly spends too much from a social point of view. This leads to the prediction that overspending is especially likely in countries with cabinets that consist of many ministers. Later in this chapter, we discuss empirical studies that test this prediction.

The Spending Game offers an intuitive explanation for the demand for specific interest policies. For example, teachers demand higher wages financed by a general tax, as they benefit from it while the costs are borne by all people. The Spending Game is a variant of the common pool problem, which is often used to explain possible conflicts between self-interests and the social interest.[7]

Exercise 3 *Show how the main result of the Spending Game hinges on the (extreme) assumption that the spending ministers* ***exclusively*** *care about their own group.*

Budgetary Procedure 3: AG **first chooses** a**, next** ED **chooses** s

We now transform the Spending Game from a static game of complete information into a *dynamic game of complete information*. Specifically, we assume that first AG chooses a, that ED observes a, and next chooses s. Due to the sequential nature of the game, ED can base s on a. To make the game more interesting, we assume that the costs of taxation are quadratic instead of linear. By solving Exercise 5, you find out what we mean by "more interesting".[8] Finally, to minimize straightforward algebra, we assume that both groups are equally large, $\sigma = \frac{1}{2}$. Table 2 presents a sequential version of the spending game.

[7] Another name for the phenomenon that politicians internalize the benefit for their constituencies but do not take the full cost of spending into account is *pork-barrel* spending.

[8] Assuming quadratic costs of taxation in the static version of the Spending Game does not make the game more interesting but leads to more algebra (see Exercise 4).

Table 2 The Spending Game - The Dynamic Version

Players: AG and ED.

What players do:

- AG chooses $a \in S_{AG} = [0, \infty)$.
- ED observes a, and next chooses $s \in S_{ED} = [0, \infty)$.

Utility functions:
AG: $U_{AG}(a, s) = -\frac{1}{2}\left(a - a^d\right)^2 - \frac{1}{2}(a + s)^2$.
ED: $U_{ED}(a, s) = -\frac{1}{2}\left(s - s^d\right)^2 - \frac{1}{2}(a + s)^2$.

Dynamic games are solved by *backward induction*. In the context of the dynamic Spending Game this means that we first determine how ED bases her decision about s on a. ED maximizes her utility function with respect to s, yielding

$$s(a) = \frac{1}{2}\left(s^d - a\right). \tag{5}$$

Equation (5) gives ED's best response to AG's choice. It shows how ED bases her decision about s on a.

Now consider AG's spending decision. AG anticipates that her choice of a affects ED's decision about s. To assess ED's response, AG solves ED's optimization problem. In practice, AG imagines that she is ED and tries to figure out how ED responds to a. Of course, this leads to (5). Next, she maximizes her utility, using (5), $U_{AG}[a, s(a)]$, yielding

$$a^* = \frac{4}{5}a^d - \frac{1}{5}s^d. \tag{6}$$

Subsitituting (6) into (5) yields

$$s^* = \frac{3}{5}s^d - \frac{2}{5}a^d. \tag{7}$$

We have proven the following proposition:

Proposition 2 *In the unique backward-induction equilibrium of the dynamic version of the Spending Game, AG chooses* $a^* = \frac{4}{5}a^d - \frac{1}{5}s^d$ *and ED chooses* $s = \frac{3}{5}s^d - \frac{2}{5}a^d$.

Proposition 2 presents two results. First, spending in one department influences spending in the other department. The reason for this result is that higher spending on one budget item increases the marginal cost of spending for the other item. If we had assumed quadratic cost in the static game, this channel would also exist in that game (see Exercise 4).

Exercise 4 *Consider the static version of the Spending Game. Assume (1) that* $\sigma = \frac{1}{2}$ *and (2) quadratic cost of taxation,* $-\tau^2$ *instead of* $-\tau$*. Determine the Nash equilibrium of this Game.*

The second result is that AG has a first-mover advantage. To see this most clearly, suppose that $a^d = s^d$. Then, $a^* > s^*$. Why does AG spend more than ED? AG dislikes spending on education as it increases the tax rate. It does not deliver benefits to her but increases the tax rate. By choosing a high value of a, AG increases the marginal cost of taxation, which discourages ED to spend on education. If AG were to like education as much as ED and $a^d = s^d$, then in equilibrium we would obtain that $a^* = s^*$ (see Exercise 6). This illustrates that a first-mover advantage is only important if the first mover wants to influence the second mover.

Exercise 5 *In the dynamic version of the Spending Game, we assume that the costs of taxation are quadratic. We no longer assume linear costs of taxation to "make the game more interesting". Determine the backward-induction equilibrium of the dynamic version of the Spending Game for the case of linear costs of taxation.*

An implication of Proposition 2 is that without further rules, the budgetary process where spending ministers choose budgets may end up in a race. Each minister wants to be the first to propose the budget for her department. In this way, she can avoid "wasteful" spending on items about which she cares less.

Exercise 6 *Consider the dynamic version of the Spending Game but suppose that not* AG *but* PM *first decides on* a*.* PM*'s preferences are represented by the utility function* $U_{PM}(a, e) = -\frac{1}{2}\left(a - a^d\right)^2 - \frac{1}{2}\left(e - e^d\right)^2 - \tau^2$.

