Status Report
2011 – 2013

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A. History of the Institution

A. A Short History of the Institution

The Max Planck Institute for Research on Collective Goods was founded in 1997 as a temporary project group "Common Goods: Law, Politics and Economics" and transformed into a permanent institute in 2003. Its mission is to study the law, economics, and politics of collective goods, defined to encompass all those goods whose provision and enjoyment are treated as community concerns.

In the early years, the institute had teams of lawyers and political scientists, led by Christoph Engel and Adrienne Héritier. When Adrienne Héritier left in 2003 to accept a joint chair at the European University Institute and the Schuman Centre in Florence, the Max Planck Society appointed the economist Martin Hellwig to replace her. At this point, therefore, the institute consists mainly of lawyers and economists.

In addition, there is a small group of psychologists. Initially brought in by Christoph Engel to support his *behavioral law-and-economics* approach to institutional analysis, in 2007 this turned into an independent Junior Research Group *Intuitive Experts* led by Andreas Glöckner.

From the beginning, the work of the institute had three main goals: It aimed to better understand collective-goods problems, to find better solutions, and to understand the political and legal processes of defining problems and choosing solutions. In the years of the project group, major research efforts concerned

- the law and politics of waste avoidance, recycling, and disposal,
- the governance of the internet, and
- the transformation of the nation state into a multi-level system of governance.

Today, the major research efforts of the institute are concerned with

- the analysis of incentive problems in public-good provision,
- the behaviorally informed design of institutions for the provision of collective goods,
- the organization and regulation of network industries: sector-specific regulation and antitrust
- the regulation of financial markets and financial institutions in order to safeguard financial stability.

The first two lines of research are intended to enlarge our understanding of foundations at a fairly general level. The last two lines of research are concerned with applications. Research objectives and strategies are laid out in this report.

B. The Overarching Framework

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Air, atmosphere, the ozone layer, climate, water, the world's oceans, land, quiet, normal radiation, landscape, fauna and flora, genetic diversity: the policy challenge of providing and distributing such natural resources was the impetus for the Max Planck Society's deliberations to establish a new research facility in the humanities section. However, even in the process of establishing the facility, it became clear that man-made goods also pose structurally related challenges. The protection of our cultural heritage, language, streets, energy networks, the liquidity of markets, the reliability of finance institutions, the stability of the finance system: all these pose very similar problems. This was the reason that the Max Planck Society did not establish an institute for environmental law or environmental policy, but deliberately founded a project group for research on collective goods.

The document on the founding of a research facility describes the problem that needs to be solved as follows: "While, on the one hand, these goods need protection, on the other hand, it is necessary for human life that they remain accessible and are used. This gives rise to a multilayered governance problem: of no slight significance here is an elementary distribution problem, indeed one both between groups or individuals and between states. The common – judicial – characteristic of the natural resources is that they can be placed under the power of disposition of individual legal subjects only to a limited extent. Even when property rights are established, the larger community has the responsibility to suitably proportion the maintenance and use of these goods and to suitably distribute the related costs and benefits. […] The research task of the project group will thus have a public policy orientation."

The multilayered governance problem mentioned in that document arises because collective goods always concern numerous people simultaneously, sometimes the community as a whole, including future generations. Were the dealings with collective goods, their provision and financing, left solely to the decentralized decisions of individuals, it is to be feared that the common dimension would be neglected; insofar, collective decision-making mechanisms are necessary. Paradigmatic for this view is the economic concept of non-excludable public goods. The individual who merely attends to his own use of the public good neglects the use that others draw from it, insofar contributing less to the cost of providing this good than is socially desirable. To take one example, according to this argumentation schema, the dangers to the natural environment because of human activity, including the well-known "tragedy of the commons", arise because individuals give their own use of the environment priority over the maintenance of the environment, which, as a public good, benefits everyone.

The concept of collective goods is, however, more encompassing than the economic concept of public goods. It is in principle possible to make the use of the services of law, schooling, or even streets, excludable, but because open access to these goods is thought superior, it is viewed as a constitutive element of the community. The use of other goods, such as the services of the large networks of telecommunications and the post, the energy industry and the railways, is tied to the payment of user fees; here too, however, regulations on non-discriminatory access and the universality of services are to ensure that the communal dimension is accounted for. Finally, in a further class of cases, the concern is with the quality of the services and relations, which are in principle left to the decentralized decision-making of individuals in the markets; here, the communal interest, for example in the reliability of financial transactions, can aim to protect both the parties involved and the system, which can hardly function without reciprocal trust in one another.

The negative assertion that the community dimension will be neglected if the dealings with collective goods, their provision and financing remain solely in the hands of decentralized decision-makers still gives us no positive content: It provides no indication of how the community dimension is to be properly dealt with, or which advantages and disadvantages are implicit in the various institutions and rules for dealing with

collective goods. In principle, every system for dealing with collective goods faces the difficulty that the required information is not readily available. Insofar as the assessment of the involved parties is relied upon, a dilemma arises: the individual has an incentive to downplay the value that the common good has for him if he expects that he will be required to pay for it, while he has an incentive to exaggerate the value that it has for him if he expects that it will not cost him anything. This dilemma also occurs for purely private goods, but it plays a subordinate role there if the good is provided in a competitive market, in which the individual has no power to influence prices. This mechanism is not available for common goods; the greater and more anonymous the involved community is, the greater the magnitude of the described dilemma.

There are no one-size-fits-all solutions for this dilemma. It is rather necessary to determine in detail which advantages and disadvantages the rules and institutions under discussion have for each of the various collective goods. Under consideration are governmental activities, i.e., political or administrative decision-making, market-based, contractual solutions, or arrangements based on individuals' decisions, yet under the influence of state-determined norms about minimal standards, liability laws, etc. The relative advantages and disadvantages of the various alternatives depend on which characteristics the collective goods under discussion possess and what precisely determines the communal dimension of the good in question.

The institute combines basic research and practical applications, for one, by dealing with the theory of collective goods and their provision under diverse abstractly formulated general conditions, and, for another, by developing concrete proposals for the design of (legal and extra-legal) institutions for the provision of individual collective goods. This is of necessity an interdisciplinary endeavour. Economists are needed to understand and structure the allocation and incentive problems that arise. Political scientists are needed to understand the mechanisms of political decision-making used for these goods. And lawyers are needed to develop proposals for the design of rules and institutions in light of concrete legal norms, so that they fit the legal order. The selective reception of results of the neighbouring disciplines is not enough. Especially in the analysis of concrete problems, it is important that all three disciplines are intensively engaged with one another. For example, the interplay between decentral market mechanisms and political decision-making mechanisms needs to be studied jointly by economists and political scientists. To judge the allocation effects of certain decisions of substantive law or procedural law, economists and legal scholars must work in collaboration.

C. Research Program

C. Research Program

C.I Public Goods and Welfare Economics: Incentive Mechanisms, Finance and Governance

C.I.1 Introduction

An important part of the institute's research programme concerns the conceptual framework for the normative analysis of public-goods provision when decision makers cannot be presumed to have the information needed to properly assess the amount of resources that should be devoted to such goods, in particular, when decision makers cannot be presumed to know the values that the different decision makers attach to the different public goods.

In the past few years, research in this area has been somewhat crowded out by research on financial stability and regulation. Therefore there has not been much progress in this area. However, this area remains on our agenda, and we plan to devote more resources to it again in the future. The following summary should be read as a statement of what is distinctive about our approach, with explanations of where we stand and what topics are on our agenda.

Our approach has three distinct features:

Whereas most of the literature considers the problem of public-good provision with private information in the context of small-economy models, in which each participant has the power to affect aggregate outcomes, we consider large economies, in which any one individual is too insignificant to affect the level of public-good provision aggregate outcome. Whereas small-economy models are useful to think about condominium owners deciding how much to spend on gardening services, it is not so useful for thinking about how a country with millions of inhabitants should decide on the level of resources devoted to the judiciary.

We look at public-goods provision and taxation in an integrated manner. The problem of how to pay for public goods is intimately related to the problem of what is an appropriate system of taxes and prices for public services.

We also want to integrate the supply side into the analysis. Many questions of funding for public goods are intimately related to questions of incentives and governance in production and provision of these goods.

Although the focus of our work is normative, in the tradition of Pigou and Samuelson, the incentive and governance considerations that we introduce lend themselves naturally to political-economy considerations. We consider these as well, but still consider the normative focus to be important because it provides a measuring rod by which to assess the strengths and weaknesses of decision procedures that are actually used.

By now, normative economics has learnt that it must take account of information and incentive problems. The theory of mechanism design provides a basis for doing so, focussing on what measure of efficiency can be achieved when these problems are taken into account. This is the very type of question that we are asking about the provision and financing of public goods in large economies.

The importance of the question is readily seen if one goes back to the typical economist's critique that political decision making gives rise to inefficient outcomes because it fails to take account of preference intensities. A majority of people who care just slightly about an issue can impose its will on a minority who care intensely about it. If the disparity between the two groups is sufficiently large, the result is inefficient in

the sense that everybody would be better off if the minority was able to "bribe" the majority to vote differently.

In this critique of collective decision making by voting, no account is taken of possible information asymmetries. One result of our research shows that, once these information asymmetries are taken into account, it may not even be possible to rely on anything else than a voting mechanism.

Our research and research interests in this area can be roughly divided into three broad topics:

Development of a conceptual and formal framework that is suitable for dealing with issues that concern the revelation, communication and use of private information in a large economy.

Development of an overarching conceptual and formal framework that can be used to integrate the theory of public-goods provision with the rest of normative economics, in particular, the theories of public-sector pricing and of taxation.

Development of a conceptual and formal framework that is suitable to address issues concerning incentives and governance on the supply side of public-good provision and can also be used to integrate the analysis of such issues with the more conventional analyses of demand and funding.

The following Sections C.I.2 – C.I.4 of this report will take up each of these topics in turn.

C.I.2 The Mechanism Design Approach to Public-Good Provision

C.I.2.1 Public Goods versus Private Goods: What is the Difference?

To fix semantics, we define a public good to be one that exhibits *nonrivalry* in the sense that one person's "consumption" of this good does not preclude another person from "consuming" it as well. When several people "consume" the public good, there may be external effects, e.g. negative externalities from crowding or positive externalities from mutual entertainment, but there is not the kind of rivalry in consumption that one has with private goods where one person's eating a piece of bread precludes another person's eating it as well.

We focus on nonrivalry as the key characteristic because this property is at the core of the allocation problem of public-good provision. Because of nonrivalry, it is efficient for people to get together and to coordinate activities so as to exploit the benefits from doing things jointly. Other characteristics, such as nonexcludability, affect the set of procedures that a community can use to implement a scheme for public-good provision and finance, but such considerations seem secondary to the main issue that nonrivalry is the reason why public-good provision is a collective, rather than individual concern.

The mechanism design approach to public-goods provision asks how a community of n people can decide how much of a public good should be provided and how this should be paid for. If each person's tastes were publicly known, it would be easy to implement an efficient level of public-good provision. If tastes are private information, the question is whether and how "the system" can obtain the information that is needed for this purpose. Because this information must come from the individuals who hold it, the question is whether and how these individuals can be given incentives to properly reveal this information to "the system".

The bottom line of the literature is that it is always possible to provide individuals with the incentive to reveal their preferences in such a way that an efficient level of public-good provision can be implemented. For this purpose, financial contributions must be calibrated to individuals' expressions of preferences for the public good in such a way that there are neither incentives to overstate preferences for the public good

in the hope that this raises the likelihood of provision at the expense of others nor incentives to understate preferences for the public good in the hope that this reduces one's payment obligations without too much of an effect on the likelihood of provision. The mechanism design literature shows that one can always find payment schemes which satisfy this condition.[1]

However, there may be a conflict between incentive compatibility, feasibility, i.e., the ability to raise sufficient funds for provision of the public good, and voluntariness of participation. In some instances, it is impossible to have a public good provided efficiently on the basis of voluntary contracting. Some coercion may be needed. The original idea of Lindahl (1919) that the notion of a public good may provide the basis for a contractarian theory of the state is then moot. Samuelson's (1954) conjecture that private, spontaneous arrangements are inappropriate for efficient public good provision is vindicated.

Samuelson (1954) stressed the difference between public and private goods. However, the mechanism design literature is not so clear on the matter. Indeed, if we consider an economy with n participants with independent private values,[2] we get the same kinds of impossibility theorems for private and for public goods: On the basis of voluntary participation and in the absence of a third party providing a subsidy to "the system", it is impossible to have a decision rule that induces an efficient allocation under all circumstances, unless the information that is available ex ante is sufficient to determine what the allocation should be.[3] If coercion is allowed, there is no problem in achieving efficiency for either kind of good.

