

**ORGANIZING COOPERATION
BARGAINING, VOTING AND CONTROL**

by

Bård Harstad



**INSTITUTE FOR INTERNATIONAL ECONOMIC STUDIES
Stockholm University**

November 2003

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Institute for International Economic Studies
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ISBN 91-7265-766-9

Printed by Akademitryck AB
Edsbruk, Sweden 2003

Doctoral Dissertation
Department of Economics
Stockholm University

ABSTRACT

This thesis comprises three theoretical essays on the organization of cooperation.

Majority Rules and Incentives concerns voting. Since the majority rule defines the extent to which winners must compensate losers, it also determines incentives to invest in order to become a winner of anticipated projects. If the required majority is large, agents invest too little because of a hold-up problem, if it is small, agents invest too much in order to become a member of the majority coalition. To balance these opposing forces, the majority rule should depend on the project's value, the level of minority protection and the externality. Delegation and revelation are typically sincere exclusively under this majority rule. With heterogeneity in size or preferences, votes should be appropriately weighted.

Uniform or Different Policies? This question is raised in the context of two negotiating regions trying to internalize externalities. Local preferences are local information, but in equilibrium, reluctance is signaled by delay. Conditions are derived for when it is efficient to restrict the attention to policies that are uniform across regions - with and without side payments - and when it is optimal to forbid side payments in the negotiations. While differentiation and side payments let the policy reflect local conditions, they create conflicts between the regions and thus delay. The results provide a foundation for the uniformity assumption frequently made in the federalism literature and characterize when it is likely to hold.

Organizations and Careers analyzes how organizational design determines the allocation of blame and fame after the firm's performance has been observed. The value of a good reputation, in turn, depends on the structure of the product market. Combined, this implies that organizational design as well as executive pay hinge on the market structure. The model shows that if competition becomes tougher and the market thicker, transparent firms decentralize while non-transparent firms concentrate control, transparency itself is improved, corporations switch from U-form to M-form, and the turnover of managers increases. The model rationalizes recent trends in both executive pay and organizational design.

for my parents and
their concern for society

ACKNOWLEDGMENTS

Impatient by birth, I have tracked record levels of frustration in the course of this work. It has been hard to understand why brilliant ideas do not just pop up, and why my enthusiasm for the alternatives fails to survive. Unwillingly but gradually, I have learned that research is more like farming than gold-mining. My greatest gratitude goes to my advisor, Torsten Persson: Thanks for patiently and generously sharing your knowledge, creative ideas and trustworthy judgment. I am also indebted to all my teachers, colleagues and friends at the Institute, who have faithfully listened and contributed to numerous presentations. Although most of these ideas failed to develop into a thesis, they are still on my list of "next to do".

The work herein was initiated during my stay at Harvard University, 2001-2002. There, I learned to love Oliver Hart's prudent analytical approach and Philippe Aghion's contagious enthusiasm. Thank you for being my teachers and advisors.

I am also grateful to my teachers and friends at the Stockholm School of Economics, where I did most of my course work. At various stages, I have benefited from two summers at the World Bank, three months at the University of Oslo, and frequent visits to the Norwegian Institute of International Affairs. At the final stage, editorial assistance from Christina Lönnblad and Annika Andreasson has been deeply appreciated. For financial support throughout the years, I thank Tore Browaldh's Foundation, Jan Wallander's and Tom Hedelius' Foundation, Stockholm School of Economics, the Nordic Academy for Advanced Study, the Norwegian Research Council and Nationalgaven til Chr. Michelsen.

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Chapter 1

Introduction

This thesis comprises three theoretical essays on the organization of cooperation. In all essays, I study institutions affecting the way agents make collective decisions, and I derive the best alternatives. This approach ties the essays together. Nevertheless, they are fundamentally different. Their various assumptions demonstrate that the design of cooperation is important in many contexts: for international institutions, within federations, and within firms. Their different questions illustrate that the organization of collective decisions has many aspects: what decisions should be taken? How? By whom?

The first essay studies a large number of agents, or countries, that must decide whether to undertake a joint public project. An example may be to liberalize the Common Market in the European Union. While some countries benefit from such a project, others might lose. In order to implement the project, it may be sufficient that a fraction of the countries approves. The required fraction that must approve the project defines the majority rule. Relative to the existing literature, my contribution is to give each country a chance to increase its value of the anticipated project by making appropriate investments in advance. Economic liberalization, for example, is more valuable for a country that has done a better job in modernizing its industry. But do countries have the appropriate incentives to invest? The important relationship is between *Majority Rules and Incentives*, as suggested by this title. If the majority rule is large, countries benefiting from the project will have to compensate most of the losers. This creates a hold-up problem, which discour-

ages investments. If the majority rule is small, countries might instead overinvest to avoid being ignored or expropriated, as a minority of losers is likely to be. To balance these opposing forces, I find the optimal majority rule to depend on the expected value of the project, the heterogeneity, and the union's enforcement capacity. This workhorse model is extended in several directions. Strategic delegation turns out to be sincere exclusively under this optimal majority rule. Externalities can be internalized by modifying the majority rule. If countries are heterogeneous with respect to size or preferences (ex ante), it is necessary to give the countries' votes different weights to make all incentives optimal.

In the second essay, there are only two agents, or regions, and both of them must agree to their joint project. Relative to the previous essay, I simplify by letting preferences be exogenous. Instead of assuming these preferences to be common knowledge, however, I let local preferences be local knowledge. While the regions may agree that some kind of agreement is valuable, each region prefers that the other contributes most. This motivates the regions to signal bargaining power by costly delay. While it is well known that bargaining under private information may be inefficient, the contribution of this essay is to explore how the incentives to signal and screen depend on the bargaining agenda. I study whether the regions would benefit if side payments were prohibited, and whether the best bargaining agenda permits - as the title asks - *Uniform or Different Policies?* The benefit of allowing policy differentiation is that local policies can be tied to local conditions. The cost is that the regions become more eager to signal bargaining power by costly delay. I first suppose that the regions negotiate the policy in isolation, before letting them negotiate side payments as well. Allowing for side payments creates gains from trade, and thus beneficial policy differentiation. In addition, regions may signal their preferences by the proposed direction of trade, and delay becomes less necessary as a signaling device. However, introducing side payments may increase the conflict of interests between the regions, and thus the incentives to signal bargaining power. I find the optimal bargaining agenda to depend on the externality, the heterogeneity and the expected value of the agreement. Besides providing normative recommendations for political cooperation, the results contribute to the literature on fiscal federalism. If, as is commonly assumed, political centralization implies that

the policy must be uniform across regions, the results describe when centralization is superior to decentralized coordination. Furthermore, since the regions need to commit to the optimal bargaining agenda in advance, and since political integration improves their ability to commit, the results provide a foundation for the uniformity assumption and characterize when it is likely to hold.

The final essay analyzes the organization of decisions within firms. The employees have aligned preferences – all would like to reduce the firm’s cost – but they may differ in their abilities to do this. In advance, the agents’ abilities are unknown to everyone: information is symmetric but incomplete. After the firms’ performance has been observed, however, the organizational design determines how beliefs about the employees’ abilities are updated. If control is centralized, for example, a single manager receives all blame following upon a failure; all fame following upon a success. This illustrates the relationship between *Organizations and Careers*, the title of the essay. What is the optimal organization design? The contribution of this essay is to combine a theory of organizations with an explicit model of the market. While the organizational design determines the creation of reputations, the value of a certain reputation depends on the structure of the product market. If competition is tough and the market thick, the firm with the best manager is able to capture a large share of the market, and firms are willing to pay a great deal to hire the very best manager. A moderately good reputation is not sufficient. Thus, the market structure determines the optimal organizational design. As a function of the market structure, I derive the value of decentralization, first in non-transparent, then in transparent firms, before I study the value of transparency itself. I also compare multidivisional (M-form) corporations with unitary (U-form) corporations, and the choice and turnover of managers. If we believe the product market to have become thicker and more competitive over time, then the model rationalizes recent changes in both organizational design and executive pay.

Essay	Context	Problem	Solution
<i>Majority Rules and Incentives</i>	Unions	Moral hazard	Majority rules
<i>Uniform or Different Policies?</i>	Federations	Private information	Bargaining agenda
<i>Organizations and Careers</i>	Firms	Uncertainty	Allocate control

The above table compares the contexts, assumptions, and questions in the three

essays. While the first two essays study cooperation in federal unions, the last essay analyzes the organization of firms. The problem in the first essay is to give agents appropriate incentives to invest. Lacking incentives is a kind of ex ante transaction cost. In the second essay, ex post transaction costs arise due to asymmetric information. The problem in the third essay is that talent is unknown to everyone. In the first essay, the problem is mitigated by selecting the appropriate majority rule, in the second by modifying the bargaining agenda, in the third by allocating control.

In isolation, each of the three essays is a tiny vector in the world of cooperation. Thanks to their different assumptions and focus, however, together they span a large space. Future research may combine the models in various ways to address old questions by old arguments, still obtaining new insights. The internal allocation of control is important for federations and political parties – not only for firms. The choice of majority rules is important for parliamentary systems and corporate boards – not only for the European Union. Side payments are controversial in many contexts. While side payments define trade in the market, transactions within a firm are typically characterized by the absence of side payments. Whether side payments are good for a particular transaction thus ought to determine the boundary of the firm.

Chapter 2

Majority Rules and Incentives^{*}

1 Introduction

On July 10, 2003, the European Convention completed its Draft Treaty establishing a constitution for the European Union. This winter, the Draft is likely to be discussed and disputed both nationally and in Brussels. If implemented, it will be the most fundamental reform in the EU since the Treaty of Rome. Central in this debate is the particular majority rule, defining the fraction of approval votes required for a proposal to replace the status quo. The Convention suggests that qualified majority voting is extended to several issues requiring unanimity in the past. Furthermore, the definition of "qualified majority" is suggested to be reduced from 71% to 60%.¹

Majority rules have been debated as long as the EU has existed. The Treaty of Rome in 1957 intended to use majority voting for most issues, but the Luxembourg Compromise in 1966 effectively gave each member country a veto for issues of "vital interest". In 1986, the Single European Act established qualified majority voting for issues related to the internal market. The range of issues to which majority voting applies was further extended by the Maastricht Treaty in 1992 and the Treaty of Nice in 2000. Each extension of majority voting is celebrated as a victory for supporters of further integration.

^{*} I am indebted to my advisor Torsten Persson for his continuous support. I have also benefited from the comments of Philippe Aghion, Geir B. Asheim, Guido Friebel, Oliver Hart, Jo Thori Lind, seminar participants at IIES, Stockholm School of Economics and the 2003 SAET conference. Thanks also to Christina Lönnblad for editorial assistance. Financial support from the Tore Browaldh Foundation is gratefully acknowledged.

¹ See <http://european-convention.eu.int>.

If everyone agrees, public decisions offer no challenge. Majority rules are important because in most public projects, some gain while others lose. What determines whether a country will gain or lose? For many and perhaps most kinds of public projects, a country's domestic policy today influences its value of the project tomorrow. The value of the project might be affected unintentionally by domestic considerations, or directly by preparation for the reform. Before the policy is determined in Brussels, it might indeed be crucial that countries invest in order to increase their values (or reduce their costs) of the project. Otherwise, implementing the project might not be worthwhile. As an example, consider liberalization of public utilities (post, electricity or public transports). So far, the European Commission has been reluctant to propose liberalization. Whether it will do so in the future is likely to depend on the extent of privatization, or the inefficiency of governmental provision. Already today, countries across Europe privatize and modernize their public sectors, perhaps in the anticipation of such a reform.² But do countries have appropriate incentives to invest? How do these incentives depend on the majority rule? What determines the optimal majority rule?

This paper provides a three-stage model of collective decisions. At the constitutional stage, members of a club select a majority rule. At the investment stage, each member, or agent as I will call her, chooses a level of investment which thereafter affects her value of some anticipated public project. Preferences are also affected by individual and aggregate shocks. At the legislative stage, a majority coalition is formed and proposes a set of side payments and whether the project should be implemented. The proposal is executed if it is approved by the required majority.

Solving the game by backward induction, we can derive the legislative outcome, equilibrium investments and the optimal majority rule. It is shown that when transaction costs vanish, the project is implemented if and only if it is socially efficient, whatever is the majority rule. The reason is that the majority coalition captures the entire value of the project if it is implemented, while it fully expropriates the minority in any case.

At the investment stage, agents face two strategic concerns. On the one hand, investments affect their bargaining power. A multilateral hold-up problem ensures

² See Parker (1998) for an overview of recent privatization in Europe.

that agents benefiting more from the project are expropriated or must compensate those benefiting less. On the other hand, investments increase their probability of obtaining political power, i.e. of becoming members of the majority coalition, since this coalition will consist of the agents most in favor of the project. If the majority rule is small, political power is very beneficial since few losers need to be compensated and a large minority can be expropriated. To improve the chances of become a member of the majority coalition, each agent invests too much. If the majority rule is large, political power is less attractive, the hold-up problem dominates, and agents invest too little. To balance the encouraging effect on political power and the discouraging effect on bargaining power, the majority rule should depend on the expected value of the project, the club's enforcement capacity (or minority protection) and ex post heterogeneity.

Besides generating insight in itself, this simple model is useful as a workhorse pulling more realistic frameworks. It is shown that, exclusively at the optimal majority rule, delegation of bargaining authority is sincere and private information is truthfully revealed. Positive (negative) externalities can be internalized by a smaller (larger) majority rule. The simple legislative game can be generalized to discuss bicameralism, presidency and rotating representation (e.g. in the Commission, as proposed by the Convention). If there is heterogeneity with respect to size or preferences ex ante, no majority rule might induce all agents to invest optimally. Instead, the agents' votes should be weighted properly and rotating representation is required.

The model is general and relevant for a wide range of collective decisions in public economics³, nationally⁴, and in corporate governance⁵. Still, the European Union

³ Another example fitting this framework is related to macroeconomic stabilization. Regional representatives in the national parliament might, at some legislative stage, negotiate the size of the national deficit and how the costs of stabilization should be distributed across regions. Ahead of this, each region may be able to reduce its own regional deficit by choosing the appropriate policy. Such policies will certainly affect its value of national stabilization at the legislative stage. Other examples include agricultural liberalization, the introduction of a common currency, environmental agreements, or the decision to go to war.

⁴ Parliamentary majority rules differ across countries. Mueller (1996) reports that Finland's constitution requires a two-thirds majority for all important decisions, and a five-sixths majority for decisions involving property rights.

⁵ Collective decisions by shareholders are typically taken by majority rule. The project under consideration may be the firm's investment or production strategy (DeMarzo, 1993), or to act

appears to fit tightly to the description, and several of the model's predictions are supported. Normative recommendations are also derived.

The debate on majority rules did not start with the European Union. Already Rousseau (1762) compared unanimity with rules requiring smaller majorities, and Condorcet (1785) is famous for his Jury Theorem; advocating the simple majority rule as the best way of aggregating information. More than a century ago, Wicksell (1896) advocated the unanimity rule as the only rule guaranteeing that only good projects are accepted. However, Buchanan and Tullock (1962) argued that the majority rule should trade off the costs of expropriating the minority (emphasized by Wicksell) against "decision-making costs" increasing with the majority rule. They did not, though, clarify what these decision making costs are. More formally, Aghion and Bolton (2003) compare the costs of expropriating the minority to the possibility of compensating the losers to derive the optimal majority rule. A similar trade-off is studied by Aghion, Alesina and Trebbi (2002) who, in addition, point to the *costs* of compensating losers.⁶

As I discuss in section 5, controversies in this literature typically arise from different assumptions about side payments. In such a context as the European Union, however, side payments are difficult to neglect. In fact, structural funds were invented to compensate the UK for the Union's agricultural policy, and the cohesion funds were introduced to convince the Mediterranean countries to accept the Single European Act. For European decision-making in general, Kirchner (1992, p. 134) finds that package deals *are built on coalitions among like-minded governments and often involve trade-offs or side-payments*. As he notices, side payments can take the form of logrolling and issue linkages as well as just redefining the project.

upon a takeover bid (Grossman and Hart, 1988, Harris and Raviv, 1988). Strategic delegation may certainly be an issue before the shareholders vote. It might also be possible for shareholders to affect their value of the project by e.g. reducing their individual risk (aversion) by investing in other assets.

⁶ These trade-offs are also discussed in the literature on corporate governance: see the previous footnote. In the public choice literature, other aspects of the majority rule are often emphasized. An early strand of literature (surveyed by Enelow, 1997) emphasizes Condorcet cycles, and argues that the majority rule should be sufficiently large to prevent cycles. Barbera and Jackson (2003a) examine majority rules that are stable and induce agents to select themselves as a decision rule. Maggi and Morelli (2003) observe that majority rules must be enforced and derive the best enforceable majority rule. The literature is far too large to survey in this paper - see instead Chapters 4-8 in Mueller (1989). To my knowledge, no other paper focuses on incentives.

While the literature on majority rules analyzes majority rules under different assumptions, the traditional public choice literature takes individual values as given: whether you win or lose from a project is simply exogenously drawn by Nature. This is in contrast with the present paper, which instead emphasizes agents' incentives to become winners.

Hold-up problems are certainly studied in bilateral contexts. Suggested institutional remedies include appropriate allocations of ownership (Grossman and Hart, 1986),⁷ authority (Aghion and Tirole, 1997) and status quo (Aghion, Dewatripont and Rey, 1994). In international contexts, the importance of the hold-up problem is recognized by e.g. McLaren (1997) who shows how prior adjustments to trade liberalization may dramatically reduce a country's bargaining power. Wallner (2003) similarly suggests that a hold-up problem hurts potential entrants to the EU which undertake reforms prior to acceptance. The present paper contributes to the literature on the hold-up problem by showing how multilateral hold-up problems can either arise or be mitigated by particular majority rules.

Also in political economics are there several recent papers discussing the effects of political regimes on incentives. Persson and Tabellini (1996) study how regional moral hazard depends on whether interregional distribution is decided by voting or bargaining. Anderberg and Perroni (2003) argue that the majority's power to design politics induces agents to imitate the majority. Relative to unanimity, majority voting can therefore support an equilibrium with less moral hazard. In a context with such incentives, the particular choice of majority rule is, to my knowledge, only discussed by Persico (2000). He focuses on investments increasing information about the project's common value. The probability of becoming a pivotal voter determines the incentives to search for such information. These incentives are vastly different from the investment in private values, studied in this paper.

That agents may have incentives to delegate to gain political power is noticed by Baron and Ferejohn (1989), who show that legislators with low bargaining power have better chances of becoming coalition members. Chari, Jones and Marimon (1997) discuss how this induces voters to elect representatives biased in favor of the public good. Brueckner (2000) finds these incentives to delegate to depend on the

⁷ Hart and Moore (1990) study optimal ownership in a multilateral hold-up problem.

extent to which unanimity is required. I take his point further by showing how the majority rule affects the incentives to delegate, and what determines the optimal rule. To my knowledge, the incentive to gain political power has never before been combined with the hold-up problem to show how these two opposing forces might be balanced.

The remainder of the paper is organized as follows. Next section presents a simple model of collective decisions. Section 3 solves this game by backward induction: incentives are found to depend on the majority rule, and the optimal majority rule is characterized. This workhorse model is then extended to discuss strategic delegation, externalities, the legislative game, and heterogeneity in size and preferences. To review, section 5 contrasts all these results to the case without side payments. Future research is discussed in the final section.

2 The Model

A continuum of identical agents $I \equiv [0, 1]$ are playing the following game.⁸ On day 0, the constitutional stage, they select a majority rule $m \in (0, 1]$ defining the required fraction of agents that must approve a policy on day 2 before it replaces the status quo. Since all agents are identical at this stage, they all prefer the same majority rule.

On day 1, the investment stage, each agent $i \in I$ makes some non-contractible investment x_i at the private cost $c(x_i)$. The function c is increasing, convex, and continuous differentiable. The purpose of this investment is to increase the benefit or reduce the cost of a particular public project that may be undertaken on day 2. Formally, after the investments have been chosen, agent i 's net value of the project is drawn to be

$$v_i = \theta + x_i + \epsilon_i, \tag{2.1}$$

⁸ The analysis becomes much less tractable if there is a discrete number n of agents. The intuition for the following results prevails, however. But when n is small, each agent does care about whether its investment increases total welfare, since she is expected to capture at least $1/n$ of this. As n grows, $1/n$ declines and the hold-up problem increases. To ensure sufficient incentives to invest, the majority rule should decrease. This is indeed the recommendation by the European Convention when the EU now accepts more members. By assuming a continuum of agents, the results below are exact when $n \rightarrow \infty$.

where θ and ϵ_i are some aggregate and individual shocks, respectively. The ϵ_i s are conveniently assumed to be independently drawn from a uniform distribution with mean zero and density $1/\mu$;

$$\epsilon_i \text{ iid } \sim U \left[-\frac{\mu}{2}, \frac{\mu}{2} \right].$$

If all agents invest the same amount, then μ measures the ex post heterogeneity in the agents' values of the project. The state of the world θ is the average and the expected net value of the project if the agents do not invest. θ may be negative, since it includes the cost of the project. θ is common for all agents, and it is drawn from a uniform distribution with an average of a and density $1/\sigma$;⁹

$$\theta \sim U \left[a - \frac{\sigma}{2}, a + \frac{\sigma}{2} \right].$$

a measures the project's expected value (without investments), and σ is a measure of the variance in total value.¹⁰

After the total and individual values have been observed by everybody, the legislative stage begins on day 2. First, an initiator (or president) is randomly drawn from the population. The initiator selects a minimum winning coalition $M \subset I$ of mass m to form the majority.¹¹ Second, the members of M negotiate a political proposal. All members of the majority coalition must agree before the proposal is submitted for a vote. A proposal specifies whether the project should be implemented as well as a set of individual transfers or taxes t_i . These taxes must fulfill the budget constraint, which is $\sum_{i \in I} t_i = 0$ if transaction costs are negligible. The cost of the project, remember, is included in the parameter θ . Third, the vote takes place. Two conditions must be met for the proposal to be implemented. Crucially, it must be approved by a mass m of agents. Otherwise, all agents receive the status quo payoff of zero (added to their sunk cost of investment $c(x_i)$). A minimum win-

⁹ Both ϵ_i and θ are assumed to be uniformly distributed. The essence of the results continue to hold, however, even if the distributions are general.

¹⁰ To be precise, the variance of θ is $\sigma^3/12$.

¹¹ Here, I simply adopt the Size Principle by Riker (1962, p. 32), which he states as follows: *In n-person, zero-sum games, where side-payments are permitted, where players are rational, and where they have perfect information, only minimum winning coalitions occur.* Section 4.3 relaxes this assumption.

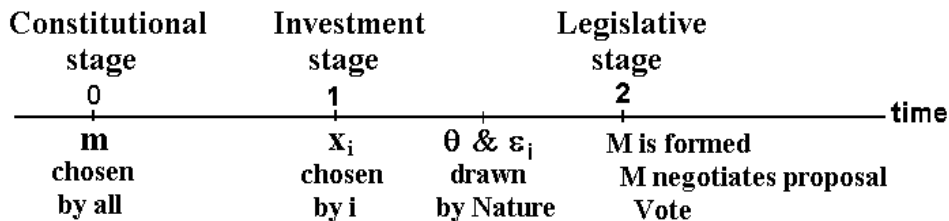


Figure 2.1: Timing of the game

ning coalition M of size m can therefore dictate the policy to some extent. However, the proposal must also be *accepted* by *all* agents, in the sense that no agents should prefer to deviate and "break" the constitution to avoid implementing the project. If some agents break the constitution, the policy will remain at the status quo, though the deviators receive utility $-r$. The r might be interpreted as the fine deviators must have to pay. In some cases, r might be a constitutional parameter, limited in order to protect minorities. In the EU, for example, the Luxembourg Compromise of 1966 allows a country to veto a proposal if it threatens its "vital" interests. In other cases, r might be limited by enforcement capacity. If the club's enforcement capacity is created by repeated interaction and trigger strategies, where deviation today terminates cooperation forever (as in Maggi and Morelli, 2003), then r reflects an agent's present value of continued cooperation.¹² In any case, the project is accepted and implemented if and only if the agents' payoffs relative to the status quo,

$$u_i = v_i - t_i,$$

are positive for a mass m of agents, and larger than $-r$ for all.

¹² If days 1-2 are repeated every year, then $r \equiv \sum_{t=1}^{\infty} \delta^t [\mathbb{E} \max\{0, \theta + \hat{x}\} - c(\hat{x})]$ where δ is the yearly discount factor, \hat{x} the equilibrium investment, and where it is assumed that (i) the project is implemented if and only if it is good ($\theta + \hat{x} \geq 0$) and (ii) these gains are expected to be evenly spread across the population. This makes the enforcement capacity r an increasing function of the discount factor δ .

3 The Solution

This section solves the game by backward induction to derive its unique subgame-perfect equilibrium. As a benchmark, observing the first-best outcome is worthwhile. Social efficiency is defined by the sum of utilities, or, equivalently, as an agent's expected utility. At the legislative stage, executing the project is optimal if and only if the project is "good", meaning that its total value $\int_I v_i di = \theta + x \geq 0$, where x denotes average investment.¹³ Under this implementation-rule, the optimal effort level at the investment stage is determined by

$$\begin{aligned} \text{Max}_x E \int_{-x}^{a+\frac{\sigma}{2}} (\theta + x + \epsilon_i) \frac{d\theta}{\sigma} - c(x) &\Rightarrow \\ c'(x^*) = q(x^*) &\equiv \int_{-x^*}^{a+\frac{\sigma}{2}} \frac{d\theta}{\sigma} = \frac{1}{\sigma} (a + x^*) + \frac{1}{2}, \end{aligned} \quad (2.2)$$

where $q(x^*)$ is the probability of the project being good ex post. The second-order condition is $\sigma c''(x^*) \geq 1$, which I assume to be fulfilled.¹⁴

3.1 Majority Rule Irrelevance

Let us now solve the final legislative stage of the game. To maximize surplus, any majority coalition M will ensure that all agents in the minority $N \equiv I \setminus M$ receive exactly their reservation utility of $-r$ by setting taxes such that

$$t_i = v_i + r \quad \forall i \in N.$$

If any $i \in N$ obtained less utility, that agent would not accept the policy and the majority would receive nothing. If any $i \in N$ obtained more than $-r$, that agent could be taxed more and these revenues could be distributed within the majority.

¹³ For this and similar integrals to be defined, v_i is assumed to be piecewise continuous in i .

¹⁴ The optimal x^* is only implicitly defined by (2.2). If $c(x) = kx^2/2$, the explicit solution for x^* is $x^* = (a + \sigma/2)/(k\sigma - 1)$ and the second-order condition is $1 - k\sigma \leq 0$. If instead $1 > k\sigma$, then (2.2) shows the *ArgMin* w.r.t. x .

Thus, the majority coalition is taxing an agent $i \in N$ more if v_i is large, since i is then more willing to accept the project. This negative effect of a larger v_i on t_i may be interpreted as a loss of bargaining power, and it completely nullifies the positive direct effect of v_i on u_i (for $i \in N$, $u_i = -r$, notwithstanding v_i).

It is often argued that distortions or transaction costs arise when agents are taxed. Suppose this is the case (although I will soon let the transaction costs vanish). Transaction costs can be formalized in several ways; for simplicity, I follow Aghion and Bolton (2003).¹⁵ For each unit expropriated by the minority, a fraction λ measures the deadweight loss. The total surplus available for the majority is then

$$\int_M v_i di + \int_N (v_i + r)(1 - \lambda) di, \quad (2.3)$$

if the project is proposed.¹⁶ Otherwise, the total surplus for the majority is

$$\int_N r(1 - \lambda) di. \quad (2.4)$$

The allocation of this surplus is determined by multilateral negotiations within the majority coalition. If the negotiations fail, the status quo remains. Though it might not be obvious how to define the bargaining game with a continuum of players, I let the solution be characterized by the Nash bargaining outcome for a finite number of players.¹⁷ This outcome coincides with the Shapley value when all

¹⁵ The following argument is quite general, and several formalizations of transaction costs lead to the same conclusions. For example, there might be non-linear transaction costs on expropriation as well as compensations, for minority as well as for majority members. Since this is not necessary for the argument, a simplified version is chosen.

¹⁶ It is here implicitly assumed that $v_i + r \geq 0 \forall i \in N$.

¹⁷ Nash's axiomatic theory for bilateral bargaining extends to multilateral situations unchanged. Since the default outcome gives zero utility for all, the Nash bargaining outcome follows from maximizing the Nash product

$$\begin{aligned} \text{Max} \prod_{\{t_i\}_i}_{i \in M} (v_i - t_i) \quad \text{s.t.} \quad \sum_{i \in M} t_i &= -\sum_{i \in N} (1 - \lambda) t_i \\ \text{and s.t.} \quad v_i - t_i &\geq -r \quad \forall i \in N, \end{aligned}$$

if the number of agents is finite and their utilities transferable. This ensures that all agents in the majority coalition receive the same utility $v_i - t_i$. Utilities are transferable within the coalition only if there are no transaction costs in transferring a surplus within the majority. This is also

coalition members have veto power, and it is a likely outcome of non-cooperative bargaining.¹⁸ It ensures that all members of the majority coalition receive the same surplus. This is achieved when coalition members with large v_i s subsidize coalition members with lower v_i s. Intuitively, a coalition member with a high value v_i has correspondingly low bargaining power, since she is eager to implement the project. Other members are then able to hold up i by requiring side payments to accept the project. As for bilateral negotiations, the value of cooperation is equally shared. As were the case for minority members, also majority members lose bargaining power when v_i is large, and this negative effect neutralizes the positive direct effect of v_i on u_i (for $i \in M$, u_i is the same, notwithstanding v_i).

If the initiator does not find implementing the project worthwhile, all minority members will be taxed by r and the initiator has no preferences for the composition of the majority coalition. Suppose then that the initiator selects coalition members randomly. If the project is to be implemented, instead, any initiator prefers to form the majority coalition with the agents having the highest possible values v_i s (to maximize (2.3)). These "winners" of the project do not need to receive (much) compensation to approve the project; they are instead ready to compensate others.¹⁹ Thus, there is a positive effect of v_i on i 's political power. If the agents undertake the same investment x on day 1, individual values on day 2 will be uniformly distributed with the mean $\theta + x$ and density $1/\mu$. The majority coalition consists of the upper

assumed by Aghion and Bolton (2003).

¹⁸ In general, there exist multiple subgame-perfect equilibria to multilateral bargaining situations. Krishna and Serrano (1996) allow each player to exit with its share of the surplus following some proposed allocation. Then, they obtain a unique equilibrium outcome coinciding with the multilateral version of the Nash bargaining solution when the discount factors between successive offers approach one (see their Theorem 1'). In this outcome, everyone receives the same utility if utility is transferable. A similar justification is provided by Hart and Mas-Colell (1996).