3.2 Budgetary Procedures B: Games of Incomplete Information

Budgetary Procedure 1a: The Prime Minister Chooses a and s. a^d and s^d are Uncertain

So far, we have only discussed a drawback of the existence of missions: ministers' tendency to ignore the costs of taxation borne by other groups. A potential benefit of specialization is that a minister who is responsible for a policy domain has the time to become an expert in that domain. To cast light on this aspect of specialization, we transform the static version of the Spending Game into a *static game of incomplete information.*

For many people, how much should be spent on agriculture or education is uncertain. For education, for example, this depends, among other things, on demographic factors, the future demand for skilled employees, and the wages of teachers. To model uncertainty about the benefits of public spending, we assume that a^d and s^d are uncertain. Specifically, we assume that a^d can take a high value and a low value

$$a^d \in \{a^e - k, a^e + k\} \text{ with } \Pr\left(a^d = a^e + k\right) = \frac{1}{2} \text{ and } k \geq 0 \tag{8}$$

$$s^d \in \{s^e - z, s^e + z\} \text{ with } \Pr\left(a^d = a^e + z\right) = \frac{1}{2} \text{ and } z \geq 0. \tag{9}$$

In (8), a^e is the expected value of a^d: $E\left(a^d\right) = \frac{1}{2}\left(a^e - k\right) + \frac{1}{2}\left(a^e + k\right) = a^e$. The two possible values of a^d occur with equal probability. The parameter k measures the amount of uncertainy about a^d. The interpretation of (9) is identical. Suppose that the prime minister makes the spending decisions on a and s. As a generalist, PM does not know the realizations of a^d and s^d. She knows the distributions of a^d and s^d. PM's spending decisions result from maximizing *expected* utility (E is the expectation operator):

$$\begin{aligned} E\left[U_{PM}(a,s)\right] &= -\frac{1}{4}\left[a - \left(a^e - k\right)\right]^2 - \frac{1}{4}\left[a - \left(a^e + k\right)\right]^2 \\ &\quad -\frac{1}{4}\left[s - \left(s^e - z\right)\right]^2 - \frac{1}{4}\left[s - \left(s^e + z\right)\right]^2 - \tau \end{aligned} \tag{10}$$

with respect to a and s. Straightforward algebra shows that PM chooses

$$\begin{aligned} a &= a^e - 1 \\ s &= s^e - 1. \end{aligned}$$

These outcomes are almost identical to the situation without uncertainty. In the present case, PM bases her spending decisions on the *expected* desired levels of spending instead of their actual levels. As a generalist, PM cannot adjust spending levels to the realizations of a^d and s^d. Note that PM's spending decisions do not depend on k and z. This is specific to the quadratic specification of the utility functions. It is generally not true.

Budgetary Procedure 2a: The Spending Ministers Choose a and s. a^d and s^d are Uncertain.

We now assume that the spending ministers make the spending decisions. Moreover, we assume that due to specialization AG observes a^d and ED observes s^d. The distribution of information is common knowledge. Game theorists say that each spending minister can have two types. AG can have two types: $a^d \in T_{AG} = \{a^e - k, a^e + k\}$ with $\Pr\left(a^d = a^e - k\right) = \frac{1}{2}$, where T_{AG} is the set of possible types for AG. Analogously, ED can have two types: $s^d \in T_{ED} = \{s^e - z, s^e + z\}$ with $\Pr\left(s^d = s^e - z\right) = \frac{1}{2}$, where T_{ED} is the set of possible types for ED. One way of looking at this is that AG (and ED) can have two utility functions. Which one depends on her type:

$$\begin{aligned} U_{AG}(a, s; a^e - k) &= -\frac{1}{2}\left[a - (a^e - k)\right]^2 - \sigma(a + s) \\ U_{AG}(a, s; s^e + k) &= -\frac{1}{2}\left[a - (a^e + k)\right]^2 - \sigma(a + s). \end{aligned}$$

As discussed above, each game describes what each player can do. A static game of incomplete information describes what *each type of player* can do. Furthermore, in a Nash equilibrium of a static game of incomplete incomplete information, the strategy of each player, and each type of player is a best response to the equilibrium strategies of other types and players. Table 3 describes the static Spending Game of incomplete information.

Table 3 The Spending Game - The Static, Incomplete Information Version

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Players: AG and ED.

What players do:

- ◦ Nature chooses $a^d \in \{a^e - k, a^e + k\}$, with $\Pr\left(a^d = a^e - k\right) = \frac{1}{2}$, and chooses $s^d \in \{s^e - z, s^e + z\}$, with $\Pr\left(s^d = s^e - z\right) = \frac{1}{2}$.
- • AG observes a^d (she learns her type). ED observes s^d (she learns her type). AG chooses $a \in [0, \infty)$. ED chooses $s \in [0, \infty)$.

Utility functions:

AG: $U_{AG}\left(a, s; a^d\right) = -\frac{1}{2}\left(a - a^d\right)^2 - \sigma\left(a + s\right)$.

ED: $U_{ED}\left(a, s; s^d\right) = -\frac{1}{2}\left(s - s^d\right)^2 - (1 - \sigma)\left(a + s\right)$.

Let us now identify the equilibrium of the Spending Game with incomplete information. Denote by $a^*_{a^d}$ the equilibrium strategy of AG with type a^d, and $s^*_{s^d}$ the equilibrium strategy of ED with type s^d. The best response of AG with type $a^e - k$ results from maximizing

$$U_{AG}\left(a, a^*_{a^e+k}, s^*_{s^d}; a^e - k\right) = -\frac{1}{2}\left[a - (a^e - k)\right]^2 - \sigma\left[a + \frac{1}{2}s^*_{s^e-z} + \frac{1}{2}s^*_{s^e+z}\right]$$

with respect to a, yielding

$$a^*_{a^e-k} = a^e - k - \sigma \tag{11}$$

where $a^*_{a^e-k}$ is the best response of AG with type $a^e - k$. In a similar way, we can derive

$$\begin{aligned} a^*_{a^e+k} &= a^e + k - \sigma &(12)\\ s^*_{s^e-z} &= s^e - z - (1 - \sigma) &(13)\\ s^*_{s^e+z} &= s^e + z - (1 - \sigma). &(14) \end{aligned}$$

This brings us to the next proposition.

