

Project GInE:

General Institutional Equilibrium Theory and Policy Implications

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Abstract

Existing institutional theory, including political economics and contract theory, convincingly show that institutional details have large impacts on economic and policy outcomes. Once this is recognized, it follows that contracts should depend on the organisational design of the institution to which the contract is offered. Stage 1 of Project Gine aims at characterising optimal contracts as a function of this design. Stage 2 develops a framework for endogenising and characterising the optimal institutional design. At Stage 3, sets of institutions are endogenised at the same time, where the design of one is an optimal response to the designs of the others. This outcome is referred to as a *general institutional equilibrium*.

Such a theory or methodological framework has several immensely important applications. Development aid contracts should carefully account for the political structure in the recipient country; otherwise the effect of aid may surprise and be counterproductive. The major application motivating this study, however, is environmental policy. Not only must the optimal environmental policy be conditioned on political economy forces; it must also be a function of institutional details, such as the political system. This can explain why the choice of instrument differs across political systems, and why politicians often prefer standards rather than economic instruments. Furthermore, we still do not have a good knowledge of how to design effective and implementable international environmental treaties. The optimal treaty design as well as the best choice of policy instrument must take into account that certain institutions (e.g., interest groups, firm structures, and perhaps even local governance) respond endogenously to these policies.

Section 2: The Project proposal

The largest problems facing mankind involve complicated interaction between sovereign states with different institutional structures. These differences contribute to explaining why negotiating an effective climate treaty is extremely difficult. In fact, we still do not know how an effective treaty should best be designed and enforced. The answers depend on what remains politically feasible, after political constraints and considerations have been taken into account. These constraints, in turn, depend on the existing type of domestic political institutions. As a further complication, the design of an institution is often endogenous: domestic institutions may endogenously respond in equilibrium and change when external factors evolve. Furthermore, the architecture of an international climate treaty *should* be an endogenous response to domestic institutions as well as the economic environment. What, then, is the equilibrium set of institutions, once we acknowledge that their design is endogenous to everything else? In short, what is the *general institutional equilibrium*?

These questions are difficult, even when we have a particular application in mind. Nevertheless, we should ideally have a general framework, helping us to think about these questions and draw lessons across various applications. Unfortunately, the state of the art is far from able to do this. In the next subsection (a), I will describe the state of the art, what tools we need to develop, the importance of such tools, and a set of particular applications and subprojects (A-E). While Project Gine is mainly motivated by the need to better understand effective environmental policy, the subprojects range from development aid to the choice of privatising public utilities, illustrating the importance of a common theoretical framework. I will end by discussing the big challenges and risks of Project Gine. In the following subsection (b), I discuss feasibility, methods, timeline, and why the PI has the appropriate background for this project.

Note that I let “institution” refer to international treaties as well as local governance structures (political systems) and organisations (such as firms). I do not discuss informal institutions such as norms or culture.

a. State-of-the-art and objectives

Stage 0. State of the art: The variety and importance of institutions

In the last decades, economic research has made quite a lot of progress towards enhancing our understanding of institutions, why they matter, and how they differ. The theory of contracts, incomplete contracts, and organization theory have analyzed various design for corporations, explained how these differ and why we observe particular designs for organizations such as firms (see the literature following Williamson, 1985; Hart, 1995). The recent literature on political economics treats politicians as players in the game, while the rules of the game are specified by the political institutions (for an overview, see Persson and Tabellini, 2000). Various institutions give dissimilar incentives and, thus, different outcomes (see Milesi-Ferretti et al., 2002; Persson et al., 1997, 2000; Persson, 2002), also for the use of natural resources (Mehlum et al., 2006). In many cases, this can explain why policies vary across political systems empirically (Persson and Tabellini, 2003). Economies in transition provide a rich set of alternative institutions that lend themselves for empirical tests as well as for theoretical analyses (Roland, 2000).

I have myself contributed to comparative institutional analysis: In Harstad (2007a), for example, I analyze bargaining outcomes for districts under decentralised and centralised political systems. In Harstad (2005 and 2010a), I study how the voting rules and other details of the political system influence the election of representatives as well as investments in collective projects.