To find a difference between public and private goods, one must look at the behaviour of such systems as the number of participants becomes large. For private goods, a larger number of participants means that there is more competition. This reduces the scope for dissembling, i.e., acting as if one cared less for a good than one actually does, in order to get a better price. With competition from others, attempts to dissemble are likely to be punished by someone else getting the good in question. Hence, there are approximation theorems showing that, for private goods, there are incentive mechanisms that induce approximately efficient allocations, even with a requirement of voluntary participation, if the number of participants is large.[4]

For public goods, there is no such competition effect. An increase in the number of participants has two different effects. On the one hand, there are more people to share the costs. On the other hand, the probability that an individual's expression of preferences affects the aggregate decision is smaller; this reduces the scope for getting a person to contribute financially, e.g., by having an increase in financial contribution commensurate to the increase in the probability that the public good will be provided. The second effect dominates if individual valuations are mutually independent and if the cost of providing the public good is commensurate to the number of participants, e.g., if the public good is a legal system whose costs are proportional, or even more than proportional, to the number of parties who may give rise to legal disputes. In this case, the expected level of public-good provision under *any* incentive mechanism that relies on voluntary participation must be close to zero.[5]

Samuelson's view about public goods versus private goods, the latter being efficiently provided by a market system, the former not being efficiently provided at all by a "spontaneous decentralized" solution, thus seem to find its proper place in a setting with many participants where, on the one hand, the forces of competition eliminate incentive and information problems in the allocation of private goods, and, on the

1 This is shown by Clarke (1971) and Groves (1973) for implementation in dominant strategies and by d'Aspremont and Gérard-Varet (1979) for Bayes-Nash implementation.

2 Independent private values: If one person is known to have a high preference for the good in question, this contains no information about any other person's preference for this good. Preferences of different people are stochastically independent.

3 For private goods, see Myerson and Satterthwaite (1983), for public goods, Güth and Hellwig (1986), Mailath and Postlewaite (1990).

4 Wilson (1985).

5 See Mailath and Postlewaite (1990), Hellwig (2003).

other hand, incentive and information problems in the articulation of preferences for a public good make it impossible to get the public good financed.

However, in the transition from a finite economy to a large economy, the question of what is the proper amount of resources to be devoted to public-goods provision is lost, at least in the independent private values framework that has been used by this literature. In this framework, a version of the law of large numbers implies that cross-section distributions of public-goods valuations are commonly known. Given this information, the efficient amount of public-goods provision, first-best, second-best, or fifty-sixth-best, is also known. The only information problem that remains is the assignment problem of who has a high valuation and who has a low valuation for the public good. This assignment problem matters for the distribution of financing contributions but *not* for the decision on how much of the public good to provide.

C.I.2.2 Do Correlations Make Incentive Problems Disappear?

If one wants to avoid the conclusion that the proper amount of resources to be devoted to public-goods provision is known *a priori* because the cross-section distribution of valuations for the public good is pinned down by the law of large numbers, one must assume that the public-goods valuations of different people are correlated so that the law of large numbers does not apply. However, for models with correlated valuations, the impossibility theorems mentioned above are no longer valid. Indeed, for models with private goods, Crémer and McLean (1988) and McAfee and Reny (1992) have shown that one can use the correlations in order to prevent people from obtaining "information rents", i.e., benefits that they must be given if they are to be induced to properly reveal their information. For public goods, Johnson, Pratt, and Zeckhauser (1990) and d'Aspremont, Crémer, and Gérard-Varet (2004) show that, generically, incentive schemes that use correlations to harshly penalize deviations when communications from different people are too much in disagreement, can be used to implement first-best outcomes – with voluntary participation and without a third party providing a subsidy, at least in expected-value terms. The incentive schemes that these analyses involve are not very convincing. They look more like artefacts of the mathematics than anything that might be used in reality. But then the question is what precisely is deemed to be implausible about them.

One answer to this question has been proposed by Neeman (2004) and Heifetz and Neeman (2006). In their view, the results of Crémer and McLean (1988), as well as the other literature, rest on an implicit assumption, which they deem to be unpalatable, namely, that agents' preferences for a good can be inferred from their beliefs about the rest of the world. Crémer and McLean (1988) do not actually specify people's beliefs. They assume that people's preference parameters are the only source of information asymmetry and heterogeneity. Beliefs about the rest of the world are implicitly defined as conditional expectations given their own characteristics and given the overall structure of correlations of characteristics across agents. Generically, preference parameters can be inferred from these beliefs. Moreover, because differences in beliefs induce differences in attitudes towards bets, i.e., state-contingent payment schemes, these differences in attitudes towards bets can be used to extract all rents. According to Heifetz and Neeman (2006), the logic of the Crémer-McLean argument breaks down if people have sources of information other than their preference parameters. In this case, it is quite possible for a given belief about the rest of the world to be compatible with two distinct values of preferences, say a value of zero and a value of ten for the good in question. Because the person with a value of ten for the good in question has the same beliefs as the person with a value of zero, it is then not possible to make the person with a value of ten reveal his high valuation and at the same time surrender the benefit that he obtains if he is actually given the enjoyment of the good; after all, this person could always act as if his value was zero. Neeman (2004) uses a version of this argument in order to prove a version of the Mailath-Postlewaite (1990) theorem on the impossibility of public-good provision in a large economy with voluntary participation, this one with

correlated values and under an assumption that, uniformly across economies with varying numbers of participants, there always is a probability that a person holding a certain set of beliefs might assign zero value to the public good. Heifetz and Neeman (2006) argue that, in the set of relevant incomplete information models, the "Beliefs Determine Preferences" (BDP) property of Crémer and McLean is in fact negligible.

Gizatulina and Hellwig (2010, 2014 a, 2014 b) cast some doubt an these claims. In Gizatulina and Hellwig (2010) we showed that the uniformity of violation of BDP in Neeman (2004) is incompatible with the notion of Palfrey and Srivastava (1986) and McLean and Postlewaite (2002) that agents are *informationally small*. In Gizatulina and Hellwig (2010), each person has private information about his preferences, but other people have noisy signals about these preferences so, if there are many such people and they can be induced to reveal their signals, an average of the signals provides fairly precise information, which can be used to induce truthful preference revelation at practically no cost. If the number of participants is large, an approximately efficient allocation rule can be implemented although participation is voluntary, the cost of the public good provision is proportional to the number of participants, and the BDP property is violated.

Gizatulina and Hellwig (2014 a) observe that Heifetz and Neeman (2006) do not actually study the BDP property as a property of belief functions but as a property of priors from which the belief functions are derived as conditional distributions. Moreover, they make no use of the fact that belief functions are conditional distributions. The same is true of Chen and Xiong (2011, 2012), who consider the genericity of the BDP property and of full surplus extraction in the context of the universal type space. In the universal type space, it does not actually make any sense to talk about properties of belief functions; belief functions in the universal type space are trivially given as projections from universal types to belief hierarchies (or to the measures on other agents' type spaces that are induced by the belief hierarchies). The question of how beliefs are generated, what information they reflect, and whether the information can be inferred from the beliefs cannot be addressed as a question about belief functions. At best it can be treated as a question about belief-closed subsets of the universal type space and about priors on such sets.

Instead of working with the universal type space, Gizatulina and Hellwig (2014 a) work with abstract type spaces à la Harsanyi. Under the assumption that each agent's types are finite-dimensional vectors and that belief mappings are continuous regular conditional probability distributions, they show that, for each agent, the set of belief functions exhibiting the BDP property is a generic subset of the set of all belief functions in the sense that it contains a countable intersection of open and dense sets of functions. The space of all (continuous) belief functions is given the topology of uniform convergence. The result follows from an extension of the classical embedding theorem for continuous functions. The reason is that beliefs are probability measures and thus infinite-dimensional objects. Gizatulina and Hellwig (2014 a) also show that their genericity result for the BDP property can be extended to tuples of belief functions that are compatible with common priors.

In a new paper, Gizatulina and Hellwig (2013) show that in a framework with abstract type spaces, under certain conditions, not only the BDP property but also the McAfee-Reny condition for full surplus extraction (FSE) are generic. Type spaces are compact metric spaces, beliefs are assumed to have continuous densities with respect to some fixed measure on the range, belief functions are assumed to map the type spaces continuously into beliefs with density functions, where the topology on the range is the topology of uniform convergence of density functions, the space of belief functions itself has the uniform topology. The result rests on the insight that the McAfee-Reny condition can be interpreted as a strengthening of the BDP condition, namely, if one knows an agent's beliefs, then one also knows that the agent himself knows his type, i.e., his beliefs cannot come from a non-degenerate mixture of types, and one can infer the type from the beliefs. Given this insight, an adaptation of the proof of the classical embedding theorem yields the desired result.

This work raises the question how our analysis of genericity of BDP or FSE belief functions in an abstract type space setting relates to the analysis of strategic behaviour in a universal type space setting, in particular, the discussion about the appropriate specification of topologies to reflect desired continuity properties of strategic behaviour. For example, the analysis of genericity of BDP and FSE belief functions in Chen and Xiong (2011, 2012) works with the product topology on the universal type space and with the denseness of finite models in that topology, but it is well known that the product topology on the universal type space gives rise to failures of continuity. The reason is that the product topology assigns ever smaller weight to ever higher-order beliefs whereas, e.g. in Rubinstein's e-mail game, such higher-order beliefs retain their importance regardless of how high the order might be. Given these questions, we are currently studying the strategic implications of our chosen topology on abstract type spaces. For the version of the model we use in our FSE paper, we find that the topology we use has the desired strategic continuity properties; by a corollary to this result, the natural mapping from abstract type spaces to (a subset) of the universal type is continuous if the universal type space is given the strategic topology of Dekel et al. (2006). Rubinstein's e-mail game does not cause problems because in any abstract-type-space representation of that game, belief functions will not be given as continuous maps from types to continuous density functions (with respect to some measure). A paper with this result is in preparation.

Gizatulina and Hellwig (2014 b) extend the analysis to families of models as studied by Heifetz and Neeman (2006). Heifetz and Neeman introduced the notion of a family of models to represent the mechanism designer's uncertainty as to what the right model might be. They showed that, if a given collection of such models is what they call "closed under finite unions", then any convex combination of common priors for a set of models will be a common prior for the union of these models. Moreover, the convex combination exhibits the BDP property if and only if the priors for the base models all exhibit the BDP property. If just one prior for one of the base models fails to exhibit the BDP property, then, within the set of common priors for the union of the models, failure of the BDP property is geometrically and measure theoretically generic. However, Gizatulina and Hellwig (2014 b) use the results of Gizatulina and Hellwig (2013, 2014 a) to show that unions of models with common priors of which one or more fail to exhibit the BDP of the FSE property are topologically meagre, i.e., the set of families within which the Heifetz-Neeman results are applicable is itself a negligible set.

Perhaps as importantly, Gizatulina and Hellwig (2014 b) show that the notion of model uncertainty in Heifetz and Neeman (2006) can be formally analysed by mapping the "unions of models" into a single larger model in which all dimensions of the relevant uncertainty are captured by uncertainty about the participants' types. Once this is seen, the problem of how the mechanism designer should deal with model uncertainty itself becomes a problem of mechanism design. In dealing with this problem, the mechanism designer can make use of the fact that, among the participants, it is common knowledge which of the original (sub-)model environments they are in. A "shoot-the-liars" reporting game may then provide him with the means of extracting this information without cost, after which he can stipulate the implementation of whatever mechanism is optimal for the original (sub-)model. Even in a Heifetz-Neeman world, the dichotomy between models with the BDP property, or with full surplus extraction, and models without the BDP property, or without full surplus extraction would then be replaced by a smooth transition between the two: If the mechanism designer assigns a small positive probability to models that do not permit full surplus extraction, then, in expected-value terms he will extract all but a small amount of the overall surplus.

The work discussed in the preceding paragraphs should not be interpreted as saying that we regard Crémer-McLean type mechanisms as plausible, or that we consider the mechanisms of Johnson, Pratt, and Zeckhauser (1990) and d'Aspremont, Crémer, and Gérard-Varet (2004) as an appropriate basis for tackling social choice problems involving public goods. The problem is to understand precisely why these approaches should be considered unsatisfactory. Gizatulina and Hellwig (2010, 2013, 2014 a, 2014 b) should be interpreted as saying that the reliance of Crémer-McLean type mechanisms on the BDP property

is less problematic than has been suggested and that an effective criticism of such mechanisms must dig deeper.