¹⁹ To some extent, the winners' surplus could be expropriated even if these were in the minority, but parts of these tax revenues would disappear as transaction costs. Moreover, as in the model by Aghion and Bolton (2003), there might be some binding limit w on how large the taxes can be, making the total surplus for the majority equal to $\int_M v_i di + \int_N w di$. Such a limit could be interpreted as another form of transaction costs. The surplus expropriated from the minority would then be fixed $w(1 - m)$, while the coalitions' surplus would increase in each v_i , $i \in M$. Even with an arbitrarily small probability for such a limit on taxation, the initiator strictly prefers to select the agents with the highest v_i as coalition members. This is also the case in the legislative game suggested by Aghion, Alesina and Trebbi (2003), and it is directly assumed by Aghion and Bolton (2003).

m fractile of this interval, i.e. $[v_m, \theta + x + \mu/2]$, where²⁰

$$v_m \equiv \theta + x + \frac{1}{\sigma} \left(\frac{1}{2} - m \right).$$

Hence, if the project is implemented, an agent i 's political power can be described as

$$\begin{aligned} i &\in N \text{ if } v_i < v_m \text{ and } m < 1 \\ i &\in M \text{ if } v_i \geq v_m \text{ or if } m = 1. \end{aligned}$$

To maximize their total surplus, the majority coalition will implement the project if and only if

$$\begin{aligned} \int_M v_i di + \int_N (1 - \lambda)(v_i + r_i) di &\geq \int_N (1 - \lambda)r_i di \Rightarrow \\ \int_M v_i di + \int_N (1 - \lambda)v_i di &\geq 0. \end{aligned}$$

Since the lowest values v_i are discounted by $(1 - \lambda)$, the majority may implement the project even if it is not socially optimal. For this reason, Wicksell (1896) recommended that decisions should be taken by unanimity. However, Buchanan and Tullock (1962) argued that this would create large decision-making costs, but they did not specify what these costs might be. Aghion and Bolton (2003), on the other hand, assume that wealth constraints make the project impossible to finance if all losers must be compensated. As all transaction costs vanish, however, the condition for implementing the project becomes

$$\lim_{\lambda \rightarrow 0} \int_M v_i di + \int_N (1 - \lambda)v_i di = \theta + x \geq 0,$$

which coincides with the social optimal condition - whatever the majority rule is! Without transaction costs, the majority coalition captures the project's entire value

²⁰ The initiator, randomly drawn from the entire population, may of course have a low value of the project, but her size is negligible.

if it is implemented, while it fully expropriates the minority in any case. The majority will then only implement projects raising total welfare. That the selection of projects becomes efficient when transaction costs disappear indicates that the Coase Theorem has bite, even if only a fraction m of the agents has political power. The utilities become

$$u_i = \left\{ \begin{array}{ll} u_N \equiv -r & \text{if } i \in N \\ u_M \equiv \frac{\theta + x + r(1-m)}{m} & \text{if } i \in M \end{array} \right\}. \quad (2.5)$$

Proposition 1: The selection of projects is always optimal when transaction costs vanish: the majority rule does not matter.

The irrelevance of the majority rule might not surprise practitioners in the European Union.²¹ In the Uruguay round, a liberalization of the Common Agricultural Policy was rejected, despite the fact that France, as the single opponent, could not formally block the reform. The Single European Act was implemented despite the fact that the UK, which opposed the reform, could have vetoed it. Instead, the UK was compensated to accept.²² That the selection of projects does not depend on the majority rule does not imply, of course, that countries are indifferent to which rules are used. UK appreciates its veto, since it would not have been compensated without it. However, the irrelevance result above does suggest that the prime importance of the majority rule may not be to select the right projects. Instead, I argue, the effects on incentives might be much more important. To emphasize this, and to avoid somewhat ad hoc transaction costs, transaction costs are henceforth assumed to be negligible.

3.2 Equilibrium Investments

Having solved the legislative game, we are now ready to study the investment decision on day 1. When an agent i decides how much to invest x_i in order to increase her value v_i of the project, she realizes that a larger v_i affects her utility u_i in three

²¹ In other contexts, e.g. if there is incomplete or asymmetric information (as in Condorcet, 1785), the majority rule may still be important for the selection of projects.

²² For discussions of these cases, see George and Bache (2001).

ways. First, there is the direct effect, holding t_i constant. If the project is implemented, it is certainly better to be prepared. But t_i is not constant: it depends on v_i . Notwithstanding if $i \in M$ or $i \in N$, a high v_i raises t_i correspondingly. This is a multi-agent hold-up problem which discourages investments. As a third effect, however, whether $i \in M$ or $i \in N$ is also depending on v_i . A high v_i might increase i 's *political power* since, as argued above, a high v_i makes i a more attractive coalition partner, and less likely to be neglected as a minority member. Thus, i might invest in order to race for political power.

Anticipating that the other agents' values are uniformly distributed with mean $\theta + x$ and density $1/\mu$, i realizes that her probability of becoming a majority member is

$$p(x_i) = \Pr(v_i \geq v_m) = m + \frac{1}{\mu}(x_i - x), \quad (2.6)$$

if $m < 1$ and $\theta \geq -x$. If it turns out that $\theta < -x$, the project will not be implemented, the selection of M is random and each agent's expected utility is zero. Agent i 's problem is

$$\text{Max}_{x_i} \int_{-x}^{a+\frac{\sigma}{2}} [p(x_i)u_M + (1 - p(x_i))u_N] \frac{d\theta}{\sigma} - c(x_i), \quad (2.7)$$

which gives the first-order condition

$$c'(\hat{x}_i) = \frac{q}{\mu}(u_M - u_N) = \frac{q}{\mu} \left(\frac{\tilde{v} + r}{m} \right), \quad (2.8)$$

where

$$q \equiv \int_{-x}^{a+\frac{\sigma}{2}} \frac{d\theta}{\sigma} = \frac{1}{\sigma}(a + x) + \frac{1}{2} \quad (2.9)$$

is the probability of a good project and

$$\tilde{v} \equiv E[\theta | \theta \geq -x] + x = \frac{1}{2} \left(a + x + \frac{\sigma}{2} \right) \quad (2.10)$$

is the expected value of a good project.²³ The second-order condition is trivially

²³ An interior solution is implicitly assumed for x_i . To be exact, however, (2.6) should be written

fulfilled.

Since the left-hand side of (2.8) increases in \hat{x}_i , i 's optimal investment \hat{x}_i decreases with the majority rule m . With a smaller majority rule, there is less need to compensate losers within the majority coalition and the number of exploitable minority members is larger. Moreover, since the size of the majority coalition m decreases, the surplus per member of the coalition increases. For these reasons, if m decreases, the gains from political power increase, as do the incentives to invest. For a small m , the agents may invest considerably in their race for political power. For a large m , the benefit of political power is low and the hold-up problem ensures that investments are low. Investments \hat{x}_i increase in the enforcement capacity r , because a larger r reduces the payoff of the minority, while it increases the surplus shared within the majority. This increases the value of political power. A smaller ex post heterogeneity μ in the individual values further encourages investments, since even a marginally larger v_i then raises the chances of becoming a majority member quite considerably.

The first-order condition (2.8) shows that i 's investment increases in the probability q of a good project. Unless the project is good, the majority coalition will be random and the investment is useless in generating political power. For a fixed probability q , the incentives to invest also increase in the expected value \tilde{v} of a good project, since a larger \tilde{v} increases the value shared within the majority. This makes i more eager to become a majority member, and to increase this probability, i invests more.

as

$$p(x_i) = \begin{cases} 0 & \text{if } m + \frac{1}{\mu}(x_i - x) < 0 \\ m + \frac{1}{\mu}(x_i - x) & \text{if } m + \frac{1}{\mu}(x_i - x) \in [0, 1] \\ 1 & \text{if } m + \frac{1}{\mu}(x_i - x) > 1 \end{cases},$$

which makes the solution to (2.7) $x_i = x - \mu(1 - m) \Rightarrow p(x_i) = 1$ if $m + (\hat{x}_i - x)/\mu > 1$, where \hat{x}_i is defined by (2.8). This can clearly not be the case for all agents (since then $x_i = x$): x would increase until $m + (\hat{x}_i - x)/\mu < 1$ and the solution becomes interior. Since $p(x_i)$ is not concave in the entire interval, the local optimum \hat{x}_i should be compared to the other local optimum of $x_i = 0$, if this makes $m + (x_i - x)/\mu < 0$. $x_i = 0$ is the better choice if $p(\hat{x}_i)(u_M - u_N) < c(\hat{x}_i)$. If an increasing number of agents choose $x_i = 0$, x decreases as does the left-hand side of this inequality (since $p(x_i)$ decreases in x) until the inequality holds with equality. It will then be a mixed strategy equilibrium where the agents are indifferent about whether to invest $\hat{x}_i > 0$, and only a fraction of them do so. To simplify, I assume μ to be so large that multiple or mixed strategy equilibria do not arise. See, however, section 4.5 where I allow agents to be heterogeneous on day 1. Then, both corner solutions of x_i exist in equilibrium.

Combined, (2.8)-(2.10) show that i 's optimal investment \hat{x}_i increases in the project's average value a for two reasons: first because a larger a increases the probability q of the project being implemented, and second because a larger a increases the benefits \tilde{v} shared within the majority. i 's investment increases in the average level of investment x for the same two reasons, since x and a have identical effects on the project's value ex post. This raises the question of whether the equilibrium is stable. Consider the equilibrium defined by (2.8) and $\hat{x}_i = x = \hat{x}$, namely

$$c'(\hat{x}) = \frac{1}{2m\mu\sigma} \left(a + \hat{x} + \frac{\sigma}{2} \right) \left(a + \hat{x} + \frac{\sigma}{2} + 2r \right). \quad (2.11)$$

The equilibrium is stable indeed if c is sufficiently convex, which I henceforth assume.²⁴ We can then state:

Proposition 2: Equilibrium investment \hat{x} increases in the project's value a and the club's enforcement capacity r but decreases with ex post heterogeneity μ and the majority rule m , if $m < 1$. If $m = 1$, $\hat{x} = 0$.²⁵

If the majority rule is large, investments are low and few projects turn out to be worthwhile implementing. Hence, a large m creates a status quo bias because agents do not invest sufficiently. The Draft Treaty, suggesting changes from 2009 onwards, should thus have immediate effects on incentives. This contrasts the conventional

²⁴ The equilibrium is stable if $\partial x_i / \partial x \leq 1$ in (2.8), which requires that $c''(\hat{x}) \geq (a + \hat{x} + r + \sigma/2) / \mu\sigma m$. If $c'(0) = 0$ and $a + \sigma/2 > 0$, then the right-hand side of (2.8) lies above the left-hand side for $x_i = x = 0$. The first time the left-hand side crosses the right-hand side when x increases, c' crosses from below, which ensures that this fixed point is a stable equilibrium. That $\partial x_i / \partial x \leq 1$ also guarantees that the parameters' effects on \hat{x}_i , for x fixed, are similar for the equilibrium \hat{x} . The explanation for this derives from implicitly deriving x_i w.r.t. an arbitrary parameter z where $c'(x_i) = f(x, z)$. This gives $c''(x_i)(dx_i/dz) = f_x(dx/dz) + f_z$ and since $dx_i/dz = dx/dz$ in equilibrium, this implies that $dx/dz = f_z / (c''(x_i) - f_x)$. Strict stability requires that $\partial x_i / \partial x < 1 \Rightarrow f_x / c''(x_i) < 1$, which ensures that $\text{sign}(dx/dz) = \text{sign}(f_z)$.

²⁵ Note the discontinuity in \hat{x} when m increases to 1. While \hat{x} might be substantial even if m is just marginally smaller than 1, \hat{x} drops to zero if m becomes exactly 1. The reason is that if $m = 1$, i is certain of becoming a majority member, even if v_i is the lowest value by far. Political power is guaranteed and the hold-up problem ensures that i has no incentives to invest. If instead $m < 1$, i knows that *some* agents will be excluded from the majority, and this will be the agents with the smallest v_i . Even if i 's probability of being excluded from the majority is very small, this probability decreases by $1/\mu$ if x_i increases by one marginal unit. However, if the individual shock ϵ_i had a bell-formed probability density function, then, as $m \rightarrow 1$, $\Pr(v_i < v_m)$ is approaching zero, as is the equilibrium investment \hat{x} . Then, there is no discontinuity.

wisdom (see e.g. Buchanan and Tullock, 1962), arguing that the status quo bias under a large majority rule is due to a less frequent (ex post) selection of projects.

3.3 The Optimal Majority Rule

To find the optimal majority rule at the constitutional stage, the equilibrium investment level \hat{x} in (2.11) should be compared to the socially optimal investment level x^* , derived in section 2 and defined by (2.2). While this optimal investment level is obviously independent of the majority rule m , equilibrium investment is not. For a larger m , more project-losers must be included in the majority coalition, and these need to be compensated. Moreover, the minority exploited by the majority is smaller, and the majority's surplus is shared between more members. For these reasons, political power motivates little and the hold-up problem dominates. Agents are then likely to underinvest.

If the majority rule m is very small, the majority coalition consists of an elite where each member receives a large share of the total surplus. Few agents need compensation and a large minority can be expropriated. This makes political power very attractive, and its prospects encourage investments more than it is discouraged by the loss of bargaining power. Agents are then likely to overinvest. These opposing forces are appropriately balanced if the majority rule makes $\hat{x} = x^*$. Comparing (2.2) and (2.11) reveals that this requires

$$m^* = (\tilde{v} + r) / \mu = (a + x^* + 2r + \sigma/2) / 2\mu, \quad (2.12)$$

if the resulting $m^* < 1$.²⁶

If the heterogeneity μ is small, the agents' values are closely concentrated. By investing just a little, i can then increase her probability of becoming a majority member quite by quite a lot. The individual return to investments is then high. If the

²⁶ If the m^* defined by (2.12) is such that $m^* \geq 1$, implying that there is overinvestment for any $m < 1$, the optimal investment level x^* is not attainable by a pure (non-random) majority rule. The second-best choice is then either the majority rule $m = 1$, making $x = 0$ in equilibrium, or a marginally smaller majority rule which implements the \hat{x} defined by (2.11) and $m = 1$. The latter is the better choice if $q(\hat{x})\tilde{v}(\hat{x}) - c(\hat{x}) \geq q(0)\tilde{v}(0)$. If the individual shock ϵ_i has a bell-shaped probability density function, however, \hat{x} approaches zero as m approaches 1. Then $m^* \in (0, 1)$ always applies. For this reason, I henceforth assume m^* to be interior.

enforcement capacity r increases, the minority is expropriated more and it becomes more attractive to be a majority member sharing these revenues. If there is an increase in the project's value a , it is possible to tax the minority more and the larger total surplus shared by the majority coalition makes political power more beneficial. Any of these changes make gaining political power more easy or attractive, and the incentives to invest increase. To ensure that the level of investments remains optimal, the majority rule must increase to discourage overinvestments.^{27,28}

Proposition 3: The optimal majority rule m^* (2.12) increases in the project's value a and the club's enforcement capacity r , but decreases in ex post heterogeneity μ .

Proposition 3 states that political issues of small average values but large heterogeneities should be taken by small majority rules. The EU's Common Agricultural Policy and its structural funds are characterized by distribution and resemble zero-sum games, while the heterogeneity in preferences typically is large. These decisions are currently taken by a qualified majority rule. International agreements, however, are package deals likely to spread the benefits more evenly, and they are typically (according to economists) of large average value. According to the theory, such decisions are indeed taken by a larger majority rule in the EU (namely by unanimity). As the EU expands, heterogeneity is likely to increase and the optimal majority rule should decrease. This fits history well.^{29,30}

4 Extensions

Since the model in the previous section is so simple, it is a useful workhorse on which more realistic frameworks can be placed. This section employs the model to discuss delegation, externalities, the legislative game, and heterogeneity in size and

²⁷ It should be noted that x^* is a function of a and σ . Since x^* is increasing in a , the positive effect of a on m^* is reinforced. The overall effect of σ is ambiguous, however.

²⁸ The positive effect of a and the negative effect of μ on m^* are in contrast to Proposition 1 in Aghion, Alesina and Trebbi (2003).

²⁹ If the EU's enforcement capacity r increases over time, however, the optimal majority rule should increase, according to Proposition 3.

³⁰ See Nugent (1996) for a discussion of the different majority rules at that time. The rules proposed by the European Convention can be found at <http://european-convention.eu.int>.

preferences (ex ante). The various extensions are independent, they all start from the model in section 2, and the reader should feel free to pick and choose among them. However, the extensions can be combined in a straightforward way, and I do discuss their intersections when this provides further insights.

4.1 Delegation and Revelation

So far in the analysis, agents invest in the project to gain political power, although the drawback is less bargaining power in the negotiation over the surplus of the project. But bargaining power may be strengthened by other means. Suppose an agent may delegate her bargaining authority to some representative with a difference preference. If this delegate is harder to satisfy, she is taxed less and compensated more notwithstanding if she is in the minority or the majority. Will such strategic delegation be distorting?

Suppose that it is possible for i on day 1 to delegate bargaining authority to some delegate with a d_i lower (or higher, if d_i is negative) value of the project.³¹ The delegate's value of the project is

$$v_{d_i} = v_i - d_i, \quad (2.13)$$

where there might be some convex cost $c_d(d_i)$ associated with strategic delegation (e.g. due to distortions). If delegation is sincere, however, $c_d(0) = 0$ and $c'_d(0) = 0$. From a social point of view, delegation has no value but it can distort the selection of projects. Thus, the optimality condition is

$$c'_d(d_i^*) = 0 \Leftrightarrow d_i^* = 0. \quad (2.14)$$

But in equilibrium, all agents will delegate similarly by d and the delegates' values

³¹ If the agent can easily and quickly hire or fire its delegate, it might be more reasonable to allow i to instead delegate at the legislative stage, after i 's value v_i has been realized. i 's decision would then depend on the realization of ϵ_i . This might, however, undermine the value of delegating in the first place, since the agent might then easily replace a delegate which is on the way of accepting or rejecting proposals counter to the preferences of her principal. Delegation is then not credible. Nevertheless, this timing is discussed in section 4.5, where I do allow for heterogeneity already at the investment stage.

become uniformly distributed with mean $\theta + x - d$. If the project is good, the majority coalition will, as previously, consist of the delegates most in favor of the project. The probability of i 's delegate becoming a coalition member is then

$$p(x_i, d_i) = m + \frac{1}{\mu} [(x_i - d_i) - (x - d)].$$

Minority members are taxed by $v_{d_i} + r$. The total value shared by the delegates in the majority is then $\theta + x - d + (1 - m)r$ if the project is implemented, and $(1 - m)r$ otherwise. It is therefore implemented if $\theta + x - d \geq 0$, which differs from the social optimality condition $\theta + x \geq 0$. If the agents delegate by $d > 0$, the delegates are too negative to the project and too few projects will be implemented. If the agents instead delegate by $d < 0$, the delegates are too positive to the project and too many projects will be implemented. The total revenue is allocated by negotiations within the majority, which ensures that all delegates in the majority increase their utility by the same u_{d_i} relative to status quo. If $\theta \geq -x + d$, this implies

$$u_{d_i} = \left\{ \begin{array}{ll} u_N \equiv -r & \text{with probability } 1 - p(x_i, d_i) \\ u_M \equiv \frac{\theta + x - d + r(1 - m)}{m} & \text{with probability } p(x_i, d_i) \end{array} \right\},$$

where u_{d_i} is i 's delegate's utility; i herself receives the utility $u_{d_i} + d_i$. The larger is d_i , $i \in N$, the more tempted is i 's delegate to reject the project and the less the majority dares to tax her. The larger is d_i , $i \in M$, the less eager is i 's delegate to implement the project and the more of the total surplus is she able to obtain. Delegating by increasing d_i is therefore useful for increasing i 's bargaining power. The disadvantage, however, is that the probability $p(x_i, d_i)$ of getting political power declines as i 's delegate becomes more negative to the project. Anticipating this, i 's problem becomes

$$\text{Max}_{x_i, d_i} \int_{-x+d}^{a+\frac{\sigma}{2}} [p(x_i, d_i)(u_M + d_i) + (1 - p(x_i, d_i))(u_N + d_i)] \frac{d\theta}{\sigma} - c(x_i) - c_d(d_i)$$

which gives the first-order conditions³²

$$c'(\hat{x}_i) = \left(\frac{\tilde{v} + r}{\mu m} \right) q \quad (2.15)$$

$$c'_d(\hat{d}_i) = q - \left(\frac{\tilde{v} + r}{\mu m} \right) q \quad (2.16)$$

where

$$q = \int_{-x+d}^{a+\frac{\sigma}{2}} \frac{d\theta}{\sigma}$$

is the probability of the project being accepted and

$$\tilde{v} = x - d + E[\theta | \theta \geq -x + d] = (a + x - d + \sigma/2) / 2$$

is the delegates' expected value of an accepted project.

Comparing (2.15) and (2.16) to the optimality conditions (2.2) and (2.14) shows that the optimal majority rule m^* is defined as before (2.12), and that this ensures sincere delegation in addition to optimal incentives.

Proposition 4: Agents delegate sincerely only at the optimal majority rule m^* in (2.12). For $m > m^*$, agents delegate to someone less in favor of the project and too few projects will be executed. For $m < m^*$, agents delegate to someone more in favor of the project and too many projects will be executed.

Another interpretation of d is useful. So far, the analysis hinges on complete and symmetric information. It may be argued, however, that i is likely to have a better estimate of v_i than has $j \neq i$. Note, first, that the argument above works in any case, as long as v_{d_i} is observable. Thus, m^* is the only majority rule which gives the agents incentives to reveal their types truthfully by sincere delegation. In fact, $(d_i + x_i + \theta)$ may be interpreted as i 's "announcement" of her expected value $x_i + \theta$. These announcements, however, do not by themselves dictate the majority

³² The second-order conditions are trivially fulfilled. For simplicity, an interior solution is assumed and the equilibrium (where $x_i = x$ and $d_i = d$) is assumed to be stable. The determinants of \hat{x}_i and \hat{d}_i then determine the equilibrium \hat{x} and \hat{d} . See the footnotes in section 3.2 for further remarks on this.

coalitions. The random shock ϵ_i is also important, and this is revealed after i 's announcement. Distorting i 's announcement (relative to her true expected value) by d_i on day 1 is modeled exactly as above. While announcing a lower value increases i 's bargaining power, it also reduces her chance to get political power. At $m = m^*$, the two incentives cancel and truthful announcements are optimal.³³

Though the result is remarkably comforting, its intuition can easily be explained. Notwithstanding if the agent considers to delegate or invest, her action has three possible effects. First, it may directly affect i 's utility through v_i , abstracting from any transfers. Second, the impact of the action on v_{d_i} influences i 's bargaining power, given its political power. Third, a high v_{d_i} makes i a more attractive coalition partner and i 's chances of gaining political power increases. While bargaining power and political power determine the distribution of surplus, only the first direct effect is of social value. To make the sum of the three effects equal to the first, the negative effect of v_{d_i} on bargaining power should nullify the positive effect of v_{d_i} on expected political power. This condition is the same, notwithstanding how v_{d_i} is influenced.³⁴

In the European Union, different majority rules are used by the European Commission, the European Parliament, and the Council. While the two first apply simple majority rules, the Council, as discussed, typically requires qualified majorities or unanimity. Proposition 4 predicts that the representatives in the Council should be more protectionistic (status quo-biased) than the Commission and the Parliament. This seems to be the case indeed.³⁵

³³ In fact, at $m = m^*$, it doesn't matter what i announces. If, however, there are some marginal costs $c_d(d_i)$ of lying, i strictly prefers to reveal its information truthfully.

³⁴ This argument implies that the majority rule m^* also ensures optimal incentives to make strategic investments, e.g. in outside options. A previous version of this paper allowed agents to invest by y_i in the status quo. This is valuable if the project turns out to be bad. If the project turns out to be good, a larger investment in the status quo gives i more bargaining power but less political power. i 's first-order condition $q - (\tilde{v} + r)q/\mu m$ coincides with the first-best condition $q - 1$ if and only if $m = m^*$. If $m > (<)m^*$, agents invest too much (little) in the status quo. These arguments also imply that it does not matter how the status quo is defined (whether the project should be undertaken); a proper majority rule ensures optimal incentives in any case.

³⁵ Also for environmental policies, Weale (2002, p. 210) observes that *the Parliament has the general reputation of having a policy position that is more pro-environmental than the Council of Ministers.*

4.2 Externalities

So far in the analysis, private investments have been assumed to affect private values only. For the European Union, however, a country's value of a project might also depend on another country's action. For example, if one country i modernizes and succeeds in creating a more competitive sector, it might as well affect a neighboring country j 's value v_j of liberalization. If j fears tough competition on the telecom market, j 's value v_j of liberalization might be reduced when i becomes more competitive. If instead j expects to import these services in any case, j 's value v_j of trade liberalization might increase when i becomes more efficient. To capture such effects, let individual values be determined by

$$v_i = \theta + (1 - e)x_i + ex + \epsilon_i,$$

where e reflects a positive (negative) externality of private investment if $e > (<)0$. The coefficients are normalized such that the social value of investments is the same as previously, and the optimal level of investment is still defined by $c'(x^*) = q(x^*)$.

Private investments are only undertaken to the extent that they affect private values. It is easily shown that agent i 's optimal investment level, corresponding to (2.8), is modified to

$$c'(\hat{x}_i) = (1 - e)q\left(\frac{\tilde{v} + r}{\mu m}\right), \quad (2.17)$$

where q and \tilde{v} are as defined in section 3.2. The larger the externality e , the less of the effect is internalized by i , and the lower is i 's investment. The majority rule can still encourage the optimal level of investment, however, if m is set such that $\hat{x}_i = x = x^*$ in (2.2):

$$m_e^* = (1 - e)(\tilde{v} + r) / \mu = (1 - e)(a + x^* + 2r + \sigma/2) / 2\mu. \quad (2.18)$$

Proposition 5: The optimal majority rule m_e^* decreases in the externality e , and it induces agents to internalize the externality.

If e is positive, then i only captures a fraction $(1 - e)$ of the total direct effect of i 's investment. If there were no side payments on day 2, agents would underinvest.

With the possibility of transfers, a larger v_i reduces i 's bargaining power, which neutralizes the first direct effect. The agents are instead motivated by the prospects of political power, but when $e > 0$, x_i is less effective in increasing v_i . To motivate optimal investment, the prospects of political power must become more attractive. This can be done by reducing the majority rule, since this decreases the number of losers that must be compensated and the surplus for each majority member increases. If the externality is negative, agents are instead likely to overinvest. A larger majority rule is then required to discourage effort to the optimal level. Worth repeating is that, in both cases, the majority rule can be chosen such that the agents internalize the externality.

Proposition 5 suggests that political issues, characterized by positive externalities of countries' investments, should be decided by a smaller majority rule. It is interesting to note that the internal market, dominated by such externalities, was the first area where majority voting was applied in the EU. According to the Single European Act, environmental issues can be decided by a qualified majority according to Article 100a, or by unanimity according to Article 130s. The latter applies to environmental issues in general, while the first applies to issues related to the internal market. Then, environmental policy is likely to have spillover effects through trade in addition to cross-border pollution.

Delegation and Externalities

To repeat, i 's choice of effort has three effects on i : the direct effect on v_i , the effect on i 's bargaining power and the prospects for political power. While only the first effect is of social value, it does not reflect the full social value of the investment when there are externalities. Making the effect on political power nullify the effect on bargaining power is not sufficient to ensure optimality. Instead, the positive effect on political power should be of a larger (smaller) magnitude than the effect on bargaining power if e is positive (negative), which is ensured by condition (2.18). But when the effects on bargaining power and political power do not cancel, then Proposition 4 implies that i delegates strategically. By comparing (2.17) and (2.16), we realize that no majority rule can make them both coincide with the optimality conditions (2.2) and (2.14).

Proposition 6: If there are externalities, no majority rule can ensure both optimal

investments and sincere delegation.

To guarantee optimal preparation for the project, m should be reduced (increased) to internalize a positive (negative) externality. This, however, will induce agents to delegate strategically to someone more (less) in favor of the project in order to increase their prospects for political power (bargaining power). To ensure sincere delegation, m should be set equal to m^* , independent of any externalities. But then, no externalities will be internalized. The optimal majority rule is likely to be a compromise, depending on what is most important: investments or sincere delegation.

4.3 Legislative Extensions

The legislative game, as described in section 2, is both simple and specific. Informed readers might have noticed several discrepancies relative to the European Union. This section generalizes the model in three ways, all of which better tie the model to European institutions in particular, and most political systems in general. While the previous results survive, new insights emerge.

The European Union consists of several chambers, not only the Council as assumed above. Indeed, most proposals are negotiated in the European Commission before they are submitted to the Council which, in turn, has small possibilities of making amendments. The European Commission also consists of national representatives. The majority rule \underline{m} applied by the Commission is typically smaller (most often $\underline{m} = 1/2$) than the majority rule m applied by the Council. To reflect this legislative game, suppose the initiator in the Commission first selects a minimum-winning coalition $\underline{M} \subset I$ of mass \underline{m} (relative to the Commission's size) which negotiates a proposal. All members of \underline{M} must agree before the proposal is submitted as a take-it-or-leave-it offer to the Council. The proposal is implemented if a fraction m in the Council approves the proposal, while everyone accepts ($u_i \geq -r \forall i$). This generalization fits most bicameral political systems, but it can also be interpreted differently: Even with one chamber, the initiator might want to select a coalition of different size, $\underline{m} \neq m$, than the majority rule. Thus, this extension may be interpreted as a relaxation of Riker's (1962) minimum-winning-coalition

assumption.

Second, the initiator, as a president, might have excessive bargaining power. Instead of assuming, as above, that all coalition-members have equal bargaining power, it is likely that the president can suggest the first proposal. Only if this offer is rejected will a randomly drawn coalition-member make another proposal. If there is a discount factor δ between successive offers, then the initiator is able to capture a share $(1 - \delta)$ of the total surplus. The other members of \underline{M} receive equal shares of the remaining fraction δ . More power to the president is reflected by a smaller δ .³⁶

Third, the Convention suggests rotating representation in the European Commission. There will be 15 commissioners with a vote and 15 without. Countries will take it in turns, in strict rotation, to have one of the proper jobs. Suppose that i is represented in the Commission with probability l_i only. With probability $1 - l_i$, i has no representative in the Commission, and $i \notin \underline{M}$ notwithstanding v_i . With these generalizations, the model can be solved by backward induction as above.

While agents $i \in \underline{M}$ have bargaining power as previously, agents $i \in I \setminus \underline{M}$ just respond to the take-it-or-leave-it offer made by \underline{M} . To implement the policy as cheaply as possible, \underline{M} expropriates the minority of mass $1 - m$ by giving them the reservation utility of $-r$. In any case, their approvals are superfluous. All other agents receive a utility of exactly zero - just sufficient to make them approve the project. If the project is to be implemented, any initiator prefers as coalition members (to \underline{M}) those \underline{m} agents (represented in the Commission) most in favor of the project. To reduce the amount of compensation, the minority not compensated to approve the project will be the $1 - m$ agents least in favor of the project. The argument for this coalition formation is similar to that in section 3.1.³⁷ When transaction costs are negligible, \underline{M} prefers to implement the project if and only if it increases total welfare. Proposition 1 survives.

Assume, for a moment, that all agents invest the same amount x , such that their values of the project become uniformly distributed with mean $\theta + x$ and density $1/\mu$.

³⁶ Kirchner (1992, p. 80) discusses the President's role in the EU. He finds that *there is a great deal of collaboration between the Presidency and the Commission in the setting of the six-monthly priorities.*

³⁷ Formally, the argument justifying this coalition formation requires some marginal transaction costs.

Anticipating this, i expects the probability of $i \in \underline{M}$ to be

$$\underline{p}(x_i) = l_i \left[\underline{m} + \frac{1}{\mu} (x_i - x) \right],$$

while the probability that i becomes a minority member is $1 - p(x_i)$ as before (2.6).