Many questions of this type remain and the set of important and possible analyses is far from exhausted. Thus, I certainly expect much more work of this kind. However, we are starting to get a fairly good understanding of how formal institutions differ and how these variations lead to different outcomes. Given this knowledge, a logical implication is that the specific characteristics of an institution must dictate how we – or a third party – optimally interact, contract, or deal with it. Stage 1 of Gine aims at deriving such a mapping from institutional details to the optimal contract, taking a principal-agent approach.

Stage 1. Contracting with institutions

Once we acknowledge that different institutions behave differently, it follows that we should deal with them differently, as well. Let me illustrate this point by first describing an important application and subproject before concluding that a general framework is necessary.

As a first application and subproject (A), consider a donor offering development aid to a recipient country. To fix ideas, suppose the donor would like to encourage a developing country to build more schools. A common way of doing this is to subsidize the building of schools, for example by conditioning the monetary transfer on the number of schools built. If the recipient is an individual agent, this strategy may well lead to a larger number of schools. For many political systems, however, the effect may actually be the reverse. The reason is the following. The government in the country facing this contract may consist of two groups, or pivotal legislators, negotiating the national budget. If one of these groups would love to spend money on schools, its eagerness is likely to strengthen when faced with the conditional aid contract. This eagerness, however, may worsen its bargaining position relative to the other group, who may instead prefer to spend the budget on arms. The latter group can hold up the first and demand that fewer schools should be built, since the benefit of each has increased for the school-loving group. Consequently, the bargaining outcome may be that the number of schools is *reduced* after the aid contract is offered. Note that the effect of aid is perverse and directly counter-productive, in contrast to traditional crowding-out arguments. A similar logic holds for the effect of sanctions. Suppose sanctions are effectively punishing the arms-loving group or legislator, as a function of the amount of money spent on arms. With the sanction in place, this group is benefitting less from each dollar spent on arms, and its eagerness to finalise the budget when negotiating with the other group is reduced. This reluctance translates into a better bargaining position, implying the arms-loving group may get a better deal where more dollars are spent on arms. These results hold if the bargaining game between the political groups is of a particular type and, in that case, the best aid contract should target the arms-loving group, while the sanction should target the school-loving group. Hence, the optimal aid contract, or the smartest sanction, should and must be a function of the institutional details in the targeted country. These examples are provocative, and they motivate me to study the more general question of how the domestic institutions determine the optimal contract provided by an interested external party (or principal).

I have already worked on projects that are somewhat related to these questions. In a recently published paper with Gunnar Eskeland (2010), we show that emission permits should be tradable if and only if the government has the possibility to commit to a sufficiently long planning horizon. If the government cannot commit, the market for permits is going to be distorted and these distortions may outweigh the gains from trade. Based on our analysis, the U.S. sulphur trading program appears to be more efficient than the design of the EU Emission Trading System for carbon dioxide. However, we are certainly not the first deriving implications of this type. For example, Endres (1997) and Endres and Finus (1999, 2002) find that quotas may be the preferred instrument if the level is determined in a bargaining game. This model is static, thus different from subproject B, described above. Hoel (1994) and Golombek, Hagem and Hoel (1995) find that a climate coalition's policy should, and will, depend on the set of nonparticipants. On development aid, Boycko, Shleifer, and Vishny (1996) provide an argument related (although different) to subproject A, described above. Besley and Coate (2003) analyse how the choice of centralisation or decentralisation depends on the decision-making procedures. Much more could be done along these lines, however.

While each of these examples or papers is provocative and interesting by itself, together they are only indicative of, and pointing towards, something bigger. The deeper story is that if institutions matter and differ, then we must deal with them differently. Besides developing subproject A, the goal of Stage 1 is to develop a rather general framework, or method, for how contracts should be set up as a function of the structure of the organisation one is dealing with. In standard contract theory (see Bolton and Dewatripont, 2005, for example), the principal is contracting with an agent. The optimal contract depends on the agent's preference, i.e., the risk aversion and cost of effort. If the agent is not an individual, but a firm or a government, then, similarly, the contract ought to be a function of the institutional design of this firm or government. This mapping is not yet characterised in contract theory (although some allow for several agents, e.g., Itoh, 1991), but it is highly important to derive exactly this mapping if we want to learn the optimal (and equilibrium) way of dealing with institutions. In some years, I imagine that we have a "new" contract theory that better explains that the optimal contract is not only a function of the agent's preference or the principal's objective, but also a function of the organisational structure of the "agent." Stage 1 of Gine is making steps towards such a general theory.