Proposition 3 *In the unique Nash equilibrium of the static version of the Spending Game of incomplete information, AG of type* a^d *chooses* $a^*_{a^d} = a^d - \sigma$ *and ED of type* s^d *chooses* $s^*_{s^d} = s^d - (1-\sigma)$*.*

The main new result of Proposition 3 is that spending ministers adjust spending to information about the desired level of spending.

We have now analyzed two budgetary procedures in an environment where spending ministers have superior information about the desired levels of spending. When choosing spending levels, PM takes the full cost of spending into account but does not adjust spending to circumstances. Which procedure yields, in expectations, better outcomes? To answer this question, we substitute the outcomes of the model into PM's utility function and compare the levels of utility each procedure generates.

Exercise 7 *Why do we use* PM*'s utility function to evaluate the two budgetary procedures?*

By substitituting $a = a^e - 1$ and $s = s^e - 1$ into PM's utility function (10), we obtain expected social welfare when PM chooses a and s.

$$\begin{aligned} E\left[U_{PM}\left(a^e-1, s^e-1\right)\right] &= -\frac{1}{2}\left(\frac{1}{2}(k-1)^2+\frac{1}{2}(-1-k)^2\right) \\ &\quad -\frac{1}{2}\left(\frac{1}{2}(z-1)^2+\frac{1}{2}(-1-z)^2\right)-\left(a^e+s^e-2\right) \\ &= -\frac{1}{2}\left(1+k^2\right)-\frac{1}{2}\left(1+z^2\right)-\left(a^e+s^e-2\right) \end{aligned}$$

Using (11-14), we can derive expected welfare when the (two types) of spending ministers choose a and s:

$$E\left[U_{PM}\left(a^*, s^* | a^d\right)\right] = -\frac{1}{2}\sigma^2 - \frac{1}{2}(1-\sigma)^2 - \left(a^e + s^e - 1\right)$$

If $E\left[U_{PM}\left(a^e-1, s^e-1\right)\right] > E\left[U_{PM}\left(a^*, s^* | a^d\right)\right]$, budgetary procedure 1a yields a higher expected social welfare than budgetary procedure 2a. Straightforward algebra shows that $E\left[U_{PM}\left(a^e-1, s^e-1\right)\right] > E\left[U_{PM}\left(a^*, s^* | a^d, s^d\right)\right]$ if

$$\sigma^2 - \sigma + \frac{1}{2} > \frac{1}{2}\left(k^2 + z^2\right) \tag{15}$$

As $0 < \sigma < 1$, the left-hand side of (15) is higher than $\frac{1}{4}$. Therefore, if uncertainty about a^d and s^d is sufficiently small (k and z close enough to zero), PM should make the spending decisions. If uncertainty about the desired levels of spending is high enough, the spending decisions should be delegated to the spending ministers. Then, the desire for flexibility dominates the cost of overspending.

Budgetary Procedure 4: AG and ED May Try to Influence PM; PM Decides.

Budgetary procedure 4 tries to combine the benefits of budgetary procedures 1a and 2a. The prime minister makes the final spending decisions but the spending ministers can try to influence her. For the working of budgetary procedure 4, the interaction between an individual spending minister and the prime minister is key. What matters for the outcomes is whether or not a spending minister can convey information about the desired level of spending to the prime minister. For analyzing this interaction, the presence of multiple spending ministers is not important. To keep the analysis simple, we exclusively focus on the interactions between AG and PM.[9] For the moment, we ignore ED. We maintain the assumption that farmers (the group AG represents) only bear a share σ of the tax.

The spending decision, a, is made in three stages. In the first stage, AG can send a report to the prime minister in which she asks for additional spending. Preparing such a report is costly. This cost equals c. Let $r_{AG}\left(a^d\right) \in \{0, 1\}$ denote AG of type a^d's decision to send a report, with $r_{AG}\left(a^d\right) = 1$ meaning that AG of type a^d sends a report, and $r_{AG}\left(a^d\right) = 0$ meaning that she does not.

After AG has chosen r_{AG}, PM forms a belief about a^d in the second stage. Let $\hat{\pi}\left(r_{AG}\right)$ denote the probability that $a^d = a^e + k$, conditional on r_{AG}, $\hat{\pi}\left(r_{AG}\right) = \Pr\left(a^d = a^e + k | r_{AG}\right)$. Before AG sends a report, the probability that $a^d = a^e + k$ equals one-half. Through choosing r_{AG}, AG may try to change the probability that PM assigns to the event that $a^d = a^e + k$. Finally, in the third stage, PM chooses a. Table 4 presents the game that describes budgetary procedure 4.

Table 4 The Spending Game - The Dynamic, Incomplete Information Version

[9] The interactions between ED and PM can be analyzed separately.

Players: AG and PM.

- Nature chooses $a^d \in \{a^e - k, a^e + k\}$, with $\Pr\left(a^d = a^e - k\right) = \frac{1}{2}$.
- AG observes a^d.
- AG of type a^d chooses $r_{AG}\left(a^d\right) \in \{0, 1\}$.
- PM observes r_{AG}. She forms a belief about the probability that $a^d = a^e + k$, $\hat{\pi}\left(r_{AG}\right)$.
- PM chooses a.

Utility functions:
AG: $U_{AG}\left(a, r_{AG}; a^d\right) = -\frac{1}{2}\left(a - a^d\right)^2 - \sigma a - r_{AG}c$.
PM: $U_{PM}\left(a, r_{AG}\right) = -\frac{1}{2}\left(a - a^d\right)^2 - a$.

The version of the Spending Game described in Table 4 is a signaling game. In signaling games, there is a player with private information, here AG, and a player who lacks this information, here PM. The informed player may try to convey her information by sending a signal. Here, AG can send a report (or not) to PM.