If $\theta \geq -x$, the project is implemented and i 's payoff becomes

$$u_i = \left\{ \begin{array}{ll} u_N = -r & \text{with probability } 1 - p(x_i) \\ u_M = 0 & \text{with probability } p(x_i) - \underline{p}(x_i) \\ u_{\underline{M}} = \delta [\theta + x + r(1 - m)] / \underline{m}l & \text{with probability } \underline{p}(x_i) \end{array} \right\},$$

since the mass of \underline{M} is $\underline{m}l$ if the average l_i is l . At the investment stage, agent i 's problem becomes

$$\underset{x_i}{Max} \int_{-x}^{a+\sigma/2} [\underline{p}(x_i)u_{\underline{M}} + (1 - p(x_i))u_N] \frac{d\theta}{\sigma} - c(x_i)$$

with the first-order condition

$$c'(\hat{x}_i) = \frac{q}{\mu} \left[\frac{l_i}{l} \frac{\delta}{\underline{m}} (\tilde{v} + r(1 - m)) + r \right],$$

where q and \tilde{v} are as defined in section 3.2. Thus, Proposition 2 continues to hold, but there are three new effects. First, i invests less if l_i is low relative to l . If l_i is small, her representation in the Commission is quite unlikely, and v_i is less likely to influence i 's political power. If l is also small, however, this is compensated by a higher payoff if i should be represented (since then, the total surplus is shared among a small mass of Commission members $\underline{m}l$). Second, i invests less if the president is powerful (δ small), since this reduces the benefit of becoming a majority member. Third, i 's investment decreases in both \underline{m} and m , since both kinds of majorities require that more agents are compensated and less are exploited by the majority. Investments are optimal if $\hat{x}_i = x^*$ (defined as previously by (2.2)) requiring that

$$\frac{mr}{\mu} + \frac{\underline{m}}{\delta} \frac{l}{l_i} \left(1 - \frac{r}{\mu} \right) = \frac{\tilde{v} + r}{\mu}.$$

The solution for m is interior only if the parenthesis is positive, which I thus assume. It follows that the two majority rules are substitutes. The incentives remain optimal even if m increases, provided that \underline{m} decreases accordingly. To encourage sufficient investments, m (or \underline{m}) should decrease if the president becomes more powerful (δ decreases). This is, indeed, the combination proposed by the Convention.

Proposition 7: i 's investment increases in her probability of being represented l_i , but decreases in others' representation l , the president's power $(1 - \delta)$, and the majority rules m and \underline{m} . Thus, the optimal majority rule m (\underline{m}) decreases in δ and \underline{m} (m), and rotating representation is of no importance if $l_i = l \forall i$.

4.4 Heterogeneity in Size

Heterogeneity in size is easily motivated. In the European Union, constitutional debates quite often separate large (e.g. Germany and France) from small (e.g. Belgium and Denmark) nations. While the size of a small country is normalized to one, suppose a fraction k of all countries to be of size $z > 1$. If the project is implemented, the total utility of a large country is $u_i^z = zv_i - t_i$, such that each citizen's utility is $v_i - t_i/z$. If a large country is in minority, it will be expropriated (or, little compensated) and receive its reservation utility. I assume the reservation utility to be the same for all citizens, $-r$, indicating that they all benefit equally from continuing cooperation, or that a country failing to implement an approved project faces a fine proportional to its size. Thus, a large minority member is taxed by $t_i = z(v_i + r)$. Similarly, assume a large country's cost of investment to be $zc(x_i)$, such that the per capita cost is the same across countries.

Whatever is the majority coalition, the majority expropriates the minority and shares the surplus equally, just as before. But whom will the initiator select as majority members? In the majority coalition, a large country negotiates with one voice, just as the others, and ends up with the same utility u_M .³⁸ This implies that $t_i = zv_i - u_M$. Thus, the cost of inviting a large country to the coalition, instead of expropriating it as a minority member, is $u_M + zr$. The cost of inviting a

³⁸ As observed by e.g. Wallace (1989, p. 202), it is well-known that small parties often do disproportionately well out of coalition bargaining.

small country, by contrast, is only $u_M + r$. Hence, with equal voting weights, small members will be preferred as coalition partners. If $m < 1 - k$, the initiator does not need to include any large countries in her coalition, and large countries lack incentives to invest as they cannot gain political power in any case.

Suppose, instead, that larger members have proportionally more voting power. The alternative to inviting one large country is then to invite z small countries, which costs $z(u_M + r)$. Then, large countries are preferred as coalition members. If $m < k$, small countries do not invest as they cannot gain political power in any case.

To give all countries incentives to invest, the initiator must be indifferent between a small and a large country that both have a high value of the project. Suppose the voting power of a large country to be w . For two countries with the same value of the project, the initiator is indifferent to their size if $u_M + zr = w(u_M + r)$, i.e., w should be a weighted average of the principle one-member-one-vote, and the alternative proportionality principle:

$$w = z \left(\frac{r}{u_M + r} \right) + \left(\frac{u_M}{u_M + r} \right). \quad (2.19)$$

Only under such weights do all countries have incentives to invest. Such regressive voting weights do indeed reflect current practices in the European Union. If r decreases, or u_M increases (by e.g. a decrease in m), the weights should be more proportional to size.³⁹

The European Convention proposes a different voting system. Instead of "complicated" weights, it is suggested that a political proposal must fulfill two criteria in the Council: First, it must be approved by a fraction m ($= 1/2$) of all countries. If π_1 and π_z denote the numbers of small and large countries that approve the project, respectively, this condition can be written as:

$$\pi_1 + \pi_z \geq m. \quad (2.20)$$

³⁹ Barbera and Jackson (2003b) provide another explanation for regressive voting schemes. In their model, a large country is more heterogeneous, and its value v_i is therefore more concentrated around its expected value. This is of no importance for the optimal weights if there are side payments, however.

Second, the project must be approved by a set of countries that together contains a fraction m_P ($= 3/5$) of the population:

$$\frac{\pi_1 + z\pi_z}{(1 - k + kz)} \geq m_P. \quad (2.21)$$

The parenthesis expresses the total population. To fulfill (2.20), the initiator prefers to select small countries as coalition members. To fulfill (2.21), instead, large countries are preferred. To give both large and small countries incentives to invest, both (2.20) and (2.21) must bind in equilibrium.⁴⁰ It can be shown that this requires:⁴¹

$$m < m_P(1 - k + kz) < mz. \quad (2.22)$$

Moreover, for small and large countries to face the *same* chance of becoming majority members, it is required that $m_P = m$.⁴² Thus, the Convention's proposal ($m_P > m$) favors large countries.

To summarize, to give both small and large countries *some* incentives to invest, it is necessary with regressive voting weights (2.19), as currently employed by the EU, or requirements on both the number of countries and the population (2.22), as suggested by the Convention. But does this ensure that the incentives are the *same* for small and large countries? As before, small countries invest until $c'(x_i) = q[u_m + r]/\mu$. Large countries invest less, however, since they have low bargaining

⁴⁰ If both (2.20) and (2.21) hold with equality,

$$\begin{aligned} \pi_1 &= \frac{mz - m_P(1 - k + kz)}{z - 1} \\ \pi_z &= \frac{m_P(1 - k + kz) - m}{z - 1}. \end{aligned}$$

⁴¹ To see this, just apply the previous footnote and require $\pi_1, \pi_z > 0$.

⁴² This can be seen by setting

$$\begin{aligned} \frac{\pi_1}{1 - k} &= \frac{\pi_z}{k} \Rightarrow \\ \frac{mz - m_P(1 - k + kz)}{(z - 1)(1 - k)} &= \frac{m_P(1 - k + kz) - m}{(z - 1)k}. \end{aligned}$$

power in the negotiations:

$$\text{Max}_{x_i} \int_{-x}^{a+\frac{\sigma}{2}} [p(x_i)u_M - (1 - p(x_i))rz] \frac{d\theta}{\sigma} - zc(x_i) \Rightarrow$$

$$c'(\hat{x}_i) = \frac{q}{\mu} \left(\frac{u_M}{z} + r \right).$$

How can we ensure that both large and small countries invest optimally? Suppose we introduce the extensions of the legislative game proposed in the previous section. Let small and large countries be represented (in the Commission) with probabilities l_1 and l_z , respectively. The investments of small and large countries become

$$\begin{aligned} c'(\hat{x}_i) &= \frac{q}{\mu} \left[\frac{l_1}{l} \frac{\delta}{m} (\tilde{v} + r(1 - m)) + r \right] \\ c'_z(\hat{x}_i) &= \frac{q}{\mu} \left[\frac{l_z}{z l} \frac{\delta}{m} (\tilde{v} + r(1 - m)) + r \right]. \end{aligned}$$

Thus, to ensure the same investment level in large and small countries, representation should be proportional to size:

$$l_z/l_1 = z. \tag{2.23}$$

By substituting this equality in the above equations, and by setting these equal to the optimal investment level, the results of Proposition 7 are confirmed. To summarize the results of this section, instead:⁴³

Proposition 8: To ensure that both small and large countries have incentives to invest, the voting weights (2.19) should be regressive in size, or a combination (2.22) of majority rules for countries and population should be applied. To ensure first-best incentives, optimal representation (2.23) is increasing in size.

⁴³ Though countries disagree over such weights in isolation, they should all agree on the optimal solution at the constitutional stage if side payments are available.

4.5 Heterogeneity in Preferences

In the simple model, agents were assumed to be identical at the investment stage. This does not characterize Europe very well. Even though countries can alter their competitiveness by domestic investments, some countries are simply more likely to gain from a reform than others. This may reflect previous policies, such as the UK's privatization effort under Margaret Thatcher. Alternatively, it reflects differences in natural conditions, as might be the case for Scandinavia's stance in agricultural politics. Thus, already at the investment stage, some countries may be certain of gaining, while others may certainly lose if some project is executed. If these countries cannot influence their political power at the legislative stage, the hold-up problem induces them to prepare too little.

Let individual values now be given by $v_i = \theta + a_i + x_i + \epsilon_i$, where the a_i s are known by everybody at the time when the x_i s are chosen, and the average a_i is zero. This modification of the model may be interpreted as an alteration of the timing, where *some* of the individual shock is revealed *before* investments are chosen.⁴⁴

As before, the majority coalition offers the minority their reservation utility only, shares the total surplus equally and implements only good projects. This coalition consists of the m countries most in favor of the project: $M = \{i \in I | v_i \geq v_m\}$ for some v_m .⁴⁵ If the project turns out to be good, i 's probability of obtaining political power is

$$p(x_i, a_i) = \left\{ \begin{array}{ll} 0 & \text{if } \frac{1}{\mu} [a_i + x_i + \frac{\mu}{2} - v_m] < 0 \\ \frac{1}{\mu} [a_i + x_i + \frac{\mu}{2} - v_m] & \text{if } \frac{1}{\mu} [a_i + x_i + \frac{\mu}{2} - v_m] \in [0, 1] \\ 1 & \text{if } \frac{1}{\mu} [a_i + x_i + \frac{\mu}{2} - v_m] > 1 \end{array} \right\}.$$

As previously, i 's problem on day 1 is given by

$$\text{Max}_{x_i} \int_{-x}^{a+\frac{\sigma}{2}} [p(x_i, a_i)u_M + (1 - p(x_i, a_i))u_N] \frac{d\theta}{\sigma} - c(x_i),$$

⁴⁴ If there were externalities, and $v_i = \theta + (1 - e)x_i + e_i x + \epsilon_i$, then heterogeneity w.r.t. the e_i s has the similar effects as heterogeneity w.r.t. the a_i s, discussed here.

⁴⁵ v_m is implicitly defined by the requirement that the mass of agents i s.t. $v_i \geq v_m$ must equal m , i.e.: $m = \int_{i \in [0,1]} \int_{v_m - a_i - \hat{x}_i}^{\mu/2} (d\epsilon_i/\mu) dF(a_i)$ where the a_i s are distributed with cdf $F(a_i)$.

where u_M and u_N are still given by (2.5). It is straightforward to show that the solution to this problem is

$$\begin{aligned} \hat{x}_i &= 0 && \text{if } a_i < a_A \\ c'(\hat{x}_i) &= \frac{q}{\mu} \left(\frac{\tilde{v}+r}{m} \right) && \text{if } a_i \in [a_A, a_B] \\ \hat{x}_i &= \frac{\mu}{2} + v_m - a_i && \text{if } a_i \in (a_B, a_C] \\ \hat{x}_i &= 0 && \text{if } a_i > a_C \end{aligned}$$

where the critical values $a_A < a_B < a_C$ are defined by

$$\begin{aligned} a_A &\equiv \frac{\mu c(\hat{x}_i)}{q(u_M - u_N)} - \hat{x}_i - \frac{\mu}{2} + v_m \\ a_B &\equiv \frac{\mu}{2} + v_m - \hat{x}_i \\ a_C &\equiv \frac{\mu}{2} + v_m. \end{aligned}$$

i 's investment is \hat{x} only if i 's individual value a_i is in the intermediate interval $[a_A, a_B]$. If i 's initial value a_i is lower than a_A , i does not find it worthwhile to invest to have a chance of becoming a majority member at the legislative stage. In any case, this probability will be very small, and i is better off not investing. Having surrendered all chances of political power, i has no incentives to invest since the majority will, in any case, expropriate her entire surplus. If $a_i > a_B$, i is certain of becoming a majority member even if i does not invest as much as \hat{x} . An investment of $\mu/2 + v_m - a_i$ is exactly sufficient to ensure that i will become a majority member, even if i should be unfortunate enough to be hit by a negative shock ϵ_i . i therefore invests exactly the amount guaranteeing political power: a larger value will just reduce i 's bargaining power and force i to compensate other members of the coalition. The larger is a_i , the less i needs to invest to guarantee political power. If $a_i = a_C$, i does not need to invest at all: i is in any case a certain majority member. For $a_i \geq a_C$, therefore, i does not invest.⁴⁶

Similar results hold for strategic delegation. If a_i is large (small), i is certain (not) to gain political power, and i increases d_i until $c'_d(d_i) = 1$ to gain bargaining

⁴⁶ If individual shocks were bell-shaped, the level of investments \hat{x}_i , as a function of a_i , would also be bell-shaped.

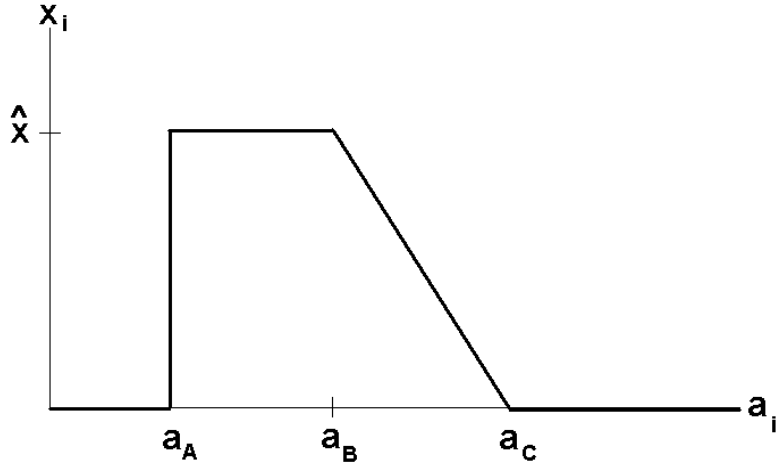


Figure 2.2: Only agents with intermediate initial values are motivated to invest by the prospects for political power.

power. i moderates d_i only if this may increase i 's political power, which is possible only if a_i is in the intermediate range. The equilibrium levels of d_i look exactly like the figure above, turned upside-down.

Can this situation be improved? The problem above is that countries with large (small) a_i s are too (un)attractive as coalition partners. As we learned in the previous section: attractiveness can be modified by voting power. Suppose country i , with the initial value a_i , has voting power w_i in the future vote upon this project. To give all countries that have invested the same x_i an equal chance of becoming a coalition member, they must all be equally attractive as coalition partners. To the initiator, this requires that the cost of inviting another coalition member, relative to the weight of her vote, should be independent of a_i . Introducing the same transaction costs as in section 3.1, the per capita surplus in the majority is, from (2.3);

$$\frac{\int_M v_j dj + \int_N (v_j + r)(1 - \lambda) dj}{\int_M dj},$$

and, it can be shown, the initiator selects the countries with the highest $x_i + \epsilon_i$

(instead of v_i) as coalition partners if

$$w_i = (\gamma - \lambda a_i) \kappa, \quad (2.24)$$

where

$$\gamma \equiv \frac{\tilde{v}(1 - \lambda) - \int_N a_j \lambda + r(1 - \lambda) dj}{\int_M dj}$$

and where κ can be any positive constant. Thus, to give all countries a fair chance to earn political power (and be motivated thereof), countries that are (un)likely to be in favor of the project should have accordingly low (large) voting power. If the transaction cost λ is negligible, the necessary differences in voting weights (2.24) are also negligible.⁴⁷

There are, as in the previous section, alternatives to adjusting the weights of votes. Suppose there are a large number of countries with initial condition a_i . If the political proposal required, by the constitution, approval from some countries with all kinds of initial conditions a_i , the initiator would prefer to collude with those that have performed best relative to their initial condition. Then, all countries are motivated to invest. A similar solution is to introduce two chambers, as in section 4.3. Even if a country with large initial value a_i is certain of being included in the broader majority m in the Council, i might still invest to be included in the more exclusive majority \underline{M} (of size $\underline{m} < m$) in the Commission. Even if an agent with small a_i is certain of being excluded from the majority \underline{M} in the Commission, i might still invest to be included in the majority m in the Council.⁴⁸

Proposition 9: With heterogeneity in initial values a_i , i does not invest if $a_i < a_A$ or if $a_i > a_C$. To motivate all agents to invest, it is necessary to allocate more voting power (2.24) to countries with low initial value of the project, or to require that the

⁴⁷ Though countries disagree over such weights in isolation, they should all agree on the optimal solution at the constitutional stage if side payments are available.

⁴⁸ Another solution may be to make all countries uncertain about their future political power, by delaying the vote further into the future. The range of a_i s where $x_i = \hat{x}$ is $a_B - a_A = \mu [1 - c(\hat{x})/q(u_M - u_N)]$, which can be shown to be increasing in the ex post heterogeneity μ . For a sufficiently large μ , all have initial values $a_i \in [a_A, a_B]$, all agents are uncertain whether they will get political power and all will invest \hat{x} . In practice, this might be obtained by delaying the legislative stage sufficiently after the investment stage: it is then hard for anyone to predict its future political power since a lot of noise (large μ) will affect the values.

majority coalition is supported by countries with different initial conditions.

5 Majority Rules and Side Payments

Crucial in the analysis above is the assumption that agents use side transfers to expropriate and compensate. As argued in the Introduction, such side payments can be accomplished by issue linkages or redefining the project, and they are thus likely to appear in contexts such as the EU. In other contexts, however, agents might not be able to use side payments. So what about majority rules and incentives? This section solves the game above, all extensions included, for the case without side payments. The outcome is contrasted to the results above. This comparison is useful both to understand the limits of the results and shed light on controversies in the literature.

The model is almost the same as in sections 2-4: only the legislative game is different. Now, each policy proposal can only specify whether the project is to be implemented; all transfers are bound to be zero. If the initiator happens to lose from the project, she prefers a coalition of other losers to ensure the project is not proposed and the vote will never take place. Assume, however, that at least one alternative can be suggested by the population (by citizen initiative). Then, some agent that gains from the project proposes to implement the project, and the final vote will be decisive. The social optimal solution is as before characterized by (2.2) and (2.14).

Whether the project will be approved depends on whether the mass of winners will be larger than the mass of losers. Suppose the values $(v_{d_i} - \theta)$ happen to be distributed according to the cdf $G(v_{d_i} - \theta)$, and that the distribution of ϵ_i is independent of i 's size.⁴⁹ The project is executed if

$$\begin{aligned} 1 - G(-\theta) &\geq m \Rightarrow \\ \theta &\geq \hat{\theta} \equiv -G^{-1}(1 - m). \end{aligned} \tag{2.25}$$

Thus, the selection of projects depends on the majority rule. The larger is m , the

⁴⁹ Voting weights w.r.t. size is then unimportant.

larger is $\widehat{\theta}$, and the fewer projects are executed. If agents were identical ($a_i = 0 \forall i$), they would invest the same amount and the values v_{d_i} would be uniformly distributed with mean $\theta + x - d$ and density $1/\mu$. The project will be implemented if the mass of winners is larger than m . (2.25) becomes

$$\theta \geq \widehat{\theta} \equiv -x + d + \mu(m - 1/2). \quad (2.26)$$

Anticipating that $d = 0$, and comparing with the above optimality condition, we notice that the selection of projects is optimal if and only if $m = 1/2$. That the optimal majority rule is exactly $1/2$ follows from the symmetric distribution of preferences, and it resembles May's (1952) Theorem.

If the project is executed, an individual's utility becomes

$$u_i = (1 - e)x_i + ex + \theta + a_i + \epsilon_i.$$

Thus, at the stage of investment, a large country's problem is

$$\text{Max}_{x_i, d_i} \int_{\widehat{\theta}}^{a + \frac{\sigma}{2}} zu_i \frac{d\theta}{\sigma} - zc(x_i) - zc_d(d_i),$$

while a small countries problem is obtained by setting $z = 1$. Both problems give the first-order conditions⁵⁰

$$c'(x_i^n) = (1 - e)q \quad (2.27)$$

$$c'_d(d_i^n) = 0 \quad (2.28)$$

where

$$q = \int_{\widehat{\theta}}^{a + \frac{\sigma}{2}} \frac{d\theta}{\sigma}$$

is the probability of the project being implemented.

If there are no externalities, i.e. $e = 0$, then (2.27)-(2.28) coincide with the

⁵⁰ The second-order conditions are trivially fulfilled.

first-best conditions (2.2) and (2.14) given q . Incentives are optimal and delegation sincere, whatever is the majority rule, the legislative game $(\underline{m}, \delta, l_i)$, the size and the initial preference a_i . These results may not come as a surprise: without transfers, only the first, direct, effect of the investments affects i 's utility. Bargaining power cannot be exploited and political power has no return. Investments are then optimal and delegation sincere. Externalities, however, cannot be internalized in this framework.

Proposition 10: Suppose there are no side payments. The selection of projects depends on the majority rule, but incentives are always optimal unless externalities exist. Heterogeneity in size or preferences, or other aspects of the political system $(\underline{m}, \delta, l_i)$, have no impact.

The result explains the strong emphasis on the selection of projects by the earlier literature: e.g. Wicksell (1896), Buchanan and Tullock (1962) and Aghion and Bolton (2003). As shown by the latter contribution (as well as section 3.1 in this paper), the selection depends on the majority rule also if side payments exist, as long as there are transaction costs. Then, the optimal majority rule is likely to depend on the form and size of these transaction costs, and Mueller (1989, p. 105) suggests that this explains the controversies in the literature. The contrast to the present paper, however, is not only due to the vanishing transaction costs; most of all, it arises because project-values are endogenous. By comparing Propositions 1-9 to Proposition 10, the effect of side payments is isolated. The good news is that the selection of projects is always efficient - whatever the majority rule (unless there is strategic delegation). The Coase Theorem extends since the winners can simply compensate the losers. The bad news is that the incentives (and delegation) may not be optimal - this hinges on the particular majority rule. Instead of ensuring that the majority rule selects the good projects, it should be set such that incentives are optimal. Then, even externalities can be internalized (unless agents can delegate). However, the majority rule must also reflect other aspects of the political system, such as the president's power and bicameralism. Moreover, heterogeneity in size or preferences threatens to distort incentives, unless votes are appropriately weighted.

6 Further Research

6.1 A Quick Summary

Motivated by the seminal debate over Europe's future constitution, this paper takes a new look on how to take collective decisions in general, and how to choose majority rules in particular. While the earlier literature emphasizes the importance of selecting the right projects, I show that the selection is always efficient if the transaction costs are negligible. While the earlier literature takes the individual values of the project as exogenous, I study the incentives to influence these values. If the majority rule is large, agents typically underinvest due to a hold-up problem. If the majority rule is small, agents typically overinvest to gain political power. To balance these incentives, the majority rule should increase in the project's expected value and the club's enforcement capacity, but decrease in the ex post heterogeneity in individual preferences. Not only does this optimal majority rule ensure appropriate incentives to invest; it also ensures sincere delegation. Positive (negative) externalities related to the investment can be internalized by a smaller (larger) majority rule, but agents may then delegate strategically. Different majority rules in bicameral systems are substitutes, and they should decrease in the president's power. Heterogeneity with respect to preferences or size should be acknowledged by appropriately weighting the votes and rotating political representation. Before I dare to draw final conclusions, however, several questions remain to be investigated.

6.2 Empirical Evidence

Before making normative recommendations, the model should earn credibility by comparing its predictions with empirical evidence. One stark prediction is that investment levels depend on the majority rule. Does it hold in reality? The European Union, with its various majority rules across issues as well as time, ought to provide empirical evidence. An obvious next step seems to be investigating domestic policies in this light, and contrasting the evidence to the above theory. Thereafter, previous majority rules should be compared to the predictions of the theory, before making normative judgements on future majority rules.

6.3 The Legislative Game

The legislative game in section 2 is both simple and special. Although the extensions discussed in section 4.3 do generalize the game, much remains to be done. What would happen, for example, if subgroups could implement the project exclusively in their countries (as is the case for the EMU)?⁵¹ In particular, the coalition formation and the bargaining procedures could be generalized, contrasted to the theoretical literature, and modified to better reflect policymaking in Europe. This will generate insights about alternative institutions, and it should bring us to safer grounds before making normative recommendations.

6.4 Timing of Agreements

One political instrument, neglected above, is the timing of the legislative game. Fearing low investments, why not implement the project already at the constitutional stage? A project that has already been implemented will surely motivate agents to adjust. The caveat, however, is that reversing the project might be costly if it turns out to be bad (θ low). Thus, there is a trade-off between efficient incentives and efficient selection of projects.

Another extension could be to let time be continuous, and let agents choose their investments at each point in time. Long before the vote, the uncertainty concerning future values is large, and all agents may invest similar amounts. Closer to the vote, some agents may be certain about their political power at the legislative stage, while others might be nervously unsure. Then, according to Proposition 9, investments are likely to diverge considerably.⁵² If, in addition, the timing of the vote can be renegotiated, a time inconsistency problem is likely to arise. Close to the vote, investments diverge and are suboptimal for most agents. Then, it is optimal to either vote right away, to get all incentives right, or delay the vote to the future, to

⁵¹ As discussed by Berglöf, Burkart and Friebe (2003), such a "threat" reduces the hold-up problem when decisions are taken by unanimity. The possibility to form an inner organization is to some extent a substitute for a reduced majority rule, and this possibility may become irrelevant when the majority rule is reduced. In their analysis, however, the effort levels are determined collectively, and there is no investments in advance.

⁵² Anticipating that ill-prepared agents get more voting power, as suggested in section 4.5, would lead to moral hazard in advance.

again make everyone uncertain about their political power at the legislative stage.

6.5 Other Applications

Majority rules are not important to the European Union only. National governments and parliaments apply various majority rules, as do corporate governance boards. If different legislators represent different jurisdictions, then regional incentives may be formalized as above. The anticipated project may be to stabilize national debt, as in Alesina and Drazen (1991), and preparing investments may be to reduce regional debt. The lower is the debt of a region, the more willing it is to stabilize debt also nationally, but the more it will have to compensate losers ill-prepared for tough financial policies. This generates a hold-up problem, and stabilization might be delayed. Applying Proposition 3 above, the solution is a lower majority rule. Then, stabilization may be implemented without the need to compensate ill-prepared regions. Fearing to be excluded from the majority coalition, incentives to reduce regional debt increase.

References

- Aghion, P., A. Alesina and F. Trebbi (2003): "Endogenous Political Institutions", Mimeo.
- Aghion, P., and P. Bolton (2003): "Incomplete Social Contracts", *Journal of the European Economic Association*, 1.
- Aghion, P., M. Dewatripont and P. Rey (1994): "Renegotiation Design with Unverifiable Information", *Econometrica*, Vol. 62, No. 2: 257-282.
- Aghion, P., and J. Tirole (1997): "Formal and Real Authority in Organizations", *Journal of Political Economy*, Vol. 105, No. 1: 1-29.
- Alesina, A., and A. Drazen (1991): "Why are Stabilizations Delayed?", *American Economic Review* 81: 1170-88.

Anderberg, D., and C. Perroni (2003): "Time-Consistent Policy and Politics: Does Voting Matter When Individuals Are Identical?", *Topics in Economic Analysis & Policy*, Volume 3, Issue 1, Article 3.

Barbera, S., and M. Jackson (2003a): "Choosing How to Choose: Self-stable Majority Rules", Mimeo.

Barbera, S., and M. Jackson (2003b): "On the Weights of Nations: Assigning Voting Power to Heterogeneous Voters", Mimeo.

Baron, D., and J. Ferejohn (1989): "Bargaining in Legislatures", *American Political Science Review*, Volume 83, No. 4: 1181-1206.

Berglöf, E., M. Burkart and G. Friebe (2003): "Reform under Unanimity", Mimeo.

Brueckner, M. (2000): "Unanimity Versus Concensus Bargaining Games: Strategic Delegation and Social Optimality", Mimeo, University of Bonn.

Buchanan, J., and G. Tullock (1962): *The Calculus of Consen. Logical Foundations of Constitutional Democracy*. Ann Arbor: University of Michigan Press.

Chari, V. V., L. Jones and R. Marimon (1997): "The Economics of Split-Ticket Voting in Representative Democracies", *American Economic Review* 87, No. 5: 957-976.

de Condorcet, M. (1785): *Essai sur l'Application de L'Analyse a' la Probabilite des Decisions Rendues a' la Pluralite des Voix*, Paris.

DeMarzo, P. (1993): "Majority Voting and Corporate Control: The Rule of the Dominant Shareholder", *The Review of Economic Studies*, Vol. 60, No. 3: 713-734.

Enelow, J. (1997): "Cycling and Majority Rule", In D. Mueller, *Perspectives on Public Choice*. Cambridge University Press.

George, S., and I. Bache (2001): *Politics in the European Union*, Oxford University Press.

Grossman, S., and O. Hart (1986): "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration", *Journal of Political Economy*.

Grossman, S., and O. Hart (1988): "One Share-One Vote and the Market for Corporate Control", *Journal of Financial Economics* 20: 175-202.

Harris, M., and A. Raviv (1988): "Corporate Governance: Voting Rights and Majority Rules", *Journal of Financial Economics* 20: 203-35.

Hart, O., and J. Moore (1990): "Property Rights and the Nature of the Firm", *Journal of Political Economy*, Volume 98, No. 6: 1119-58.

Hart, S., and A. Mas-Colell (1996): "Bargaining and Value", *Econometrica*, Vol. 64, No. 2: 357-380.

Kirchner, E. J. (1992): *Decision-making in the European Community: the Council Presidency and European Integration*, Manchester University Press.

Krishna, V., and R. Serrano (1996): "Multilateral Bargaining", *Review of Economic Studies*, 63: 61-80.

Maggi, G., and M. Morelli (2003): "Self Enforcing Voting in International Organizations", Mimeo.

May, K. (1952): "A Set of Independent, Necessary and Sufficient Conditions for Simple Majority Decisions", *Econometrica* 20: 680-684.

McLaren, J. (1997): "Size, Sunk Costs, and Judge Bowker's Objection to Free Trade." *American Economic Review*, Vol. 87, No. 3: 400-420.

Mueller, D. C. (1989): *Public Choice II*, Cambridge University Press.

Mueller, D. C. (1996): *Constitutional Democracy*, Oxford University Press.

Nugent, N. (1996): *The Government and Politics of The European Union*.

Parker, D. (1998): (Ed.) *Privatization in the European Union: Theory and Policy Perspectives*, Routledge.

Persico, N. (2000): "Committee Design With Endogenous Information", forthcoming *Review of Economic Studies*.

Persson, T., and G. Tabellini (1996): "Federal Fiscal Constitutions: Risk Sharing and Moral Hazard", *Econometrica*, Vol. 64, No. 3: 623-646.

Riker, W. H. (1962): *The Theory of Political Coalitions*, Yale University Press.

Rousseau, J. J. (1762): *On Social Contract or Principles of Political Right*. (translated to English by Bondanella, Conaway, W.W. Norton & Company, 1988).

Wallace, H. (1989): "Bargaining in the EC", in Tarditi et. al. (Eds.), *Agricultural Trade Liberalization and the European Community*, Oxford University Press.