Stage 2. Endogenous and optimal institutional design

The middle stage of Gine aims at characterizing the institutional design that is the optimal and/or equilibrium choice. There are several reasons for exploring this: In reality, institutions are often endogenously formed, and this should be taken into account when contracting with it. For example, designing an aid contract or smart sanction, as discussed above, may motivate political agents in the recipient country to reform or change its political institutions. Furthermore, when contracting with institutions, as in Stage 1, I have presumed that the principal can provide and commit to a contract at the start of the game. One way of making such a commitment may be to design a constitution that is bound to behave in line with the principal's interest. In addition to these justifications, deriving the optimal institution is often important by itself.

To be specific, I am particularly interested in the optimal environmental treaty formed by independent countries. In a working paper (Harstad, 2010b), I derive the optimal (and equilibrium) contract on emission if investments in abatement technologies are noncontractible (as in the Kyoto Protocol). If the countries cannot commit to the long-run, then I show that short-term contracts may actually *reduce* everyone's welfare relative to the scenario with no agreement at all. In fact, the countries would have been better off if they could have committed to never negotiate since, anticipating this, they would have invested more in technology. This theoretical result is disturbing, in my view, and it motivates me to further analyse the optimal treaty design, taking into account the incentives to invest in technology. This subproject (B) consists of several parts, since I prefer to gradually relax the assumptions regarding (i) whether countries are similar or instead highly asymmetric, (ii) whether the enforcement capacity is related to how ambitious the agreement is, (iii) whether countries can decide if they should opt out of the negotiations, and (iv) whether they find it costless to exit at a later stage. If there is a participation stage, as indicated in part (iii), then Barrett (2005), for example, finds that very few countries prefer to participate, in equilibrium. In a dynamic model, however, I expect to find a more positive prediction for the following reason. If only a few countries participate, they may find it worthwhile to negotiate a short-term agreement only. Since this is very inefficient, this credible threat deters countries from opting out. Furthermore, combining part (ii) and part (iii) suggest a linkage between the enforcement capacity and the number of participants: When a participant decides whether to comply, as in part (ii), it considers the sanction following non-compliance. Since implementing such a sanction is costly to the complying members, they may prefer to themselves limit the number of signatories and thus the likelihood for having to implement a sanction. This connection between compliance and participation should be further explored.

Recently, I have been planning a rather different subproject (C), trying to explain why the western world does not "purchase" the South's tropical forests with the objective of preserving it. This is related to another recent working paper I have (Harstad, 2010c), where I show that an incomplete climate coalition may benefit from purchasing fossil fuel deposits (or the right to extract them) in nonparticipating countries. For similar reasons, the coalition would benefit from purchasing tropical forests or the (permanent or temporary) right to lodge. If this result is not surprising, the puzzle is why such mutually beneficial trade does not happen to a larger extent in the real world. A dynamic theory may provide a potential explanation. Based on a simple example, I suspect that there is no equilibrium where the West is always purchasing the forest, no matter how valuable protection is to the West. If an immediate sale were, in fact, an equilibrium, the South would have preserved the forest also if the West should deviate in one particular period, since the West would then be expected to pay a good price in the next period. Anticipating this, the West would indeed deviate from the proposed equilibrium and instead wait. In equilibrium, therefore, there must be deforestation, at least at a positive rate. This is true even if the West would have been willing to pay the entire required amount in a similar static game. The outcome may in fact be even worse if there are several countries interested in protecting the forest (deforestation may then increase). This illustrates the importance of coordination and an international institution paying for protection on behalf of the multiple interested parties. Without such coordination, my conjecture is that privatising the forest (allowing for e.g. ecotourism) is beneficial, because it generates sale and protection, even though this may reduce everyone's value of the pristine forest. This setting or game should be further explored, and the optimal contract should be derived. In particular, I would like to investigate whether the West should buy or rent the forest, or whether it instead should buy or rent the land. A natural extension is to formalise the decision-making procedure in the South's government and study how the optimal contract should depend on that governance structure. This would firmly tie this subproject to Stage 1, above. The real-world importance of such an analysis is easy to understand. Paying for preservation is gradually becoming acceptable for the West, as illustrated by the emergence of REDD funds (Reducing Emissions from Deforestation and Forest Degradation). The government of Norway, located in the same city as my host institution, has been one of the first and largest contributors to REDD funds. Typically, such funds are given to national governments conditional on outcomes – but ignoring local enforcement

mechanisms. We are still learning the optimal conditions for providing REDD funds, and subproject C aims at contributing to this learning.