C.I.2.3 Robustness and Large Economy Models

The ability to exploit correlations between valuations requires precise information not just about the joint distribution of the different participants' public-good valuations, but also about the different participants' beliefs about the other agents' valuations, the other agents' beliefs about the other agents' valuations, etc. It seems implausible that a mechanism designer should have this information. Ledyard (1979) and Bergemann and Morris (2005) have proposed a *robustness requirement* that would eliminate the dependence of an incentive scheme on this kind of information. According to Bergemann and Morris, a social choice function, e.g. in the public-good provision problem a function mapping cross-section distributions of valuations into public-good provision levels and payment schemes, is *robustly implementable* if, for each specification of "type spaces", in particular, for each specification of beliefs that agents hold about each other, one can find an incentive mechanism that implements the outcome function in question.

In public-good provision problems with quasi-linear preferences, robust implementability is, in fact, equivalent to *ex post* implementability and to implementability in dominant strategies. This eliminates all social choice functions whose implementation would involve an exploitation of correlations and agents' beliefs about correlations. In particular, social choice functions with first-best outcomes are not robustly implementable. The mechanisms for first-best implementation in Johnson et al. or d'Aspremont et al. make essential use of information about beliefs, beliefs about beliefs, etc.

Given these findings, Bierbrauer and Hellwig (forthcoming) argue that the robustness criterion of Ledyard (1979) and Bergemann and Morris (2005) provides the proper setting for understanding the essence of the difference between public and private goods. All the findings from the independent-private-values case carry over to robust implementation with correlated values. In particular, (i) for private goods, approximately efficient implementation is possible with voluntary participation if the number of participants is large, and (ii) for public goods with provision costs commensurate to the number of participants, hardly any provision at all is possible with voluntary participation if the number of participants is large. These results hold regardless of what is being assumed about correlation structures. In particular, they leave room for an analysis of large economies in which the question of how much of the public good should be provided is not moot.

However, the analysis of such large economies "in the limit" when each participant is insignificant give rise to some technical and conceptual questions. First, if one thinks about uncertainty in the large economy as involving a mixture of individual and aggregate shocks, there is a need for developing the appropriate mathematical framework for this purpose. The issue is how to formalize the notion of a continuum of conditionally independent random variables in such a way that cross-section distributions are well defined. Second, since most concepts of game theory and mechanism design have been developed for models with finitely many participants, the question is how to adapt these concepts with a continuum of participants.

Hellwig (2011) develops a formulation of incomplete-information models for a continuum of agents who only care about the cross-section distribution of characteristics in the economy and gives conditions for the existence and uniqueness of common priors in such models. The conditions given are a straightforward adaptation of a simple condition for finite-player models that is developed in Hellwig (2013). Following a referee's questions about the mathematical foundations for dealing with a continuum of conditionally independent random variables, this paper is currently being revised. With arguments and techniques from Sun (2006) and Hammond and Sun (2008), the formulation of Hellwig (2011) is now derived from more fundamental assumptions, most importantly essential pairwise exchangeability of the assignment of

(random) types to agents, which is a strong form of anonymity. By a version of De Finetti's theorem, this assumption implies that agents' types are conditionally independent and identically distributed and that, in symmetric games, agents care only about the cross-section distribution of types.

The formulation of a large-economy model in Hellwig (2011) is an abstract version of the model used in Bierbrauer and Hellwig (2011/2013) to study mechanism design for public-good provision. In such models, the existence of a common prior is useful as a basis for welfare analysis in the presence of incomplete information.

C.I.2.4 Coalition Proofness

Even if one is not concerned about problems of power abuse, one may be less than convinced by the proposition that, in the absence of participation constraints, it is always possible to implement first-best allocations. Following Bierbrauer (2009a), Bierbrauer and Hellwig (2011/2013) consider the implications of imposing an additional requirement of *coalition proofness*.

The additional requirement is motivated by the observation that robust implementation of first-best allocation rules may have to rely on people giving information that they would be unwilling to give if they appreciated the way it is being used. In a large economy, where no one individual has a significant impact on the level of public-good provision, individual incentive compatibility conditions are trivially met if payments are insensitive to people's communications about their preferences. One can thus use a scheme with equal cost sharing to find out the aggregate valuation for a public good and to implement a first-best provision rule; this kind of implementation is actually robust in the sense of Bergemann and Morris (2005).

However, this kind of implementation is abusing the notion that, if a person's communication about his or her preferences does not make a difference to either the level of public-goods provision or the payment that the person has to make, then the person is indifferent between all messages and therefore may as well communicate the truth. If there was just the slightest chance that a person's communication would make a difference, at least some people would strictly prefer *not* to communicate the truth.

To see why this might happen, observe that first-best implementation relies on information concerning the intensities of people's preferences. If there is a large number of people whose benefits from the public good are just barely less than their share of the cost, first-best implementation may require that the public good be provided because the large benefits that the public good provides to a few other people are more than enough to outweigh this small shortfall. If, instead, the people who oppose the public good have no benefit at all from it, first-best implementation may require that the public good should not be provided because the shortfall of their benefits relative to their costs is not compensated by the net benefits that are available to others. In this constellation, the overall outcome depends on the information that can only be obtained from people who don't want the public good to be provided at all, namely whether their opposition is mild or strong. Truthtelling is individually incentive compatible because nobody believes the information that he provides to make a difference. However, truthtelling is not coalition-proof: If someone was to organize a coalition of opponents so as to coordinate on a manipulation of the information they provide, the overall incentive mechanism would no longer be able to implement first-best outcomes.

Bierbrauer and Hellwig (2011/13) provide an abstract formulation of the requirement of coalition proofness and its implications for robust implementability in the public-good provision problem. Following Laffont and Martimort (1997, 2000), in addition to robust incentive compatibility, they require that the incentive mechanism for public-good provision be immune to the introduction of a "manipulation mechanism" whereby a coalition organizer collects information from coalition members and uses this information to distort the information that is provided to the overall mechanism. The introduction of a manipulation

mechanism is itself modelled as a mechanism design problem with its own set of incentive and participation constraints. Coalition proofness fails if there exist a manipulation mechanism and a set of agents such that, if all agents in this set subscribe to the manipulation mechanism, and all other agents do not, then all agents in the set are strictly better off than they would be without the manipulation mechanism.

For the simplest version of the public-good provision problem, with a non-excludable public good coming as a single, indivisible unit that costs k, Bierbrauer and Hellwig (2011/13) show that robust implementability and coalition proofness jointly imply that (i) people's payments must be the same in all states in which the public good is provided and the same in all states in which the public good is not provided, and that (ii) the decision to provide the public good must be a non-decreasing function of the number of participants for whom the benefits of the public good exceeds the difference between provision-state payments and non-provision-state payments. Information about the intensities of likes and dislikes cannot be used because reports about this information are subject to manipulation by the coalitions concerned. Whereas conditions (i) and (ii) are only shown to be necessary for robust implementability and coalition proofness, they are in fact necessary and sufficient if the requirement of coalition proofness is weakened to the effect that immunity is only required against manipulations by coalitions that are themselves immune to manipulations by further subcoalitions.

Bierbrauer and Hellwig (2011/13) also show that robustly implementable and (weakly) coalition-proof social choice functions can in fact be implemented by *voting mechanisms*, i.e., by mechanisms where people are simply asked to vote for or against provision of the public good, and the outcome is made to depend on the number of "yes" votes. The standard economist's criticism that voting abstracts from intensities of likes and dislikes and therefore leads to inefficient outcomes is therefore moot, at least if one allows for the formation of coalitions that distort information about the intensities of likes and dislikes.

In the course of several revisions of this paper, we have also shown that the given results for large-economy models can in fact be obtained as limits of the corresponding results for finite-economy models as the number of participants goes out of bounds. In finite-economy models as well as large-economy models, robustly implementable and coalition-proof mechanisms must be voting mechanisms. The new version of the paper also shows that the analysis is not limited to binary choices, i.e., choices involving the provision or non-provision of the public good. For an example with multiple provision levels, the paper shows that implementable and coalition-proof mechanisms must again be voting mechanisms. We conjecture, but have not yet been able to prove, that, depending on the provision cost function, there may be voting paradoxes. Specifically, we expect such paradoxes to arise if the provision cost function involves increasing returns to scale (decreasing marginal costs).

Robustness in the transition from finite economies to large economies distinguishes the coalition proofness approach of Bierbrauer and Hellwig (2011/2013) from the *informative voting* approach of Bierbrauer and Sahm (2006/2010), which also tries to articulate our unease about first-best implementation in large economies. In the informative voting approach, people's choices are required to satisfy the additional condition that they should still be considered optimal if there was even the slightest chance of their affecting aggregate outcomes. This condition, which corresponds to the assumption of *informative voting* in political economy, eliminates the possibility that people choose what they choose because they believe that their choices matter anyway. As a result, they vote their preferences even though they do not expect their votes to have an effect on aggregate outcomes. In a large economy, this imposes additional constraints on mechanism design. These constraints typically preclude first-best implementation, for reasons that are roughly the same as for coalition proofness. However, in contrast to coalition proofness, informative voting restrictions do not have any bite in large finite economies. For example, Groves-Clarke mechanisms can satisfy informative voting restrictions (with strict preference for chosen actions) in all finite specifications but, as one takes limits, in the transition to a large economy, strict preference becomes indifference, and, in the limit, informative voting restrictions are violated.

C.I.3 Public-Goods Provision, Public-Sector Pricing and Taxation

C.I.3.1 Public-Goods Finance under Participation Constraints

Textbook treatments of public economics are usually split into treatments of mechanism design and public-goods provision, public-sector pricing under a government budget constraint, and redistributive taxation. Relations between these three locks are rarely discussed. Our work over the past few years has attempted to overcome this separation and to provide an integrated framework for public economics within which relations of the different parts to each other can be discussed and potential conflicts and contradictions assessed. As a step in this direction, Hellwig (2004/2009, 2007a) has shown that the traditional three-way split between the theory of mechanism design and public-goods provision, the Ramsey-Boiteux theory of public-sector pricing under a government budget constraint, and the theory of redistributive taxation should be replaced by a two-way split between models with and models without participation constraints.

Specifically, Hellwig (2004/2009) shows that it may be desirable to use income taxes for public-goods finance. In a model with endogenous production and with productivity levels differing across people, income taxation provides a way of extracting some of the surplus from production though, as in Mirrlees (1971), the extraction is limited by incentive constraints because individual productivity levels are private information. Under the additional assumption that people are free to retrade private goods and unbundled public-goods admission tickets, the paper shows that it is always desirable to use nonlinear income taxes as well as public-goods admission tickets as a source of funds for financing public goods. This confirms the Atkinson-Stiglitz (1976) critique of the Ramsey-Boiteux approach for not paying sufficient attention to the role of direct taxation as a source of government funds. However, contrary to the claims of Atkinson and Stiglitz, positive admission fees for excludable public goods as well as non-uniform indirect taxes are desirable, in addition to income taxation, if participation constraints are imposed. Optimal public sector prices and indirect taxes and optimal income tax schedules must satisfy a version of the Ramsey-Boiteux inverse-elasticities rule and a version of the Mirrlees formula for the optimal marginal income tax.

Bierbrauer (2009c, 2011a) criticizes Hellwig's dichotomy between models with and models without participation constraints on the grounds that, if participation constraints are to be taken seriously, they must be derived rather than imposed. For a model of the provision of a single excludable public good, he shows that this can actually be done if the provision is delegated to a profit-maximizing entrepreneur. If the entrepreneur's cost is his own private information, the imposition of participation constraints, i.e., giving each agent a veto right may be the only viable way of limiting the monopoly profits that the entrepreneur might otherwise extract.

Within a Ramsey-Boiteux setting, Aigner and Bierbrauer (2014) study the problem of how to tax financial services, a question that has been prominent in recent policy debate. They use a model of "boring banking", in which the bank uses some inputs to provide services for depositors and some other inputs to screen loan customers, to study optimal taxation in a general-equilibrium setting. Under the assumptions of perfect competition and constant returns to scale, they find that a variety of "different" modes of taxation that have been considered in the policy debate are in fact equivalent. The differences that have been stressed in the policy debate have in fact been due to differences in revenue raised by the government and in utility obtained by the private participants. Once these differences are corrected for, different modes of taxation that end up having the same effects on margins between final outputs and final inputs are shown to be equivalent. Matters are different if there are rents, from monopoly power or from decreasing returns to scale. In this case, the different tax modes that have been proposed may differ with respect to their impact on rents but the logic of Ramsey, Boiteux, Diamond, and Mirrlees, which demands that these rents should be taxed away, still dominate the analysis.