Wallner, K. (2003): "Specific Investments and the EU enlargement", *Journal of Public Economics*, Volume 87, Issues 5-6: 867-882.

Weale, A. (2002): "Environmental Rules and Rule-making in the European Union", in A. Jordan (Ed.), *Environmental Policy in the European Union. Actors, Institutions and Processes*, Earthscan Publications Ltd.

Wicksell, K. (1896): "Ein neues Prinzip der gerechten Besteuerung." *Finanztheoretische Untersuchungen*, Jena: iv-vi, 76-87, 101-59. Translated by J. Buchanan and reprinted as "A New Principle of Just Taxation" in *Classics in the Theory of Public Finance*, New York, St. Martin's Press (1967): 72-118.

Chapter 3

Uniform or Different Policies?^{*}

1 Introduction

To get a more favorable deal, it is in any negotiator's interest to demonstrate a willingness to walk away. When bargaining power is private information, this motivates the parties to signal their strength and screen their opponent, even if this is costly. Such inefficiencies are inherent in any bargaining under private information (for a survey, see Ausubel, Cramton, and Deneckere, 2002).¹ How do these inefficiencies depend on the bargaining agenda? This paper proposes simple restrictions on the bargaining agenda and characterizes when these are valuable. By nailing the analysis to a particular example, the results shed light on existing institutions as well as controversies in the literature on fiscal federalism.

I study two regions trying to coordinate their policies to internalize externalities. By reducing or cleaning pollution, say, each region does not only improve the air

^{*} I am indebted to my advisor Torsten Persson for his continuous support throughout this work. I have also benefited from the help of Philippe Aghion, Alberto Alesina, Oliver Hart, Bob Staiger, Lucy White, seminar participants at IIES, Harvard University, University of Oslo, the Norwegian School of Economics and Business Administration, the EEA Summer Meeting (2002), the North American Econometric Society Meeting (2002) and the 24th Norwegian Conference in Economics. Thanks also to Christina Lönnblad for editorial assistance. Financial support from Jan Wallander's and Tom Hedelius' Foundation and the Norwegian Research Council is gratefully acknowledged.

¹ One approach to this problem, initiated by Myerson and Satterthwaite (1983), is to exclude unreasonable outcomes and pick the best alternative in the remaining set. Although useful in providing upper bounds to what is achievable, the best mechanism typically hinges on the players' beliefs in complex ways, and it requires considerable commitment. A different approach, pursued in this paper, is to explicitly analyze negotiations and investigate how the outcome depends on the bargaining agenda. This is related to the literature on issue linkages, further discussed below.

quality in its own region; but also in the other region. Local values of clean air, however, are local knowledge. The regions negotiate the agreement in an alternating offer bargaining game, where each region can delay as long as it desires before making an offer.² While this bargaining game should be interpreted as an example only, it is useful in that (i) it implements the best "reasonable" mechanism, and (ii) it provides intuition for how this is achieved. In this context, I ask the following three questions. When would the regions, behind a veil of ignorance, prefer to commit to uniform agreements where both must make equal contributions? Is it of any importance whether the regions can make side payments? Should side payments be possible?

Federal politics are often characterized by extensive harmonization. In the European Union, for example, Article 100a (Single European Act) calls for approximation of laws and harmonization measures, which has led to an explosion of directives calling for uniform policies for waste, chemicals, and other measures (discussed by McCormick, 2001). Such clauses are puzzling. While economists recognize the need to coordinate policies when there are externalities, the first-best policy ought to reflect local conditions. By allowing our two regions negotiate unconstrained, the region with the highest value of clean air must clean most in equilibrium. Although this outcome is due to the difference in bargaining power, it is appealing that most cleaning is located where it is appreciated. However, since the regions disagree on how the burden should be shared, they may signal reluctance to participate by strategic delay. By giving in early, a region reveals a high willingness to pay for the agreement, and it must thus bear the lion's share of the cost. For this reason, Alesina and Drazen (1991) find that stabilization is typically delayed.³ A commitment to uniform policies, evaluated in this paper, reduces the conflict of interest between the regions. Since the regions will have to make equal contributions to an agreement in any case, they do not find it worthwhile to signal bargaining power by delay. To

² In this respect, the bargaining game is similar to those suggested by Admati and Perry (1987) and Cramton (1992), as is the equilibrium I consider.

³ Alesina and Drazen (1991) study a war of attrition between legislators trying to stabilize the economy. The proposal-maker must bear the lion's share of the stabilization cost. Hsieh (2000) endogenizes this assumption: accepting early stabilization reveals a politician's willingness to pay. Another politician can therefore safely require that the first bears most of the stabilization cost. Anticipating this, every politician is reluctant to propose stabilization, and stabilization is delayed.

judge whether the policy should be differentiated instead of uniform across regions, the gains from differentiation should be compared to the cost of delay.⁴ Proposition 1 shows how the optimal bargaining agenda depends on the expected value of an agreement, the amount of externality and heterogeneity.⁵

If the regions are closely integrated, issue linkages and logrolling might be intrinsic in the political debate. It is then realistic to let the regions negotiate over side payments in addition to the policy. The policy will then always be optimally differentiated in equilibrium, since the region contributing less can compensate the one contributing more. Thus, there are gains from trade. In addition, a region can signal its type by proposing a certain direction of trade, which provides an efficient way of signaling bargaining power, and delay becomes less necessary as a signaling device. With side payments on the agenda, it is therefore always better to allow policy differentiation (Proposition 2). However, Proposition 3 suggests that it might be even better to prohibit both side payments and differentiation, since this ensures that there is absolutely no delay.

Bargaining agendas:

		Differentiation?	
		no	yes
Side payments?	no	x	d, x
	yes	s, x	d, s, x

Are side payments good? Having analyzed the outcome with and without side payments (by horizontal comparisons in the above table), it is constructive to com-

⁴ This tradeoff is quite similar to that analyzed by Bolton and Farrell (1990). They study firms' entry into a market. While the cost of decentralizing this decision might be delay (as well as duplication when both firms enter), the benefit is that the most efficient firm is likely to enter first. A clumsy government, in contrast, will immediately but randomly select one firm. This comparison suggests that uniform vs. differentiated policies may be interpreted as centralization vs. decentralization, an interpretation which is further discussed below.

⁵ The most-favored nation (MFN) principle can be interpreted as a form of uniform policies. McCalman (2002) shows that MFN increases efficiency when one large country engages in trade negotiations with many small countries. In his paper, the MFN principle is good because, by aggregating the small countries' participation constraints, uncertainty is reduced. In my paper, by contrast, a uniform policy might be good because it reduces the conflict of interest between the countries.

pare the two cases (by a vertical comparison) to examine the impact of side payments. For international negotiations, side payments are facilitated by issue linkages. The more issues, the larger are the possibilities for trade concessions. Negotiations in the European Council (consisting of the heads of states), are thus likely to involve side payments. Side payments are less likely for issues determined by the Council of Ministers, where the various ministers lack discretion over other policies. Since the European Union's decision-making procedures are currently under debate, and since countries generally disagree on the extent of issue linkages, it is both important and timely to ask whether side payments are good. By allowing side payments, any action increasing total utility can be implemented as a Pareto improvement by making the winner compensate the loser. It is therefore a common presumption that *side payments are needed to reach the best result* (Cesar and de Zeeuw, 1996, p. 158). The existing literature on issue linkages (see e.g. Inderst, 2000) emphasizes such gains from trade, but it also detects distributive effects. The present paper contributes to this debate. On the one hand, another rationale for side payments is presented. When the regions negotiate over side payments as well as the policy, a region can signal its type by the combination it suggests. Signaling by the proposed direction of trade can thus replace costly delay as a signaling device. On the other hand, the distributive effect of side payments may increase the conflict of interest between regions. Without side payments, a reluctant region is likely to contribute less to the agreement; with side payments, it may even be able to acquire transfers from the other region. If so, bargaining power pays off more, and the incentive to signal reluctance increases when side payments are possible. For side payments to be beneficial, the gains from trade must be sufficiently large. Depending on the expected value of the agreement, the externality and the heterogeneity, Proposition 4 presents conditions under which prohibiting side payments is good indeed.

The results of this paper describe the *optimal* bargaining agenda. In the model, policy differentiation and side payments will always be included unless regions are able to *commit* to the optimal agenda in advance (before they know their own types). The necessity to commit ties this paper to the literature on fiscal federalism (surveyed by Oates, 1999) in two ways. To some extent, frequent interaction facilitates the possibilities to commit, since sticking to the optimal agenda today is motivated

by cooperation tomorrow. In other cases, it is necessary to commit by writing a more formal constitution. For either reason, regions in a federal union should be better able to commit to uniform policies when this is optimal. Thus, the theory predicts more uniform policies within than across federal unions. This is exactly the critical assumption made in the federalism literature,⁶ though it is often criticized as being ad hoc.⁷ The analysis in this paper provides a microeconomic foundation for the uniformity assumption, and characterizes when it is likely to hold.

Suppose that we rely on the assumption that centralization implies uniform policies. Centralizing the policy is then a certain way of committing to uniform policies. The comparison between uniform and differentiated policies becomes identical to the comparison between centralization (requiring uniform policies) and decentralization (where the negotiating regions are free to propose differentiation and perhaps side payments). Thus, Proposition 1-4 may be interpreted as conditions for when centralization outperforms decentralization. Traditionally, the fiscal federalism literature evaluates decentralization vs. centralization, assuming that if the policy is

⁶ Oates (1972) initiated an entire literature based on these assumptions. Recently, Alesina and Spolore (1997) have analyzed the optimal and equilibrium size of nations when the benefit of a large size is increasing returns to scale, while the cost is that the policy must be uniform across heterogeneous regions. Bolton and Roland (1997) investigate the breakup of nations under similar assumptions, while Ellingsen (1998) studies political integration. Still assuming uniform policies, Cremer and Palfrey (1996) show how this may lead to centralization when citizens are risk averse. In his survey over the fiscal federalism literature, Oates (1999, p. 1130) states that *There is clearly some kind of trade-off here between internalizing spillover benefits (and costs) and allowing local differentiation.*

⁷ Lockwood (2002) claims that the uniformity assumption is *not derived from any explicit model of government behavior*, and Besley and Coate (2003) therefore declare that *Oates' analysis is suspect*. Several papers suggest how the political game may induce uniformity. Cremer and Palfrey (2000) show how a majority might vote for a federal mandate, i.e. a minimum level for local policies, which might be too strict. The reason is that voters unaffected by the mandate (sincerely) vote together with those benefiting from a stricter mandate. Uniformity might also be the result of a politician's behavior: Seabright (1996) explains how a centrally elected politician is not sufficiently concerned with local preferences, because these voters are unlikely to be pivotal in the next election. Panagariya and Rodrik (1993) argue that a uniform tariff across industries might be optimal to reduce lobbying and tie the hands of politicians favoring certain groups. Their argument is equally relevant in a regional context. Similarly, Besharov (2002) shows that uniform policies may be optimal to avoid costly lobbying. It is less clear why uniformity should result from asymmetric information. In a situation with private information, Bordignon, Manasse and Tabellini (2001) show that it is still optimal to differentiate regional transfers even if this requires that the region with the lowest tax base must signal this by an inefficiently large tax rate. If the central government is unable to commit, however, it might be difficult to screen the different types, and only a uniform policy is possible (Köthenburger, 2003).

decentralized, there will be no political coordination. However, even if the policy is decentralized, the regions still have incentives to coordinate if externalities exist. It is therefore reasonable to relax this assumption, as is done in this paper. While some of the traditional insights are confirmed, others are turned upside-down.

The paper is organized as follows. Next section models the economy and the bargaining game in a context without side payments. The following section describes the equilibrium and its properties, and discusses circumstances under which a uniform policy is better than a differentiated one. Section 4 repeats this exercise with side payments, while Section 5 compares the two cases and derives conditions under which side payments should be prohibited. The alternative interpretations of the results are discussed in the concluding section. All proofs are found in the Appendix.

2 The Model

2.1 The Environment

Two regions, A and B , consider whether to undertake a joint public project and, if so, how its total cost of 1 should be distributed between them. To fix ideas, suppose A and B suffer from a symmetric regional environmental problem. A fraction e of A 's emission crosses the border and pollutes region B , while a fraction $1 - e$ remains as local pollution in region A . A 's value of clean air is v_A , but there is a unit cost to clean or reduce emission. Let x_A denote the amount A cleans or reduces emission. Making symmetric assumptions for region B , the regional (von Neumann-Morgenstern) utilities are

$$\begin{aligned} u_A &= [(1 - e)x_A + ex_B]v_A - x_A \\ u_B &= [(1 - e)x_B + ex_A]v_B - x_B. \end{aligned} \tag{3.1}$$

A region pays the entire cost of its cleaning, while it only receives a fraction $(1 - e)$ of the benefit. Since the other region enjoys the remaining fraction e , each region prefers the other region to clean as much as possible. If $e = 1/2$, cleaning is a pure public good.

Assume that a region will not clean unless an agreement is formed. The reason may simply be that $v_i(1 - e) < 1$,⁸ so that it is not in the interest of one region to clean alone. Alternatively, there may exist constitutional constraints, requiring that environmental policy must be negotiated at the federal level. Relative to this default outcome, the regions are considering a joint public project that will reduce total emission by one unit, i.e. $x_A + x_B = 1$.⁹ x_A is therefore A 's contribution to the public project. A *uniform policy* requires that both regions have the same environmental standard, or that they both reduce emission by the same amount. In either case, this implies that $x_A = x_B$. Assume that $v_i > 1$, such that both regions benefit from a uniform agreement relative to no agreement.¹⁰ If the policy is not uniform, the amount of *differentiation* is defined as

$$d \equiv x_B - x_A.$$

There are potential benefits from differentiating the policy if the regions are heterogeneous ($v_A \neq v_B$). This can be seen from rewriting (3.1) as

$$\begin{aligned} u_A &= \frac{1}{2}[v_A - 1] + \frac{1}{2}[1 - (1 - 2e)v_A]d \\ u_B &= \frac{1}{2}[v_B - 1] - \frac{1}{2}[1 - (1 - 2e)v_B]d \end{aligned} \quad (3.2)$$

and defining total welfare as

$$u \equiv u_A + u_B = \frac{1}{2}(v_A + v_B) - 1 + \left(\frac{1}{2} - e\right)(v_B - v_A)d. \quad (3.3)$$

If $e < 1/2$, pollution is mainly a local problem, and $d > 0$ is efficient if and only if

⁸ In statements that may be true for either region, I let i denote any of these, i.e. $i \in \{A, B\}$.

⁹ There must be a boundary on how much it is possible to clean, since utility functions are linear. If there were regional constraints $x_i \leq k$ for some $k > 0$, it would be first-best that both regions set $x_i = k$ and thus, no value from differentiation. It is, however, reasonable that the policy can be differentiated along the Pareto frontier, and this is better captured by $x_A + x_B = 1$. Allowing any agreement $x_A + x_B \leq 1$ would not change the results, as the inequality would always bind in equilibrium.

¹⁰ I thus abstract from the issue of participation. If $v_i < 1$ were possible, differentiation or side payments would be necessary to encourage i to participate, which would certainly reduce the case for uniform policies (see e.g. Hoel, 1992).

$v_B > v_A$; that is, it is efficient that the region with the highest value of clean air reduces its emission most. If $e = 1/2$, however, cleaning is a pure public good and there is no value from differentiating the policy. If $e > 1/2$ (e.g. due to the plants' strategic location), most of the emission crosses the border, and $d < 0$ is efficient if and only if $v_B > v_A$; that is, it is optimal that the region with the lowest value of clean air reduces its emission most.

However, A and B have conflicting interests in *how* the policy should be differentiated. Each region prefers that the other region contributes most. This is ensured by assuming¹¹

$$1 - (1 - 2e)v_i > 0. \quad (3.4)$$

Moreover, local preferences are local information.¹² Each region i knows only its own type $v_i \in \{\underline{v}, \bar{v}\}$, and the fact that the other region's type is either \underline{v} or $\bar{v} > \underline{v}$ with equal probability.¹³

2.2 A Bargaining Model

In the above environment, regions A and B try to make an agreement. This subsection suggests a bargaining game describing their negotiations. Naturally, this bargaining game should only be interpreted as an example since the regions may negotiate differently. Nevertheless, the following procedure is useful because (i) it

¹¹ This assumption is trivially fulfilled if it is not in the interest of one region to clean alone. By rewriting (3.4) as $e > (1 - 1/v_i)/2$, it requires the externality to be so large that each region prefers to enjoy clean air as the outcome of the other region's cleaning, instead of cleaning itself.

¹² This is a standard assumption in the fiscal federalism literature, and it is also empirically plausible. For example, in a discussion of European environmental policies, Mäler (1991) observes that *the control costs and environmental damage in one country are known to that country only*.

¹³ The model can be interpreted and modified in several alternative ways. First, instead of negotiating the allocation of costs, regions may negotiate how to share a cake. The utility function above can be rewritten as $u_A = (1 + ev_A)x_B + (1 - e)v_Ax_A - 1$. Let the regional cost of the cake be fixed and equal to one for each region; x_B be A 's share of the cake; x_A be B 's share. The externality (from cake consumption) should now be interpreted as $1 - e$, instead of e as before. Otherwise, the results will be the same.

Second, instead of heterogeneity related to values, the heterogeneity might be related to costs. This requires me to slightly rewrite the model, although the analysis and the trade-offs would be similar.

Third, allowing for observed heterogeneity in addition to the unobservable heterogeneity above is straightforward. A 's type could either be \underline{v}_A or \bar{v}_A , while B 's type could be \underline{v}_B or \bar{v}_B . If the observable heterogeneity were larger, a differentiated policy would most likely to be better.

implements the most efficient "stable" and "robust" mechanism (defined in the next section), and (ii) it provides intuition for how implementation is achieved.

In most respects, the bargaining game is standard. The regions make alternating offers over d , A makes the first offer, time is continuous and the time horizon is infinite. An early agreement is preferred to a later one, since i 's present value of an agreement settled at time t is $\delta^t u_A$, where $\delta < 1$ is the regions' common discount factor. The *minimum* time between offers is arbitrarily small (and approaching zero). However, I relax the standard assumption that a region *must* make a proposal at a certain time. Each region is allowed to delay as long as it wishes before making an offer. This provides a way for the regions to signal their types. In this respect, the game is similar to the seller-buyer bargaining games proposed by Admati and Perry (1987) and Cramton (1992), as is the equilibrium. Admati and Perry find a unique sequential equilibrium when the seller's type is known, while the buyer's type is either high or low. Cramton describes an equilibrium in a symmetric game with two-sided private information, and where the distribution of types is continuous.¹⁴

3 Uniform or Different Policies?

3.1 The Outcome with Differentiation

Suppose that both regions' types were common knowledge. The above bargaining game would then have the same unique equilibrium as in the standard Rubinstein (1982) bargaining game.¹⁵ The amount of differentiation would be given by d_R ,

¹⁴ In this paper, as in most of the literature on bargaining with private information, bargaining power is signaled by costly delay. Alternatively, bargaining power may be signaled by proposing a suboptimal or an incomplete agreement. In fact, all results in this paper continue to hold if, instead of delaying to t , each region can credibly reduce the total amount of cleaning in the relevant agreement from 1 to δ^t . Instead of delaying, a low-type region would then signal its bargaining power by proposing a less ambitious project.

¹⁵ Note that an affine transformation of the utilities gives

$$\begin{aligned}\tilde{u}_A &\equiv \frac{u_A}{\frac{1}{2}[1 - v_A(1 - 2e)]} = w_A + d \\ \tilde{u}_B &\equiv \frac{u_B}{\frac{1}{2}[1 - v_B(1 - 2e)]} = w_B - d,\end{aligned}$$

defined as

$$d_R: \begin{array}{c} \\ \\ \end{array} \begin{array}{cc} & B\text{'s type} \\ & \underline{v} \quad \bar{v} \\ A\text{'s type} \quad \underline{v} \quad \bar{v} & \begin{array}{cc} 0 & d' \\ -d' & 0 \end{array} \end{array} \quad (3.5)$$

where

$$d' \equiv \frac{1}{2} \left[\frac{\bar{v} - 1}{1 - \bar{v}(1 - 2e)} - \frac{\underline{v} - 1}{1 - \underline{v}(1 - 2e)} \right]. \quad (3.6)$$

If B has a high value of clean air, B is very eager to settle the agreement quickly. Since eagerness reduces the bargaining power, a low-type A forces B to contribute most to the agreement, so then $d = d' > 0$.

When local preferences are local information, the final agreement will still be the one determined by (3.5), but only after each low-type region has credibly signaled its type by a sufficient delay. The outcome will be the following. Suppose A is of high type. Then, A immediately proposes that the two regions should make equal contributions ($d = 0$). A high-type B immediately accepts. A low-type B , however, rejects A 's offer and delays until time t_1 before suggesting (by proposing $-d'$) that A contributes most. This is immediately accepted by A . Suppose instead A is of low type. Then, A does not make any immediate offer. Instead, A delays until t_1 before suggesting (by proposing d') that B contributes most. A high-type B immediately accepts. A low-type B , however, rejects A 's offer and delays until t_2 before suggesting that they make equal contributions ($d = 0$), which A immediately accepts.

When a region accepts an offer d_R , it does so because it is convinced that the

where

$$w_i \equiv \frac{v_i - 1}{1 - v_i(1 - 2e)}$$

is region i 's willingness to pay for the agreement in terms of d . In the Rubinstein (1982) alternating offer bargaining game, as the time between offers approaches zero, d will be set such that \tilde{u}_A and \tilde{u}_B are equalized:

$$d_R = \frac{w_B - w_A}{2},$$

which gives (3.5). This will still be the equilibrium when regions have the possibility to delay the agreement, since no region could benefit from a delay.

other region is of a certain type. Each delay is exactly sufficiently long to credibly signal that the region is of a low type. A high-type region is less patient, and cannot afford such a delay. The low-type region therefore separates itself from the high-type, by taking an action (delay) that the other type cannot afford.¹⁶ This requires that

$$\begin{array}{l}
 \text{delay:} \\
 \begin{array}{c}
 \begin{array}{cc}
 & B\text{'s type} \\
 & \underline{v} \quad \bar{v} \\
 A\text{'s type} & \begin{array}{cc}
 \underline{v} & t_2 & t_1 \\
 \bar{v} & t_1 & 0
 \end{array}
 \end{array}
 \end{array}
 \end{array}
 \tag{3.7}$$

where

$$\begin{aligned}
 \delta^{t_1} &= 1 - \left[\frac{(1 - \bar{v}(1 - 2e))d'}{\bar{v} - 1 + (1 - \bar{v}(1 - 2e))d'} \right] \\
 \delta^{t_2} &= 1 - 2 \left[\frac{(1 - \bar{v}(1 - 2e))d'}{\bar{v} - 1 + (1 - \bar{v}(1 - 2e))d'} \right].
 \end{aligned}
 \tag{3.8}$$

3.2 Equilibrium Properties

While the previous subsection merely described the equilibrium outcome, this subsection characterizes some of its properties and justifies the attention it will be paid.

As stated by the following Lemma 1, the above outcome can be supported as a sequential equilibrium. Moreover, it is the unique equilibrium if we apply a certain *optimistic intuitive criterion* to refine the set of equilibria. No pooling equilibria then exist.¹⁷ In addition, the above outcome has several attractive properties. It is symmetric, and there is no first-mover advantage. Since only low-type regions delay, an agreement is settled earlier if it is more valuable. And when the regions finally settle the agreement, they do so at "fair" terms, i.e. according to the Rubinstein outcome (3.5). This feature is of particular importance in our context. It is widely agreed that international negotiations must be self-enforcing, since external enforcement mechanisms are seldom available. After an agreement has been formed, *A* can

¹⁶ This is possible since the utility function $\delta^t u_i$ fulfills the single-crossing property.

¹⁷ The definitions and discussions of these concepts are relegated to the Appendix, to separate the theoretically inclined reader from the more applied one.

leave the agreement with the only consequence that the agreement breaks down.¹⁸ If A does so, the two regions have incentives to renegotiate a new agreement. If, at this point in time, A 's and B 's types are common knowledge, they immediately agree on the Rubinstein bargaining outcome (3.5). Anticipating this, no other agreement than (3.5) is robust for such a unilateral request to renegotiate. Thus, it is reasonable to require $d = d_R$ to make self-enforcing agreements renegotiation-proof.

Definition 1: Suppose the types are common knowledge. An agreement d is *stable* if and only if $d = d_R$.

To fully evaluate the above equilibrium outcome, however, we should ask what else could be achieved. Notwithstanding how the regions solve their problem, their method could be substituted by a mechanism where honest revelation is an equilibrium. In our context, we can define a mechanism in the following way:

Definition 2: Let $\hat{v} = \{\underline{v}, \bar{v}\}$ be each player's strategy set. A *mechanism* is a mapping $M : \hat{v}^2 \rightarrow \mathbb{R} \times \mathbb{R}^+$, which determines an outcome (d, t) for each pair of possible types the regions may announce.

Unrestricted mechanism design is often criticized as requiring too much of the institutional environment. First, the optimal mechanism typically implies ex post suboptimal outcomes.¹⁹ If, however, the agreement must be self-enforcing, as argued above, then the mechanism should be restricted to outcomes that are ex post stable. I will say that a mechanism M is *stable* if $d = d_R$ whenever the regions announce their true types.

Second, the optimal mechanism typically requires the regions to simultaneously announce their types, thereby preventing the behavior of one from depending on that of the other. This is not how regions solve problems in practice, however. In

¹⁸ Barrett (2001) writes that *the rules for international law allow countries to withdraw from an international treaty, at least after giving sufficient notice; and, as to reaffirm this freedom, nearly all treaties include an explicit provision for withdrawal.*

¹⁹ It is well known that optimal static mechanisms are not robust to bilateral renegotiation. Beaudry and Poitevin (1993) allow the informed agent to renegotiate its inefficient offer, and find that the executed contract still contains distortions when there are common values. However, if they restricted their attention to private values, as I do, then the executed contract would be ex post efficient.

negotiations, as the one described above, regions reveal their types sequentially, and perhaps little by little. While a region might be uncertain about its opponent's value before making an offer, the opponent's value might just as well have been revealed. Moreover, in reality, it is hard to separate exactly what is private information, and what regions know about each other (perhaps by espionage). A mechanism *only* working whenever types are private information, does not seem very appealing. In contrast, I will define a robust mechanism to be one that works *even* if a region should be aware of the other region's type.

Definition 3: A mechanism M is *robust* if it is incentive compatible, whether or not one region knows the other region's type.

If mechanisms must be stable and robust, then the regions can actually not do better than in the equilibrium outcome described above.²⁰

Lemma 1: (i) Equations (3.5)-(3.8) characterize a sequential equilibrium outcome, (ii) which is unique under the *optimistic intuitive criterion*. Moreover, (iii) it implements the most efficient stable robust mechanism.

3.3 When is Uniformity Better?

Suppose that before knowing their own types, the two regions anticipate the above outcome. Since each region may be of low or high type with equal probability, their total expected utility can be written as

$$u^d = \frac{1}{4}(\bar{v} - 1) + \frac{1}{2} \left[\frac{\bar{v} + \underline{v}}{2} - 1 + \left(\frac{1}{2} - e \right) (\bar{v} - \underline{v}) d' \right] \delta^{t_1} + \frac{1}{4}(\underline{v} - 1)\delta^{t_2}. \quad (3.9)$$

Suppose, further, that the two regions would be able to commit to uniform policies ($d = 0$) if they ever reached an agreement. Would they make such a commitment? If they did, the proceeding bargaining outcome would be simple. A would

²⁰ How restrictive are the requirements that the mechanism must be stable and robust? By relaxing the first of these, and assuming that $e < 1/2$, the best separating mechanism implies that d' is as large as possible, while the delays are still given by (3.7). The following Proposition 1 is not altered. If relaxing the second requirement, the best mechanism dictates no delay if only one region announces low type, but a longer delay if both do. If $e \geq 1/2$, no mechanism can do better than a uniform policy.

immediately suggest an agreement, and B would immediately accept, whatever are their types. There would be no conflict of interest, as they would not have discretion over d . Thus, there would be no point in signaling reluctance by delay, as there would be no way of exploiting bargaining power.²¹ The total expected utility would be

$$u^0 = \frac{1}{4}(\bar{v} - 1) + \frac{1}{2} \left(\frac{\bar{v} + \underline{v}}{2} - 1 \right) + \frac{1}{4}(\underline{v} - 1). \quad (3.10)$$

By comparison, differentiation provides costs as well as benefits. The potential benefit is that the region with the highest value of clean air will reduce its emission most, the cost that such an agreement only occurs with some delay. Such delays are necessary for a low-type region to credibly signal its type which, in turn, is necessary to make the other region accept a larger contribution.

It turns out that a uniform policy is better whenever the externality is large while the heterogeneity and the expected value of the agreement are low. The basic intuition for this is the following. If the externality e is low, it is beneficial that the high-type region cleans most, since this will imply that the air is cleanest where this is most appreciated. Thus, the differentiation following from the bargaining game is valuable. If $e \approx 1/2$, however, cleaning is (almost) a pure public good and it is of no importance where it is located, since the cost is the same in both regions. The value of differentiation is then low. If $e > 1/2$, it would be optimal that the low-type region contributed most. In equilibrium, however, the high-type region contributes most, since it has the lowest bargaining power. Allowing for differentiation would then clearly be perverse. Thus, the benefit from a differentiated policy decreases when e becomes larger. The cost, it turns out, increases. As e increases, each region benefits more from the other region's contribution, and the high type becomes more tempted to imitate the low-type's strategy. To credibly signal bargaining power, delay must increase. In sum: if e increases, the cost of differentiation increases while the benefit decreases, and a uniform policy becomes better.

Define heterogeneity by the relative difference in the two types' net value of a

²¹ If utilities were concave in x_i , however, different types would prefer different levels of cleaning, even if the contributions were bound to be equal in both regions. In that case, it would still be a conflict of interest between the regions under uniform policies. If the utility functions were not extremely concave, however, the conflict of interest would be even larger if differentiation were allowed, which would increase the delay.

uniform agreement:

$$h \equiv \frac{\bar{v} - 1}{\underline{v} - 1} > 1.$$

As heterogeneity increases, the *value* of differentiation increases directly, which makes a differentiated policy better relative to a uniform one.

The expected value of clean air is

$$v \equiv \frac{v + \bar{v}}{2}.$$

Suppose that $e \leq 1/2$. If v increases, there is an increase in the gains from cleaning at home. The value of convincing the other region to contribute more, $(1 - (1 - 2e)v_i)$, decreases. In particular, the high-type region becomes less tempted to delay for the only purpose of contributing less. Thus, delay decreases, and differentiation is more likely to be best. If $e > 1/2$, however, most of the domestic pollution comes from the other region. Then, it becomes more important that the other region does most of the cleaning, which makes it more tempting to signal bargaining power, and there is an increase in delay. This makes a uniform policy even more superior.

It should be noticed that the discount factor δ affects neither the cost nor the benefit of differentiation. If δ decreases, delay becomes more costly, but there is a corresponding decrease in the delay required to credibly signal reluctance. The cost of delay remains the same. The benefit of differentiation comes closer in time, but its present value remains constant.

The above discussion is not complete, however. If e , h , or v changes, so does the amount of differentiation d' . And when d' changes, so do both the cost and the benefit of differentiation. If d' increases, for example, the amount of differentiation increases, and thus also the potential benefit. But a larger d' makes the high-type more tempted to imitate the low-type, and to credibly signal bargaining power, delay must increase. The proof of Proposition 1 shows that costs and benefits increase similarly when d' increases, and the two effects cancel.