The existing theory and experience on REDD funds is surveyed by Vatn et al. (2009). On climate policies, given that we do not yet have a good treaty in place, we are obviously far from understanding what the best possible treaty design is, notwithstanding a growing literature on this topic (see, e.g., Barrett, 2005; Aldy and Stavins, 2007; Carraro et al. 2009).

More generally, there are several strands of literature endogenising various types of other institutions. For example, Gersbach (2009) studies the best democratic constitution. More particular analyses endogenise institutions such as privatisation (Biais and Perotti, 2002); whether countries political integrate or secede (Ellingsen, 1998; Bolton and Roland, 1997); or how countries prefer to exclude members (Jehiel and Scotchmer, 2001). While Schelling (1960) taught us about the benefits of commitments when negotiating, Haller and Holden (1997) show how such a commitment may be implemented by selecting an institution that requires a supermajority. Another research program aims at endogenising democratisation itself (Acemoglu and Robinson, 2000, 2001, 2006). Most recently, Acemoglu, Egorov, and Sonin (2011) investigate how political coalitions and constitutions evolve over time in a dynamic setting, focusing on stability. I have myself contributed to the literature on optimal institutions when deriving the optimal voting rules (Harstad, 2005; 2006; 2010a) or the firms' equilibrium organisational design (Harstad, 2007b).

While these strands of literatures are all very interesting, most of these papers study the choice of institutions given a quite arbitrary possibility set. For example, scholars often compare two or more institutional designs (e.g., parliamentary versus presidential systems, or private versus public ownership). Unfortunately, this approach has resulted in a gap between the applied literature and the theoretical literature on implementation theory (Jackson, 2001) and mechanism design (Börger, 2010). The general goal of Stage 2 is to close, or narrow, this gap. The most general and formal approach when endogenising institutions is to derive the optimal institution subject to a larger possibility set, only limited by well-defined and reasonable constraints such as participation constraints and the lack of third parties that could have enforced the contract. This way, we should be more confident when advocating a particular institution or when explaining its existence. Such a general framework or method will certainly have many applications, including but not limited to subproject B on climate treaties and C on forest preservation.

Stage 3. General Institutional Equilibrium

Once it is acknowledged that the design of a particular institution should be endogenised, as in Stage 2, it may follow that all relevant institutions, or at least a subset of them, should be treated as endogenous at the same time.

For example, Perotti (2001) shows how the design of a federal system depends on institutions in the labour market. Likewise, one could ask what the equilibrium labour market institutions are, given the particular federal system. When designing an international treaty on climate change or deforestation, as discussed above, one may need to take into account that the domestic governance institutions may respond endogenously – just as the international treaty is designed as an optimal response to the functioning of the local institutions. To further illustrate the broad applicability of a general theory, let me describe two rather different subprojects which I plan to work on.

Subproject D considers a country's decision of whether to privatise the provision of public utilities, and thus rely more on markets and less on a plan-based economy. Privatisation is, in effect, a commitment to let private owners make decisions that maximise profit rather than some kind of political objective (such as the consumer surplus). Anticipating the larger profit, foreign investors may provide more capital. This is good, also for the previous owner (the median voter or the government). Thus, as capital becomes more mobile, privatisation becomes more attractive. Furthermore, privatisation seems to become more attractive if the neighbouring countries have already privatised: privatisation is then preventing a capital-loss rather than attracting new capital, and this is more important if the induced welfare, as a function of the capital located within the country, is a concave function. Thus, my conjecture is that, while there might be multiple (general institutional) equilibria in this model, we are more likely to observe a bandwagon of privatisation across countries if capital becomes more mobile. Another conjecture is that more free trade in the final good is a substitute to privatisation, since also the median voter tends to maximise profit (rather than consumer surplus, for example) when the good is, for the most part, sold and consumed abroad. A final conjecture is that these forces are stronger for highly unequal societies than for countries with smaller income difference between the median voter and the average shareholder (or owner). In the extreme case where the median voter is also a median shareholder, the choice between private and public ownership would not matter. This may explain why the discussion on public versus private ownership appears to be more intense in the Americas than in Scandinavia, for example. These conjectures are all based on a brief and preliminary note I

drafted recently. Unfortunately, I have not yet had the possibility to develop these ideas, but they are a natural part of Stage 3.