Signaling games are solved by identifying perfect Bayesian equilibria. In the context of our model, a perfect Bayesian equilibrium requires that PM's strategy is a best response to the strategies of the two types of AG ($a^d = a^e + k$ and $a^d = a^e - k$). Moreover, the two types anticipate how PM will respond to their actions. The strategies of the two types should be a best response to PM's strategy. Finally, in a perfect Bayesian equilibrium, we require that PM updates her belief about a^d in a reasonable way. Reasonable means that when forming a belief about $\hat{\pi}\left(r_{AG}\right)$, PM takes the strategies of the two types of AG into account, and applies Bayes' rule.

In solving signaling games, game theorists often distinguish separating, pooling, and semi-separating equilibria. For the present game, we successively discuss these equilibria.

Separating Equilibria

In a separating equilibrium, the different types of the sender (here $a^d = a^e + k$ and $a^d = a^e - k$) send different messages (prepare a report or not). As a result, the receiver (here the prime minister) learns the sender's type. We now identify the conditions under which a separating equilibrium of the Spending Game exists, in which

1. $r_{AG}(a^e + k) = 1$ and $r_{AG}(a^e - k) = 0$.

2. Posterior beliefs equal $\hat{\pi}(1) = 1$, $\hat{\pi}(0) = 0$.

3. PM chooses $a = a^d - 1$.

Item 1 says that AG only sends a report to PM if the desired level of spending on agriculture is high. Item 2 shows that the prime minister can infer AG's type from r_{AG}. Note that the posteriors follow logically from the equilibrium strategies. This is a requirement for a perfect Bayesian equilibrium. Finally, item 3 shows that PM adjusts spending to the realization of the desired level of spending.

To verify if the specified separating equilibrium exists, it remains to show that AG wants to reveal her type. Suppose that AG observes $a^d = a^e + k$. For a separating equilibrium to exist, $r_{AG}(a^e + k) = 1$ must be a best response. AG should not have an incentive to not prepare a report. If in the equilibrium under consideration, type $a^e + z$ prepares no report, PM believes that $a^d = a^e - k$. Hence, PM would choose $a = a^e - k - 1$. For type $a^d = a^e + k$, preparing a report yields a higher payoff than not preparing one if

$$\begin{aligned} & -\frac{1}{2}\left[a^e + k - 1 - (a^e + k)\right]^2 - \sigma\left(a^e + k - 1\right) - c \\ > \; & -\frac{1}{2}\left[a^e - k - 1 - (a^e + k)\right]^2 - \sigma\left(a^e - k - 1\right), \text{ implying} \end{aligned}$$

$$\begin{aligned} -\frac{1}{2} - \sigma\left(a^e + k - 1\right) - c &> -\frac{1}{2}\left(-2k - 1\right)^2 - \sigma\left(a^e - k - 1\right) \\ c &< \bar{c}_H = 2k\left(1 - \sigma + k\right) \qquad (16) \end{aligned}$$

Hence, the first requirement for the existence of a separating equilibrium is that the cost of preparing a report, c, is sufficiently small and that uncertainty about a^d is sufficiently large. If c is too high relative to k , preparing a report is not worth the effort.

Now suppose that AG observes $a^d = a^e - k$. Then, AG must prefer not prepare a report to prepare one. If AG prepares a report, PM believes that $a^d = a^e + k$. AG of type $a^e - k$ prefers $r_{AG}(a^e - k) = 0$ to $r_{AG}(a^e - k) = 1$ if

$$\begin{aligned} & -\frac{1}{2}\left[a^e - k - 1 - (a^e - k)\right]^2 - \sigma\left(a^e - k - 1\right) - c \\ > \quad & -\frac{1}{2}\left[a^e + k - 1 - (a^e - k)\right]^2 - \sigma\left(a^e + k - 1\right), \text{ implying} \end{aligned}$$

$$\begin{aligned} -\frac{1}{2} - \sigma\left(a^e - k - 1\right) \quad &> \quad -\frac{1}{2}\left(2k - 1\right)^2 - \sigma\left(a^e + k - 1\right) - c \\ c \quad &> \quad \bar{c}_L = 2k\left(1 - \sigma - k\right). \end{aligned} \tag{17}$$

Inequality (17) shows that c must be sufficiently large relative to k. The intuition is that it should not be too easy or too beneficial for type $a^e - k$ to prepare a report to PM to increase spending on a. Note that $\bar{c}_L < \bar{c}_H$. An equilibrium in which PM learns AG's type requires that $\bar{c}_L \leq c \leq \bar{c}_H$. This brings us to the next proposition.

Proposition 4 *A separating equilibrium of the dynamic version of the Spending Game of incomplete information exists if*

$$2k\left[k - (1 - \sigma)\right] = \bar{c}_L \leq c \leq \bar{c}_H = 2k\left(1 - \sigma + k\right).$$

In this equilibrium, the spending decision is socially optimal.

Proposition 4 presents conditions under which a budgetary procedure exists that leads to the socially optimal spending decision. In this procedure, PM makes the final spending decision. This circumvents overspending. The spending minister affects PM's decision by sharing private information by preparing a report. As a result, PM can adjust her spending decisions to circumstances. The price of this budgetary procedure is the cost of preparing a report when $a^d = a^e + k$, borne by AG.

Note that $\bar{c}_L$ is possibly smaller than zero. If σ or k is sufficiently large, the preferences of AG and PM are closely aligned, such that (i) when $a^d = a^e + k$, both AG and PM prefer $a = a^e + k - 1$ to $a = a^e - k - 1$, and (ii) when $a^d = a^e - k$, both

AG and PM prefer $a = a^e - k - 1$ to $a = a^e + k - 1$. In that case, a single word of AG to PM suffices to let PM respond to circumstances. If AG of type $a^e - k$ wants PM to choose $a^e + k - 1$, a sufficiently high cost of preparing a report must discourage her from preparing a report.