In reality, d' may not be determined by negotiations alone. Economic or technological constraints may limit to what extent the policy can be differentiated, such that $d \in [-D, D]$ for some $D \geq 0$. If this constraint were binding, i.e. if $d' > D$, it is easily shown that the outcome (3.5)-(3.8) continues to describe the equilibrium if

just d' is replaced by D . As argued above, the amount of differentiation (d' or D) does not affect whether a uniform policy is better. The following proposition holds in any case.^{22,23}

Proposition 1: $u^0 \geq u^d$ if and only if condition (3.11) holds. This is more likely if the externality e is large, the heterogeneity h small, and the value v low.

$$h \left[2(v-1) \left(\frac{1-2e}{e} \right) - 1 \right] \leq 3. \quad (3.11)$$

In the European Union, some Treaties call for more harmonization than others. Comparing Articles 100a and 130s in the Single European Act is enlightening. While the latter Article applies to environmental issues in general, the former encourages harmonization measures particularly for policies affecting the internal market, where the externality is likely to be larger. Interestingly, derogation (policy differentiation) is not possible under Article 100a, while it is under Article 130s. Moreover, uniform policies are easier to implement under Article 100a, since this requires a qualified majority only, as opposed to the unanimity required by Article 130s. Both differences seem to be in line with Proposition 1.

4 Introducing Side Payments

-Side payments may not be relevant if we consider coordination in a single issue. But they may be highly relevant when the coordinating countries are integrated also in other areas of policy, as in Europe today (Persson and Tabellini, 1995, p. 2000). As issue linkages and logrolling become intrinsic in the political debate, side payments can be included and perhaps not excluded from the bargaining agenda. Moreover,

²² A careful reader may suggest that $D = 1$, since $d > 1$ would imply that A increases its emission by signing the agreement. But some types of policy are easier to differentiate than others, and since there exist contexts where both $D < 1$ and $D > 1$ might be reasonable, I do not specify a value for D .

²³ The above analysis is restricted to the comparison between zero differentiation and equilibrium level of differentiation. Could an interior solution be optimal, making D endogenous? The answer is no. If d' were replaced by D , it can be shown that there is some optimal value D^* maximizing u^d . However, unless (3.11) holds, $D^* > d'$, such that it would never be optimal to restrict D below d' .

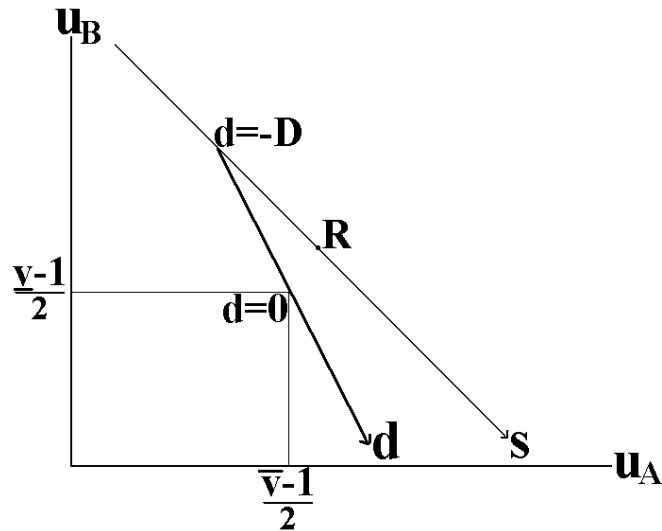


Figure 3.1: The static Pareto frontier when the agenda is (d, s) , $e < 1/2$, A is of high type and B is of low type. R indicates the outcome if information is symmetric.

economists typically presume that side payments improve the efficiency of negotiations. For these reasons, I now introduce s as a (possible negative) side payment from B to A . Transaction costs related to such side payments are supposed to be negligible. We can then rewrite (3.2) as

$$\begin{aligned} u_A &= \frac{1}{2}[v_A - 1] + \frac{1}{2}[1 - v_A(1 - 2e)]d + s \\ u_B &= \frac{1}{2}[v_B - 1] - \frac{1}{2}[1 - v_B(1 - 2e)]d - s. \end{aligned} \quad (3.12)$$

The bargaining game is similar to that above, but now, each proposal is a pair (d, s) . The static Pareto frontier is drawn in the figure below.

4.1 The Outcome with Side Payments and Differentiation

If information were complete, the bargaining outcome would be an immediate agreement where $d \in [-D, D]$ would maximize the sum of the utilities while s would be set so as to equalize A 's and B 's utilities.²⁴ If $v_A = v_B$, the bargaining outcome

²⁴ This can simply be shown by using arguments similar to Rubinstein (1982).

(d, s) would be $(0, 0)$.²⁵ Otherwise (d, s) are given by

	$v_A = \underline{v}$ and $v_B = \bar{v}$	$v_A = \bar{v}$ and $v_B = \underline{v}$
$e \leq 1/2$	(D, \underline{s})	$(-D, -\underline{s})$
$e > 1/2$	$(-D, \bar{s})$	$(D, -\bar{s})$

(3.13)

where

$$\begin{aligned}\underline{s} &\equiv \frac{1}{4}(\bar{v} - \underline{v}) - \frac{D}{4}[2 - (\bar{v} + \underline{v})(1 - 2e)] \\ \bar{s} &\equiv \frac{1}{4}(\bar{v} - \underline{v}) + \frac{D}{4}[2 - (\bar{v} + \underline{v})(1 - 2e)].\end{aligned}$$

If the regional contributions were equal, side payments would go from the high-type region to the low-type region, since the former benefits more from an agreement than the latter. But if one region contributes more than the other, it must be compensated. The net side payment will consist of the sum of these two forces. If $e < 1/2$, most of the pollution is local and it is optimal that the high-type region cleans as much as possible. The two forces then pull in opposing directions, and it is unclear whether the side payment \underline{s} that equalizes utilities is positive or negative. If $e > 1/2$, however, most of the emission crosses the border and it is optimal that the low type cleans most. The side payment to the low type is then $\bar{s} > \underline{s}$, which is clearly positive. If pollution is a pure public good ($e = 1/2$), it is of no importance where cleaning takes place, as long as the side payment equalizes utilities.

When local preferences are local information, the final agreement will still be that determined by (3.13), but only after each low-type region has credibly signaled its type. The outcome will be the following. Suppose $e \leq 1/2$. If region A is of high type, it proposes $(d, s) = (0, 0)$ at $t = 0$. A high-type B immediately accepts. A low-type B rejects A 's offer and delays to t_1^s before it counteroffers $(-D, -\underline{s})$, which A accepts. If region A is of low type, it does not make any immediate offer. Instead, A delays to t_1^s before proposing (D, \underline{s}) . A high-type B immediately accepts. A low-type B rejects A 's offer and delays to t_2^s before it counteroffers $(0, 0)$, which

²⁵ If regions were of the same type, and if transaction costs were identical to zero, the choice of d would be of no importance as long as s is such that the utilities are equal. A small but negligible transaction cost would make $s = d = 0$ the strictly better agreement, however.

A immediately accepts. If $e > 1/2$, the game is similar, but now a low-type region suggests contributing *most* (against the compensation $\bar{s} > \underline{s}$), because this gives the largest total utility.

When a region accepts an offer, it does so because it is convinced that the other region is of a certain type. Each delay is exactly sufficiently long to credibly signal that the region is of a low type. A high-type region finds the low-type region's strategy unattractive, for two reasons. First, a high-type region is less patient, it cannot afford such a delay. Second, a low-type region *pays* the other region to contribute most (or least, if $e > 1/2$). A high-type region, in contrast, would benefit from the opposite agreement. The regions are exploiting "gains from trade" by allocating cleaning where it is most valuable. A region can thus signal its type by proposing a certain direction of trade.²⁶ If $D|1 - 2e|$ is large, the gains from optimal differentiation are large, the high-type is little tempted to imitate the low-type, and the necessary delay to separate the two types decreases. In fact, if $D|1 - 2e| \geq 1$, proposing a direction of trade is a sufficient signal: delay is not necessary and the bargaining outcome is first best. If $D|1 - 2e| < 1$, however, it is necessary that

<i>delay:</i>		<i>B's type</i>	
		\underline{v}	\bar{v}
<i>A's type</i>	\underline{v}	t_2^s	t_1^s
	\bar{v}	t_1^s	0

where

$$\begin{aligned} \delta^{t_1^s} &= 1 - \left[\frac{(\bar{v} - \underline{v})(1 - |1 - 2e|D)}{2(\bar{v} - 1) + (\bar{v} - \underline{v})(1 - |1 - 2e|D)} \right] \\ \delta^{t_2^s} &= 1 - 2 \left[\frac{(\bar{v} - \underline{v})(1 - |1 - 2e|D)}{2(\bar{v} - 1) + (\bar{v} - \underline{v})(1 - |1 - 2e|D)} \right]. \end{aligned} \tag{3.14}$$

²⁶ That a player can signal its type by the proposed direction of trade is related to the result by Cramton, Gibbons and Klemperer (1987) on how to efficiently solve a partnership. When the parties have roughly equal shares, there is confusion about who is going to sell/buy the shares in the partnership, which makes it easier to encourage a player to reveal its value.

4.2 Equilibrium Properties

As stated by Lemma 2, the above outcome can be supported as a sequential equilibrium. In addition, it has similar features to the case without side payments; it is symmetric, and there is no first-mover advantage. Since only low-type regions may delay, an agreement is settled earlier if it is more valuable. And when the regions finally settle the agreement, it is stable, i.e., it coincides with the outcome in (3.13) if information is complete. This sequential equilibrium is, in fact, unique if we restrict the attention to stable outcomes and apply the same *optimistic intuitive criterion* as before.²⁷ No pooling equilibria exist. Finally, the sequential equilibrium implements the most efficient stable robust mechanism.²⁸

Lemma 2: (i) Equations (3.13)-(3.14) characterize a sequential equilibrium outcome, (ii) which is unique under the *optimistic intuitive criterion* and if we require the outcome to be stable. Moreover, (iii) it implements the most efficient stable robust mechanism.

4.3 When is Uniformity Better?

When both differentiation and side payments are on the negotiation table, the total expected utility can be written as

$$u^{ds} = \frac{1}{4}(\bar{v} - 1) + \frac{1}{2} \left[\frac{\bar{v} + \underline{v}}{2} - 1 + (\bar{v} - \underline{v}) \left| \frac{1}{2} - e \right| D \right] \delta^{t_1^s} + \frac{1}{4}(\underline{v} - 1)\delta^{t_2^s}. \quad (3.15)$$

Suppose the two regions were able to commit to uniform policies ($D = 0$) should they ever reach an agreement. Would they make such a commitment? If side payments, but not differentiation, are on the bargaining agenda, the outcome is exactly as above if we set $D = 0$. Define the resulting total expected utility as u^s . By inspection, it is clear that u^{ds} increases in D , for two reasons. First, as D

²⁷ Definitions of these concepts are found in the Appendix.

²⁸ Once more, we can ask how restrictive the stable- and robust-requirements are. By relaxing the first of these, the best mechanism suggests sufficiently large side payments (from the low-type to the high-type region) to make imitation unattractive for the high type. This achieves the first-best. If we only relax the second requirement, the best mechanism dictates no delay if only one region announces low type, but a longer delay if done by both.

increases, it becomes possible to concentrate more of the cleaning to one region, and the gains from doing this efficiently increases. Second, it becomes more costly for high-type regions to imitate the low-type region's strategy, since this would imply inefficient differentiation. Thus, the need for delay is smaller. For these two reasons, it is always better to allow policy differentiation if side payments are on the agenda.

Proposition 2: $u^{ds} \geq u^s$ always.

This proposition does *not* imply that differentiation is good whenever side payments *can* be part of the agenda. It might be beneficial to prohibit *both* side payments and differentiation, that is, $u^0 \geq u^{ds}$. By doing this, delay is ensured to be zero. By allowing both side payments and differentiation, however, differentiation is set optimally.

It turns out that it is better to prohibit both side payments and differentiation whenever $e \approx 1/2$ and when h and D are small. The basic intuition is as follows. If $e < 1/2$, in equilibrium, most of the cleaning takes place in the high-value region, and its benefit is decreasing in e . If $e > 1/2$, optimal differentiation implies that the low-type region does most of the cleaning, and this benefit is increasing in e . In either case, the value of such differentiation is increasing in the heterogeneity h and the possible amount of differentiation, D . If $e \approx 1/2$, however, it is of no importance where cleaning takes place, and there is little value of differentiation. The potential cost of differentiation is delay, but this is decreasing in the gains from trade $D|1 - 2e|$, since such trade provides an efficient signaling device. If $D|1 - 2e| \geq 1$, there is in fact no delay, and the first-best is attainable by allowing both differentiation and side payments.²⁹

Proposition 3: $u^0 \geq u^{ds}$ if and only if both $D|1 - 2e| < 1$ and (3.16) hold. This is more likely if the heterogeneity h is small, the possibilities to differentiate D is

²⁹ It should be noticed that the average value v does not influence this condition. Without side payments, a larger v makes a region more willing to contribute (when $e < 1/2$) and less willing to engage in haggling over d . The utility of a high-type region thus increases relative to a low-type region. Side payments adjust to nullify this effect.

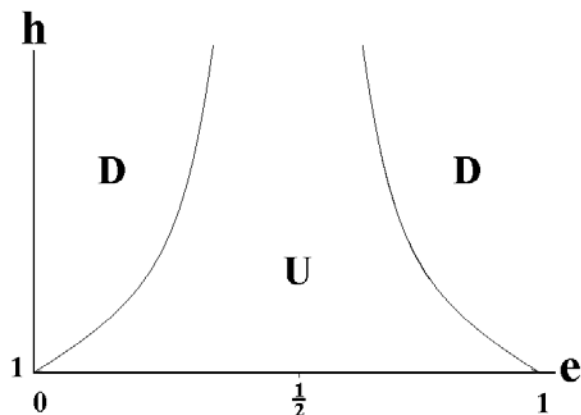


Figure 3.2: Prohibiting both differentiation and side payments, instead of allowing them both, is optimal if and only if the parameters are such that we are in area U .

small and contributions are almost pure public goods, i.e., $|\frac{1}{2} - e|$ is small

$$h \left(\frac{2}{1 - |1 - 2e|D} - 3 \right) \leq 3. \quad (3.16)$$

5 Are Side Payments Good?

-*Side payments are needed to reach the best result* (Cesar and de Zeeuw, 1996, p.158). By introducing side payments, any outcome raising total welfare can be Pareto improving by making the winner compensate the loser. It is therefore a common presumption that side payments increase the efficiency of negotiations, and economists are eager to advocate issue linkages as a way of introducing side payments.³⁰ It is therefore puzzling why side payments are seldom observed to be an explicit part of

³⁰ E.g. Barrett (2001) writes that side payments can *sustain a vastly superior outcome compared to the agreement without side payments*. From a game-theoretic perspective, however, it is not clear whether side payments are beneficial. Jackson and Wilkie (2003) show that the possibility to commit to side payments conditional on strategies may induce players to inefficiently tilt the equilibrium in their favor. In the present paper, however, agents are not able to make such a commitment prior to the game, and side payments would always be first-best if information were perfect. Side payments may also be bad if there are externalities on third parties. Bagwell and Staiger (2001) notice that side payments may reduce the efficiency in trade negotiations if one country can *pay* a second country to liberalize trade, instead of reciprocal liberalization (which would also be beneficial for a third country).

international agreements. Cesar and de Zeeuw conjecture that *the reason might be that it is difficult...to determine the precise willingness to pay.*

Suppose that behind a veil of ignorance, the regions were able to prohibit side payments in future negotiations. Would they? The above analysis makes us well equipped to address this question. The bargaining outcomes for the relevant cases are already discussed: Section 3 made a horizontal comparison between the two agendas in the first row of the table

		Differentiation?	
		no	yes
Side payments?	no	x	d, x
	yes	s, x	d, s, x

Section 4 did a similar comparison between the two agendas in the second row, and compared agenda (d, s, x) to agenda (x) . This section exhausts the model by making a vertical comparison.

Introducing side payments to the agenda has three effects. First, it allows one region to compensate the other for contributing more. Such trade is valuable whenever the policy is suboptimally differentiated without side payments. Second, a region can signal its type by the proposed direction of trade. If $e < 1/2$, it is not very attractive for the high-type region to imitate the low-type region's strategy by paying the other region to do most of the cleaning. The necessary delay to credibly signal bargaining power is then smaller. There is, however, also a third effect. Without side payments, a low-type region might convince the other region to contribute more. If side payments are allowed, the low-type region may also require transfers from the other region. If so, bargaining power pays off even more and it is more attractive to imitate the low-type's strategy. The *incentives* to signal bargaining power increase, and this effect might outweigh the reduced *necessity* to signal by delay. The resulting delay can either decrease or increase.³¹

It turns out that if $e < 1/2$, introducing side payments reduces the expected

³¹ This possibility is noticed by observers. Concerning European cooperation, Héritier (2002, p. 186) writes that *If an issue is perceived as redistributive, the decision process rapidly becomes polarized and clear-cut conflict lines emerge... Those adversely affected fend off expected costs and signal their rejection of the proposal.*

utility whenever h is large, while D and e are small. The basic intuition is as follows. If D is large, the gains from trade are large, and proposing a certain direction of trade is a credible signal of type. Then, side payments are good as they facilitate trade. If D is low, however, the gains from trade are small, and signaling a certain direction of trade is not a very convincing signal. At the same time, bargaining power is not very useful without side payments, since it is not possible to differentiate the policy to any considerable extent in any case. Introducing side payments, however, allows the low-type region to force the high-type region to pay in side payments what it cannot pay in policy. The incentives to signal bargaining power increase, as does delay. Thus, if D is small, side payments are bad. In other words, unless the existing conflict between the regions is sufficiently large, allowing side payments is detrimental to efficiency since it creates a costly conflict of interest. It follows that excluding side payments is always optimal if the policy must be uniform, i.e. $u^0 > u^s$.

If the heterogeneity h is large, there is a great deal of differentiation d' even without side payments, and the gains from trade $D - d'$ are small. The difference in bargaining power, however, is large, and it is quite likely that the low type will get side payments from the high type. To credibly signal bargaining power, delay must increase when side payments are possible. In this case, efficiency is larger when side payments are prohibited.

If v is large or e is low, regions are more willing to clean domestically, instead of engaging in haggling. A large v makes cleaning more valuable, and a small e makes domestic cleaning more important. Regions are therefore less tempted to signal bargaining power, and delay is reduced. Introducing side payments, however, destroys the peace. Once more, bargaining power becomes valuable. Regions become more attracted to signaling bargaining power in order to tilt the transfers in their direction, and delay increases. Thus, side payments are good only if v is small and e is large. If $e > 1/2$, the policy is suboptimally differentiated without side payments. The gains from trade are then larger, and side payments are more likely to increase efficiency.³²

³² It should be noticed that (3.17) is also the condition for when $\underline{s} \leq 0$. Suppose that $d' \geq D$, such that the constraint $d \in [-D, D]$ binds even if side payments are prohibited. Differentiation

Proposition 4: Suppose that $e \leq 1/2$. $u^d \geq u^{ds}$ if and only if (3.17) holds. This is more likely if the externality e is small, the heterogeneity h large, the value v of the agreement large, while the possibility to differentiate D is small

$$\frac{h-1}{h+1} \geq D \left(\frac{1-v(1-2e)}{v-1} \right). \quad (3.17)$$

6 Interpretations

6.1 International Cooperation

This paper has studied two regions (or countries) trying to coordinate their policies so as to internalize externalities. While policy differentiation is necessary to tie local policies to local conditions, it increases the conflict of interests between the countries, and thus delay when bargaining power is private information. While side payments create gains from trade as well as an efficient signaling device, they may also increase the conflict of interest between the countries, and thus delay. The results described how the best bargaining agenda hinges on the value of an agreement, the externality, the heterogeneity, and the possibilities to differentiate.

The results can be interpreted in several ways. On the positive side, the findings may explain why side payments often fail to be an explicit part of international agreements,³³ and why federal policies are characterized by uniform policies.³⁴ On the normative side, the results describe when such harmonization clauses are a good idea, and when it is efficient to allow for issue linkages (e.g. by letting the issue be determined in the European Council, instead of the Council of Ministers that has less discretion). To implement the optimal bargaining agenda, however, a commitment

is then optimal, and there are no gains from trade. Allowing side payments is then beneficial if and only if this reduces delay. Delay is reduced if and only if it becomes less tempting for the high type to imitate the low type's strategy. Whether the high type is more or less tempted to imitate the low type depends on whether it will receive or pay side payments. If the high-type region will be compensated for contributing more in equilibrium, then the high type is better off by allowing side payments, and delay is less necessary to make the low type's strategy unattractive for the high type. If, instead, in equilibrium, the high-type region will pay the low-type region, the high-type region is worse off when side payments are allowed, and it becomes more tempting to imitate the low type's strategy. Then, more delay is necessary to credibly signal bargaining power.

³³ This is questioned by e.g. Cesar and de Zeeuw (1996).

³⁴ Documented by e.g. McCormick (2001).

is required in advance, which provides additional interpretations.

6.2 Decentralization vs. Centralization

The above arguments are closely related to the literature on fiscal federalism (surveyed by Oates, 1999). This literature typically compares decentralization vs. centralization of a political instrument under two assumptions. First, the policy is uniform whenever the instrument is centralized. Relying on this assumption, centralization should be a certain way of committing to uniformity. Second, there is no coordination between regions if the policy is decentralized. However, even if the policy is decentralized, the regions have incentives to cooperate whenever externalities exist. According to the Coase Theorem, they will also be quite successful in doing so. If we thus relax the second assumption, the case for decentralization coincides with the case for differentiation analyzed above. If the policy is decentralized, regions coordinate and differentiate the policy whenever they are heterogeneous. These regional negotiations are likely to be inefficient and delayed, however. Centralizing the policy, instead, gives a clumsy central government no other choice than to implement uniform policies across the regions. While this certainly has a cost when regions differ, the benefit is less delay. Propositions 1 and 3 show that centralization is better if heterogeneity is low and the externality large. While this is in line with the traditional literature, the results also provide new recommendations. Proposition 1 shows that differentiation is better when the value of an agreement is large, because delay is then smaller. Hence, more important decisions should be decentralized. Moreover, in contrast to the earlier literature, I find that it is the existence of asymmetric information which makes the case for centralization. With complete information, it is always better to differentiate the policy, and thus allow decentralized coordination. With asymmetric information, instead, decentralized coordination is likely to be inefficient and centralization may be better. Finally, the central government's uniform policies do not constitute a disadvantage, calling for more decentralization (as normally argued). In contrast, it is the uniform policy which makes centralization potentially attractive, since it reduces the transaction costs.

The analysis also suggests a case for partial decentralization. Comparing Propo-

sitions 1 and 4, a differentiated policy might be better than a uniform one, but side payments may still be a bad idea. This will typically be the case if heterogeneity is large while there is a limit to how much it is possible to differentiate the policy. The best political regime is then to decentralize the relevant policy while restricting the regions' discretion over side payments.

6.3 Integration and Uniformity

As described by Propositions 1-4, regions may benefit if negotiating uniform instead of differentiated policies. As noticed, however, this requires commitment. Without commitment, a reluctant region can easily propose differentiation and perhaps side payments. One way of committing is to use trigger strategies in frequent interaction, where regions stick to the restricted bargaining agenda (without differentiation or side payments) if this facilitates future cooperation. Another way of committing is to write formal agreements, calling for harmonized policies. For either reason, regions constituting a federal union should be better able to commit to a restricted agenda when this is the best solution. Hence, we should observe more uniform policies between regions forming a federal union than between regions that do not. This is exactly the first assumption, mentioned above, made by the traditional literature on fiscal federalism. The above analysis thus provides a theoretical foundation for this, and characterizes when the uniformity assumption is likely to hold. According to this argument, however, this uniformity is not a necessary shortcoming due to the central government's inability to differentiate, as claimed by the fiscal federalism literature. In contrast, the uniformity is a benefit arising as the federal union makes the regions better able to commit.

6.4 Status Quo Bias

Quite often, constitutional rules make renegotiation costly. A justification for such status-quo bias is provided by the analysis of this paper. In fact, a commitment to uniform policies may be interpreted as a commitment to stick to an agreement settled behind a veil of ignorance. One certain way of committing is to create obstacles to renegotiations. While the cost of this is that the policy cannot be

optimally differentiated ex post, once the types are realized, the benefit is that regions will not undertake distorting signaling and screening to tilt the agreement to their advantage. Even if regions were allowed to renegotiate the allocation of contributions, a status quo bias on other political issues may effectively prevent the introduction of side payments. Thus, Propositions 1-4 above can alternatively be interpreted as conditions making a status quo bias rational.

6.5 Future Research

Designing a constitution permits more than banning differentiation and side payments. More importantly, a constitution defines how future decisions will be taken, that is, the rules of the bargaining game. Investigating how different constitutional rules are able to mitigate the inefficiencies described in this paper is an interesting issue for future research. This raises a host of questions. To which extent, for example, is it a good idea to concentrate the agenda-setting power to one region? How does the optimal constitution change when the number of regions increases? What is the optimal majority rule?

The general lesson of this paper is that parties negotiating under private information may benefit from simply constraining the agenda. With a great deal of discretion, a strong party is fully able to exploit its bargaining power. It is then very beneficial to signal bargaining power and screen the other party. Typically, this creates distortions. By instead restricting the agenda, the conflict of interest between the parties may decrease, it becomes more difficult to exploit bargaining power, and distortions diminish. If the value of discretion is small, efficiency benefits from constraining the agenda.

This trade-off between flexibility and costly signaling can be applied to many contexts. Take the Theory of the Firm. By definition, a market transaction requires a price and thus, a conflict between the seller and the buyer. It is no surprise that most bargaining theory is developed for such situations. If the transaction were undertaken in-house, however, the incentives might be less conflicting. In fact, it can be argued that in-house transactions are insensitive to whether the realized benefit is larger than the realized cost. These pieces of information may be private to different employees with small incentives to coordinate. But, as they are not

haggling, delay is reduced. The traditional theory of the firm, such it is surveyed by Hart (1995), emphasizes how ownership affects incentives prior to negotiations. It might be time to turn the attention to ex post transaction costs. When is it good to forbid side payments within firms? Which transactions are better undertaken within instead of between firms?

Appendix

PROOF OF LEMMA 1

Proof of (i) and (ii): At any point in time, a *history* after N offers is the set of proposed and rejected offers: $H_N = \{d_N, t_N\}_N$. Let \mathbf{H}_N denote the set of such possible histories, define $H_0 \equiv (0, 0)$, and let \mathbf{H} be the set of all possible histories (any N). A *pure strategy* for A is a rule f_A that says, whenever N is even, whether A should accept the previous offer or make a counteroffer d_{N+1} after some delay $t_{N+1} - t_N \geq 0$; that is, $f_A : \mathbf{H} \rightarrow \{\text{accept}, (\mathbb{R}, \mathbb{R}_+)\}$. Let A 's *belief* $b_A : \mathbf{H} \rightarrow [0, 1]$ denote the probability A puts on the event $v_B = \underline{v}$ after some history H_N . Similarly, f_B and b_B denote B 's strategy and beliefs about A 's type. At time $t = 0$, $b_A = b_B = 1/2$.

A *sequential equilibrium* (Kreps and Wilson, 1982) is a set of strategies and beliefs such that after every history, each player's strategy is optimal, given its beliefs and the other player's strategy, and the beliefs are consistent with Bayes' rule. The *intuitive criterion* (Cho and Kreps 1987) is a refinement which puts restrictions on beliefs outside the equilibrium. In essence, it requires that any action out of equilibrium beneficial for exactly one type, implies that beliefs place probability one on this type. To ensure a unique equilibrium in the above game in a simple way, I will apply an even stronger updating rule.

Definition 4: Let $(d, t)_i$ denote an (expected) outcome if i is of high type, given i 's belief. Let $F_i \equiv \{(d, t) | (d, t) \succ_i (d, t)_i \text{ if and only if } v_i = \underline{v}\}$. The *intuitive criterion* requires that $b_j = 1$ after $i \neq j$ has taken some action leading to an outcome in F_i . In addition, the *optimistic intuitive criterion* requires that $b_i = 0$ if i has taken some action leading to an outcome outside F_i .

This criterion requires that after a region has made an offer, unless this offer is

unattractive for the high-type region, the region is believed (by the other region) to be of high type for certain. This way of updating beliefs is quite "optimistic", though certainly possible.