As a more general subproject (E), I would like to think about institutional competition where districts or countries choose policies or institutions having in mind that they can later switch to their neighbours' choice if that should turn out to be more successful. Two forces seem to interact. On the one hand, a district may want to select an institution that also the neighbouring districts later can implement, particularly if such coordination generates some kind of coordination benefit. This possibility to free-ride, on the other hand, may motivate the neighbouring district to reduce its effort in trying to succeed with its own institutional choice. This reduction in effort harms the first district, hoping to use the neighbour's institution as a safety net in case its own "experiment" fails. That such decentralised experimentation may lead to free-riding is well-known from Bolton and Harris (1999), for example. In my setting, a district may be able to reduce the neighbours' ability to free-ride by selecting domestic policies or institutions that cannot easily be adopted elsewhere. At this point, I do not fully understand which force that is strongest, when one force may dominate the other, and how this depends on the institutional details. However, the answers are going to teach us when institutional competition leads to convergence or divergence of institutions, and whether such competition would benefit from being regulated by a federal or super-national institution. It is natural to investigate these questions as a part of Stage 3.

While these subprojects are quite different, they share the feature that sets of institutions are endogenous at the same time. Thus, they would both benefit from a more general method or framework for analysing the general institutional equilibrium. The final and most ambitious goal of Gine is to work towards a general theory, or a common framework or methodology, for analyzing institutions as a general equilibrium, where the design of one institution is an endogenous response to the design of the others. In addition to the literature mentioned above, a natural inspiration for this ambitious goal is general equilibrium theory (Arrow and Debreu, 1954) where, in contrast to partial analyses, the demand and supply of all goods are simultaneously determined. The ultimate goal of Gine is to work towards an analogous general equilibrium theory for (or allowing for) institutions.

Importance, impact, and applications

A general theory, as outlined above, would be a great contribution to economic theoretical research, in my view. First, a general theory of contracting with organisations (Stage 1) will contribute to contract theory and complement the existing literature that focuses on agents and the agents' preference. Second, such a theory will help us understand how external players are, or should be, dealing with institutions. A method for endogenising institutions (Stage 2) – closer to that used in mechanism design and implementation theory – will fill or narrow the embarrassing gap between this theoretical literature and the applied literature. Thus, more general methods will justify the choice of particular institutions in analyses and make us more confident when advocating or predicting a particular design. A general institutional equilibrium framework (Stage 3) will dramatically help us think about institutional design as endogenous, not only in a partial equilibrium setting, but as endogenous in a bigger setting, other institutions taken into account. For these reasons, I am convinced that the economic profession needs to work towards a more general theory, or at least develop general methods and analytical tools when studying the questions above.

Nevertheless, the ultimate benefit of such theories or methods may best be appreciated by thinking about potential applications. Above, I have mentioned and referred to a number of examples, covering many different topics. Even when abstracting from the general theory, and the lessons and methods it would provide, it is clear that the applications are themselves very important. Full-fledged analyses of subprojects A-F are, by themselves, important contributions.

One application I have repeatedly returned to is development aid. As mentioned at Stage 1, we must take domestic institutions into account when designing development aid contracts (whether these are conditional or targeted). As illustrated in Stage 2, we may also need to understand, and take into account, that the institutions are endogenous and that they may change as a result of development aid. Understanding the big picture may thus require a general institutional equilibrium, discussed as Stage 3.

However, the main application that motivates me is environmental policymaking. First, we need a political economy of the environment to determine what policies and which instruments that ought to be used, as a function of the existing institutions (Stage 1). Similarly, we need a better understanding of what international policies that may be effective and how this answer depends on domestic institutions. Second, as Stage 2 demonstrates, we have not yet understood the appropriate international institutional framework for dealing with environmental problems such as climate change or deforestation. Intuitively, the design of these institutions should be functions of political economy forces and various domestic institutions, but this mapping remains to be detected. Finally, we must better understand how institutions evolve endogenously.