Pooling Equilibria

We now identify the conditions under which a pooling equilibrium exists. In a pooling equilibrium, both types of AG follow the same strategy. For example, both types a^e+k and a^d-k send no report to PM , $r_{AG}(a^e + k) = 0$ and $r_{AG}(a^e - k) = 0$. In a pooling equilibrium, r_{AG} does not contain information about a^d. Consequently, $\hat{\pi}(1) = \hat{\pi}(0) = \frac{1}{2}$ and PM cannot adjust spending on a to circumstances, $a = a^e - 1$. Two pooling equilibria exist: one in which neither type sends a report, and one in which both types send a report. We only identify the conditions under which a pooling equilibrium exists in which both types of AG send a report. Exercise 9 asks you to derive the conditions for the existence of the other pooling equilibrium. Suppose a pooling equilibrium in which

1. $r_{AG}(a^e + k) = 1$ and $r_{AG}(a^e - k) = 1$.

2. Posterior beliefs equal $\hat{\pi}(1) = \frac{1}{2}$.

3. PM chooses $a = a^e - 1$.

Item 1 says that AG, irrespective of her type, sends a report. Item 2 shows that PM does not learn anything from $r_{AG} = 1$ about a^d. Item 3 shows PM's best response. To prove that the three items together form a pooling equilibrium, there remains to show that neither type of AG has an incentive to not prepare a report. What would PM believe if she does not receive a report? In a perfect Bayesian equilibrium, PM uses AG's strategy to assess the probability that $a^d = a^e + z$. However, as AG always prepares a report in equilibrium, $r_{AG} = 0$ is an out-of-equilibrium choice. This means that AG's equilibrium strategy is of little help in determining PM's belief about a^d if $r_{AG} = 0$. We must make an assumption about what PM believes about a^d if $r_{AG} = 0$. We assume that when PM observes $r_{AG} = 0$ she believes that AG's type is $a^e - k$: $\hat{\pi}(0) = 0$. The reason for this assumption is that in our model spending ministers prepare reports in the hope to convince the prime minister to increase spending. Consequently, not sending a report is likely to be interpreted as a signal that additional spending is not really needed. As a result, it is unlikely that type $a^e + k$ does not send a report.

The existence of the pooling equilibrium requires that neither type $a^e + k$ nor type $a^e - k$ has an incentive not to prepare a report. Given the out-of-equilibrium belief, type $a^e - k$ is more inclined not to prepare a report than type $a^e + k$. Hence, assume that $a^d = a^e - k$. If type $a^e - k$ prepares a report, she anticipates that PM chooses $a = a^e - 1$. If she does not send a report, she anticipates that PM chooses $a = a^e - k - 1$. For type $a^e - k$, $r_{AG} = 1$ yields a *higher* utility than $r_{AG} = 0$, if

$$
\begin{aligned}
& -\frac{1}{2}\left[a^e - 1 - (a^e - k)\right]^2 - \sigma\left(a^e - 1\right) - c \\
> \; & -\frac{1}{2}\left[a^e - k - 1 - (a^e - k)\right]^2 - \sigma\left(\alpha^e - k - 1\right), \text{ implying}
\end{aligned}
$$

$$
\begin{aligned}
-\frac{1}{2}\left(k - 1\right)^2 - \sigma\left(a^e - 1\right) - c &> -\frac{1}{2} - \sigma\left(a^e - k - 1\right) \\
c &< \bar{c}_{AG} = k\left(1 - \sigma - \frac{1}{2}k\right) \qquad (18)
\end{aligned}
$$

This brings us to the next proposition.

Proposition 5 *A pooling equilibrium of the dynamic version of the Spending Game of incomplete information, in which* $r_{AG}\left(a^e + k\right) = r_{AG}\left(a^e - k\right) = 1$, $\hat{\pi}\left(1\right) = \frac{1}{2}$, *and* $a^* = a^e - 1$, *exists if* $c < \bar{c}_{AG} = k\left(1 - \sigma - \frac{1}{2}k\right)$.

In a pooling equilibrium, the spending minister does not affect the ultimate decisions on a. PM makes the spending decision without adjusting a to circumstances. Budgetary procedure 4 is therefore outcome equivalent to budgetary procedure 1a where PM makes the spending decision alone. The condition in Proposition (5) shows that for a pooling equilibrium to exist the common pool problem should be big (that is, σ should be small) and k should be moderately high. If σ is close to one or k is high, the preferences of PM and AG are closely aligned. Then, type $a^d - k$ has no reason to conceal her type.

Exercise 8 *Could the pooling equilibrium explain the existence of wasteful paperwork?*

A comparison between the conditions for the existence of a separating equilibrium and a pooling equilibrium shows that for the same set of parameters both equilibria can exist (this requires that $\bar{c}_L < c < \bar{c}_H$ and $c < \bar{c}_{AG}$). For these sets of parameters, the model does not precisely predict how budgetary procedure 4 works out. To see what this means, let us return to our initial model with two spending ministers. Suppose that $a^e = s^e, k = z$ and $\sigma = \frac{1}{2}$. For these parameters, the department of agriculture and education are essentially identical (except for the realizations of a^d and s^d). Nevertheless, it is possible that AG's behavior is described by a separating equilibrium, while ED's behavior is described by a pooling equilibrium.