Suppose A is revealed to be of low type by making an offer at t_A . A high-type B will not be able to convince A that B is of low type. Thus, B accepts any $d \leq d'$, and will itself immediately propose d' if A 's proposal is some $d > d'$ (remember that d' is the equilibrium when $b_A = 0$ and $b_B = 1$ are correct beliefs). A low-type B , on the other hand, maximizes its utility by proposing an offer in F_B which is acceptable by A if $b_A = 1$; that is, it must be unattractive to a high-type B and acceptable to the low-type A with beliefs $b_A = 1$:

$$\underset{(d,t_2)}{Max} \frac{1}{2} [\underline{v} - 1 - (1 - \underline{v}(1 - 2e)) d] \delta^{t_2} \quad \text{s.t.}$$

$$\begin{aligned} \frac{1}{2} [\bar{v} - 1 - (1 - \bar{v}(1 - 2e)) d'] \delta^{t_A} &\geq \frac{1}{2} [\bar{v} - 1 - (1 - \bar{v}(1 - 2e)) d] \delta^{t_2} \\ d &\geq 0. \end{aligned}$$

The solution is

$$\begin{aligned} d &= 0 \\ \delta^{t_2 - t_A} &= \frac{\bar{v} - 1 - (1 - \bar{v}(1 - 2e)) d'}{\bar{v} - 1}. \end{aligned}$$

Suppose instead that A is revealed to be of high type by making an offer at t_A . A high-type B will not be able to convince A that B is of low type, and B accepts any $d \leq 0$, and will itself immediately propose $d = 0$ if A 's proposal is some $d > 0$ (remember that $d = 0$ is the equilibrium when $b_A = 0$ and $b_B = 0$ are correct beliefs). A low-type B , on the other hand, maximizes its utility by proposing an acceptable offer in F_B ; that is, it must be unattractive to a high-type B and acceptable to a high-type A with beliefs $b_A = 1$:

$$\underset{(d,t_B)}{Max} \frac{1}{2} [\underline{v} - 1 - (1 - \underline{v}(1 - 2e)) d] \delta^{t_B} \quad \text{s.t.}$$

$$\begin{aligned}\frac{1}{2}(\bar{v}-1)\delta^{t_{\bar{A}}} &\geq \frac{1}{2}[\bar{v}-1-(1-\bar{v}(1-2e))d]\delta^{t_{\bar{B}}} \\ d &\geq -d'.\end{aligned}$$

The solution is

$$\begin{aligned}d &= -d' \\ \delta^{t_{\bar{B}}-t_{\bar{A}}} &= \frac{\bar{v}-1}{\bar{v}-1+(1-\bar{v}(1-2e))d'}.\end{aligned}$$

Having found B 's optimal strategy, let us turn to A . If A is of high type, it can (by Definition 4) not afford to persuade B to believe that $b_B \neq 0$. Thus, A can either make a pooling offer $-d'$ which is acceptable to B whatever its type, or A can make a screening offer $d = 0$ which will only be accepted by a high-type B . Since we know B 's reaction in either case, it is easily calculated that A is better off by making the screening offer $d = 0$ at $t_{\bar{A}} = 0$. This gives A the expected utility

$$\bar{u}_A = \frac{1}{4}(\bar{v}-1) + \frac{1}{4}[\bar{v}-1-(1-\bar{v}(1-2e))d']\delta^{t_{\bar{B}}}.$$

The low-type A 's problem is then to make an offer which is not attractive to a high-type A , but acceptable to a high-type B with beliefs $b_B = 1$ (it can easily be shown that a low-type A will not make a pooling offer):

$$\underset{(d,t_A)}{\text{Max}} \frac{1}{4}[\underline{v}-1+(1-\underline{v}(1-2e))d]\delta^{t_A} + \frac{1}{4}(\underline{v}-1)\delta^{t_2-t_A}\delta^{t_A} \quad \text{s.t.}$$

$$\begin{aligned}\bar{u}_A &\geq \frac{1}{4}[\bar{v}-1+(1-\bar{v}(1-2e))d]\delta^{t_A} + \frac{1}{4}(\bar{v}-1)\delta^{t_2-t_A}\delta^{t_A} \\ d &\leq d'.\end{aligned}$$

The solution can be shown to be

$$\begin{aligned}d &= d' \\ \delta^{t_A} &= \frac{\bar{v}-1}{\bar{v}-1+(1-\bar{v}(1-2e))d'}.\end{aligned}$$

Combined, it follows that $\delta^{t_1} \equiv \delta^{t_A} = \delta^{t_B}$ and δ^{t_2} are such as these are defined in (3.8). In equilibrium, the low type will delay and the high type will not. The beliefs in the optimistic intuitive criterion are therefore consistent with Bayes' rule. It follows that these beliefs and the strategies above constitute a sequential equilibrium, which is unique under the optimistic intuitive criterion. Since strategies are symmetric in the sense that $\delta^{t_A} = \delta^{t_B}$, and since B acts after A 's type has been revealed, the low-type A 's strategy is not attractive to the high-type A , even if A had "spied" on B and had beliefs $b_A \in \{0, 1\}$. Thus, the mechanism is transparent. It can also be shown that no pooling equilibrium exists under a weak form of the intuitive criterion (where $b_j = 1/2$, unless i 's action is in F_i).³⁵

Proof of (iii): According to Definition 2, a *mechanism* is a rule mapping any pair of announced types to an outcome (d, t) . Readers preferring to design static mechanism in terms of the probability of agreement, instead of time, can simply let δ^{t_i} denote this probability. I will now calculate the most efficient mechanism that is stable ($d = d_R$) and incentive compatible, even if a region should be aware of the other region's announcement (i.e. robust). This mechanism maximizes the total expected utility by minimizing delay, subject to these constraints and the regions' incentive constraints. The participation constraints are fulfilled when $d = d_R$. Let t_0 , t_1 and t_2 denote the time of the settlement when, respectively, none, one and both regions announce low type. Since the game is symmetric, I do not need to let t_1 depend on which of the regions announces low type (this would not change the result). The problem is

$$\begin{aligned} \underset{t_0, t_1, t_2 \in [0, \infty)}{\text{Max}} \quad u^d &= \frac{1}{4}(\bar{v}-1)\delta^{t_0} + \frac{1}{4}(\underline{v}-1)\delta^{t_2} + \frac{1}{2} \left[\frac{1}{2}(\underline{v} + \bar{v}) - 1 + \left(\frac{1}{2} - e \right) (\bar{v} - \underline{v})d' \right] \delta^{t_1} \quad s.t. \\ & \frac{1}{2}(\bar{v} - 1)\delta^{t_0} \geq \frac{1}{2}[\bar{v} - 1 + (1 - \bar{v}(1 - 2e))d']\delta^{t_1} \quad (\overline{IC}) \end{aligned}$$

³⁵ In a previous version of this paper, the probability that $v_i = \underline{v}$ could be $p > 1/2$. Then, pooling offers might be optimal and pooling equilibria where all types suggest a uniform policy $d = 0$ might exist. Uniform policies might then be the outcome even if heterogeneous regions are allowed to differentiate the policy. However, the set of parameters under which such pooling equilibria exist is strictly smaller than the set of parameters under which a commitment to uniform policies would be good. The results of the paper thus survive, while the analysis would be more complicated.

$$\frac{1}{2}[\bar{v} - 1 - (1 - \bar{v}(1 - 2e))d']\delta^{t_1} \geq \frac{1}{2}(\bar{v} - 1)\delta^{t_2}, \quad (\underline{IC})$$

where (\overline{IC}) and (\underline{IC}) are the high type's incentive constraints when the other region announces high and low type, respectively. When (\overline{IC}) and (\underline{IC}) both hold, truthful announcement becomes optimal also if a region is uncertain about the other region's type. It is easily checked that the low type's incentive constraints are not binding, and these can therefore be ignored. The solution is that $t_0 = 0$, while t_1 and t_2 are set such that

$$\begin{aligned} \delta^{t_1} &= \frac{\bar{v} - 1}{\bar{v} - 1 + (1 - \bar{v}(1 - 2e))d'} \\ \delta^{t_2} &= \frac{\bar{v} - 1 - (1 - \bar{v}(1 - 2e))d'}{\bar{v} - 1 + (1 - \bar{v}(1 - 2e))d'} \Leftrightarrow (3.8). \end{aligned}$$

PROOF OF PROPOSITION 1: Define the *net* values of a uniform agreement as $\underline{n} \equiv \underline{v} - 1$ and $\bar{n} \equiv \bar{v} - 1$. Note that $\bar{n} = 2(v - 1)h/(h + 1)$ and $(1 - \delta^{t_2}) = 2(1 - \delta^{t_1})$. By comparing (3.9) and (3.10):

$$\begin{aligned} u^d &\leq u^0 \Leftrightarrow \\ \frac{1}{2} \left(\frac{1}{2} - e \right) (\bar{v} - \underline{v})d'\delta^{t_1} &\leq \frac{1}{2} \left(\frac{\underline{v} + \bar{v}}{2} - 1 \right) (1 - \delta^{t_1}) + \frac{1}{4}(\underline{v} - 1)(1 - \delta^{t_2}) \Leftrightarrow \\ (1 - 2e)(\bar{v} - \underline{v})d' &\leq (\underline{v} + \bar{v} - 2)(1 - \delta^{t_1})/\delta^{t_1} + (\underline{v} - 1)2(1 - \delta^{t_1})/\delta^{t_1} \Leftrightarrow \end{aligned}$$

$$\begin{aligned} (1 - 2e)(\bar{v} - \underline{v})d' &\leq (3\underline{v} + \bar{v} - 4) \frac{[1 - \bar{v}(1 - 2e)]d'}{\bar{v} - 1} \Leftrightarrow \\ (1 - 2e)(\bar{n} - \underline{n})\bar{n} &\leq (3\underline{n} + \bar{n})[1 - (\bar{n} + 1)(1 - 2e)] \Leftrightarrow \end{aligned}$$

$$\begin{aligned} (1 - 2e)(2\bar{n} + 2\underline{n})\bar{n} &\leq (3\underline{n} + \bar{n})2e \Leftrightarrow \\ (1 - 2e)2(v - 1)h &\leq (3 + h)e \Leftrightarrow \\ h[2(1 - 2e)(v - 1) - e] &\leq 3e \Leftrightarrow (3.11). \end{aligned}$$

PROOF OF LEMMA 2

Proof of (ii): This proof is similar to the proof of Lemma 1. With side pay-

ments, a *history* after N offers is the set of proposed and rejected offers: $H_N = \{d_N, s_N, t_N\}_N$. A *pure strategy* for A is a rule $f_A : \mathbf{H} \rightarrow \{\text{accept}, ([-D, D], \mathbb{R}, \mathbb{R}^+)\}$. Let $(d, s, t)_i$ denote an (expected) outcome if i is of high type, given i 's belief. Let $F_i \equiv \{(d, s, t) | (d, s, t) \succ_i (d, s, t)_i \text{ if and only if } v_i = \underline{v}\}$. The *intuitive criterion* requires that $b_j = 1$ after $i \neq j$ has taken some action leading to an outcome in F_i . In addition, the *optimistic intuitive criterion* requires that $b_i = 0$, if i has taken some action leading to an outcome outside F_i . The attention will be restricted to stable offers (Definition 1).³⁶

Suppose $e \leq 1/2$, and that A is revealed to be of low type by making an offer at t_A^s . A high-type B will not be able to convince A that B is of low type, and will propose $d = D$ and $s = \underline{s}$, giving B utility $\bar{u}_B = [\bar{v} + \underline{v} - 2 + (\bar{v} - \underline{v})(1 - 2e)D] / 4$. In considering A 's offer, a high-type B accepts anything that would make B 's utility at least as large as \bar{u}_B . A low-type B , on the other hand, prefers to propose a stable agreement $(0, 0, t_2^s) \in F_B$ which is thus acceptable to A

$$\text{Max}_{t_2^s \geq t_A^s} \frac{1}{2} (\underline{v} - 1) \delta^{t_2^s} \quad \text{s.t.}$$

$$\bar{u}_B \delta^{t_A^s} \geq \frac{1}{2} (\bar{v} - 1) \delta^{t_2^s}.$$

The solution is

$$\begin{aligned} \delta^{t_2^s - t_A^s} &= \frac{\bar{v} + \underline{v} - 2 + (\bar{v} - \underline{v})(1 - 2e)D}{2(\bar{v} - 1)} \quad \text{if } (1 - 2e)D < 1 \\ t_2^s &= t_A^s \quad \text{if } (1 - 2e)D \geq 1. \end{aligned}$$

Suppose instead that A is revealed to be of high type by making an offer at t_A^s . A high-type B will not be able to convince A that B is of low type, and will propose $d = s = 0$, giving B utility $(\bar{v} - 1) / 2$. In considering A 's offer, a high-type B accepts anything that would make B 's utility at least as large as $(\bar{v} - 1) / 2$. A low-type B , on the other hand, prefers to propose the stable agreement $(-D, -\underline{s}, t_B^s) \in F_B$ which

³⁶ Wang (2000) also restricts the attention to stable offers in his derivation of unique equilibria in the Cramton (1992) model. See the next footnote for my justification for restricting the attention to stable offers.

is thus acceptable to A .

$$\underset{t_B^s \geq t_A^s}{Max} \frac{1}{2} [\underline{v} - 1 + (1 - \underline{v}(1 - 2e)) D + \underline{s}] \delta^{t_B^s} \quad \text{s.t.}$$

$$\frac{1}{2} (\bar{v} - 1) \delta^{t_A^s} \geq \frac{1}{2} [\bar{v} - 1 + (1 - \bar{v}(1 - 2e)) D + \underline{s}] \delta^{t_B^s}.$$

Substituting for \underline{s} , the solution becomes

$$\begin{aligned} \delta^{t_B^s - t_A^s} &= \frac{\bar{v} - 1}{\bar{v} - 1 + (\bar{v} - \underline{v})(1 - (1 - 2e)D)/2} \quad \text{if } (1 - 2e)D < 1 \\ t_B^s &= t_A^s \quad \text{if } (1 - 2e)D \geq 1. \end{aligned}$$

Having found B 's optimal strategy, let us turn to A . If A is of high type, it cannot afford to persuade B to believe that $b_B \neq 0$. Thus, A can either make a pooling offer which is acceptable to B whatever its type, or A can make a screening offer which only a high-type B would accept. Since we know B 's reaction in either case, it is easy to calculate that A is better off by making the screening offer $d = s = 0$ at $t_A^s = 0$. This gives A the expected utility

$$\bar{u}_A = \frac{1}{4} (\bar{v} - 1) + \frac{1}{4} [\bar{v} - 1 - (1 - \bar{v}(1 - 2e)) D - \underline{s}] \delta^{t_B^s}.$$

The low-type A 's problem is then to make an offer which is not attractive to a high-type A , but acceptable to a high-type B with beliefs $b_B = 1$. It can easily be shown that a low-type A will not make a pooling offer, so A proposes the stable agreement $(D, \underline{s}, t_A^s) \in F_A$

$$\underset{t_A^s \geq 0}{Max} \frac{1}{4} [\underline{v} - 1 + (1 - \underline{v}(1 - 2e)) D + \underline{s}] \delta^{t_A^s} + \frac{1}{4} (\underline{v} - 1) \delta^{t_B^s - t_A^s} \delta^{t_A^s} \quad \text{s.t.}$$

$$\bar{u}_A \geq \frac{1}{4} [\bar{v} - 1 + (1 - \bar{v}(1 - 2e)) D + \underline{s}] \delta^{t_A^s} + \frac{1}{4} (\bar{v} - 1) \delta^{t_B^s - t_A^s} \delta^{t_A^s}.$$

The solution can be shown to be

$$\begin{aligned} \delta^{t_A^s} &= \frac{\bar{v} - 1}{\bar{v} - 1 + (\bar{v} - \underline{v})(1 - (1 - 2e)D)/2} \quad \text{if } (1 - 2e)D < 1 \\ t_A^s &= 0 \quad \text{if } (1 - 2e)D \geq 1. \end{aligned}$$

If $e > 1/2$, the proof proceeds in the same way, but since d changes signs in the optimal agreement, $(1 - 2e)$ should be replaced by $|1 - 2e|$. Combined, it follows that $\delta^{t_1^s} \equiv \delta^{t_A^s} = \delta^{t_B^s}$ and $\delta^{t_2^s}$ are such as these are defined in (3.14). In equilibrium, the low type will delay and the high type will not. The beliefs under the optimistic intuitive criterion are therefore consistent with Bayes' rule. It follows that these beliefs and the above strategies comprise a unique equilibrium under the optimistic intuitive criterion when the agreement must be stable.³⁷ It can also be shown that no pooling equilibrium exists under a weak form of the intuitive criterion (where $b_j = 1/2$ unless i 's action is in F_i).³⁸

Proof of (i): The above equilibrium is shown to be unique under the optimistic intuitive criterion and when the agreement is stable. Thus, it is a sequential equilibrium if proposals must be stable. If beliefs are such that $b_i = 0$ whenever $j \neq i$ proposes an agreement which is not stable, it is easily shown that the above strategies constitute a sequential equilibrium even if offers do not have to be stable.

Proof of (iii): I will now calculate the most efficient mechanism that is stable and robust. This mechanism maximizes the total expected utility by minimizing delay subject to these constraints and the regions' incentive constraints. The participation constraints are fulfilled when the agreement is stable. Let t_0^s , t_1^s and t_2^s denote the time of the settlement when none, one and both regions announce low type, respectively. Since the game is symmetric, I do not need to let t_1^s depend on which of the regions announces low type (doing this would not change the result). Suppose $e \geq 1/2$. The problem is

$$\underset{t_0^s, t_1^s, t_2^s \geq 0}{Max} \quad u^{ds} = \frac{1}{4}(\bar{v} - 1)\delta^{t_0^s} + \frac{1}{2} \left[\frac{v + \bar{v}}{2} - 1 + (\bar{v} - \underline{v}) \left| \frac{1}{2} - e \right| D \right] \delta^{t_1^s} + \frac{1}{4}(\underline{v} - 1)\delta^{t_2^s} \quad \text{s.t.}$$

³⁷ Why require the agreement to be stable? If A is proved to be of low type, a low-type B could save delay by proposing $d = -D$ instead of $d = 0$, by adjusting the side payments accordingly (to equalize utilities). If small transaction costs were related to the side payments, however, A and B would prefer to renegotiate and set $d = s = 0$, when both are proved to be of low type. Hence, signaling by proposing $d = -D$ would not be credible, since the agreement would not be stable.

³⁸ In a previous version of this paper, the probability that $v_i = \underline{v}$ could be $p > 1/2$. Then, pooling offers might be optimal, and pooling equilibria where all types suggest $d = s = 0$ might exist. Uniform policies might then be the outcome even if heterogeneous regions are allowed to differentiate the policy and negotiate over side payments. However, the set of parameters under which such pooling equilibria exist is strictly smaller than the set of parameters under which a commitment would be good. The results of the paper thus survive, while the analysis would be more complicated.

$$\frac{1}{2}(\bar{v} - 1)\delta^{t_0^s} \geq \frac{1}{2}[\bar{v} - 1 + (1 - \bar{v}(1 - 2e))D + \underline{s}] \delta^{t_1^s} \quad (\overline{IC})$$

$$\frac{1}{2}[\bar{v} - 1 - (1 - \bar{v}(1 - 2e))D - \underline{s}] \delta^{t_1^s} \geq \frac{1}{2}(\bar{v} - 1)\delta^{t_2^s} \quad (\underline{IC})$$

where (\overline{IC}) and (\underline{IC}) are the high type's incentive constraints when the other region is of high and low type, respectively. When (\overline{IC}) and (\underline{IC}) both hold, truthful announcements are optimal also if a region is uncertain about the other region's type. It is easily checked that the low type's incentive constraints are not binding. Substituting for \underline{s} , it follows that $t_0^s = 0$, while t_1^s and t_2^s are set such that:

$$\begin{aligned} \delta^{t_1^s} &= \frac{\bar{v} - 1}{(\bar{v} - 1) + \frac{1}{2}(\bar{v} - \underline{v})(1 - (1 - 2e)D)} \quad \text{and} \\ \delta^{t_2^s} &= \frac{(\bar{v} - 1) - \frac{1}{2}(\bar{v} - \underline{v})(1 - (1 - 2e)D)}{(\bar{v} - 1) + \frac{1}{2}(\bar{v} - \underline{v})(1 - (1 - 2e)D)} \quad \text{if } (1 - 2e)D < 1. \\ t_0^s &= t_1^s = t_2^s = 0 \quad \text{if } (1 - 2e)D \geq 1. \end{aligned}$$

If $e > 1/2$, a similar maximization problem gives the same solution if only $(1 - 2e)$ is replaced by $|1 - 2e|$.

PROOF OF PROPOSITION 3: If $D|1 - 2e| \geq 1$, we know that the policy is optimally differentiated with no delay. Therefore, assume that $D|1 - 2e| < 1$, and apply the same definitions of \underline{n} and \bar{n} as in the proof of Proposition 1. $u^0 \geq u^{ds}$ whenever the benefit from an optimally differentiated policy is smaller than the cost of delay:

$$\begin{aligned} \frac{1}{2} \left((\bar{v} - \underline{v}) \left| \frac{1}{2} - e \right| D \right) \delta^{t_1^s} &\leq \frac{1}{2} \left(\frac{\underline{v} + \bar{v}}{2} - 1 \right) (1 - \delta^{t_1^s}) + \frac{1}{4}(\underline{v} - 1)(1 - \delta^{t_2^s}) \Leftrightarrow \\ (\bar{v} - \underline{v}) |1 - 2e| D &\leq (\underline{v} + \bar{v} - 2) \frac{1 - \delta^{t_1^s}}{\delta^{t_1^s}} + (\underline{v} - 1) \frac{2(1 - \delta^{t_1^s})}{\delta^{t_1^s}} \Leftrightarrow \\ (\bar{v} - \underline{v}) |1 - 2e| D &\leq [3\underline{v} + \bar{v} - 4] \frac{(\bar{v} - \underline{v})(1 - |1 - 2e|D)}{2(\bar{v} - 1)} \Leftrightarrow \\ 2\bar{n} |1 - 2e| D &\leq [3\underline{n} + \bar{n}] (1 - |1 - 2e|D) \Leftrightarrow \\ \bar{n}(3|1 - 2e|D - 1) &\leq 3\underline{n}(1 - |1 - 2e|D) \Leftrightarrow \\ h \left(\frac{3|1 - 2e|D - 1}{1 - |1 - 2e|D} \right) &\leq 3 \Leftrightarrow (3.16). \end{aligned}$$

PROOF OF PROPOSITION 4: Side payments are beneficial if and only if $u^{sd} \geq u^d$, which requires:

$$[\underline{v} + \bar{v} - 2 + (\bar{v} - \underline{v}) |1 - 2e| D] \delta^{t_1^s} + (\underline{v} - 1) \delta^{t_2^s} \geq$$

$$[\underline{v} + \bar{v} - 2 + (\bar{v} - \underline{v}) (1 - 2e) d'] \delta^{t_1} + (\underline{v} - 1) \delta^{t_2}.$$

By introducing side payments, there are always gains from trade since $|1 - 2e| D \geq (1 - 2e) d'$. Suppose that $e \leq 1/2$ and $d' < D$. Comparing (3.8) and (3.14), we notice that side payments reduce delay whenever $(\bar{v} - \underline{v}) (1 - |1 - 2e| D) / 2 < [1 - \bar{v} (1 - 2e)] d'$. Substituting for d' , we observe that this condition always holds! Suppose, therefore, that $d' \notin [-D, D]$. When this condition binds, d' should be substituted in equilibrium by D . Then, there are no gains from trade, and side payments are good if and only if they reduce delay. The condition for this is:

$$\begin{aligned} (\bar{v} - \underline{v}) (1 - (1 - 2e) D) &\leq 2 [1 - \bar{v} (1 - 2e)] D \Leftrightarrow \\ (\bar{v} - \underline{v}) &\leq D [2 - (\bar{v} + \underline{v}) (1 - 2e)] \Leftrightarrow \\ h - 1 &\leq D \left[\frac{2e(h + 1)}{v - 1} - (h + 1) (1 - 2e) \right] \Leftrightarrow (3.17). \end{aligned}$$

This condition will always be satisfied when $d' < D$. If $e > 1/2$, the requirement for when side payments reduce delay is relaxed. In addition, the gains from trade are larger. Thus, the larger is e , the more likely are side payments to increase efficiency.

References

- Admati, A. and M. Perry (1987): "Strategic Delay in Bargaining", *Review of Economic Studies* 54: 345-364.
- Alesina, A. and A. Drazen (1991): "Why are Stabilizations Delayed?", *American Economic Review* 81 (5): 1170-1188.
- Alesina, A. and E. Spalore (1997): "On the Number and Size of Nations", *Quarterly Journal of Economics* 112: 1027-1056.

Ausubel, L., P. Cramton, and R. Deneckere (2002): "Bargaining with Incomplete Information", in R. J. Aumann and S. Hart (Eds.), *Handbook of Game Theory*, Vol. 3, Amsterdam: Elsevier Science B.V., Chapter 50: 1897-1945.

Bagwell, K. and R. Staiger (2001): "Shifting Comparative Advantage and Accession in the WTO", mimeo.

Barrett, S. (2001): "International Cooperation for Sale", *European Economic Review* 45: 1835-1850.

Beaudry, P. and M. Poitevin (1993): "Signaling and Renegotiation in Contractual Relationships", *Econometrica* 61 (4): 745-782.

Besharov, G. (2002): "Influence Costs in the Provision of Local Public Goods", Mimeo, Duke University.

Besley, T. and S. Coate (2003): "Centralized versus Decentralized Provision of Local Public Goods: A Political Economy Analysis", *Journal of Public Economics*, forthcoming.

Bolton, P. and J. Farrell (1990): "Decentralization, Duplication, and Delay", *Journal of Political Economy* 98 (4): 803-26.

Bolton, P. and G. Roland (1997): "The Break-up of Nations: A Political Economy Analysis", *Quarterly Journal of Economics* 112 (4): 1057-90.

Bordignon, M., P. Manasse and G. Tabellini (2001): "Optimal Regional Redistribution Under Asymmetric Information", *American Economic Review* 91 (3).

Cesar, H., and A. de Zeeuw (1996): "Issue Linkage in Global Environmental Problems", in A. Xepapadeas (Ed.), *Economic Policy for the Environment and Natural Resources: Techniques for the Management and Control of Pollution*, Cheltenham, E. Elgar.

Cho, I. and D. Kreps (1987): "Signaling Games and Stable Equilibria", *Quarterly Journal of Economics* 102: 179-221.

- Cramton, P. (1992): "Strategic Delay in Bargaining with Two-Sided Uncertainty", *Review of Economic Studies* 59: 205-25.
- Cramton, P., R. Gibbons and P. Klemperer (1987): "Dissolving a Partnership Efficiently", *Econometrica* 55: 615-32.
- Cremer, J. and T. Palfrey (1996): "In or Out?: Centralization by Majority Vote", *European Economic Review* 40: 43-60.
- Cremer, J. and T. Palfrey (2000): "Federal Mandates by Popular Demand", *Journal of Political Economy* 108 (5): 905-27.
- Ellingsen, T. (1998): "Externalities vs Internalities: A Model of Political Integration", *Journal of Public Economics* 68: 251-68.
- Hart, O. (1995): *Firms, Contracts, and Financial Structure*, Oxford University Press.
- Héritier, A. (2002): "The Accommodation of Diversity in European Policy-making and its Outcomes: Regulatory Policy as a Patchwork", in A. Jordan (Ed.), *Environmental Policy in the European Union. Actors, Institutions and Processes*, Earthscan Publications Ltd.
- Hoel, M. (1992): "International Environment Conventions: The Case of Uniform Reductions of Emissions", *Environmental and Resource Economics* 2: 141-59.
- Hsieh, C. (2000): "Bargaining over Reform", *European Economic Review* 44: 1659-76.
- Inderst, R. (2000): "Multi-issue Bargaining with Endogenous Agenda", *Games and Economic Behavior* 30: 64-82.
- Jackson, M. and S. Wilkie (2003): "Endogenous Games and Mechanisms: Side Payments Among Players", *Review of Economic Studies*, forthcoming.
- Kreps, D. and R. Wilson (1982): "Sequential Equilibria", *Econometrica* 50 (4): 863-94.

Köthenburger, M. (2003): "On the Benefits of (De)centralization", Mimeo, University of Munich.

Lockwood, B. (2002): "Distributive Politics and the Benefits of Decentralisation", *Review of Economic Studies* 69: 313-38.

McCalman, P. (2002): "Multilateral Trade Negotiations and the Most Favoured Nation Clause", *Journal of International Economics* 57 (1): 151-76.

McCormick, J. (2001): *Environmental Policy in the European Union*, Palgrave.

Myerson, R. and M. Satterthwaite (1983): "Efficient Mechanisms for Bilateral Trading", *Journal of Economic Theory* 29 (2).

Mäler, K. G. (1991): "Environmental Issues in the New Europe", in Atkinson, A. B., and R. Brunetta (Eds.), *Economics for the New Europe*, New York University Press, New York.

Oates, W. (1972): *Fiscal Federalism*, Harcourt Brace: New York.

Oates, W. (1999): "An Essay on Fiscal Federalism", *Journal of Economic Literature* 37: 1120-49.

Panagariya, A. and D. Rodrik (1993): "Political-Economy Arguments for a Uniform Tariff", *International Economic Review* 34 (3): 685-703.

Persson, T. and G. Tabellini (1995): "Double-Edged Incentives: Institutions and Policy Coordination", *Handbook of International Economics*, Vol. III.

Rubinstein, A. (1982): "Perfect Equilibrium in a Bargaining Model", *Econometrica* 50 (1): 97-110.

Seabright, P. (1996): "Accountability and Decentralisation in Government: An Incomplete Contracts Model", *European Economic Review* 40: 61-80.

Wang, R. (2000): "Separating Equilibria in a Continuous-time Bargaining Model with Two-Sided Uncertainty", *International Journal of Game Theory* 29: 229-40.

Chapter 4

Organizations and Careers^{*}

1 Introduction

-The benefit of working for a decentralized firm as Anderson is that we all share the company's success. (pre-Enron likely claim)

Once a firm's performance is observed, the allocation of blame and fame is determined by organizational design. Were control highly centralized, the chief executive officer (CEO) would receive all blame following a fiasco; all fame following a success. When control is decentralized, instead, the glory of success will be shared by all managers that may influence the firm's performance. A manager's reputation is more exposed if such a firm is transparent and the outcome of different subtasks observable. This is particularly true if the manager is young and her talent unknown. The allocation of control, the transparency of subtasks, and the choice of managers are all crucial for the production of individual reputations. How, then, should a firm design its organization?

Reputation and talent are increasingly important for individual careers. Kanter (1989, pp. 310-312) observes that *the creation of star quality is a hallmark in the dynamics of the professional career, and the key variable in success is reputation.*

^{*} I am grateful for comments from Philippe Aghion, Heski Bar-Isaac, Erik Berglöf, Tore Ellingsen, Guido Friebel, Nicola Gennaioli, Mariassunta Giannetti, Oliver Hart, Jaime Ortega, Torsten Persson and seminar participants at EARIE (2003), SITE (the Stockholm Institute of Transition Economics) and Forskermøtet (Norwegian annual conference). Thanks also to Annika Andreasson for editorial assistance. Financial support from the Tore Browaldh Foundation is gratefully acknowledged.

The relevance of reputation is reflected in executives' pay. Murphy (1999) finds that top CEO pay has increased relative to both average CEO pay and average wages. The average CEO made about 30 times more than the average production worker in 1970. By 1996, the average CEO received a nearly 90 times greater cash compensation, and a total realized compensation of *210 times* the earnings for production workers. The question of how organizational design influences careers seems to be more important than ever. What causes the trend in executive pay? How does it affect organizational change?

This paper intends to answer these questions. The explanation requires a model with three parts: the product market, Bayesian learning about employees, and organizational design. While the *creation* of reputations is determined by organizational design, the *value* of a certain reputation is determined by the product market. Thus, the market structure determines the optimal organizational design. I argue that more intense competition and thicker markets rationalize recent changes in both executive pay and organizational design.

For the product market, I modify Salop's (1979) simple model of price competition in the circular city. A firm's cost (or quality) is assumed to depend on the manager's talent. With a talented manager, the firm finds it profitable to increase its production. A firm's willingness to pay for a particular manager is thus an increasing and convex function of her expected ability (which I call reputation). If competition becomes tougher (more substitutable products) and the market thicker (more consumers), demand becomes more sensitive to the price. The best-governed firm is then able to capture a huge share of the market. The executive's wage, as a function of her reputation, becomes steeper and more convex. This model provides a mapping from the market structure to the value of reputation. The effects resemble "the economics of superstars" as analyzed by Rosen (1981), but, as argued by Frank and Cook (1995), the effects seem to be fairly general.

The product market is combined with public Bayesian learning about the managers' abilities. Good performance in period 1 indicates that the firm's manager is talented, and her wage in period 2 increases accordingly. However, alternative organizational designs differ in how the market learns about the managers' talents. A firm internalizes the managers' career possibilities, since present wages can be

reduced accordingly. A firm will therefore choose its organizational design in order to maximize the total value of learning. We will examine decentralization of control, transparency, M-form vs. U-form corporations, and the particular choice of manager. Since organizational design determines the allocation of learning, while the market structure determines the value of a reputation, the combined model provides a mapping from market structure to organizational design.

That today's performance affects tomorrow's wage is a fundamental pillar of the career concern literature initiated by Fama (1980) and formalized by Holmström (1982). Though some of this literature addresses organizational design, it typically focuses on the effects on *incentives* to provide effort.¹ There is no value of *learning* per se, since future wages are simply assumed to be linear in expected abilities. With this linearity assumption, the organization of learning is irrelevant. A few recent papers, however, evaluate organizations where the internal labor market breaks the linearity between value and reputation.² The present paper contributes to this literature by showing how the market structure determines executives' future pay, as a function of reputations, and thus also optimal organizational design.

My model of the product market is similar to that by Raith (2003), who studies optimal incentive contracts. He finds that as competition becomes tougher and the market thicker, explicit incentives should be strengthened. In contrast to this paper, he studies incentives and neglects learning and reputation. Such learning is emphasized by Hörner (2002), who shows that competition encourages firms to continue providing good quality even after their good-quality type is (almost) revealed. In contrast to this paper, he studies effort and neglects organizational design. The closest antecedent is probably the paper by Demougin and Siow (1994). They analyze fast-track vs. up-or-out hiring policies, where the equilibrium regime depends on e.g. the skill-premium. Though they discuss the organization of *training* within the firm, this can also be interpreted as *learning* about the employees, since some trainees turn out to be successful, others not. Compared to Demougin and Siow (1994), the present paper discusses other aspects of organizational design, and is more explicit in modeling the market structure.

¹ Examples are Aghion and Tirole (1995), Jeon (1996) and Ortega (2003).

² Examples are Meyer (1994), Ortega (2001) and Carrillo (2003). These do not consider the external job market for managers, however.