These endogenous outcomes must be taken into account when designing environmental policies, whether they are national or international.

Needless to say, the general framework may have several other applications. For example, the organisational design of one firm may depend on the organisational structure of its competitors and trading partners. The optimal design of the welfare state (e.g. the system and magnitude of the benefits provided) is a function of institutions in the labour market and these, in turn, endogenously respond to the welfare system in place. A large group at my host institution (ESOP, UiO) is currently analysing these mechanisms, and the connection to Gine is going to be close and mutually beneficial.

Risks and challenges

Clearly, the ambitious research agenda outlined above is very challenging, and the Reviewer may rightly wonder whether this is at all feasible. I anticipate several types of risks or major challenges: First, generalising applied theory is always difficult, and it is never clear, in advance, whether this will, in the end, succeed. Second, a common perception is that the only general lesson from new institutional economics is that the answers depend on the specific institutions. This is often interpreted as meaning that generalisations are not and cannot be possible. Third, each of the stages above is very ambitious and demanding, and even one of them could be more than enough, particularly within a 5-year plan. On the top of this, there are still holes in the literature at Stage 0. In particular, we are lacking satisfying theories for institutions such as interest groups and activists. Finally, the mechanisms I have referred to are often dynamic, further complicating the analysis.

Personally, I share all these concerns. These risks explain why I have not had the guts to jump on this project as a tenure-track faculty, and they are the reasons for why help and funding from the ERC is essential. In the previous subsection, I argued that it is necessary to work towards a more general theory, despite the difficulties just mentioned. The next section outlines a method and a plan for the project, addressing these challenges.

b. Methodology

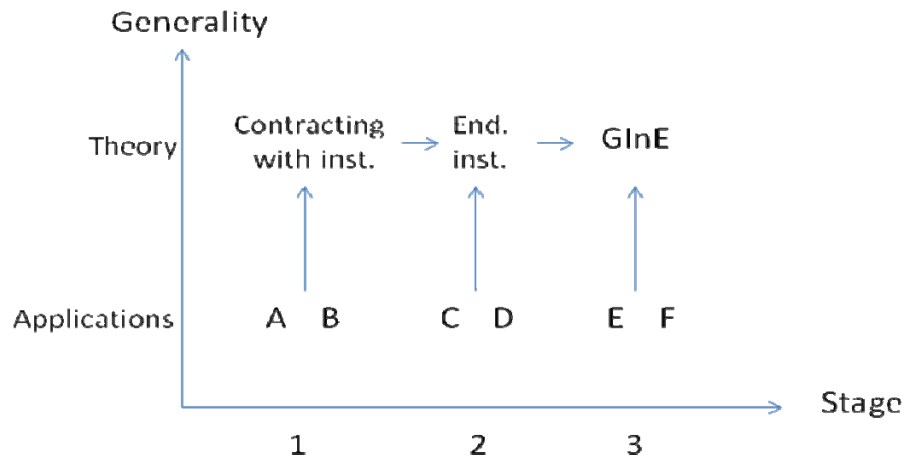
Feasibility

It is useful to disentangle the project's different parts to better understand what is risky and what is feasible. In the diagram below, I let the first axis measure the stage of the project while the second axis measures the level of generality. The ultimate goal – a general institutional equilibrium theory – is top-right in the diagram.

Stage 3, endogenising sets of institutions, is harder than Stage 1. Generalising the theories is obviously harder than working out the applied subprojects A-F, described above. Thus, as we move up and to the right in the diagram, we increase the difficulty and the risk and reduce the likelihood of success.

Regarding the applications, I have already discussed some hypotheses and conjectures of A-F, and I am confident that I will be able to verify or falsify some of them using the methods described below, and thus colour the lower part of the diagram. Thus, in my view, the risk is *not* whether I will be able to say or find anything at all, but *how general* the theories and the methods end up being.

Although Project Gine requires a huge amount of work, note that Stages 1 and 2 are complementary since the optimal institution may depend on how one should interact with other institutions. Stages 2 and 3 are complementary, as well, since endogenising one institution is a step towards a general institutional equilibrium. These complementarities explain why Stages 1-3 belong to the same project.