Exercise 9 *Identify the conditions under which a pooling equilibrium of the dynamic version of the Spending Game of incomplete information exists in which both types of AG choose $r_{AG} = 1$, and both types of ED choose $r_{ED} = 1$. Explicitly discuss your assumptions about the out-of-equilibrium beliefs.*

A Semi-Separating Equilibrium

We now assume that $\bar{c}_{AG} < c < \bar{c}_L$. Then, no separating equilibrium exists in which PM always learns AG's type, and no pooling equilibrium exists in which both types of AG choose $r_{AG} = 1$. The pooling equilibrium does not exists because type $a^d = a^e - k$ has an incentive to send a report. The separating equilibrium does not exist because type $a^d = a^e - k$ has an incentive to send a report. We show that in this environment, an equilibrium in *mixed strategies* exists, in which

1. $r_{AG}(a^e + k) = 1$ and $r_{AG}(a^e - k) = \eta$, with

$$\eta = \frac{(1-\sigma) + \sqrt{(1-\sigma)^2 - 2c}}{c} k - 1$$

2. Posterior beliefs equal $\hat{\pi}(1) = \frac{1}{1+\eta}$, $\hat{\pi}(0) = 0$.

3. PM chooses $a = a^e + \frac{1-\eta}{1+\eta} k - 1$ if $r_{AG} = 1$, and $a = a^e - k - 1$ if $r_{AG} = 0$.

A key feature of this equilibrium in mixed strategy is that type $a^e - k$ sends a report with probability η, $r_{AG}(a^e - k) = \eta$. $a^e + k$ always sends a report, $r_{AG}(a^e + k) = 1$ (see Item 1). When forming her belief about AG's type, PM

takes into account that type $a^e + k$ always sends a report, while type $a^e - k$ sends a report with probability η. Item 2 shows that Bayes' rule implies that

$$\hat{\pi}(1) = \frac{\frac{1}{2}}{\frac{1}{2} + \frac{1}{2}\eta} = \frac{1}{1+\eta}. \tag{19}$$

After having received a report ($r_{AG} = 1$) from AG, PM maximizes

$$-\frac{1}{1+\eta}\frac{1}{2}\left[a - (a^e + k)\right]^2 - \left(1 - \frac{1}{1+\eta}\right)\frac{1}{2}\left[a - (a^e - k)\right]^2 - a \tag{20}$$

with respect to a, yielding

$$a = a^e + \frac{1-\eta}{1+\eta}k - 1$$

Note that if $\eta = 0$, PM responds to r_{AG} as in the separating equilibrium. By contrast, if $\eta = 1$, PM responds to $r_{AG} = 1$ as in the pooling equilibrium, in which type $a^e - k$ always sends a report (see Exercise 9).

Finally, consider the probability with which type $a^e - k$ chooses to send a report, η. In an equilibrium of mixed strategies, the type of player who follows the mixed strategy is indifferent between alternative strategies. If the player were not indifferent, she would prefer one strategy to the other and thus would not mix. In the present Spending Game, type $a^e - k$ is indifferent between preparing a report, $r_{AG} = 1$, and not preparing it, $r_{AG} = 0$:

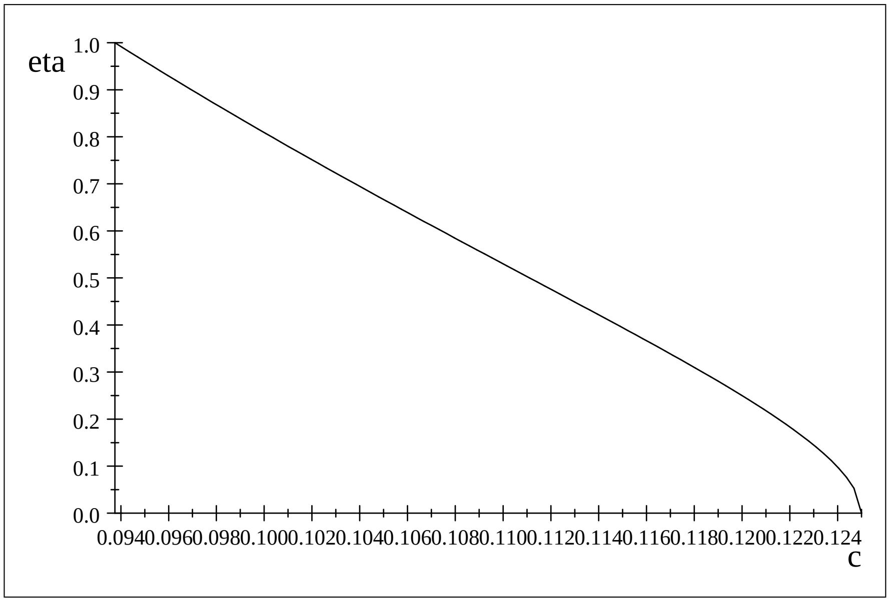
$$\begin{aligned} & -\frac{1}{2}\left(a^e + \frac{1-\eta}{1+\eta}k - 1 - (a^e - k)\right)^2 - \sigma\left(a^e + \frac{1-\eta}{1+\eta}k - 1\right) - c \\ = & -\frac{1}{2} - \sigma\left(a^e - k - 1\right). \end{aligned}$$

Solving this equality for η yields

$$\eta = \frac{(1-\sigma) + \sqrt{(1-\sigma)^2 - 2c}}{c}k - 1, \tag{21}$$

where the first line gives the utility of type $a^e - k$ when she sends a report to PM and the second line gives her utility when she does not send a report. Solving this equality for η gives (21). Tedious algebra shows that if $c = \bar{c}_{AG}$, $\eta = 1$, meaning that type $a^e - k$ always sends a report. We are back at the pooling equilibrium. If $c = \bar{c}_L$, $\eta = 0$, so that we are back at the separating equilibrium. In the interval

$[\bar{c}_{AG}, \bar{c}_L]$, η decreases in c. Therefore, a higher cost of preparing a report for the prime minister decreases the probability that an $a^e - k$ type sends a report. The figure below illustrates.