The paper is organized as follows. The next section presents the first two parts of the model: the market structure - from which we can derive the value of a reputation - and Bayesian learning about the manager's ability. When this combined framework is in place, the analysis of alternative organizational design easily follows in section 3. In five different subsections, we study decentralization in non-transparent firms, decentralization in transparent firms, the value of transparency itself, the comparison between M-form and U-form organizations, and equilibrium turnover of managers. To simplify, there are only two periods, all agents are risk neutral, and there is no effort. Section 4 argues that the results generalize if these assumptions are relaxed, though they raise interesting questions for future research. Section 5 summarizes the model's predictions and relates them to empirical evidence on executive pay, organizational change, and the positive correlation between firm size and wages. The final section concludes and discusses how this paper's approach can be fruitfully applied to other areas.

2 The Model

The model consists of three parts. To formalize the product market, I borrow Salop's (1979) workhorse model of price competition in the circular city. I let a firm's unit cost depend on its managers' abilities, and there is free competition in the labor market. The structure of the product market will then determine how ability is rewarded. A manager's expected ability, or reputation as I call it, is formed by Bayesian updating based on the firm's past performance. Together, these two parts show how the market structure determines the value of learning about a manager's ability. Exactly how we update our beliefs about the different managers' abilities depends on the firm's particular organizational design, which constitutes the third part of the model. Since the market structure determines the value of reputations, while reputations are determined by organizational design, the model provides a mapping from the market structure to the optimal organizational design.

The timing of the game is the following. First, each potential firm (represented by its owner) decides whether to enter the market place. There, it costs one unit to

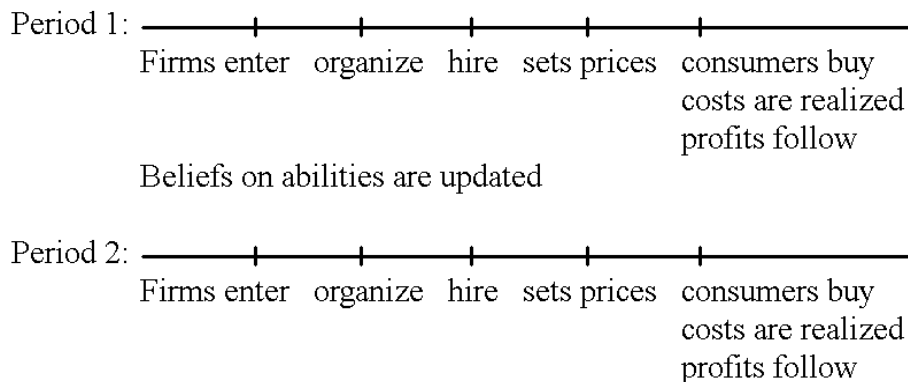


Figure 4.1: Timing of the game

operate the firm.³ The market place consists of a large circular city with perimeter 1.⁴ The n firms that enter choose their organizational design, and they hire and pay managers. Thereafter, each firm simultaneously commits to its product price, knowing only its own expected unit cost and the distribution of costs among other firms. The firms are automatically located equidistant from one another on the circle. A mass m of consumers is uniformly distributed on the circle, and each of them buys one single product. Since they face linear travel costs $t > 0$, each consumer buys from the producer which minimizes the sum of expenses: price and travel cost. Finally, the firms' unit costs and profits are realized.

To smooth the reader's burden, the introduction of alternative organizational designs is postponed to the next section. At this stage, it suffices to stick to a simple organizational form where one manager is undertaking one task. Then, a firm i 's unit cost is

$$c_i = 1 - y_i$$

which is stochastic since the outcome of the cost reduction task

$$y_i = a_i + \epsilon_i$$

³ The only role of this running cost is to make the number of firms finite. In contrast to the standard model by Salop (1979), this running cost should not be interpreted as an entrance fee, since that would imply complicating hysteresis in the dynamic version of this model.

⁴ The exact perimeter of this circle does not matter as long as it is large, since then the number of entering firms will be (approximately) proportional to the perimeter.

depends on the manager's ability a_i and some shock ϵ_i , and both of these are unknown to everyone. The shock ϵ_i is firm-specific and normally distributed with mean zero and variance σ_ϵ^2 :⁵

$$\epsilon_i \sim N(0, \sigma_\epsilon^2)$$

This game is repeated in two subsequent periods. In the first, firms can only recruit managers from a large pool of identical risk neutral candidates whose reservation wage and expected ability are both normalized to zero:⁶

$$a_i \sim N(0, \sigma_a^2).$$

But after the firms' performances in the first period are observed, some of the managers earn a positive reputation,

$$r_i \equiv E(a_i | y_i),$$

and these managers become attractive for firms in the second period. Managers who have earned a negative reputation in the first period are not hired as managers in the second period, and they step back to basic work where they earn their reservation wage of zero.⁷ There is no discounting between the two periods. All learning is public, and there is no asymmetric information.⁸

The game is solved by backward induction in the remainder of this paper. The first subsection finds the product market solution, which is similar for both periods. The next subsection shows how this determines a manager's second-period wage, as

⁵ In an alternative context where shocks are correlated, Hart (1983) discusses how competition might reduce the noise in measuring the manager's performance (due to yardstick competition).

⁶ A positive reservation wage would not affect the results. In fact, the running cost of 1 may be interpreted as $w_0 l$, where l is a fixed number of required workers and w_0 is their reservation wage. One of these employees is then appointed manager.

⁷ The intuition for this assumption is that managers who have earned a negative reputation can always return to work where no important decisions are taken. The alternative assumption is that their wages are reduced below their reservation wage of zero. This would not affect the results, but I find it harder to justify.

⁸ Neither firms nor individuals have private information about abilities. Analyses of labor markets where workers have private information go back to Spence (1973). For analyses of labor markets where the firm has more information than the market, see e.g. Greenwald (1979), Waldman (1984) and Acemoglu and Pischke (1998).

a function of her reputation. This reputation is generated by Bayesian updating, and the third section discusses how the value of this learning depends on the market structure. The next section shows how the allocation of learning hinges on the particular organizational design: the best design will therefore depend on the market structure. Though the value of exposure materializes as higher expected pay for the firms' managers, firms internalize this since better career possibilities allow them to reduce wages in period one.

2.1 The Product Market

Let's first solve for the product market. Consider a consumer at location x , between firm 1 (at location 0) and firm 2 (at location $\frac{1}{n}$). This consumer buys from firm 1 instead of firm 2 if

$$\begin{aligned} p_1 + tx &\leq p_2 + t\left(\frac{1}{n} - x\right) \Rightarrow \\ x &\leq \frac{1}{2n} + \frac{p_2 - p_1}{2t}. \end{aligned}$$

By considering both of a firm's closest competitors, and the density of consumers m , firm i 's total demand becomes

$$\frac{m}{n} + \frac{m}{t} \left(\frac{p_{i-1} + p_{i+1}}{2} - p_i \right). \quad (4.1)$$

For simplicity, subscripts indicating period 1 or 2 are omitted, and each consumer is assumed to buy from one of the two closest firms.⁹ Firm i 's gross profit, or surplus, becomes

$$s_i = m(p_i - c_i) \left[\frac{1}{n} + \frac{1}{t} \left(\frac{p_{i-1} + p_{i+1}}{2} - p_i \right) \right].$$

⁹ Though this assumption is not really needed for the results, it simplifies the analysis. To ensure that it holds, Raith (2003) assumes that the travel costs are quadratic, and that some further conditions are satisfied. It can also be ensured by assuming that the travel cost t is sufficiently large, however.

Firm i chooses its price in order to solve

$$\begin{aligned} \underset{p_i}{Max} Es_i &= Em(p_i - c_i) \left[\frac{1}{n} + \frac{1}{t} \left(\frac{p_{i-1} + p_{i+1}}{2} - p_i \right) \right] \Rightarrow \\ p_i &= \frac{Ec_i + \bar{p}}{2} + \frac{t}{2n} \end{aligned}$$

where $\bar{p} = Ep_j$ is the average price in the market. Since all other firms do the same, $\bar{p} = \bar{c} + t/n$, where \bar{c} is the average unit cost. Expected surplus becomes

$$Es_i = \frac{m}{t} \left(\frac{t}{n} + \frac{\bar{c} - Ec_i}{2} \right)^2. \quad (4.2)$$

It is straightforward to allow for heterogeneity in expected quality as well. Suppose firm i 's expected quality Eq_i raises the consumers willingness to pay accordingly. If we for a moment rename i 's unit cost to k_i , (4.2) continues to hold if we redefine $Ec_i \equiv Ek_i - Eq_i$ and $\bar{c} \equiv \bar{k} - \bar{q}$. Thus, higher expected quality has the same effect as lower expected cost since both allow the firm to raise its mark-up between price and expected cost. The parameter c_i can therefore be interpreted as the difference between unit cost and quality, though I simplify by calling it cost.¹⁰

2.2 The Market for Managers

Having analyzed the product market, this subsection calculates a manager's salary as a function of her reputation in the second period. The next subsection formalizes how this reputation is formed in period 1.

The crucial task for a firm's manager is to reduce the unit costs (which may, alternatively, be interpreted as an increase in quality). Since $c_i = 1 - a_i - \epsilon_i$, a manager with reputation r_i reduces the expected unit costs by r_i . The firm's surplus (4.2) can then be rewritten as

$$Es(r) = \frac{m}{t} \left(\frac{t}{n} + \frac{r - \bar{r}}{2} \right)^2 \quad (4.3)$$

¹⁰ The difference, of course, is that while firms are affected by the actual realization of costs, it is consumers who are affected by the actual realization of quality. This does not matter as all agents are risk-neutral.

where \bar{r} is the average reputation of the firms' managers, and subscripts denoting firm i are eliminated for simplicity.

Assume that the number of firms is always larger than the number of managers with a positive reputation.¹¹ Even in the second period, then, some firms will hire unknown managers with zero reputation and such firms will enter until their net profit is zero, implying

$$\begin{aligned} Es(0) - 1 &= \frac{m}{t} \left(\frac{t}{n_2} - \frac{\bar{r}}{2} \right)^2 - 1 = 0 \Rightarrow \\ n_2 &= \frac{t}{\sqrt{\frac{t}{m}} + \frac{\bar{r}}{2}} \end{aligned} \quad (4.4)$$

where n_2 denotes the number of firms in the second period. Substituting (4.4) in (4.3) gives

$$Es(r) = \frac{m}{t} \left(\sqrt{\frac{t}{m}} + \frac{r}{2} \right)^2. \quad (4.5)$$

How much is a firm willing to pay for a manager with reputation $r > 0$? A firm is willing to pay the amount by which profit increases:

$$w(r) = s(r) - s(0) = r \sqrt{\frac{m}{t}} + r^2 \frac{m}{4t}. \quad (4.6)$$

This is, indeed, the salary a firm *has* to pay in order to attract such a manager, since a large number of firms bid for a smaller number of managers with positive reputation. As the travel cost t decreases, products become less differentiated, demand more elastic and competition more intense. Similarly, if the thickness of the market m increases, demand becomes more elastic and competition more intense as more firms enter the market. In these circumstances, the firm of the manager with the best reputation sets the lowest price and captures a huge share of the market. A firm is then willing to pay a lot for a manager with a very good reputation; a fairly good

¹¹ This assumption will always hold in equilibrium in this section since some of the managers in the first period will earn a negative reputation. The assumption is also fulfilled in the next section - where a firm might have more than one manager - if a sufficiently large number of these are exiting (dying or retiring) after the first period. This assumption would also have to hold if there were more than two periods and recruitment of new managers in each.

reputation is not enough.

Lemma 1: A manager's second-period wage (4.6) is an increasing and convex function of her reputation r . This function becomes steeper and more convex as competition increases (t decreases) and the market gets thicker (m increases).

The result is stated as a lemma for two reasons. First, it will be instrumental to the results in the next section. Second, it is not entirely new. Already Rosen (1981) showed that decreasing transport costs would increase both the variance and the skewness of the wage distribution relative to the distribution of abilities.

2.3 The Value of Exposure

As the previous subsection calculated the value of a reputation, it's time to study how reputation in the second period is created by performance in the first. Remember that cost reduction y is determined by

$$\begin{aligned} y &= a + \epsilon, \text{ where} & (4.7) \\ a &\sim N(0, \sigma_a^2) \\ \epsilon &\sim N(0, \sigma_\epsilon^2). \end{aligned}$$

Since the market observes profit and market shares in the first period, everyone can calculate the firm's unit cost and estimate the manager's ability. After observing the outcome in the first period, the second-period belief about this manager's ability becomes

$$\begin{aligned} a|y &\sim N([1 - \lambda]y, \lambda\sigma_a^2), \text{ where} & (4.8) \\ \lambda &= \frac{\sigma_\epsilon^2}{\sigma_\epsilon^2 + \sigma_a^2}. \end{aligned}$$

The expected posterior belief about the manager's ability is her reputation, $r = (1 - \lambda)y$. It follows from (4.7) and (4.8) that, before a manager has undertaken any

task, her second-period reputation r is distributed as

$$r \sim N(0, \sigma_r^2), \text{ where} \quad (4.9)$$

$$\sigma_r^2 \equiv \frac{\sigma_a^4}{\sigma_\epsilon^2 + \sigma_a^2}. \quad (4.10)$$

Let $f(r)$ denote the pdf of (4.9). Combined with the value of a certain reputation, (4.6), we can calculate a first-period manager's future expected wage, which you may call the value of learning, or the value of exposure:

$$V(\sigma_r) = \int_0^\infty w(r)f(r)dr = \sigma_r \sqrt{\frac{m}{2\pi t}} + \sigma_r^2 \frac{m}{8t}. \quad (4.11)$$

Lemma 2: The value of exposure (4.11) is increasing in the toughness of competition ($1/t$), the thickness of the market (m) and the variance in future reputation (σ_r^2).

The value of exposure is positive since $w(r)$ is convex. If m/t increases, $w(r)$ becomes more convex, and the *value* of an excellent reputation relative to a moderate reputation amplifies. The *probability* to earn an excellent reputation increases in the degree of exposure, σ_r^2 . Thus, when m/t increases, the value of exposure, and the value of *more* exposure, both increase.¹²

The larger the expected value of reputation $V(\sigma_r)$ is, the more attractive it is to be a manager in the first period. Relative to the reservation wage, the firm can reduce the executive's salary by $V(\sigma_r)$ and still attract a manager, since a higher expected wage in period 2 compensates for a lower wage in period 1. It might surprise that, in the first-period, your wage is reduced if you are appointed to manager. But this hinges on the assumption that all employees have the same reputation in period 1. For a given reputation, it seems reasonable indeed that the wage decreases as the career prospects increase. The same result is found by MacDonald (1988) and Demougin and Siow (1994).¹³

¹² Note that the average reputation \bar{r} enters neither in (2.10) nor (4.11): it cancels when the number of firms n_2 is endogenous. This implies that there is no general equilibrium effect of learning, and the value of learning is not affected by the number of firms in period one.

¹³ Were there no trade in managers between firms, for example because firms had private infor-

That the firm internalizes the benefits of higher expected future wages is standard in the literature, and it follows from the theory of equalizing differences initiated by Adam Smith (1947) and surveyed by Rosen (1986). As will be clear below, alternative organizations differ in how its employees are exposed. To make the firm attractive for employees and reduce salaries, each firm designs its organization in order to maximize the total value of exposure. The following section solves this problem.

3 Organizational Design

This section discusses alternatives to the simple organizational design above. The potential benefit of all the alternatives arises from their effect on how *reputations* are generated. I abstract from any *static* advantages of decentralization, such as those surveyed by Bolton and Dewatripont (1995). In the second period, and in a static model, the simple design outlined above will be optimal. Hence, the value of reputation in the second period and exposure in the first are still determined by the market structure as by (4.6) and (4.11).

Suppose cost reduction can be separated in two subtasks:

$$\begin{aligned}
 y &= \frac{1}{2}(y_A + y_B) \text{ , where} \\
 y_A &= a_A + \epsilon_A \\
 y_B &= a_B + \epsilon_B \\
 \epsilon &= \frac{1}{2}(\epsilon_A + \epsilon_B) \\
 \epsilon_A, \epsilon_B &\sim \text{iid } N(0, \sigma^2) \text{ , where} \\
 \sigma^2 &= 2\sigma_\epsilon^2.
 \end{aligned}
 \tag{4.12}$$

a_A (a_B) is the ability of the manager undertaking task A (B). For example, task A might be cost reduction and task B quality improvement (or A and B might be two different products). In the previous section, both subtasks were centralized to one single manager, and only the aggregate performance was observed. In such a

mation about their abilities, then firms could still be able to capture the value of learning if they have all bargaining power relative to the manager.

non-transparent firm, the next subsection analyses whether the two tasks should be undertaken by two different managers instead. While this allows us to learn about two managers instead of only one, each lesson is less precise. The second subsection discusses such decentralization in a transparent firm where the outcome of both subtasks are observable, while the value of transparency itself is calculated in the third subsection. The fourth subsection modifies (4.12) in order to compare U-form and M-form corporations. The optimal choice and turnover of managers are discussed in the final subsection.

3.1 Concentration of Control in non-Transparent Firms

Decentralizing control implies that different subtasks are undertaken by different employees. In a non-transparent firm, the market observes (or calculates) y but not the different subtasks y_A and y_B . With two managers, 1 and 2, observed performance is

$$y = \frac{1}{2}a_1 + \frac{1}{2}a_2 + \epsilon. \quad (4.13)$$

The advantage of having two managers is that we learn about two employees, not only one. A successful firm "graduates" two managers with positive reputation. There might be some additional training cost κ associated with decentralization, however. The advantage of concentrating control is that we learn more about one single manager and we are more willing to believe that good performance is due to this particular manager's ability. Hence, the chance to earn an excellent reputation is better in the centralized firm. As competition increases and the market gets thicker, the value of one excellent relative to two moderate reputations increases, and this makes concentration of control superior.¹⁴

Proposition 1: Non-transparent firms concentrate control as competition increases and the market gets thicker.

Proof: In a decentralized firm, the posterior belief about each manager's ability

¹⁴ According to (4.13), costs and profits will be more volatile if they depend on the (unknown) ability of only one manager. That firms managed by powerful CEOs have more volatile profits is indeed documented by Adams, Almeida and Ferreira (2002). This does not matter for a risk neutral firm, however.

becomes

$$a|y \sim N(2[1-\lambda]y, \lambda\sigma_a^2), \text{ where}$$

$$\lambda = \frac{\sigma_a^2 + 4\sigma_\epsilon^2}{2\sigma_a^2 + 4\sigma_\epsilon^2}.$$

Before observing y , each of the managers' future reputation $r = 2[1-\lambda]y$ is distributed as

$$r \sim N(0, \sigma_{DN}^2), \text{ where} \tag{4.14}$$

$$\sigma_{DN}^2 = \frac{\sigma_a^4}{2\sigma_a^2 + 4\sigma_\epsilon^2}.$$

The reputation of a manager in a decentralized non-transparent firm has variance $\sigma_{DN}^2 < \sigma_{CN}^2 = \sigma_a^4/(\sigma_\epsilon^2 + \sigma_a^2)$, which is the variance of the manager's reputation in a centralized non-transparent firm (labeled σ_r^2 in the previous section). The benefit of concentrating control becomes

$$V(\sigma_{CN}) - 2V(\sigma_{DN}) + \kappa = (\sigma_{CN} - 2\sigma_{DN}) \sqrt{\frac{m}{2\pi t}} + (\sigma_{CN}^2 - 2\sigma_{DN}^2) \frac{m}{8t} + \kappa$$

where the first parenthesis is negative and the second positive. As m/t is low, the first term dominates and the sum is negative for small κ . As m/t increases, however, the second term dominates and the sum becomes positive. *QED*

Centralizing control enhances transparency since individual contributions become observable. It is therefore unclear whether it is transparency or task allocation that drives Proposition 1. To illuminate this, the next subsection analyzes decentralization in a transparent firm.¹⁵

¹⁵ For fixed wages, concentration of control to manager 1 is clearly beneficial for this manager. When undertaking tasks provide such personal rents, Prendergast (1995) shows that the manager will concentrate control to herself if she has discretion over how control should be allocated. Proposition 1 indicates that this tendency should magnify as competition increases and the market gets thicker.

3.2 Decentralization in Transparent Firms

In a transparent firm, both subtasks y_A and y_B are observable. Still, centralization teaches us more about one manager while decentralization teaches us about two managers. For the centralized firm, transparency does not matter since average performance y is a sufficient statistic for estimating the manager's ability a . For the decentralized firm, transparency allows us to learn more since it separates individual performances. The value of more learning increases as m/t increases. This overturns the result of Proposition 1:

Proposition 2: Transparent firms decentralize control as competition increases and the market gets thicker.

Proof: In a centralized firm, the posterior belief about the single manager's ability becomes

$$a | \{y_A, y_B\} \sim N\left([1 - \lambda] \frac{y}{2}, \lambda \sigma_a^2\right), \text{ where} \quad (4.15)$$

$$\lambda = \frac{\sigma^2}{2\sigma_a^2 + \sigma^2}.$$

Ex ante, then, the manager's future reputation is distributed according to

$$r \sim N(0, \sigma_{CT}^2), \text{ where}$$

$$\sigma_{CT}^2 = \frac{2\sigma_a^4}{2\sigma_a^2 + \sigma^2} = \sigma_{CN}^2.$$

In a decentralized firm, each manager undertakes one task and, according to (4.9), her future reputation has the distribution

$$r \sim N(0, \sigma_{DT}^2), \text{ where} \quad (4.16)$$

$$\sigma_{DT}^2 \equiv \frac{\sigma_a^4}{\sigma_a^2 + \sigma^2} < \sigma_{CT}^2.$$

Again, we learn more about the single manager than about each of the two in a

decentralized firm ($\sigma_{CT}^2 > \sigma_{DT}^2$). The benefit of concentrating control becomes

$$V(\sigma_{CT}) - 2V(\sigma_{DT}) + \kappa = (\sigma_{CT} - 2\sigma_{DT}) \sqrt{\frac{m}{2\pi t}} + (\sigma_{CT}^2 - 2\sigma_{DT}^2) \frac{m}{8t} + \kappa$$

where both parentheses are negative. If m/t is small, a positive κ makes the expression positive. As m/t increases, however, the negative terms dominate and decentralization becomes optimal. *QED*

While a manager in a centralized firm does twice as many observable tasks than in a decentralized firm, this does not imply that we learn twice as much about the manager in the centralized firm. After the first performance is observed, the uncertainty about the manager's ability is reduced and so is the lesson we draw from observing the outcome of one additional task. Marginal learning is decreasing in the number of tasks, and allocating the two tasks to different managers maximizes the total amount of learning. The value of this, in turn, is larger when the market is thick and tough.¹⁶

Comparing Proposition 1 and 2 reveals that transparency is a crucial characteristic of the firm. The next subsection discusses how the value of transparency itself depends on the market structure.

3.3 The Value of Transparency

Compare the two decentralized firms in subsections 3.1 and 3.2. By observing the outcome of each subtask y_A and y_B we are able to make a more precise estimate about each manager's ability. We are more willing to believe that good performance is due to one particular manager's talent. It follows that each manager's chance to earn an excellent reputation is larger in the transparent firm. Since the premium for excellent reputation is larger as competition increases and the market gets thicker, we get the following result:

¹⁶ Since $\sigma_{CT}^2 > \sigma_{DT}^2$, $f_{CT}(r) > 2f_{DT}(r)$ for large r . This implies that if $w(r)$ were sufficiently convex, centralization would dominate as m/t increased. While a quadratic $w(r)$ is not convex enough to make this possible, other market structures might overturn the result in Proposition 2. However, the general lesson - that firms are more likely to decentralize as m/t increases if the firm is transparent - is likely to be robust.

Proposition 3: Decentralized firms become more transparent as competition increases and the market gets thicker.

Proof: In a decentralized firm, each manager's future reputation is distributed according to (4.14) or (4.16) if the firm is non-transparent or transparent, respectively. Since $\sigma_{DT}^2 > \sigma_{DN}^2$, the value of transparency is

$$2V(\sigma_{DT}) - 2V(\sigma_{DN}) = (\sigma_{DT} - \sigma_{DN}) \sqrt{\frac{2m}{\pi t}} + (\sigma_{DT}^2 - \sigma_{DN}^2) \frac{m}{4t}$$

where both parentheses are positive. There might be some technical or administrative cost associated with transparency as well, but as m/t increases, the terms above become very large and the benefits of transparency dominate. *QED*

As noted in the previous subsection, transparency does not matter if the firm is centralized. For the decentralized firm, Proposition 3 actually follows as a corollary to Proposition 1 and 2, and it should not be surprising to the reader at this point. Nevertheless, the result is stated explicitly since it is interesting in its own right.

By comparing the three propositions above, we get the following ranking. If m/t is small, i.e. the market is thin and the competition weak, then the optimal design might be decentralization in a non-transparent firm if the cost of transparency is significant. As m/t increases, concentration of control becomes optimal since this enhances the manager's chance to earn an excellent reputation. As m/t increases further, however, it becomes optimal to switch to a transparent decentralized firm to maximize learning about the employees.

In many reasonable cases, concentration of control implies decentralization. Suppose, for example, that agent 1 (the CEO) undertakes task A while task B is undertaken jointly by agents 1 and 2. Proposition 1 suggests that, as m/t increases, it becomes better to concentrate the responsibility for task B . If overload prevents 1 to undertake both tasks, the only alternative is that 2 gets full responsibility for task B . Even without overload, Proposition 2 advocates that responsibilities for the two observable tasks should be split between the agents as m/t increases if both tasks are observable. For either reason, concentrating the responsibility of task B requires delegation.

3.4 U-form vs. M-form

The two tasks A and B may be interpreted as cost reduction for two different products produced by the same firm. Each of these tasks, then, may be separated in two subtasks, such that

$$\begin{aligned} y_A &= \frac{1}{2}a_{1A} + \frac{1}{2}a_{2A} + \epsilon_A \\ y_B &= \frac{1}{2}a_{1B} + \frac{1}{2}a_{2B} + \epsilon_B \end{aligned} \quad (4.17)$$

where a_{ij} is the ability of the manager responsible for function $i \in \{1, 2\}$ for product $j \in \{A, B\}$. In a multi-divisional (M-form) corporation, responsibility is allocated according to product, such that $a_{1j} = a_{2j} = a_j$ for $j \in \{A, B\}$. (4.17) is then identical to (4.12). In a unitary (U-form) corporation, responsibility is allocated according to function, such that $a_{iA} = a_{iB} = a_i$ for $i \in \{1, 2\}$ and (4.17) becomes

$$\begin{aligned} y_A &= \frac{1}{2}a_1 + \frac{1}{2}a_2 + \epsilon_A \\ y_B &= \frac{1}{2}a_1 + \frac{1}{2}a_2 + \epsilon_B \end{aligned} \quad (4.18)$$

The U-form corporation is assumed to be able to exploit returns to scale since each manager can specialize on one kind of task.¹⁷ The advantage of the M-form corporation is that it reveals more information about individual contributions.^{18, 19} In Maskin, Qian and Xu (1999), this makes it less costly to encourage managers to provide effort by explicit contracts since conditional variance is reduced. Aghion and Tirole (1995) suggest that also implicit incentives are larger in the M-form

¹⁷ For this reason, all firms will adopt the U-form in the second period. (2.10) and (4.11) continue to be the value of reputation and learning.

¹⁸ A classic example of the U-form was the early Ford Motor Company, which was organized into a number of functionally specialized departments: production, sales, purchasing and so on. By contrast, General Motors is the prototypical M-form, since it comprises a collection of fairly self-contained divisions, e.g. Chevrolet, Oldsmobile and Pontiac. See Chandler (1962) for an investigation of the switch from U to M-form in the 20th century.

¹⁹ Other advantages of the M-form have been suggested. Williamson (1975) claims that the CEO becomes overloaded in the U-form. Milgrom and Roberts (1992) suggest that the M-form is better at coordinating finance and investment decisions. Qian, Roland and Xu (2003) emphasize the M-form's larger flexibility w.r.t. experimentation. In all these papers, the benefit of the U-form is increasing returns to scale.

corporation, since there is less moral hazard in teams. While my model abstract from incentives, the emphasis on market competition provides a new rationale for the M-form. The advantage of more information is that the market can make a more precise estimate about each manager's ability. We are more willing to believe that good performance for a product is related to the ability of the manager if she is solely responsible for this product. Thus, each manager's chance to earn an excellent reputation is larger in the M-form corporation. The M-form's advantage dominates as tougher competition and a thicker market boost the premium for excellent relative to moderate reputations.

Proposition 4: Firms switch from U-form to M-form as competition increases and the market gets thicker.

Proof: In the U-form corporation, posterior belief about the average reputation $\bar{a} = \frac{1}{2}(a_1 + a_2)$ follows from (4.15):

$$\bar{a} | \{y_A, y_B\} \sim N\left([1 - \lambda] \frac{y}{2}, \lambda \sigma_a^2\right), \text{ where}$$

$$\lambda = \frac{\sigma^2}{2\sigma_a^2 + \sigma^2}.$$

Since the market cannot identify individual contributions, $r_i = E a_i = E \bar{a} = (1 - \lambda) y / 2 = (a_1 + a_2 + \epsilon_A + \epsilon_B) (1 - \lambda) / 2$. Ex ante, then, each manager's future reputation is distributed according to

$$r_i \sim N(0, \sigma_U^2), \text{ where}$$

$$\sigma_U^2 = \frac{\sigma_a^4}{2\sigma_a^2 + 2\sigma^2}.$$

In the M-form corporation, future reputation is distributed according to $r \sim N(0, \sigma_M^2)$ where $\sigma_M^2 = \sigma_{DT}^2$ in (4.16). $\sigma_M^2 > \sigma_U^2$ and the value of switching from U to M-form is

$$2V(\sigma_M) - 2V(\sigma_U) - 2\kappa = (\sigma_M - \sigma_U) \sqrt{\frac{2m}{\pi t}} + (\sigma_M^2 - \sigma_U^2) \frac{m}{4t} - 2\kappa$$

where both parentheses are positive and 2κ is the cost of not exploiting returns to scale (e.g. saved training costs). If m/t is small, a positive κ makes the expression

negative. As m/t increases, however, the positive terms dominate and the M-form becomes superior. *QED*

3.5 Turnover of Managers

Let's now take the organizational structure as given and study the choice of managers. Above, we solved this for the second period, but the question was not relevant for the first period since all agents were identical. It is, however, straightforward to relax this assumption. It follows from the analysis above that firms prefer employees with high expected, as well as very uncertain, abilities. In reality, these two merits often conflict. To shed light on this trade-off, suppose there is some old manager with reputation $r > 0$ even in the first period. A firm hiring this old manager will certainly concentrate control.²⁰ The firm's willingness to pay for this manager is the expected increase in profit²¹

$$s(r) - [s(0) + V(\sigma_*)l_*] \quad (4.19)$$

where the best alternative is to hire $l_* \in \{1, 2\}$ young managers with zero reputation and extract the surplus $V(\sigma_*)$ from the exposure of each. The benefit of hiring the old manager is that current profit is increased. The disadvantage of hiring the old manager is that there is no value of learning about this manager's ability, either because it is already revealed or because the manager retires the next period. Hence, there exist some $\hat{r} > 0$ defined by

$$s(\hat{r}) - [s(0) + V(\sigma_*)l_*] = 0 \quad (4.20)$$

The old manager is (willing to be) hired only if $r \geq \hat{r}$, i.e. when the firm's willingness to pay (4.19) is positive. This implies, first, that some managers are fired (or not hired) even if they have performed better than expected. Second, some old managers are replaced by younger candidates even if these have lower expected abilities. These

²⁰ If it were optimal to hire the good old manager and let another agent undertake task B , it would also be optimal to let this (or another) agent undertake task A since the profit function is convex and since this would save the hiring cost of the old manager.

²¹ Training costs are neglected for simplicity, though the result still holds if they are introduced.

results are also found by Demougin and Siow (1994) for the case of trainees and by Carrillo and Mariotti (2001) for the case of political candidates. In our context, we are interested in how the age and turnover of managers depend on market structure, i.e. how \hat{r} depends on t and m .