C.I.3.2 Public Goods Provision, Income Taxation, and Redistribution Without Participation Constraints

If no participation constraints are imposed, public-good provision can in principle be financed by non-distortionary, lump sum taxation. The Atkinson-Stiglitz (1976) critique of the Ramsey-Boiteux approach to public-sector pricing and indirect taxation is therefore applicable. There remains the question of what can be said about distributive concerns and, in particular, the relation between public-good provision and utilitarian redistribution à la Mirrlees (1971). If differences in earning abilities were the only source of heterogeneity and, hence, the only source of distributive concerns, the Atkinson-Stiglitz theorem would imply that, even with distributive concerns, it is undesirable to charge public-sector prices in excess of marginal costs or to levy distortionary indirect taxes unless, due to complementarities in consumption, these measures help to reduce distortions in redistributive income taxation.[6] As discussed in Hellwig (2004/2009, 2005, 2010 a), however, one must also take account of differences in public-goods preferences as a source of heterogeneity and of distributive concerns. For a single excludable public good, Hellwig (2005) has shown that such distributive concerns can make it desirable to charge access prices above marginal costs in order to facilitate redistribution from people who gain a lot of utility from the enjoyment of the public good to people who do not draw such benefits from it. Hellwig (2010 a) shows that, in this setting, simple pricing mechanisms may actually be dominated by mechanisms with nondegenerate admission lotteries, with higher prices charged for admission lotteries with higher admission probabilities. Hellwig (2010 a) also provides a sufficient condition for randomization to be undesirable; remarkably, this condition is the same that ensures undesirability of randomization in the literature on price discrimination by a multi-product monopolist.

Whereas Hellwig (2005, 2010 a) deals with the case of a single excludable public good, without any concern for the production side of the economy, Hellwig (2004/2009) allows for multiple public goods and endogenous production, with heterogeneity in productivities (earning abilities) as well as public-goods preferences. In this model, each source of heterogeneity gives rise to distributive concerns of its own. If the different sources of heterogeneity are independent, each one of them calls for distortions in pricing or taxation as a basis for redistribution, in admission fees for excludable public goods as well as income taxes. If the different sources of heterogeneity are positively affiliated, the distributive concerns are even stronger. The resulting formulae for optimal public-sector prices and income taxes can be interpreted as a combination of a Ramsey-Boiteux weighted inverse-elasticities and the Mirrlees rule for the optimal marginal income tax. Because of the multiple sources of heterogeneity and distributive concerns, the Atkinson-Stiglitz theorem does not apply.

As an offshoot from this work, Hellwig (2007 b, c) had also taken a new look at the standard model of optimal utilitarian income taxation. Hellwig (2007 b) provided the most general formulation to date of the Mirrlees-Seade characterization of the optimal income tax schedule, with a unified proof for finite and for continuum models that relates the mathematics to the economics and shows what exactly is the role of each assumption that is imposed. Hellwig (2007 c) had shown that randomization in income taxation is undesirable if preferences exhibit a property of nondecreasing risk aversion/inequality aversion; examples in the literature, in which randomization is desirable, are thereby put into perspective.

Bierbrauer (2011b) uses the result in Hellwig (2007c) to refute the criticism that Piketty (1993) has raised against the Mirrleesian approach, namely, that taxes levied on one agent are independent of the other agents' productivity levels. Bierbrauer shows that Piketty's analysis rests an implicit assumption that different agents' productivity levels are negatively correlated.

Bierbrauer and Boyer (2010, 2013) place the analysis of Mirrleesian income taxation in a setting of political competition. To avoid running into voting paradoxes, they assume that there are only two produc-

6 Minor extensions of this theorem are given in Hellwig (2009, 2010 b).

tivity levels and consider the implications of competition for votes when politicians differ in ability, i.e., the costs of running the government, and any redistribution scheme must be incentive compatible. Assuming that the low-productivity group is larger, they find a tradeoff between distributive concerns and efficiency concerns for the politicians. Outcomes depend on parameter constellations. The leading case is shown to be one where the optimal Mirrleesian income tax for a Rawlsian welfare function is implemented.

Aigner (2014) studies the interaction of distributive and allocative concerns in the context of environmental taxation, which might have adverse distributive effects-The problem is considered in a standard Mirrleesian framework of optimal income taxation with two productivity groups, augmented by a second consumption good, which induces a negative environmental externality. The analysis of optimal taxation is done once in a setting with first-best income taxation and once in a setting with second-best income taxation à la Mirrlees. After identification of a term in the formalism that can be taken to stand for the "greenness" of the Pigouvian tax on the good with the negative externality (which is an issue because, in a general-equilibrium setting, there is no natural numéraire), the paper shows that, somewhat surprisingly, an increase in the welfare weight of the less productive group makes the "greenness" term go up if a first-best allocation is to be implemented and to go down if a second-best interior allocation is to be implemented. The reasons have little to do with the political considerations that originally motivated the analysis and a lot with the effects of the welfare weight of the low-productivity group on the shadow price of the resource constraint: In a first-best allocation, only high-productivity people work; if their welfare weight goes down, the shadow price of the resource constraint goes down because it is less problematic to have these people work extra. In a second-best interior allocation, in contrast, the shadow price of the resource constraint goes up because with more redistribution, deadweight losses from having to satisfy incentive constraints are higher.

Whereas Hellwig (2004/2009, 2005, 2010 a) had studied models of large economies with cross-section distributions of taste and productivity parameters satisfying a law of large numbers (and therefore being common knowledge). In contrast, Bierbrauer (2009 a, 2014) studies the interdependence of public-good provision and income taxation when there is aggregate uncertainty about public-good preferences, i.e., there is a genuine problem of finding out what level of public-good provision is desirable. These papers show that, if a robustness condition is imposed, the standard procedure of having separate analyses of public-good provision and income taxation, effectively neglecting the information problems in public-good provision,[7] can be vindicated, at least if preferences are additively separable between consumption and leisure. In this case, the arguments given in Section C.I.2.3 imply that, in a large economy, it is always possible to induce truthtelling about public-good preferences by having payments be independent of reported preferences; moreover, implementation is independent of people's beliefs about each other, i.e., robust. Given the financing needs that arise from efficient public-goods provision, there remains the Mirrlees problem of determining an optimal income tax schedule with a view to these financing needs and redistribution.

C.I.3.3 Enforcement and Compliance

Issues of enforcement have been central to the work of Christian Traxler while he was at the institute. Even before coming to the institute, he had initiated a large-scale project investigating enforcement and compliance with respect to the payment of fees for radio and television in Austria. Results of this project are presented in Traxler and Winter (2012), Rincke and Traxler (2011), and Fellner, Sausgruber and Traxler (2013).

Traxler and Winter (2012) report on the results of a survey that was conducted concerning compliance with respect to the obligation to pay fees for radio and television in Austria. Econometric analysis of the evi-

7 See, e.g., Boadway and Keen (1993).

dence from the survey suggests that compliance behaviour is very much influenced by people's beliefs on the frequency of compliance by others. This finding cannot be explained by sanctions varying with the frequency of compliance; actual sanctions are independent of this frequency and depend mainly on the severity of the delinquency.

Fellner, Sausgruber, and Traxler (2013) report on a field experiment involving mailings to suspected evaders of television fees in Austria. Some mailings just reminded people of their obligation to pay these fees, some were accompanied by a threat of legal sanctions, some by an appeal to moral norms, and some by information about the compliance behaviour of others. Relative to a control group, there was a strong effect of these mailings on all people receiving such mailings. Mailings threatening legal sanctions had a strong additional effect, mailings appealing to moral norms or containing information about the behaviour of others did not have such an additional effect. For the addressees of the mailings, the findings confirm the economic model of delinquent behaviour as a result of a consideration of costs and benefits, with little regard for moral or social norms. However, the addressees consist of a selected group of the population, namely people who were known to live at a given address and had not previously registered to pay their television fees. Attitudes and behaviours of people in this select group are probably not typical for the population at large, of which more than 90 % are in compliance anyway. However, when thinking about enforcement policies, the attitudes and behaviours of the potential delinquents may be the thing to focus on, even if these attitudes and behaviours cannot be generalized to the population at large.

Rincke and Traxler (2011) study the effects of enforcement activities on compliance behaviours. Econometrically, the problem is to avoid spurious correlations and simultaneity bias, due to the fact that enforcement officers' choices of where to go and look for potential evaders are endogenous, perhaps driven by information on where suspected evasion rates are high or by the consideration that it is more comfortable to do this job in a densely settled area, e.g., a city, than in a distant mountain valley. To deal with the identification problem, Rincke and Traxler make use of a natural experiment that was provided by extraordinary snow fall in the winter of 2005/2006. The snow fall had a differential impact on enforcement officers' costs of getting to different parts of the country, e.g., more severe effects in remote mountain valleys or in places at higher altitudes. Using such weather-related variables as instruments, Rincke and Traxler find that compliance behaviour is positively affected by enforcement activities, not just directly, because offenders are caught, but also indirectly, because, presumably through word of mouth, information about such activities spreads in the local community and people who have failed to comply so far begin to have second thoughts. To be more precise: Rincke and Traxler find that, following enforcement activities in a given area, registration for television fees in that are goes up, i.e., some non-compliers begin to register even though they have not been directly affected by the enforcement as such.

C.I.4 Governance, Finance, and Efficiency in Public-Goods Production[8]

C.I.4.1 The Research Problem

Most of normative public economic theory, including the work on which we have reported in Sections C.I.2 and C.I.3 does not pay any attention to the supply side of the economy, in particular to the production of public goods. The focus is exclusively on the demand side and on the implications of nonrivalry for preference revelations and finance under conditions of incomplete information. The nature and properties of the public goods are taken as given; the production side is represented by an exogenously given cost function.

8 This part of the report is not much changed since 2009. As mentioned in the introduction to this chapter, the financial crisis has diverted our attention away from the issues raised here, but we continue to believe that the problems raised are important and promising and hope to return to them soon.

The significance of this lacuna is obvious if one considers the financing of production. According to Atkinson and Stiglitz (1976), the government budget constraint is just what the term says, a constraint, whose impact should be minimized. Therefore any need for funds to finance production should be covered from direct taxes, preferably lump sum taxes. According to Hellwig (2004/2009), the scope for direct taxation may be limited by participation constraints, and therefore one may need entry fees as well as direct taxes to finance production. Even so, a subsidization of public-goods provision from direct taxation is desirable, as is some cross-subsidization between the different public goods.[9] There is no notion that any one public good or any one subset of public goods ought to be self-supporting. Any notion that the production sector should be divided up into separate units, with a proviso that each unit finance itself, is rejected because this would entail replacing the single, integrated budget constraint for the entire production sector by a multiplicity of separate constraints for the different subunits. This would further restrict the set of admissible allocations and would presumably reduce welfare.

However, this line of argument neglects information and incentive problems on the production side of the economy. The notion that welfare is increased by having an integrated production sector with a single, consolidated budget constraint stems from the Pigouvian tradition of welfare economics, in which the planner has complete information about preferences and technologies. The modern theory of normative public economics has done away with the complete-information assumption, but it has done so in a piecemeal fashion, with mechanism design models of the demand for public goods and screening models for the supply,[10] without integrating the two.

Taking account of information and incentive problems in production, one expects subsidization and cross-subsidization schemes to have negative effects on producers' efforts. If a producer knows that any deficit is going to be covered by funds from another source, he may be less concerned about cost efficiency or about tailoring his product to the needs of his customers.[11] The same holds for a producer who knows that any surplus he earns is going to be siphoned off for use in some other part of the system. This should lead to a more critical view of subsidization and cross-subsidization schemes in the financing of production.

However, the insights concerning the benefits of such schemes that have been developed in normative public economics so far do not automatically become obsolete. The mere fact that incentive effects in production matter does not by itself invalidate the arguments underlying the inverse-elasticities rule, e.g., arguments in favour of cross-subsidizing local public transport from profits in electricity distribution. What we need is a framework for comparing such benefits of cross-subsidization with the costs of negative incentive effects. As yet, we do not have a conceptual framework for assessing the trade-offs that are involved.

The problem has been around for a long time. Remarkably, though, hardly any work has been done on it. Laffont and Tirole (1993, Ch. 15) provide an example in which it is better to have average cost pricing, i.e. to have the activity in question finance itself, rather than marginal-cost pricing with a public subsidy covering fixed costs. In the example, the firm has private information about the level of fixed costs, i.e. about the size of the subsidy it can claim under marginal-cost pricing. The supervisory authority has this information as well, but this authority is captured and tends to go along with the firm's demands unless it is under pressure from consumers. Average-cost pricing is a device to make consumers be interested in and to exert pressure with respect to the level of fixed costs that the supervisory authority certifies.