Methods

It is certainly necessary to apply a wide range of tools and methods to get progress on Gine. Applying the methods of political economy, for example, is not enough, since this literature typically focuses on exogenously given institutions or a limited set of possibilities. Applying contract theory is insufficient, as well, since the organisational design of the “agent” is traditionally not taken into account. In environmental economics, the models are typically closely tied to the application in mind, often failing to capture the generality of the problem. Thus, I need to apply the most recent methods of contract theory and incomplete contracts *together* with the tools of political economics and the lessons of political science. In addition, I need to draw on organisational economics and institutional theory, more generally.

The methods used to develop subprojects A-F will differ from the methods used when generalising the theory. When developing applications, I favour simple models and models that are similar to those used in the associated literature. The models are all analysed using game theory. Subproject A combines a simple domestic bargaining game with a donor-recipient framework. The model is likely to be static. Subproject B needs a dynamic framework, however, and otherwise it will rest on a simple bargaining game with an endogenous status quo policy. Subproject C is built on my existing work on dynamic climate policies (Harstad, 2010b), and it will be based on a similar dynamic model where countries can both pollute and invest in technologies over time. Subproject D, on paying for preservation, is also requiring a dynamic analysis, but this game is more similar to a war of attrition model since the decision to lodge is irreversible. Furthermore, this model does not necessarily need the investments in technology. Subproject E is somewhat similar to the tax competition literature, but my argument needs to rely on international trade models, allowing for capital mobility, and political economy, describing governance under public ownership. A three-stage model should be enough, at least in the simplest version of the model. Subproject F is part of the experimentation literature analysing bandit-problems (as Bolton and Harris, 1999) and, thus, it requires a dynamic analysis.

When developing the general framework, I will further employ game theory and more advanced contract theory (Bolton and Dewatripont, 2005). While this part is more difficult since a number of assumptions in the applied models need to be relaxed, the general model is actually simplified in other respects relative to the applications. For example, I believe a lot of progress can be made without (or before) analysing a fully dynamic framework. In the simplest case, two stages suffice: first, the institutions (or the contracts) are endogenously chosen; second, a game is played. In a general institutional equilibrium, the design of one institution is an optimal or equilibrium response to the other institutional designs. Thus, at Stage 3 of Gine, I will need to apply general equilibrium theory.

While this project is, for the most part, quite theoretical, I am aware of the risk that the connection to reality may become weak. Since the project is both ambitious and long-lasting, I plan to mitigate this risk by doing some case studies of real world institutions. Even economic theorists must admit that we can learn a lot from case studies such as those investigated by Elinor Ostrom (1990), the 2009 Nobel Prize laureate in Economics. Since my main application and motivation is environmental policies, and an important subproject deals with the preservation of tropical forests, I hope to be able to observe first-hand the institutions that have worked to protect tropical forests in some countries in Central America, while institutions in other countries have failed in this mission. Such an experience may also clarify and reveal what are the most important political or institutional constraints when deriving the theories above. For this reason, I have included funds for such a field trip in the budget, year 1 and 2. In this mission, I also expect to

draw on my existing contacts in the World Bank and Norad (Norad is an agency in Oslo involved in administering the REDD funds of Norway).

Timeline

The natural approach when colouring the diagram above is to start down-left, and head up-right. At each stage, I plan to first develop the applications and subprojects (A-E). I expect to discover new ideas and applications, as well, and some of these may also be worth developing further. Thereafter, I will generalise, as much as possible, the underlying lesson, mechanism, method, and tool. I plan to complete one stage, develop applications and theories and submit these for publications in the leading academic journals, before starting the next stage. Roughly, my timeline is the following:

- Year 1 and 2: Stage 1, applications (A) and thereafter generalisations.
Stage 2 initiated: Applications (B and C) and thereafter generalisations.
Mid-term scientific report.
- Year 3 and 4: Stage 2 completed.
Stage 3, applications (D and E) and thereafter generalisations.
Final scientific report.

Needless to say, this plan is tentative. In practice, the subprojects and the work at the different stages may overlap and the time needed at each stage may depend on the amount and speed of progress. In addition, the timeline will be influenced by the interests and backgrounds of my new team members.

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