Relationship between $c \in [\bar{c}_{AG}, \bar{c}_L]$ and η (for $\sigma = \frac{1}{2}$ and $k = \frac{1}{4}$).

Summary

Let us briefly summarize the main results of budgetary procedure 4, where, at a cost c, AG can send a report to PM to ask for a higher budget a. We have shown that if $c \in [\bar{c}_L, \bar{c}_H]$, a separating equilibrium exists in which the spending minister's decision to prepare a report or not conveys information about the need for additional spending. The cost of preparing a report can be too low for a separating equilibrium to exist. A pooling equilibrium would then occur in which the spending minister would always prepare a report. The act of sending a report would not convey information about the desired level of spending. If the cost of preparing a report is too high, another pooling equilibrium exists in which the spending minister would never send a report. Also then, the prime minister would not learn the desired level of spending.

We have treated parameter c as exogenous. However, one could think of c as part of the budgetary procedure. For example, the PM may formulate conditions a report must satisfy before it is taken into consideration. Stricter conditions lead to a higher value of c. In this way, PM can ensure that a separating equilibrium exists.

We have also discussed an equilibrium in mixed strategies. It is hard to imagine that a spending minister's decision to prepare a report is made by throwing dices or tossing coins. The possibility of an equilibrium in mixed strategies of the Spending Game is partly the result of our assumption that there are only two types of AG. If we had assumed a continuum of types, this equilibrium would not exist. The main reason for presenting the equilibrium in mixed strategies is that in signaling games equilibria in mixed strategies often exist. In Chapter 6, we discuss games, in which equilibria in mixed strategies make more sense.

4 A Geographic Interpretation of the Common Pool Problem

In the previous section, the common pool problem arises from fragmentation in the cabinet due to specialization. Individual spending ministers want high budgets to promote special interests. The problem is that those budgets are financed through general taxation. Early literature (Buchanan and Tullock (1962) and Weingast et al. (1981) shows that geographic fragmentation may also raise a common pool problem. In many countries, politicians represent electoral districts. Electoral competition in a district gives incentives to politicians to promote policies that are good for their district. When these policies are financed through a general tax, a common pool problem, similar to the one discussed in the previous section, arises.

The Spending Game can therefore also explain the common pool problem that arises from geographic fragmentation. The spending ministers should be replaced by politicians representing districts. These representatives possess superior information about what is going on in their districts. Again budgetary procedures may limit the power of representatives of districts. Geographic fragmentation as the source of the common pool problem is important in countries where legislators represent districts.

5 Empirical Results

The various spending games discussed in this chapter generate three main predictions. First, when spending ministers choose budgets, fragmentation increases public spending. The budgets spending ministers choose are decreasing in σ. A larger cabinet means a better representation of smaller groups (or districts). Second, budgetary procedures that give decision power to politicians who promote the general interest mitigate the common pool problem and thereby reduce public spending. Finally, when budgetary procedures grant decision powers to specialists, budgets adjust to circumstances. This may increase the variance of spending over time.

In the last decades, several empirical studies have tried to test the first two predictions of the Spending Game.[10] In this section, we discuss some of these studies. Three lines of empirical research on budgetary institutions can be distinguished. First, a few studies use council sizes of *municipalities* to test the predictions of the Spending Games. In these studies, council size is in taken as a proxy for fragmentation. Second, a few studies use variation of fragmentation across states. Finally, most evidence on the spending model relies on the variations of budgetary rules across countries.

Testing the Spending Game with Data from the State Bavaria in Germany

Egger and Koethenbuerger (2010), hereinafter EK, present probably the most convincing evidence for an impact of council size on government spending. They used data from 2056 municipalities in the state of Bavaria in Germany. In Bavaria, a state law stipulates how municipality population determines council size. The first two columns of Table 1, which are taken from EK, illustrate. It shows, for example, that a council size of a municipality with a population of 25,000 citizens equals 30 members. For determining the impact of council size on public spending this state law is important. It rules out reverse causality. The third column of Table 1 presents public spending per capita for the different categories of municipalities. The general pattern is that public spending per capita is higher in bigger municipalities.

[10] As far as we know, no empirical evidence exists on the third prediction of the spending model that decision power to specialists leads spending to better adjust to circumstances.

Population Size (in 1000)	Council Size	Per Capita Spending Euro
0<pop<1	8	1511
1<pop<2	12	1516
2<pop<3	14	1504
3<pop<5	16	1531
5<pop<10	20	1589
10<pop<20	24	1621
20<pop<30	30	1571
30<pop<50	40	1981
50<pop<100	44	2254
100<pop<200	50	2562
200<pop<500	60	2185

Table 5: Population determinig council size. Per Capita Spending in 2056 municipalities over the period 1983-2004 in Bavaria.

One cannot conclude from Table 5 that larger councils cause higher public spending per capita. The benefits of many public programs may exceed the costs only if the municipality population is large enough. Disentangling population size and council size effects on public spending is difficult. To estimate the impact of council size on public spending per capita one would ideally randomly assign councils with different sizes to municipalities. Obviously, this is not what the state law stipulates. However, to approximate this ideal, EK use the discontinuities in the relationship between municipality population and council size. Although demand for public projects is probably higher in a municipality with 40,000 inhabitants than in a citizen with 20,000 inhabitants, the demand for public projects is more or less the same in a municipality with 19,900 inhabitants as in a municipality with 20,050 citizens. More generally, municipalities just below and just above thresholds are very similar except for council size. For those municipalities, differences in public spending can be attributed to council size.