However, this model cannot be regarded as a basis for the development of a more general normative analysis. The analysis and its conclusion are highly dependent on the details of the specification of infor-

9 Fang and Norman (2005) argue that, in addition, the cross-subsidization scheme should encompass all private goods.

10 For the latter, see Baron and Myerson (1982), Laffont and Tirole (1993).

11 This insight is at least as old as the Ramsey-Boiteux theory itself. Indeed, Boiteux (1956) considered a single public enterprise subject to a stand-alone budget constraint precisely because he was aware of the incentive implications of a requirement of cost recovery for this enterprise, without any prospect for cross-subsidization from other parts of the public sector.

mation and of political interdependence. A general conceptual framework for studying the tradeoffs between negative incentive effects and positive Ramsey-Boiteux effects of subsidization and cross-subsidization schemes has not yet been developed.

Bierbrauer (2011) also obtains the conclusion that the imposition of a self-financing requirement may be desirable if a regulated firm with private information about costs produces and sells access to an excludable public good. The key assumption is that the relation between the policy maker and the regulated firm is incomplete, i.e., not fully contingent on all possible configurations of technologies and public goods preferences. While access to public funds certainly is in the firm's interest and, moreover, is conducive to achieving undistorted first-best outcomes, as opposed to distorted second-best outcomes, the consumers may prefer the imposition of a self-financing requirement for the firm because this limits the fraction of the surplus that the firm can extract and therefore leads to a higher level of consumer surplus. This analysis, however, involves a single excludable public good and as such is not suitable for studying cross-subsidization.

C.I.4.2 Ingredients of the Analysis: An Overview

It seems appropriate to start by looking at the problem in terms of standard incentive theory. Any one activity requires the effort of a manager as an input, this effort is unobservable, and must be called forth by appropriate incentives. Providing the activity with a separate budget, which is taken out of the general public budget, provides a basis for using profit as a basis for rewarding managerial effort. The incentive effects of subsidization and cross-subsidization schemes will then be similar to the incentive effects of a profit tax or subsidy, which are well known from the literature on moral hazard in insurance and in finance.[12] The problem would be to compare the efficiency losses associated with these incentive effects to the efficiency gains from the allocative effects considered in Ramsey-Boiteux theory.

However, there are a few difficulties that must be dealt with. Most importantly, the notion that *every* activity should self-finance is unrealistic. For some activities, self-financing seems impossible, for others, it is undesirable. An example where self-financing is impossible is provided by the railway system in Germany; most experts believe that this system is unable to finance the costs of the railway track network. An example where self-financing is undesirable is provided by the judicial system. Even though the services that the judicial system provides are, in principle, excludable, overriding social and political concerns in a democratic society militate against the use of user fees as a basis for financing this system.

Even in the private sector, private parties' limited ability to pay and limited liability cause problems for incentive provision based on profits. The impossibility of making the manager or entrepreneur participate in large losses tends to weaken incentives for effort and to induce excessive risk taking.[13] The treatment of insolvency therefore figures among the central issues in the theory of financial contracting.[14] Going beyond the discussion of incentive effects *ex ante*, this theory also focuses on the implications of insolvency for governance, e.g. the specification of intervention and control rights of the different claimants to the firm's assets. A major issue concerns the credibility – and the incentive effects – of contractual arrangements *ex ante* when these arrangements are subject to renegotiation, or to breach, *ex post*.

Credibility is likely to be even more difficult to establish when the activities in question serve the public interest. For a company or a person producing a purely private good, especially when in competition with others, insolvency poses a serious threat. New money is unlikely to be forthcoming unless the financiers can expect to recover the opportunity costs of their funds. For a company of person producing a public service,

12 E.g. Holmström (1982), Jensen and Meckling (1976).
13 Jensen and Meckling (1976), Stiglitz and Weiss (1981), Hellwig (2009).
14 Gale and Hellwig (1985), Aghion and Bolton (1992), Hart and Moore (1990, 1998)

the prospect of insolvency is less threatening, especially if there are no other companies or persons producing the same service. The public at large has some interest in having the provision of the service continued, and the politicians in charge do not want to be blamed for its being discontinued. This makes it likely that, even if, *ex ante*, a self-financing requirement was imposed, in the event of insolvency *ex post*, the public purse would be used to provide continued finance.

The research problem of studying tradeoffs between incentive effects and allocative (Ramsey-Boiteux) effects of subsidization and cross-subsidization in public production must therefore be widened so as to encompass the problem of how to establish the credibility of arrangements that are intended to limit the scope for subsidization and cross-subsidization of individual activities. The scope for subsidization and cross-subsidization in public production must not be regarded as a policy parameter, but must be treated as a consequence of institutions and contracts that govern subsidization procedures and that provide for greater or lesser credibility of budget constraints.

In pursuing these questions, we want to draw on the large literature on soft versus hard budget constraints,[15] as well as the literature on cross-subsidization in private corporations.[16] Combining ideas from financial contracting and governance theory, these literatures investigate how the "hardness" of a budget constraint affects behaviours in different settings with different specifications of information asymmetries, moral hazard, and control rights assignments. Cross-subsidizations arising from soft budget constraints are sometimes treated as desirable and sometimes as the unavoidable consequences of a lack of arrangements that would make *ex ante* commitments credible. Some indications of the different possibilities are given in the analyses that Schmidt und Schnitzer (1993) and Schmidt (1996) provided of the effects of hardening budget constraints by privatization. For private corporations, Inderst and Müller (2003) and Inderst and Laux (2006) have indicated some incentive and governance implications of intra-firm cross-subsidization through internal capital markets. The task will be to adapt and extend the insights from this research so as to provide a basis for the more general welfare theoretic analysis of incentives, governance, and allocative (Ramsey-Boiteux) effects that we are interested in.

C.I.4.3 Some Research Questions

Along the lines suggested above, the first task would be to study the tradeoff between incentive effects and allocative effects of cross-subsidization mechanisms in a model of incentive contracting. The question is how the consideration of allocative effects changes optimal incentive schemes, in particular, how the effects of different degrees of hardness of budget constraints on output prices are to be taken into account.

In a second step, the analysis should take in the problem of making budget constraints credible.[17] This must be treated as a problem of institutional design. The problem is likely to be most difficult for those activities where hard budget constraints are in principle problematic because (i) the community is dependent on these activities and (ii) these activities cannot or should not be self-financing in the market. Of particular interest will be quasi-market arrangements under which subsidies are not paid to producers directly, but subsidies are paid to users who can then use them to pay for the goods or services in question. Examples would be voucher schemes for subsidizing education or, in the case of Germany, the subsidies which the Länder use to pay in order to maintain railway traffic on certain lines, relying on competition among railway transportation companies to keep the costs down.

15 For a survey, see Kornai, Maskin, Roland (2003).
16 For a survey, see Hellwig, Laux, Müller (2002).
17 This problem concerns not just budget constraints for providers of public goods but also budget constraints for local and regional governments in a federal state or for national governments in a currency union. For a discussion in the context of the European Monetary Union, see Franz et al. (2010), Hellwig (2011c).

In this context, it will be necessary to extend the theory of hard versus soft budget constraints and of privatization. Apart from taking account of the impact that alternative arrangements have on output prices, it will be also important to consider the difficulties of contracting on matters of public interest. "Incomplete-contracts" theory gives many arguments for why the specification and subsequent enforcement of contractual obligations give rise to incentive problems of their own. These arguments apply to obligations concerning the public interest at least as much as to obligations concerning the delivery of goods of services to another private party. The theory would therefore suggest that control rights are needed as a substitute for effective contractual rules. But then, something like the privatization of a production activity involves a tradeoff between the hardening of budget constraints and the loss of control that are thereby induced. We should develop a framework for studying the determinants of this tradeoff.

An example of these issues was provided by the discussion about the privatization of Deutsche Bahn AG a few years ago. There seems to be a consensus that the network of railway tracks is not viable on its own, but needs a public subsidy of some 3 billion euro per year. Political discussion of privatization had focussed on whether the company should be privatized as a whole, including the network of railway tracks, or whether the privatization should be limited to the transportation companies, which, in principle, should be economically viable on their own, without direct public subsidies. Underlying this question is the conflict between different concerns about control rights assignments in a world in which contracts are incomplete. Deutsche Bahn AG prefers to retain the integrated structure of railway track and transportation in one company, in combination with a contract determining the Federal Government's yearly subsidies, as well as the track investments that are to be made. The alternative solution of having the railway track continue to be run by a public company, with contracts governing relations between the public railway track company and the privatized transportation company is rejected because the incompleteness of contracting is seen as an impediment to efficiency in relations between the public railway track company and the privatized transportation company. However, the very reasons for being sceptical about a reliance on contracts in relations between the railway track company and the transportation company are also reasons for being sceptical about a reliance on contracts between the Federal Government as a financier and the integrated railway company as a manager of the railway tracks.[18]

Underlying this conflict is the theoretically interesting question how one might balance conflicting concerns about control rights assignments when the vertical chain of relations involves more than two parties (here, the Federal Government, the railway track company, and the railway transportation company), and an overall vertical integration of all three parties is ruled out. What factors determine which control rights assignment is to be preferred? To what extent is it possible to use contractual arrangements in order to implement flexible control rights assignments that provide for a compromise between the two alternatives mentioned above? As a matter of pure contract theory, these questions are of interest and shall be pursued in their own right. In addition, it will be of interest to investigate how the treatment of conflicting control rights concerns affects the tradeoff between the incentive effects of hardening budget constraints and the disadvantages from control loss by privatization.

Apart from contractual arrangements, the analysis must also take account of the possibility of using sector-specific regulation in order to govern conduct so as to take account of the public interest even after privatization. In practice, sector-specific regulation is used to enforce the provision of network access to other companies so that they can compete in downstream markets. Sector-specific regulation is also used to implement *universal-service* regulations by which an industry is obliged to provide a certain minimum of services at uniform and low prices to everybody. However, the insights of contract theory concerning the limits of "complete contracting" for incentive provision apply to such regulation as well; the assignment of intervention rights to the regulator himself raises new questions about incentives and accountability.

18 Hellwig (2006).

In the wake of the financial crisis, plans for the privatization of Deutsch Bahn have been shelved, at least for a while. However, the conceptual questions raised have appeared anew in the context of the electricity industry and the plans for replacing nuclear energy by renewable energy, in particular wind energy. Whereas in the past, investment in long-distance electricity transmission grids played a minor role, relative to the costs of generation, the switch from a steady to a volatile source of electricity generation, with much larger distances between places of generation and places of use, has put grid investments, and funding needs for such investments, squarely on the agenda for economic policy. For earlier research on this kind of issue, see Höffler and Kranz (2011 a, 2011 b), Höffler and Wambach (2013).

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C.II The Behaviorally Informed Design of Institutions for the Provision of Collective Goods

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C.II.1 General Outline

C.II.1.1 Motivation

The bulk of our work is experimental. Yet, we deliberately keep the original mission statement: "The Behaviorally Informed Design of Institutions for the Provision of Collective Goods", since our area of interest has not changed. We also see no reason categorically to exclude other empirical methods, or theory, or doctrine, by the very definition of our task.

All research on collective goods asks one of the following three questions: is there a collective-goods problem in the first place? If so, is an existing or a proposed institution able to solve the problem, or at least to improve the situation? Finally, do the normatively appropriate problem definition and the normatively preferable institutional response stand a chance of being implemented?

It is natural to address all these three questions by way of rational-choice analysis. Collective-goods problems are then defined as pure public goods, club goods, or common pool resources. In each case, the analysis focuses on incentives and information, and on the way in which institutions shape incentives and channel the information which is required to address the collective-goods problem. Normative analysis deals with the optimal design of incentives, positive analysis with the actual incentives that are generated in a given institutional context. The mechanism design approach summarized above does the former kind of analysis, public choice theory the latter. Here the rational-choice paradigm helps us understand why the political process often fails to harness sovereign powers in the interest of changing incentives such that collective-goods problems disappear.

While evidently fruitful, the rational-choice perspective is also limited. This is due to the very same factor that has made the rational-choice model so visibly successful. The model rests on the strict distinction between objectives and constraints. The objects of study are utility-maximizing individuals reacting to changes in opportunity structures. For methodological reasons, the individual is modeled as Homo Oeconomicus. For sure, these are only assumptions, not claims about reality. They are imposed in order to capture the essence of social phenomena and institutions, and to make predictions for the effect of changing circumstances. However, the scope of this analysis is inherently limited.

An alternative research strategy, which starts with what is known about human behavior, is likely to develop a fairly different depiction of collective goods. Some phenomena that are made visible by behavioral analysis can hardly even be translated back into the world of rational choice. Our work focuses on this alternative approach.