Proposition 5: Turnover increases as competition gets tougher and the market thicker.

Proof: (4.20) implies

$$s(\hat{r}) - s(0) = V(\sigma_*)l_* \Rightarrow$$

$$\left(\hat{r} - \frac{\sigma_* l_*}{\sqrt{2\pi}}\right) \sqrt{\frac{m}{t}} + \left(\hat{r}^2 - \frac{\sigma_*^2 l_*}{2}\right) \frac{m}{4t} = 0$$

If $l_* \in \{1, 2\}$, this expression can only hold if the first parenthesis is positive and the second negative. If m/t increases for a fixed \hat{r} , the last term decreases relatively more than the first increases, and the left-hand side becomes negative. To restore equality, \hat{r} must increase. *QED*

As competition increases and the market gets thicker, the benefits of hiring a good manager $s(\hat{r}) - s(0)$ and learning about new managers $V(\sigma_*)l_*$ both increase. The value of learning is the expected value of reputation when the young candidates are chosen. It is then a small probability such a young candidate earns an excellent reputation. While a tougher market increases the value of a good reputation, the value of an excellent reputation increases relatively more. The chance to discover a superstar will then dominate the benefit of keeping a fairly good manager. As competition increases and the market gets thicker, more old managers are fired and replaced by younger candidates.

4 Extensions

Several simplifying assumptions are made to make the analysis tractable. In particular, the previous subsection on turnover craves a model with more than two periods. In general, the assumption of risk neutrality seems provocative when organizations differ in their allocation of individual risk. Ignoring the role of incentives

might be puzzling in a model which otherwise resembles career concern models. It is not obvious how any of these assumptions should be relaxed, and doing so will certainly complicate the analysis. Nevertheless, the following subsections argue that these extensions are unlikely to overturn the results, though they raise interesting questions for future research.

4.1 Multiple Periods

By restricting the analysis to two periods, the value of reputation (in the second period) is separated from the value of learning (in the first). This makes the analysis clean and the effects clear. The discussion of the manager's age and turnover, however, is mostly relevant in a multiperiod setting.

Suppose there is an infinite number of periods, and that each agent works two periods. Since the profit function is convex in the manager's abilities, it cannot be beneficial for a firm to appoint several managers with different reputations: the value of hiring another good manager would be larger than the value of hiring the first. Furthermore, a firm with one old manager would not benefit by decentralizing and hiring another similar old manager: the latter would not add to expected surplus. And, to exploit returns to scale, such a corporation will adopt the U-form, as there is no value of learning about the single old manager. Again, alternatives to the simple organizational form are relevant only if the firm hires young managers.

A firm that hires young managers will in equilibrium find it optimal to hire $l_* \in \{0, 1\}$ young managers, and the value of learning about each of them will be $V(\sigma_*)$. Faced with this alternative, what is the firm's willingness to pay for an old manager with reputation $r > 0$? The answer is given by the expected increase in surplus:

$$s(r) - [s(0) + V(\sigma_*)l_*].$$

As before, there must exist some $\hat{r} > 0$ defined by

$$s(\hat{r}) - [s(0) + V(\sigma_*)l_*] = 0. \tag{4.21}$$

Firms prefer to appoint l_* young managers instead of hiring an old manager with reputation $r < \hat{r}$, even if they all have the same reservation wage. Realizing this,

the value of a reputation r becomes

$$w(r) = \text{Max} \{0, s(r) - s(0) - V(\sigma_*)l_*\}. \quad (4.22)$$

The expectation of (4.22) gives us the value of learning:

$$V(\sigma_*) = \delta \int_{\hat{r}}^{\infty} [s(r) - s(0) - V(\sigma_*)l_*] f_*(r) dr \Rightarrow$$

$$V(\sigma_*) \left[\frac{1}{\delta} + l_* \int_{\hat{r}}^{\infty} f_*(r) dr \right] = \int_{\hat{r}}^{\infty} [s(r) - s(0)] f_*(r) dr$$

where future benefits are discounted by δ and $f_*(r)$ is the ex ante pdf of r for the equilibrium organizational design (when the firm hires young managers). Suppose m/t increases for a fixed \hat{r} . This raises the value of a good name $s(r) - s(0)$, and this increase is larger the larger is r , since the profit function and $s(r)$ become more convex. This implies that the value of learning $V(\sigma_*)$, which is a weighted average of $s(r) - s(0)$ for $r \geq \hat{r}$, must increase proportionally more than $s(\hat{r}) - s(0)$. To restore the equality in (4.21), \hat{r} must increase. Consequently, Proposition 5 continues to hold. The intuition is the same as in the two-period setting.

As m/t increases, $s(r)$ and the value of learning increases as before. Firms are then increasingly willing to adopt transparency and the M-form instead of the U-form, and Proposition 3 and 4 continue to hold. However, it is no longer sufficient with only a fairly good reputation to land a good job: only reputations $r > \hat{r}$ help. To increase the chance for this, it becomes more important that each manager's exposure (σ_*^2) is large. This strengthens the case for transparency and concentration of control: Proposition 1, 3 and 4 are reinforced while Proposition 2 is weakened.²² The basic insight we got from comparing Proposition 1 and 2 continues to hold for the same reason as before. As m/t increases, a transparent firm is more likely to

²² This is related to the footnote in subsection 3.2. When \hat{r} increases, $w(r)$ becomes more convex, and the value of an excellent relative to a moderate reputation increases. Since concentration of control increases the probability that r is very high, this might become the optimal design even if the firm is transparent. It will certainly be the case if \hat{r} is so large that $f_{CT}(\hat{r}) \geq 2f_{DT}(\hat{r})$, though subsection 3.2 shows it is not the case for $\hat{r} = 0$. Therefore, the benefit of decentralization in a transparent firm seems to be bell-formed in m/t since the benefit of larger variance dominates the benefit of learning about two managers only if \hat{r} is large. Investigating this conjecture in more detail seems to be an interesting topic for future research.

decentralize than a non-transparent firm.²³

4.2 Risk Aversion

The assumption of risk neutrality might seem like a restrictive assumption since alternative organizations have different implications for individual risk. Relaxing this assumption, however, will not change the results.

A risk neutral firm might be able to fix a performance-contingent salary for risk averse employees. Since there is no moral hazard, the firm can offer a perfect insurance to managers. This means that a manager's first-period salary becomes the sum of the reservation wage and $-w(E(a|y))$, i.e. the salary is larger if performance is bad. This compensates the manager for lower future salary following a fiasco, and it appears as a financial parachute. Tougher competition and a thicker market increase this parachute relative to the manager's salary following good performance. Since financial parachutes seem to have increased over the last decades, this prediction seems to be reasonable.

Even if the firm is risk averse or if it cannot commit to performance-contingent salaries, the results continue to hold. Let each manager have the concave utility function $u = u(w(r))$. Since the agents are risk averse with respect to their salary, this introduces a cost related to transparency and concentration of control. Learning is beneficial only if u is convex with respect to r , and this depends on whether $u(\cdot)$ is "more" concave than $w(r)$ is convex. However, as competition increases and the market gets thicker, $w(r)$ becomes more convex and it becomes more likely that u is convex with respect to r . Therefore, larger m/t makes learning more beneficial (or less costly) *relative* to a lower m/t , and this makes a firm more likely to hire new managers, adopt transparency and the M-form, to centralize control if it is non-transparent and to decentralize control if it is transparent.

²³ That $s(r)$ increases in m/t follows from (4.5), where the number of firms is given by (4.4). But in a dynamic setting, entrants can reduce wages by recruiting young managers. So, if $V(\sigma_*)l_*$ is large, more firms are willing to enter. This makes profit and the number of firms functions of $V(\sigma_*)l_*$ and this complicates the analysis. The results continue to hold, however. Moreover, this effect on n is negligible if the discount factor δ is small, since then $V(\sigma_*)l_*$ is too small to influence the entrance decision.

4.3 Effort and Incentives

The literature on career concerns emphasizes two important effects. First, current performance affects future salaries. Building on this pillar, the model above analyzed organizational forms as the market structure changes. Second, the effect on future wages motivates effort. It is therefore tempting to introduce effort in the model above.

Suppose managers are risk neutral and that performance-contingent contracts can be written. The firm can then, at no cost, write contracts inducing optimal effort (by selling the profit to the managers). Incentives can be perfectly shaped independently on organizational design. The analysis of the optimal design is then identical to the one above.

However, much of the literature on career concerns assumes that no explicit contracts can be written. If this is the case, how does organizational design affect incentives?²⁴ Ortega (2003) discusses incentives in the non-transparent firm, such this is modelled in section 3.1. Starting from an equal sharing of the task, he shows that total effort increases if control is marginally concentrated to one agent. Whether complete concentration maximizes effort depends on the cost of effort. If this function is quadratic, then full concentration maximizes effort.

Dewatripont, Jewitt and Tirole (1999) show that effort is larger if an agent is undertaking few tasks, since this reduces either the noise in estimating the agent's ability or the fuzziness in focus. This implies that decentralization increases effort in a transparent firm. This contrasts the result by Ortega (2003), and is partly explained by the difference in transparency.²⁵

Effort is obviously larger in a transparent firm relative to a non-transparent firm, since the former prevents moral hazard in teams. For the same reason, Aghion and Tirole (1995) find that effort is larger in the M-form relative to the U-form

²⁴ It is a priori not clear whether implicit incentives motivate more effort. Gibbons (1987) shows that a ratchet effect may discourage effort more than it is encouraged by career concerns. Similarly, Meyer and Vickers (1997) show that whether relative performance evaluation is beneficial depends on the agent's bargaining power relative to the principal's. In the analysis above, however, firms compete freely for managers. Moreover, Roland and Sekkat (2000) show that the career concern motive dominates the ratchet effect as competition increases. I will therefore only discuss the career concern motive for effort.

²⁵ Another difference is that there is duplication of effort in Ortega's model if control is shared.

corporation. Finally, Holmström (1982) shows that career concerns are stronger earlier in the career, such that replacing the old manager with a young one increases effort. All these results suggest that effort increases after each of the organizational changes triggered by an increase in m/t .

How does the *value* of more effort depend on the market structure (m/t)? The model of section 2.1 shows that the value of reducing costs is larger if competition is tough and the market is thick. For similar reasons and in a similar model, Raith (2003) shows that the optimal effort is larger in these circumstances. As a larger m/t makes effort more valuable, it should become more beneficial to concentrate control in a non-transparent firm, decentralize control in a transparent firm, increase transparency, switch from U to M-form and increase the turnover of managers. The results of section 3 seem to be reinforced by introducing incentives!

There is, however, also a direct effect of competition on incentives. As m/t increases, so does the premium on excellent reputation. This increases incentives to provide effort even if the organizational form is unchanged. But if the effort induced by career concerns is still below the optimal level, then the results above hold as discussed. Holmström (1982) explains, however, that incentives for effort might be too strong early in the career. If this is the case, then some of the results above might be overturned. It might then be optimal, for example, to reduce transparency in order to commit to lower effort. Exploring the consequences for organizational design is beyond the scope of this paper, though it seems like an interesting area for future research.

4.4 Incentive Contracts - and the Absence of RPE

After extending the model to capture effort and incentives, a natural next step would be to allow explicit incentive contracts as well. This seems like a fruitful area for research, since, as I will argue in this subsection, such an extension may shed light on the puzzling absence of relative performance evaluations (RPE) for managers.

Raith (2003) combines the circular city (of section 2.1) with incentives and explicit contracts. He shows that, as competition increases and the market gets tougher, effort becomes more valuable (for the same reason as ability becomes more valuable in my model). To encourage more effort, then, the owner of the firm should

increase the pay-performance sensitivity for the manager. In this way, Raith concludes a long debate of whether competition increases efficiency.²⁶

It is therefore puzzling that the empirical literature on incentive contracts is less conclusive. Jensen and Murphy (1990) found that the pay-performance sensitivity had decreased since the 1930s. Recent studies, as Hall and Liebman (1998), have documented the opposite, but Bertrand and Mullainathan (2001) show that the pay-performance sensitivity does not distinguish between luck and skill. They suggest that the reason for the pay-performance sensitivity is that the manager is able to capture the wage setting process. If the pay-performance sensitivity were supposed to encourage effort, it should take into account observable shocks that affect the entire industry. But, as documented by e.g. Garen (1994) and Aggarwal and Samwick (1999), such relative performance evaluation (RPE) is surprisingly absent from most incentive contracts.

Gibbons and Murphy (1990) provide one of the few studies that find evidence for RPE. In contrast to other studies, they include the effects on future salaries. In fact, Boschen and Smith (1995) find that the cumulative response on wages following good performance is ten times as large as the contemporary effect. These studies suggest that implicit incentives should be very important. And, as Gibbons and Murphy (1992) show, implicit and explicit incentives are substitutes. In line with this, Murphy (1999) finds that the evidence for explicit RPE is stronger where the evidence of implicit RPE is weaker. If implicit incentives have increased substantially over the last decades, it should therefore not be surprising that the evidence for explicit RPE is scarce.

The model above provides two justifications for increased implicit incentives. First, (4.6) shows that the value of talent goes up as competition increases and the market gets tougher. This makes it more important for the manager to simulate

²⁶ The arguments go back to John Hicks' claim that the best of all monopoly rents is a quiet life, and Leibenstein's (1966) discussion of x-inefficiency. Hart (1983) suggests that increased (yardstick) competition makes it easier for the principal to monitor the agent. However, Hermalin (1992) surveys the arguments and finds the results ambiguous: on the one hand, increased elasticity of demand raises the value of effort. On the other, less demand reduces the scale over which effort is effective. Raith (2003) shows that the latter effect disappears if the number of firms is endogenous, and he concludes that Leibenstein was right. The principal should provide the manager with stronger incentives as competition increases.

high abilities, and her incentives to work hard increases.²⁷ Second, Section 3 shows that increased competition and thicker markets induce firms to reorganize in order to attract employees. The previous subsection argued that all these changes were likely to induce more effort. Summarized, increased competition and thicker markets increase implicit incentives directly as well as indirectly through organizational change. The need to increase incentives by RPE might therefore be low.

5 Predictions and Evidence

The paper provides several predictions for how the market structure affects executive wages and organizational design. These should also change over time if the market structure evolves. It seems likely that both the toughness of competition and the thickness of markets have increased over the last decades. Consumers receive more information about different products, they are more mobile, and a larger variety of products makes the closest pair of substitutes even closer. More consumers, economic integration and growth make the market thicker.

This section summarizes the main predictions of the paper and relates them to some empirical evidence. The first subsection discusses the predictions for executives' wages, as these appear in section 2. This is important, since the model of section 2 drives the organizational changes of section 3. The next subsection summarizes the predictions for organizational change. Finally, it is shown that the theory can shed light on the puzzling correlation between firm size and wages.

5.1 Executive Pay

Lemma 1 of section 3 makes two main predictions. First, since $w(r)$ becomes steeper as m/t increases: top executives' salaries should increase as competition gets tougher and the market thicker. Since these changes also make $w(r)$ more convex, the second prediction is that the variance and skewness in pay should increase in m/t . Lemma 2 shows that also the value of learning increases in m/t . A young executive pays up-front for this future value, in the form of lower wages today. It follows that the

²⁷ Kanter (1989) discusses the widely held belief that work hours have increased the last decades.

wage gap between young and old executives should increase in m/t . Finally, since abilities are revealed over time, wage inequality within one cohort should increase in the cohort's age.

Empirically, Murphy (1999) shows how CEO pay has tripled relative to average pay over the last three decades, and he finds that relative CEO pay is particularly large in the US (where the market is probably thicker and competition tougher). For the income distribution in general, Neal and Rosen (2000) document that both inequality and skewness have increased over time, and they are certainly larger in the US than in most developed countries. They also find that average wages, wage inequality and skewness within one cohort all increase in the cohort's age, and that these differences between cohorts have increased over time. As they discuss, standard sorting or matching models of the labor market can also explain how average wage, inequality and skewness increase in a cohort's age. These theories, however, are less able to explain the time trend or the explosion in CEO pay.

5.2 Organizational Change

Section 3 provides several predictions for organizational change. As m/t increases, Proposition 1, 2 and 3 states that non-transparent firms should centralize control, transparent firms should decentralize control, and transparency itself should increase. Proposition 4 claims that corporations should switch from U to M-form as m/t increases, and Proposition 5 suggests that turnover of managers should increase in m/t .

The interesting contrast between Proposition 1 and 2 might be difficult to test, however, since it is not clear how transparency should be defined. But since Proposition 3 suggests that transparency itself should increase, the overall effect may be that firms decentralize control as m/t increases. Such decentralization is, indeed, well documented (see e.g. Caroli and Van Reenen, 2001).²⁸ Moreover, one certain way to decentralize in a transparent way is to outsource tasks to different firms. Outsourcing and smaller firms are both parts of recent trends. Abraham and Taylor

²⁸ To once again cite Kanter's (1989, p. 307) discussion of modern firms: *highly decentralized organizations with matrix structures or project assignments tend to provide general management responsibilities to many more people, much earlier in their careers.*

(1996), for example, discuss the recent growth in outside contracting and alternative explanations.

The shift from U to M-form in the last century is well documented by Chandler (1962). Several rationales for this shift are provided in the literature, see e.g. Williamson (1975), Milgrom and Roberts (1992), Aghion and Tirole (1995) or Maskin, Qian and Xu (1999). While these contributions clarify benefits of the M-form, they typically fail to show that the benefits of the M-form have increased over time relative to the benefits of the U-form. This shift in relative benefits is the central point of Proposition 4.

That the probability for forced CEO-turnover increases with bad performance is empirically documented by Gibbons and Murphy (1990) and Huson, Parrino and Starks (2001). Murphy (1999) finds that old average-performing CEOs have much higher departure probability (36.3%) than young executives realizing returns 30% *below* the industry average (8.5%). Huson, Parrino and Starks (2001) show that the frequency of forced turnover has increased in the period 1971-1994, while Hadlock and Lumer (1997) find that turnover has increased since the 1930s. Fee and Hadlock (2000) find that turnover increases as competition increases in the newspaper industry. All these facts are consistent with Proposition 5.

The organizational changes also affect executive pay. The general lesson from Proposition 1-5 is that learning about the managers increases as m/t increases. This reveals more of the managers' abilities, and the variance in their reputations increases. This, in turn, makes their wages more different. Therefore, tougher competition and thicker markets increase the variance of CEO pay directly as well as indirectly through organizational change.

5.3 Firm Size and Wages

The positive correlation between firm size and wages is well documented. Though some explanations are summarized by Oi and Idson (1999), there is still no consensus on the answer. The model in this paper suggests two (kinds of) reasons for the correlation between firm size and wages.

Consider the second period. A firm that hires a manager with good reputation will certainly have to pay a higher salary. At the same time, this firm will produce

more and expect a larger profit due to lower costs. The positive correlation between size and executive pay is immediate.

If industries differ in their market size m and competition t , then the willingness to pay (4.6) for the best managers will be largest in the industries where m/t is largest. According to (4.1) and (4.5), these are also the industries where production and profit per firm are largest. Again, there is a positive correlation between size and executive pay. These arguments for matching large firms and good managers are analyzed by Rosen (1982).²⁹

However, studies by e.g. Brown and Medoff (1989) and Gibbons and Katz (1992) find that there is still a substantial size-wage effect after controlling for worker characteristics. In fact, even peace-rate workers earn more in larger firms. This suggests that wages might be higher to compensate for inferior working conditions. But, these authors argue, even this argument fails to account for the correlation, in particular because working conditions are similar across firms within the same industry.³⁰

The arguments of section 3 suggest a remedy. The performance of a large firm depends on a large number of workers. If the performance is good, these workers improve their individual reputation only marginally. The market is less able to learn about an employee if the firm is large.³¹ Since salaries are convex in expected abilities, workers prefer to work for small firms where their talents are easier to recognize. Hence, larger firms must compensate for lower career possibilities by higher wages. Since the value of learning is increasing in m/t , the size-wage effect should increase over time and be larger in countries where m/t is large. In fact,

²⁹ Since m/t affects profit and production as well as salaries, the model above does not predict that the relationship between size and wages should vary with m/t . Murphy (1999) documents that this relationship is remarkably stable over time as well as across countries. Moreover, as Proposition 5 suggests that turnover should be higher in industries where m/t is large, there should be a positive correlation between firm size and executive turnover. This correlation is, indeed, documented by Murphy (1999).

³⁰ Other explanations for the size-wage effect are proposed, e.g. efficiency wages or profit sharing. But after discussing several alternatives, Gibbons and Katz (1992) conclude that *we know of no model that fits all the facts*" while Brown and Medoff (1989) admit that *"our analysis leaves us uncomfortably unable to explain it.*

³¹ That learning takes longer in large firms is consistent with the finding (by Brown and Medoff, 1989) that there is less worker turnover in large firms. Slower learning reveals bad matches between firms and employees later.

Oi and Idson (1999) do show that the size-wage effect is larger in the US than in Europe and that the effect is larger in 1983 than in 1979.³²

This argument implies that the size-wage effect should decrease (as the value of learning decreases) with the worker's tenure. Brown and Medoff (1989) show that the size-wage effect is, indeed, smallest for the highest pay class. The exception is CEOs, where the matching argument by Rosen (1982) may be more powerful.

6 Conclusion and Future Research

Reputation and talent are increasingly important for individual careers. This paper shows how such concerns determine organizational design. Section 2 showed that the executive's future wage, as a function of expected ability, is steeper and more convex the tougher the competition and the thicker the market. This motivates firms to become more transparent, decentralize control, switch from U-form to M-form, and increase their turnover of managers. Besides rationalizing recent organizational changes, the model improves our understanding of executive wages and why they may differ across firms.

As already discussed, it seems fruitful to extend the model by including effort in order to better understand incentive contracts and how these evolve over time. The framework above is also applicable to many other circumstances where organizations and reputations are related. For example, instead of studying the organization *within* firms, the theory could be applied to study the organization *between* firms. This appears to me as a timely research question, as there is a growing literature on the reputation of firms. Tadelis (1999) suggests that the existence of firms' reputations induces firms to secretly trade their names, and he (2002) shows how such trade might enhance incentives to build a reputation in the first place. Cabral (2000) applies these ideas to study the motivation for umbrella branding. Common for this literature - as for the literature on career concerns - is the assumption of a linear relationship between ability and its value. Section 3 above showed that this

³² However, Oi and Idson (1999) suggest the last finding is due to recession in 1983, and this time-span is anyway too short to "test" the theory. In addition, increased labor mobility over the last decades has perhaps pushed towards a weaker size-wage relationship, offsetting the force suggested above.

assumption typically fails if we take the product market into account. Then, the organizational design have important effects on how blame and fame is allocated between firms, and the value of a certain reputation will depend on the market structure. This raises a host of questions related to the boundary of the firm. Which combination of tasks will a firm prefer to do in-house, and which should be delegated to other firms? Which set of products will be produced under the same brand? How do the answers to these questions depend on the firm's age, reputation and - in particular - the market structure?

References

- Abraham, K. G. and S. K. Taylor (1996): "Firms' Use of Outside Contractors: Theory and Evidence", *Journal of Labor Economics* 14 (3): 394-425.
- Acemoglu, D. and S. Pischke (1998): "Why do Firms Train? Theory and Evidence", *Quarterly Journal of Economics*, Vol. 113, 79-119.
- Adams, R., H. Almeida and D. Ferreira (2002): "Powerful CEOs and their Impact on Corporate Performance", mimeo.
- Aggarwal, R. and A. Samwick (1999): "The Other Side of the Trade-off: The Impact of Risk on Executive Compensation", *Journal of Political Economy* 107, no. 7: 65-105.
- Aghion, P. and J. Tirole (1995): "Some Implications of Growth for Organizational Form and Ownership Structure", *European Economic Review* 39 (3/4): 440-455.
- Bertrand, M. and S. Mullainathan (2001): "Are CEOs Rewarded for Luck? The Ones Without Principals are", *Quarterly Journal of Economics*, August: 901-32.
- Bolton, P. and M. Dewatripont (1995): "The Time and Budget Constraints of the Firm", *European Economic Review* 39: 691-99.
- Boschen, J. and K. Smith (1995): "You Can Pay Me Now or You Can Pay Me Later: the Dynamic Response of Executive Compensation to Firm Performance", *Journal of Business* 68 (4): 577-608.

Brown, C. and J. Medoff (1989): "The Employer Size-Wage Effect", *Journal of Political Economics* 97, no. 5: 1027-59.

Cabral, L. (2000): "Stretching Firm and Brand Reputation", *Rand Journal of Economics*, Vol. 31., No. 4, 658-673.

Caroli, E. and J. Van Reenen (2001): "Skill Biased Organizational Change? Evidence from a Panel of British and French Establishments", *Quarterly Journal of Economics*, November: 1449-92.

Carrillo, J. (2003): "Job Assignments as a Screening Device", *International Journal of Industrial Organization* 21: 881-905.

Carrillo, J. and T. Mariotti (2001): "Electoral Competition and Politician Turnover", *European Economic Review* 45 (1): 1-25.

Chandler, A. (1962): *Strategy and Structure*, New York: Doubleday & Company, Inc.

Demougin, D. and A. Siow (1994): "Careers in Ongoing Hierarchies", *American Economic Review* 84 (5): 1261-77.

Dewatripont, M., I. Jewitt and J. Tirole (1999): "The Economics of Career Concerns, Part II: Application to Missions and Accountability of Government Agencies", *Review of Economic Studies* 66, 199-217.

Fama, E. (1980): "Agency Problems and the Theory of the Firm", *Journal of Political Economy*, vol. 88, no. 2.

Fee, C. E. and C. J. Hadlock (2000): "Management Turnover and Product Market Competition: Empirical Evidence from the U.S Newspaper Industry", *Journal of Business*, April.

Frank, R. H. and P. J. Cook (1995): *The Winner-Take-All Society*, The Free Press.

Garen, J. E. (1994): "Executive Compensation and Principal-Agent Theory", *Journal of Political Economy* 102, no. 6: 1175-99.

Gibbons, R. (1987): "Piece-Rate Incentive Schemes", *Journal of Labor Economics* 5, no. 4, Part 1: 413-429.

Gibbons, R. and L. Katz (1992): "Does Unmeasured Ability Explain Inter-Industry Wage Differentials", *Review of Economic Studies*, Vol. 59, no. 3: 515-35.

Gibbons, R. and K. Murphy (1992): "Optimal Incentive Contracts in the Presence of Career Concerns: Theory and Evidence", *Journal of Political Economy*, vol. 100, no. 3: 468-505.

Gibbons, R. and K. Murphy (1990): "Relative Performance Evaluation for Chief Executive Officers", *Industrial and Labor Relations Review* 43, Special Issue (February): 30-51.

Greenwald, B. (1979): *Adverse selection in the Labor Market*, New York: Garland.

Hadlock, C. J. and G. Lumer (1997): "Compensation, Turnover and Top Management Incentives", *Journal of Business*, April.

Hall, B. J. and J. B. Liebman (1998): "Are CEOs Really Paid Like Bureaucrats?", *Quarterly Journal of Economics*, August.

Hart, O. (1983): "The Market as an Incentive Mechanism", *Bell Journal of Economics* 14, 366-382.

Hermalin, B. (1992): "The Effects of Competition on Executive Behavior", *RAND Journal of Economics* 23, no. 3: 350-365.

Holmström, B. (1982): "Managerial Incentive Problems-A Dynamic Perspective", republished 1999 in *Review of Economics Studies* 66: 169-82.

Hörner, J. (2002): "Reputation and Competition", *American Economic Review* 92, no 3: 644-63.

Huson, M., R. Parrino and L. Starks (1993): "Internal Monitoring Mechanisms and CEO Turnover: a Long-Term Perspective", *Journal of Finance*, Vol. 56, No. 6, December: 2265-97.

Jensen, M. and K. Murphy (1990): "Performance Pay and Top-Management Incentives", *Journal of Political Economy*, v. 98, no. 2: 225-64.

Jeon, S. (1996): "Moral Hazard and Reputational Concerns in Teams: Implications for Organizational Choice", *International Journal of Industrial Organization* 14, 297-315.

Kanter, R. M. (1989): *When Giants Learn to Dance. Mastering the Challenge of Strategy, Management and Careers in the 1990s*, Simon and Schuster.

Leibenstein, H. (1966): "Allocative Efficiency vs. 'X-Efficiency'", *American Economic Review* 56: 392-415.

MacDonald, G. M. (1988): "The Economics of Rising Stars", *American Economic Review* 78, no. 1: 155-66.

Maskin, E., Y. Qian and C. Xu (2000), "Incentives, Information, and Organizational Form," *Review of Economic Studies*, 67(2) April: 359-78.

Meyer, M. (1994): "The Dynamics of Learning with Team Production: Implications for Task Assignment", *Quarterly Journal of Economics*.

Meyer, M. and J. Vickers (1997): "Performance Comparisons and Dynamic Incentives", *Journal of Political Economy*, vol. 105, no. 3.

Milgrom, P. and J. Roberts (1992): *Economics, Organization and Management*, Prentice Hall.

Murphy, K. J. (1999): "Executive Compensation", in *Handbook of Labor Economics*, Volume 3B, edited by O. Ashenfelter and D. Card, Elsevier.

Neal, D. and A. Rosen (2000): "Theories of the Distribution of Earnings", in *Handbook of Income Distribution*, Volume 1, edited by A. B. Atkinson and F. Bourguignon, Elsevier.

Oi, W. Y. and T. L. Idson (1999): "Firm Size and Wages", in *Handbook of Labor Economics*, Volume 3B, edited by O. Ashenfelter and D. Card, Elsevier.

Ortega, J. (2003): "Power in the Firm and Managerial Career Concerns", *Journal of Economics and Management Strategy*, Vol. 12 (1) (forthcoming).

Ortega, J. (2001): "Job Rotation as a Learning Mechanism", *Management Science*, Vol. 47, No. 10, pp. 1361-1370.

Prendergast, C. (1995): "A Theory of Responsibility in Organizations", *Journal of Labor Economics* 13, no. 3: 387-400.

Qian, Y., G. Roland and C. Xu (2003): "Coordinating Tasks in M-Form and U-Form Organizations", mimeo.

Raith, M. (2003): "Competition, Risk and Managerial Incentives", *American Economic Review*, forthcoming.

Roland, G. and K. Sekkat (2000): "Managerial Career Concerns, Privatization and Restructuring in Transition Economies", *European Economic Review* 44 (10): 1857-72.

Rosen, S. (1981): "The Economics of Superstars", *American Economic Review* 71, no. 5: 845-58.

Rosen, S. (1982): "Authority, control and the distribution of earnings", *The Bell Journal of Economics* 13, Issue 2 (Autumn): 311-23.

Rosen, S. (1986): "The Theory of Equilizing Differences", in *Handbook of Labor Economics*, Volume 1, edited by O. Ashenfelter and R. Layard, Elsevier Science Publishers.

Salop, S. C. (1979): "Monopolistic Competition with Outside Goods", *The Bell Journal of Economics*, Vol. 10, No. 1: 141-156.

Smith, A. (1947): *An Inquiry into the Nature and Causes of the Wealth of Nations*, Modern Library Edition.

Spence, A. M. (1973): "Job Market Signaling", *Quarterly Journal of Economics* 87: 355-74.

Tadelis, S. (1999): "What's in a Name? Reputation as a Tradeable Asset", *American Economic Review* 89, no. 3: 548-63.

Tadelis, S. (2002): "The Market for Reputations as an Incentive Mechanism", *Journal of Political Economy*, vol. 110, no. 4: 854-82.

Waldman, M. (1984): "Job Assignments, Signaling and Efficiency", *Rand Journal of Economics*, XV, 255-67.

Williamson, O. (1975): *Markets and Hierarchies*, New York: Free Press.

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