Figure 4 presents EK's main findings for three categories of spending and total spending (all per capita). Spending on all categories is higher in municipalities with population sizes just above the thresholds than just below the thresholds. Except for the effect of council size on investment expenditure, the effects are significant from zero at a one percent level.

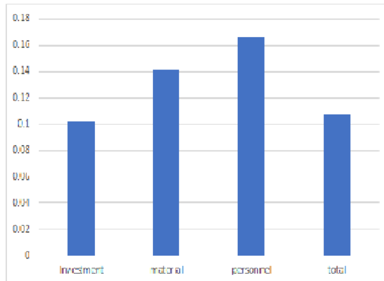


Figure 4: The Effect of Council Size on Public Spending.

Below we discuss other empirical studies that test the main predictions of the Spending Game. At least relative to some of these other studies, the study by EK is a "neat" study for several reasons. First, because EK's estimates are based on comparisons between municipalities with sizes just below and above the thresholds that determine the council sizes in municipalities, it is reasonable to interpret the evidence offered by EK as causal. Second, as municipality sizes are determined by law, reverse causality is excluded. Third, the data set consists of municipalities in one state in Germany. This means that the municipalities are likely to be very similar in many respects. Finally, the number of municipalities is 2056, which gives the study "empirical power".

Testing the Spending Game with Data from City Governments in the U.S.

To estimate the effect of council size on government spending, the homogeneity of Bavarian municipalities is an advantage. A drawback of this homogeneity is no variation in political institutions. This makes the data set unuseful for testing the other predictions of the spending game. Baqir (2002) uses data on 1971 city governments in the U.S. that also allows for testing the prediction that the common pool problem is less severe if the prime minister makes spending decisions.

In the U.S., the size of the city council varies from 3 to 50 elected members.

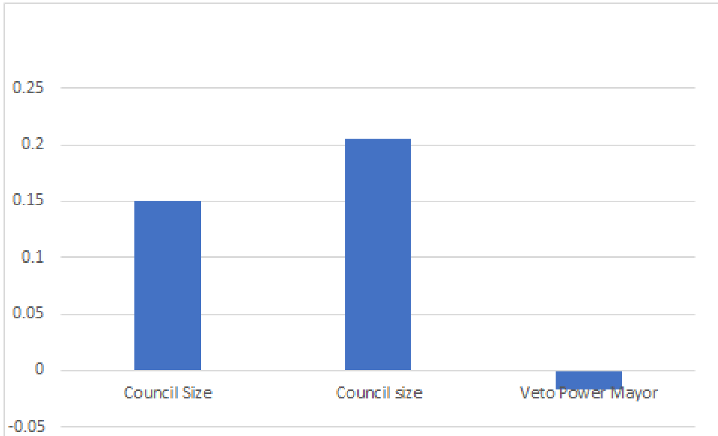


Figure 5: The effect of council size on ln spending.

Council size is not determined by law as in the German state Bavaria. City governments determine council size themselves. Potentially, this raises a concern of reverse causality. Moreover, Baqir can not utilize discontinuities in council sizes to estimate the effect of council size on government spending as EK do. This means that we should be hesitant to interpret Baqir's empirical results as causal.

Relative to the German data, the main benefit of the U.S. data is that there is variation in electoral systems across cities. For our purpose, a very relevant variation is that in roughly 20% of the city governments, the mayor has veto power. The spending game predicts that in those city governments, council size does not affect public spending.

Figure 1 presents Baqir's main results. The first bar presents the effect of council size on the logarithm of government spending per capita, G, when no distinction is made between cities where mayors have veto power and cities where they have not. The second bar gives this effect for cities in which mayors have no veto power. The effects, described by the first two bars, are significant at the 1 percent level. The third bar gives the effect of council size on G in cities where mayors have veto power. The effect is slightly negative and not significant. The first bar supports the first prediction of the Spending Game. Fragmentation increases public spending.

The second and third bars provide evidence for the prediction that granting decision power to a politician who is less sensitive to specific interests reduces or even eliminates the common pool problem.

All in all, Baqir (2002) reports strong evidence for the main predictions of the Spending Game. Though his empirical strategy is not as neat as EK's, the evidence seems convincing. In his paper, Baqir shows that city governments rarely change council sizes. This makes reverse causality unlikely. Furthermore, his results are remarkably stable for alternative specifications.

Empirical Evidence from Cross-Country Studies

Several studies use cross-country data to test the main predictions of the Spending Game. These studies typically try to explain a budgetary outcome, like government spending or budget deficits.[11] The usual approach is to construct a measure of government fragmentation and a measure of centralization. Presidential systems are considered to be more centralized, as usually they grant power to a person who is less prone to promote special interests [see Persson, Roland, and Tabellini, 1997, 1998, 2000 for models that show how political institutions shape fiscal outcomes].

Generally, cross-country studies provide support for the main predictions of the Spending Game. Fragmentation is associated with higher budget deficits (Hardin and Von Hagen, 1994, Von Hagen, 2005, Den Haan et al. 2013). Centralization is often associated with lower budget deficits. Finally, Presidential systems have less government spending and lower budget deficits.

In comparison with the EK study on municipalities in Bavaria, cross-country studies are not "neat". Reverse causality cannot be excluded. The number of countries is typically small. Countries differ in many respects (one may wonder if one could compare Luxembourg with the United States). However, in combination with the evidence on the effects of budgetary procedures on spending in municipalities, the conclusion that budgetary procedures matter seems justified. Fragmentation generally increases public spending. Delegating decision power to politicians who are supposed to promote the general interests reduces the common-pool problem.

[11] It is possible to construct a model of the common pool that explains budget deficits (Velasco, 2000). This model predicts that more fragmentized governments run higher budget deficits. Power to a non-spending minister, the prime minister or the finance minister, partially solves the common-pool problem.