The behavioral analysis of collective goods is not virgin territory. Suffice it to recall a few of the well-known findings: where (simple) rational-choice models would predict the "tragedy of the commons", in practice it is often conspicuously absent. There are various reasons for this, but the fact that they have a more realistic picture of human motivation is part of the explanation. "Public-goods games" are one of the workhorses of experimental economics. Again, contribution rates found in the laboratory by far exceed the prediction of zero contributions made by rational-choice models. If all beneficiaries of a public good agree on a contribution level, in rational-choice terms this is just "cheap talk". At the level of implementing the agreement, the original social dilemma is repeated. However, psychologists have traced a powerful cheater-detection mechanism, effectively exploiting subtle signals. It has bite, since punishing sentiments kick in when cheating seems patent. Emotions thus trump rationality and help solve the social dilemma. It is in this context that our work on the behavioral analysis of collective-goods problems is situated. We are adding new dimensions, exploring new fields of application, and translating the findings into institutional analysis and design.

Likewise, we are of course not the first to be interested in the behavioral analysis of institutions. Behavioral effects have never been fully absent from institutional analysis. An obvious illustration is "moral suasion". But the most prominent force in the area is the growing behavioral law and economics movement. It mainly piggybacks on the Kahneman/Tversky critique of the rational-choice approach. It either interprets legal institutions as remedies to individually or socially detrimental "biases". Or it criticizes the legal community for overlooking that biases prevent the law from being effective. Both have obvious value. Suffice it again to recall two well-known findings. It is much easier to get an appropriate understanding of consumer-protection legislation if one understands the psychological underpinnings of strategies like the "foot-in-the-door technique of salesmen". Environmental policy has long been tempted by torts as a tool for "ex-post regulation", in light of the experiences from concrete cases. This is, however, dubious advice, given the strong "hindsight bias". Once one has seen the evidence of a risk materializing, it is next to impossible to form a proper assessment of its ex-ante likelihood. Consequently, regulation by torts finds itself on a slippery slope towards ever stricter rules.

Some of our work is exactly in this tradition, where it seems helpful to assess the potential of institutions, and of the law in particular, in order to solve collective-goods problems. But in two ways we are going beyond this earlier work. We make a point of not exclusively looking at biases. Related to this, the Kahneman/Tversky literature and the experimental economics literature are not the only sources we are tapping. Rather, we try to purchase directly from psychology. And we are particularly interested in the law as a governance tool. We are convinced that, in a behavioral perspective, one is able to gain a much richer understanding of the law's potential. In these ways, we also hope to bridge the gap between (new) behavioral law and economics and (old) law and psychology. While there has for decades been direct interaction between lawyers and psychologists on issues like lie detection or eyewitness testimony, this strand of research has not thus far been very interested in the law as a governance tool.

Interdisciplinarity is never easy. However, in major US law schools, law and economics has almost become a standard approach. Behavioral law and economics is seen as one of the major strands of this approach, and is itself making headway. The situation in Germany is significantly different. Here, antitrust law notwithstanding, economic analysis is still rare, if not actively combated. The behavioral analysis of law is only just tentatively starting. Against this backdrop, it is inevitable that the widespread skepticism about a closer interaction between law and the social sciences be taken seriously. We are trying to respond at two levels. At one level, we are attempting to determine the proper role of input from the social sciences in both legal doctrine and legal science. At the other level, we are comparing alternative paradigms, starting with rational-choice and behavioral analysis, but not confining ourselves to these.

In earlier reports, we had to admit that the third fundamental question regarding collective goods would lend itself to behavioral analysis no less than the first two, but was largely beyond the scope of our attention. This has changed. A considerable strand of our work now addresses rule generation, from a behavioral, usually experimental angle.

C.II.1.2 Summary Report

Over the last three years, on all three overarching questions, the group has been very active. We have also continued to contribute to three obvious meta-questions: the relationship between law and (behavioral) social science, experimental methodology and data analysis. Given the findings are fairly rich and faceted, this summary report is confined to finished work, be it published or available as a working paper. For future directions, please see the portraits of individual researchers.

1. Problem Definition

Most of our work on defining social problems the law actually does or might want to address starts from game theory. We thus predominantly work in the paradigm of behavioral economics. We are of course aware of the inevitable limitations inherent in any paradigm, and inherent in this specific paradigm. Some of our contributions therefore directly purchase from psychology. We always carefully discuss external validity. Since the legal community has had less exposure to experiments in the tradition of experimental economics, in our papers – the ones that target legal outlets – a discussion of the status of the argument always features prominently. We make a point of the many facets of the real-world problem that triggered our research, facets that are not captured by the design of the experiment; yet, at the same time, we stress why causal inference should be critical for the proper interpretation of the law in force, and for legal policy.

That said, game theory nonetheless provides the most natural and the most appropriate way of organizing our findings. Given that the mission of the institute is deepening our knowledge of collective goods, this report starts with cooperation problems (a), including markets (where non-cooperation of suppliers would be socially desirable) (b). We then turn to bargaining (c) and (intellectual) property (d) as two major institutions for enabling decentral coordination in markets. While principal-agent relationships are not confined to the interior of the firm, this is the most prominent and the best study application (e). We have begun to work on a different class of games where the problem is coordination, not cooperation (f). Further contributions are in the tradition of the heuristics and biases paradigm, and address non-interactive choice (g). There are also a number of contributions to general behavioral theory (h), and to the translation of these findings into legal doctrine (i).

a) Cooperation

In its most basic form, a cooperation problem is characterized by a difference between individual and social rationality. The individual is best off if she pursues her own goals, knowing or at least taking into account that others suffer, or do not benefit to the ideally possible extent. If one assumes "standard preferences", game theory predicts that the social optimum is not reached. This analysis provides a natural justification for legal intervention. The sovereign state has the power to overrule individual selfishness. Sovereignty is the technology to avoid the trap of the social dilemma.

Many of our contributions have revolved around testing and refining the behavioral assumptions underlying this prediction. Are individuals indeed as selfish as predicted by standard theory? The natural tool for exploring this question is the dictator game (aa). Are individuals even willing to forego a higher income for themselves if this means tolerating exploitation? The natural tool for exploring this question is the ultimatum game (bb). Do groups find a way to coordinate on an outcome closer to the social optimum, even if each member could exploit the willingness of others to cooperate? The natural tool for exploring this question is the prisoner's dilemma, possibly specified as a linear public good (cc).

aa) Dictator Games

As one of the founding fathers of the empirical legal movement once put it, the legislator should not believe individual empirical papers, but it should believe entire empirical literatures. Therefore summarizing an experimental literature is not only interesting in its own right. It has also value for the legal consumers of that evidence. In that spirit, the meta-study by Engel (2011b) demonstrates how rare it is for entire experimental populations to disregard completely the distributional imbalance characteristic for the standard dictator game. While this is a very robust finding, the amount given is also highly sensitive to subtle manip-

ulations of the design and, even more importantly for policymakers, there is pronounced heterogeneity. If the legal order does not intervene, some help for the needy is to be expected, but there will be a pronounced amount of free-riding.

Chmura, Engel et al. (2013) use this meta-study to provide them with a benchmark against which they cast new light on one of the definitional questions of criminology. While much of that discipline is interested in explaining crime, from a rational choice perspective the opposite question is more challenging. Why is there not more crime, given that the expected value of the sanction is very often below the expected benefit from crime? One reason might be a prominent explanation for giving in dictator games: aversion against advantageous inequity. If that was true, prison inmates should give significantly less in the dictator game. For the theory treats inequity aversion as a personality trait that is stable across situations. Yet, the prediction is clearly refuted. Prison inmates give almost exactly as much as the general population. A further meta-study organizes the evidence on a competing explanation of crime, a lack of self-control (Engel 2012a).

In the typical design of the dictator game, the dictator's endowment is manna from heaven. If dictators have to earn their endowment in a real-effort task, they give considerably less. Nisvan, Gangadharan et al. (2011) refine this finding. In the first stage of their experiment, participants compete in a tournament that defines their earnings. If the winner is chosen to be the dictator, she gives considerably less than if this role is assigned to the second in line.

In a natural field experiment, Aretz and Kube (2013) show that a plausible other determinant does not influence how much individuals give: if they are given a choice between multiple recipients, they do not give more.

Two papers by psychologists unpack the underlying mental process. Dickert, Sagara et al. (2011) show that individuals actually take two decisions: whether to give anything and, if so, how much. While the former decision is influenced by mood management, for the latter decision empathy is critical. Dickert, Kleber et al. (2011) investigate in which ways the presentation of numerical information about the needs of potential recipients influences the amount given.

bb) Ultimatum Game

The standard ultimatum game pairs one proposer with one responder. Two papers investigate in which ways standard results change if this two-person interaction is put into a social context. Fischer and Güth (2012) pair one proposer with two responders. The proposer is free to exclude one responder from the game, which leaves this player with a minimum income. The pie to be distributed among the remaining two players increases. They find no signs of indirect reciprocity. The remaining responder does not increase her acceptance threshold if the other responder has been excluded intentionally, compared to a baseline where exclusion was at random. McDonald, Nikiforakis et al. (2013) have participants compete in a real-effort task for the role of proposer. The remaining participants are randomly assigned the role of responder, or they receive a fixed payment and remain passive. Responders ignore the outsider if she is poor, but raise their acceptance threshold if the fixed payment to the outsider is high (also see Nicklisch and Wolff 2012).

cc) Prisoner's Dilemma

In line with the mission of the institute, a considerable amount of our work directly tests social dilemmas. Glöckner, Irlenbusch et al. (2011) introduce heterogeneity into a linear public good. One group member is

privileged by the fact that her contributions yield a higher return for themselves and all other group members. They compare a setting where contributing the entire endowment is a dominant strategy for the privileged player with another setting where the dominant strategy remains to contribute nothing. In the former setting, privileged players contribute significantly more, but non-privileged players contribute significantly less. The authors interpret their result as saying that leadership requires sacrifice.

Engel and Zhurakhovska (2012a) add a passive third player to a symmetric two-person prisoner's dilemma with discrete action space. Using the strategy method, they manipulate the degree by which making a cooperative move inflicts harm on the passive outsider. However severe the harm, active players do not become less willing to cooperate. They do, however, become more pessimistic about the willingness of their anonymous counterpart to cooperate. Conditional on their more pessimistic beliefs, they are more willing to cooperate if this is to the detriment of the outsider. Harm on third parties serves as a lubricant for cooperation (see also Ding (2012) on another context effect).

One of the deepest puzzles of the social sciences is the emergence of cooperation, in particular in large-scale societies. How can it be that there is so much non-selfishness, even in the absence of powerful institutions who discipline free-riders? Fischer, Frid et al. (2013) propose a novel explanation. When deciding how to behave, agents engage in "mimicry". The critical component of the strategy is a similarity index. If the other player in question has been observed or is expected to act such that my cooperation promises to be more profitable than my defection, I cooperate myself; I defect otherwise. The authors use simulation to demonstrate how well this strategy performs, and that it outperforms all alternative strategies over time, in particular in environments where initially hostile and unpredictable agents are frequent (on a related topic, see also Traxler and Spichtig 2011).

Several papers cast light on decision-making in dilemma situations. Previous attempts in the literature at explaining choices in dilemma games with personality measures have been rather frustrating. It has even been claimed that, given that there seems to be so little consistency of behavior across games, that prominent motivational models are not helpful. Engel and Zhurakhovska (2012b) show this skeptical stance to be premature. Provided one controls for beliefs, it can be shown that a prisoner's dilemma is a game of multiple motives. Possible gains from co-operation matter, as do risk and loss aversion, and the degree of greed.

Glöckner and Hilbig (2012) demonstrate another moderating variable. While risk aversion predicts defection in a hostile environment, it predicts cooperation in a cooperation-friendly environment. Now, the risk participants dread is missing gains from cooperation.

Using eye-tracking, Fiedler, Glöckner et al. (2013) show that differences in social value orientation are associated with characteristic differences in information search. The more participants are concerned with the well-being of others, the more intensely they search for information (see also Fiedler, Glöckner et al. 2012).

Deck and Nikiforakis (2012) modify the standard design of a public good and implement a minimum-effort game. While effort is costly, payoff only depends on the lowest effort in the group of six. This, of course, transforms the public good into a coordination game with multiple equilibria. They manipulate the information set. While in the baseline participants have no information about provisional choices of other group members, in the first treatment they see a sample, and in the second treatment they see all provisional choices. In the second design, participants almost perfectly coordinate on the payoff-dominant equilibrium, while seeing a sample does not make coordination on this equilibrium more likely than in the baseline.

b) Markets

It is straightforward to model the relationship between competitors as a prisoner's dilemma. Collectively, they are best off if they collude. This gives them a share of the monopoly profit. Yet, individually, all are best off if the remaining competitors are faithful cartelists, while the firm in question undercuts price or, for that matter, exceeds its quota. Now there is a rich experimental literature on prisoner's dilemma games, and an equally rich experimental literature on collusion. Engel and Zhurakhovska (2011) run an experiment to bridge the gap between both literatures. Arguably, the difference is social embeddedness. Collusion is socially undesirable and exposes firms to a risk of legal sanctions. Moreover, collusion inflicts harm on the opposite market site. The experiment crosses both qualifications. The risk of sanctions has the expected dampening effect, even if the sanction is not a deterrent. By contrast, the degree of harm is immaterial and, conditional on beliefs, even fosters collusion. Since the latter finding seems most important, and has ramifications unrelated to collusion, the current version of the paper focuses on this aspect. A small theoretical contribution shows that mapping collusion to a linear public good is also technically feasible, but requires more challenging definitions of the payoff function (Engel 2011a).

While the experimental literature on oligopoly is rich, it has almost exclusively been written by economists. Institutional detail is not routinely taken into account by this literature. This gives room for fertile cooperation between antitrust lawyers and economists. One application is a graphic term from merger control. On both sides of the Atlantic, antitrust authorities are concerned if a merger has the effect that a particularly aggressive firm leaves the market. Aggressiveness may, of course, have many sources. Yet, one plausible source is behavioral. Some individuals are just particularly competitive. Such individuals are not unlikely to select themselves into sales or higher management. They may help create a culture of competitiveness in their firms. Engel and Ockenfels (2013) exploit a well-worn tool from social psychology, the ring measure of social value orientation, to pre-classify participants by their individual degree of competitiveness. They have rivalistic participants enter a symmetric Cournot duopoly. After 10 periods, either duopolist may negotiate with the entrant over market exit. Rivalistic entrants do make markets more competitive, compared with benchmark markets where entrants just maximize profit or are socially minded. Yet, the effect is only present when, pre-entry, the market was collusive. This is, of course, also the situation when antitrust policy finds mavericks most desirable. The authors observe no buyouts, though, most likely because the one firm that orchestrates the merger gives her remaining competitor a free lunch.

Several contributions directly speak to the legal audience, based on behavioral insights. In his monograph, Morell (2011) does so for the abuse of a dominant position, with a special eye to the normative assessment of rollback rebates. Upon the invitation of GD-COMP, Engel (2011e) summarizes the experimental insights that are relevant for the treatment of research and development agreements. Relying on his meta-study of oligopoly experiments, Engel (2011c) sketches the insights to be gained from experiments for antitrust law more generally.

c) Bargaining

Money is a powerful facilitator. Money makes everything comparable and therefore tradable. Yet, even in markets, this assumption is sometimes too strong. The well-established firm does not want to sell the premises in the city center, since this is where the firm was once founded. But if this same firm was offered to become the leading partner in a joint venture, this firm may want to reconsider letting another partner use the precious piece of land. This is one illustration of the problems Hortala-Vallve, Llorente-Saguer et al. (2013) are interested in. They experimentally compare two negotiation protocols. The first one is free bargaining. In the alternative protocol, each negotiator assigns points that express the comparative valuation of each of the negotiated issues; of course, this introduces the functional equivalent of a currency. They

find that unconstrained negotiations do better if preferences are common knowledge, whereas the point allotment mechanism does better if there is preference uncertainty.

d) Intellectual Property

In the debate over intellectual property, the starting point is frequently the claim that knowledge is a pure public good. Once a new technology has been invented, there is neither rivalry in consumption (as long as one brackets the possibility of a monopoly profit from being ahead of others, the invention does not become less valuable if it is used by others), nor is there exclusion (intellectual property legislation notwithstanding, everybody can appropriate the new idea). This starting point has often been criticized as being overly simplistic. Engel and Kleine (2013) test one of the criticisms in the lab. Out there in the field, appropriating a foreign innovation is usually an investment decision on its own. Appropriation is at least costly, and usually also risky. They translate this into a game where two competitors may invest an endowment in either risky innovation or risky appropriation. Unlike the impression frequently conveyed in the policy debate, the prospect of appropriation does not deter innovation. Participants split their endowments into either purpose in the qualitative way suggested by standard theory. Actually they invest even considerably more into innovation than predicted. If there is a policy problem, it results from too much investment into either purpose, in particular if appropriation has low risk (see also the theory paper by Engel 2011f).

Privacy is not routinely regarded as a public good. Yet, with the advent of social networks like Facebook, this is an appropriate model. Social networks do not hide their business model. They provide their services for free, but on the condition that they may use the information customers introduce into the network as they, the social networks, deem fit. The most important use is pattern recognition. The more data the network has collected, the better it is able to predict future choices based on less and less information. Actually this information about cues need not even have been given to the network by the person affected. If I know three of your friends, this may be enough to predict how you will react to a stimulus. The resulting public-good nature of social networks has not only largely escaped public attention. It additionally has an important twist. The ability of the network to inflict harm on its official users, and even on non-users, is not developing linearly in time. For quite some time, a lot of information in the hands of the network may still be quite harmless. But at some point, the information becomes good enough to be used. It is this feature of the policy problem that Engel and Fairfield (2013) model and test experimentally. While holding the expected value constant, they manipulate the factor by which contributions to a linear public good made in an earlier round lose their negative impact on today's profit. If this effect is backloaded, participants contribute significantly more to a public bad, and make significantly less profit (for an application to German criminal procedure, see Englerth and Hermstrüwer (forthcoming)).

e) Principal Agent

A considerable strand of our work is concerned with the determinants of behavior in principal-agent relationships. Kube, Puppe et al. (2012) investigate in a field experiment in which ways giving employees a bonus increases performance. The effect turns out substantially stronger if the bonus comes as a nicely wrapped gift, compared with its money equivalent. The effect is no longer distinguishable, and equally strong, if cash is also wrapped as a gift.

Using the same natural setting of a university library, Kube, Puppe et al. (2013) demonstrate that wage cuts have a sizeable negative effect on performance.

For another field experiment, Goerg and Kube (2012) exploit the fact that our library underwent labor-intense reorganization. They invite student helpers and compare a piece rate with several bonus schemes. If the bonus is paid for a goal chosen by the employee herself, this has a strong positive effect. Yet, the effect is equally strong if the goal is chosen by the employer (provided the goal is sensible) and, most interestingly, if workers are just induced to set a goal, without receiving an extra bonus (for a further contribution to this line of research, see Goerg, Abeler et al. (2011)).

Several papers deal with the legal framework of relations within a firm. Bünstorf, Engel et al. (2013) experimentally test the effects of a non-compete clause on workers' effort. If participants hold standard preferences, the fact that the worker cannot leave the firm and competes with her former employer upon making an innovation, or increasing the customer base for that matter, should reduce effort, provided the compensation paid when exercising the clause is not very high. In the lab, this prediction is rejected. Effort is not significantly lower, even if compensation leaves most of gains from innovation with the employer. In such a setting, employers motivate employees by paying substantial wages upfront.

Many legal orders aim at inducing firms not to serve the monetary interests of their shareholders exclusively, but to take the effects of their action on multiple stakeholders into account. However, stakeholders other than the workforce do not usually have a formal say on corporate decision-making. Legal orders content themselves with admonishing firms to take the effects on the broader social context into account. In a lab experiment, this manipulation fails to be effective. Actually it even is counter-productive (Fischer, Goerg et al. 2013). See also Hamann (2012), discussing deliberate choice vs. intuitive decision-making at the board; Han and Jekel (2011), investigating the role of job satisfaction in the interaction between leaders and members of teams; Himmler, Cornelissen et al. (2011), using field data to see the repercussions of perceived unfairness in CEO compensation on worker effort; and Weinschenk (2011), modeling procrastination in a team.

f) Coordination and Anti-coordination

While many social problems arguably result from a dilemma, coordination problems are not infrequent either. Fehr, Heinemann et al. (2011) study the power of arbitrary, minimal interventions, which in the game-theoretic literature are called sunspots, as coordination devices. They not only show that public signals serve that purpose. Even salient private signals may shift the equilibrium away from risk dominance.

Building on earlier work published in the American Economic Review, Selten, Chmura et al. (2011) deepen the analysis of their data and Chmura, Goerg et al. (2012) study experimentally in which ways choices and thereby equilibria change over time in a set of repeated games where the Nash equilibrium of the stage game requires mixing. It turns out that two competing learning models explain different aspects of the data: impulse-matching learning, and self-tuned, experience-weighted attraction learning.

The game studied by Hortala-Vallve and Llorente-Saguer (2012) may be seen as an anti-coordination game. The game goes by a martial name: Colonel Blotto game. In the cover story, two colonels, fighting for different countries, decide how many troops to deploy in one of several battlefields. A battlefield is won by the colonel who has sent more troops. The war is won by the colonel who has won in more battlefields. The intuitive solution is an equilibrium in mixed strategies. The theory paper characterizes the conditions for equilibria in pure strategies and characterizes the set of games in which such equilibria exist (see also the ambiguous act equilibria developed by Bade 2011a).

g) Biases

While most of our experimental work is in the tradition of experimental economics, there are also a few contributions in the heuristics and biases tradition that originated in social and cognitive psychology. This programme focuses on potential defects of isolated individual choices, not on socially undesirable outcomes of interactive choices.

Towfigh and Glöckner (2011) address a hotly debated issue of German (legal) policy. In Germany, the *länder* hold a monopoly on betting. Critics assert that this is just a way for prime ministers to have a considerable amount of money at their personal disposal, rather than having to subject it to parliamentary control. Yet, the official justification of the monopoly is the purported danger of gaming for bettors. Critics say that the fact that sports betting is not part of the monopoly is just a historical accident. In official statements, however, the difference is justified with the smaller personal risk inherent in "games of skill", compared to "games of chance". In a field experiment, the authors show that the opposite holds true. In games of skill, over-optimism and the illusion of control make bettors seek even more risk.

Using a huge set of data from a Chinese online lottery, Ding (2011) demonstrates a whole panoply of biases: there is evidence for the gambler's fallacy, for hot-hand fallacy, and an inclination to choose culturally contingent prominent numbers.

Grechenig and Roberto (2011) discuss the importance of hindsight bias for the definition and application of negligent behavior in torts and contract.

h) General Behavioral Theory

We benefit from contributions to general behavior of theory made in other parts of the institute. Psychologists investigate in which way the personality trait of victim sensitivity influences the ability to detect cooperativeness, and show that both are negatively correlated (Gollwitzer, Rothmund et al.). Glöckner and Pachur (2012) demonstrate that cumulative prospect theory is able to predict risky choices over time, and that the predictive intertemporal power of the theory is increased if one fits parameters per individual rather than per sample. Fiedler and Glöckner (2012) use a whole set of measures, mostly from eye-tracking, to develop a process model for risky choice. Von Weizsäcker (2011) develops a behavioral model for past choices changing future preferences, and defines the conditions under which welfare statements can nonetheless be made.

i) Translation into Legal Doctrine

Translating the relevance of our findings on problem definition for legal doctrine has not been our focus. Yet, Engel (2013a) uses his dataset with all publicly available decisions of the German Constitutional Court promulgated in 2011 to show empirically that the court is substantially ahead of the academic literature when it comes to deciding which purposes justify intrusions into fundamental freedoms. While the court does not use technical language, concepts developed in the social sciences find their way into law through this channel.

2. Institutional Intervention

In economic parlance, the law shapes the opportunity structure for private action and interaction. Even if this is done with the intention to facilitate the exercise of free will and the decentral coordination among

private parties, in a way the law defines the institutional framework for private activity, and it excludes courses of action that do not fit this framework. In that sense, any legal rule intervenes into freedom or property; much law is openly interventionist. This explains why the second strand of our work addresses the behavioral effects of intervention, be that minimal intervention (a), sanctions (b), post-hoc intervention into contractual relations (c), or formal legal intervention (d).

a) Triggering Social Preferences

Many of us have been interested in social preferences making minimal intervention practical. Engel and Kurschilgen (2013) show that it suffices to ask participants in a linear public good in every period whether they believe a social norm exists and, if so, which minimum contribution is required. These two questions are strong enough almost to stabilize cooperation. Framing these questions as statements about the emergence of a rule of customary law does not increase cooperation. Cooperation and normative expectations can be shown to co-evolve (see also Engel (2011d) on the relevance for the conceptualisation of customary law; further, see Petersen (2011) on the importance of uncertainty in the formation of customary law).

Engel, Beckenkamp et al. (2014) comparatively assess two recommendations derived from a prominent approach in criminal policy, the broken windows theory. The approach has been explicitly used in cities like New York and Los Angeles to curb crime, and concomitant with the intervention the crime rate has indeed been strongly reduced. In the policy debate, the approach has often been equated with "zero tolerance policies". If that was the core of the matter, the critical component would have to be early intervention. If society spots the first signs of even minor social disorder, it should immediately step in and go after the perpetrators. Using a rich set of data from public-goods experiments run all over the world, we demonstrate that there is indeed a small effect of early vigilance, but it is not lasting. By contrast, there is a much stronger effect from first impressions. What participants experience in the first round of interaction explains their behavior throughout the entire game. This suggests that criminal policy should focus on impression management, rather than deterrence.

In a follow-up paper, Engel, Kube et al. (2011) manipulate, rather than measure, first impressions. Exploiting the fact that there are pronounced differences between the general willingness to cooperate in a public good across locations, they give negative information to participants in a context where co-operation is generally high, and they give positive information to participants in a context where co-operation is generally low. Negative information has a strong effect, whereas the effect of positive information is much weaker. That asymmetry, too, is important news for criminal policy. It is much more difficult to put a community back on a good track once social order is on the decay. By contrast, if first impressions are poor, this is very likely even to affect individuals who, in principle, would have been willing to live up to more demanding social standards.

Cornelißen, Himmler et al. (2013) complement the findings from the lab with evidence from the field. If individuals gain the impression that society is not applying fair standards, this can spill over to other, unrelated areas of life. Specifically if, in a country, the rich are perceived to pay too little in taxes, this engenders a considerably higher degree of absenteeism at the workplace.

A final experiment is related, although it really is only a preparatory step towards the legal research question that has triggered the endeavor. Arguably, many legal rules do not achieve their stated purpose because their addressees ad hoc compare the benefit from violating the rule with the expected cost from legal intervention. Rather, the legal rule shapes how addressees construe the issue, and it leads to the adoption of behavioral routines. While automization in principle enhances the governance effect of legal intervention, it potentially has a downside. Once addressees have established their routines, it may be very

difficult for the law to change them, even if the old rule is no longer functional. Our experiment tests how difficult it is to overcome a routine, and in which ways the presence of significant others (arguably other individuals the law effectively alerts to the rule change) helps. Being paired with a role model indeed helps participants realize that the world has changed (Betsch, Lindow et al. 2011).

b) Punishment

The quintessential technique to curb socially undesired behavior is punishment. One of the surprises of the literature in experimental economics has been the willingness of experimental subjects to engage in costly punishment, although this means contributing to a second-order public good. Balafoutas and Nikiforakis (2012) test, in a field experiment, whether this is just an artifact of the experimental setting. They study violations of two well-known social norms by passengers in a large Athens subway station. This provides them with an almost completely anonymous, one-shot interaction. They find punishment, but it is confined to a minority.

Traxler and Winter (2012) use survey evidence to demonstrate that individuals' willingness to punish violations of legal obligations like tax evasion or fare-dodging by disapproval or social exclusion depends on the perceived prevalence of the violation; the more a violation is common, the less the willingness is to engage in costly social punishment.

Engel and Zhurakhovska (2013b) rely on punishment in a linear public good to cast new light on an old puzzle in the legal literature. All over the world, judges receive a fixed salary. There are indirect incentives like career concerns or the prospect of re-election. But incentives could at best partly explain why judges overall seem to do a reliable job. The authors isolate an alternative motive by adding an additional player to the game. This player does not benefit from the public good. She receives a flat fee plus an additional endowment she may use for punishing active players. Most of these additional players neither keep their endowments for themselves nor use them in a spiteful manner. Rather they discipline the groups they happen to be assigned to. Being in charge suffices to motivate them.

In the field, the threat of sanctions is frequently imperfect. Arguably, the likely sanction, multiplied by the probability of its enforcement, is often below the benefit from breaking the legal rule. If addressees were to maximize profit, the sanction should be devoid of effect. This is not the impression one gains in legal practice. Individuals seem to care, even if the sanction does not deter. A public-goods experiment allows us to isolate one explanation. Individuals might be weakly averse against exploiting others. The degree of this aversion would not be strong enough to constrain the selfish motives inherent in a social dilemma. Yet, a small sanction may tilt the balance in favor of cooperation. Classifying participants by their individual degree of social value orientation, this is indeed what Engel (2013c) finds.

Glöckner, Kube et al. (2011) give participants two options for punishment: punishment that becomes immediately notified to the addressee, and punishment of which feedback is withheld until the end of the game. This combination is a much more effective deterrent than either form of punishment in isolation (see also Hilbig, Zettler et al. (2012): on the moderating role played by dispositional honesty/humility).

In the literature on social dilemmas, punishment is usually presented as a solution. If only those exposed to the dilemma are given the opportunity to sanction each other, even if sanctions are costly, this gives them a technology to discipline free-riders. Yet, punishment potentially has a dark side (which, of course, is a prominent justification for the state's monopoly of force). Those who have been punished may retaliate, which may trigger a feud. Nikiforakis, Noussair et al. (2012) demonstrate that the risk of feuds is much more pronounced if there is room for normative conflict. Specifically, they create conflict by offering two equally convincing fairness norms, equality and desert.

While feuds have the potential to be disastrous, experimental participants are not blind to this risk. If the design of the experiment makes it possible for the feud to destroy more and more resources, participants are less rather than more likely to let this happen (Nikiforakis and Engelmann (2011)). Nicklisch and Wolf (2011) do not find a pronounced negative effect of counter-punishment either.

Fischer, Grechenig et al. (2013) find another limitation of punishment. The limitation does not depend on whether punishment is by other group members or by an authority. While punishment stabilizes contributions if the punisher is perfectly informed about the recipient's choices, punishment loses its beneficial effect if the information about the recipient's contributions to the public good is noisy.

Legal orders do not exclusively rely on criminal law for disciplining those who violate legitimate normative expectations. Frequently the law either exclusively or additionally gives those who suffer from norm violations the right to claim damages. In the law and economics literature, damages are routinely given a forward-looking interpretation. They are equated with fines. If that interpretation was correct, the right to claim damages should have the same disciplining effect as punishment. Eisenberg and Engel (2012) test this hypothesis in a linear public good. They find that compensation indeed has a disciplining effect, but it is confined to the slope of contributions. If the expected value of compensation is sufficiently high, contributions (almost) stabilize. Giving participants the choice between punishment and compensation does not change results. This speaks against recipients caring about intentions. They are no less disciplined if they know that the punisher has been selfish (see also Grechenig, Baumann et al. (2011): on the deterrent effect of incomplete strict liability).

Kube and Traxler (2011) study the interaction of central and decentral sanctions. In a linear public good, participants are given the possibility to punish each other. In the treatment, participants are additionally exposed to a small risk of an automatic fine for any contribution less than the complete endowment. When participants decide about punishment, they do not know whether the recipient will also be fined. This reduces decentral punishment. Nonetheless, the welfare balance from introducing the second sanction is positive.

In the criminology literature, it is taken for granted that the certainty of punishment is more important than its severity. One explanation of the effect goes back to Gary S. Becker. He has shown that, in equilibrium, only risk-seeking individuals commit crimes. Risk-seeking implies that an increase in certainty is a stronger deterrent. Engel and Nagin (2013) implement a stealing game to test the hypothesis. It is only supported if the expected value of stealing is negative, i.e., if the sanction would deter a profit-maximizing individual. If the expected value of stealing is positive or if it is zero, i.e., if a profit-maximizing agent is indifferent between stealing and refraining from it, even risk-seeking participants exhibit a stronger reaction to an increase in severity.

Corruption is a vexing evil of modern societies. While legal orders all over the world make it a crime, they differ in one respect: some legal orders target the briber and the official with equally severe sanctions; other legal orders treat the briber more mildly. Engel, Goerg et al. (2012) demonstrate that asymmetric punishment is a bad idea. Punishing sentiments give bribers a psychologically credible threat if the recipient takes the bribe, but does not return the favor she was asked for. The asymmetry thus gives the briber a technology to enforce the corrupt deal.

c) Post Hoc Intervention

Not so rarely, the law post hoc changes the outcomes of relations individuals have created voluntarily. We have experimentally studied two such instances. The German statute on copyright gives authors the right to ask for an additional license fee if the work turns out a blockbuster. We show that this provision not only

assuages the hurt feelings of individuals who find out they have sold a jewel for a trifle. Actually the rule is even efficient. More goods trade at a lower price. The rule implements the functional equivalent of a success-contingent contract. It does so despite the fact that our experimental authorities were almost exclusively guided by ex post equality, and disregarded the fact that the original fee insured the author against the risk of project failure (Engel and Kurschilgen 2011).

The second experiment addresses straightforward redistribution. Arguably, effort and redistribution are negatively correlated. The more income is redistributed, the lower the incentive to engage in productive effort. And the higher the effort, the smaller the support for redistribution. Using data from the World Value Survey, we find the former relationship, but not the latter. In the lab, we again find that redistribution reduces effort, but now we even find a positive willingness of those engaging in high effort to support redistribution (Buch and Engel 2012).

d) Formal Legal Intervention

In the law and economics literature, legal intervention is normally modeled as a change in the opportunity structure. The law changes the game, be that by changing payoffs, or by changing the structure of the game. This is often an elucidating perspective. But this view neglects many subtleties of the law in action. One strand of our work explicitly addresses these additional features.

In the law and economics literature, the situation into which the law intervenes is usually modeled as a well-defined problem. In the courtroom, this is frequently not a plausible assumption. The very essence of the conflict the court is asked to decide upon is imperfect knowledge. All agree that the problem to be solved is not well defined. There tends to be room for improvement, but even at the end of the legal procedure, the uncertainty is normally only reduced, but not completely removed. Essentially, court cases are ambiguous.

Relying on the parallel constraint satisfaction model that is at the core of the work of the independent research group in psychology, we study two implications of this ambiguity. Intuition serves an important function. It enables individuals to make choices even if they know they have only partly understood the issue. This might hold a piece of troubling news for the law. Intuition might be so powerful that it overrides standard-of-proof instructions. Intuitive jury members would override the distinction between preponderance of the evidence and beyond-reasonable-doubt instructions. Happily, this hypothesis turns out to be wrong. Apparently, the intuitive process of story construction can be fine-tuned by explicit intervention (Glöckner and Engel (2013)).

In a second respect, the news for the law is less benign. The adversarial system critically relies on the expectation that ritualized conflict is the best way of approximating truth. A classic illustration is criminal procedure. Using the same, deliberately ambiguous case as in the previous study, we randomly assign the roles of prosecutor and defense counsel. We have participants sketch pleadings. The task, however, is not to convince the jury, but to predict the decision of a neutral court; in criminal procedure, this is particularly relevant when deciding about a plea bargain. Despite the fact that we give a strong financial incentive for accuracy, random assignment of the role creates pronounced bias (Engel and Glöckner (2013)).

Intuitively, most lawyers would think that training and experience matter. But can the effect actually be shown, and how strong is it? Dickert, Herbig et al. (2012) test experienced lay judges, law students, and controls on a series of difficult criminal law cases that all center around the question whether action was premeditated. Law students are significantly and strongly more likely than the other two groups to decide the same way as the German Supreme Court. They are also least likely to show an emotional reaction, in

particular when the information they receive about the case is rich (see also the overview on legal expertise and intuition by Glöckner and Ebert (2011)).

In most procedures, courts and other legal authorities do not just decide. They also have to justify their decisions. Engel and Zhurakhovska (2013a) implement a linear public good with an additional player in the role of authority to test the power of justification. In the baseline, the reasons given only go to the experimenter. Active group members know that authorities have to justify themselves, but they do not learn what authorities say. In a first treatment, reasons are only communicated to the recipient of punishment. In a second treatment, all group members learn all reasons. Authorities reduce monetary punishment whenever reasons are communicated to addressees. Yet, reasons actually do only serve as substitutes if they are made public.

The right to be heard is a fundamental feature of the rule of law. Kleine, Langenbach et al. (2013) use a lab experiment to measure how much individuals care. In the first part of the experiment, two participants are given a real-effort task with asymmetric workload and piece rate. That way the authors induce a conflict between fairness norms. An impartial third participant decides upon the distribution of profit between the two active participants. In the treatment, active participants may send the authority a message about the distribution they deem fair. The actual measure is an unannounced dictator game where active participants may share a fraction of a new endowment with the authority. If they had voice, they would share almost twice as much, even if the decision of the authority were not in their favor.

In the old days, the roles of prosecutor and judge were not separated. It has been a major advancement in the rule of law to make judges impartial. The price was the openly one-sided role of prosecution. Now prosecutors are frequently suspected of using whatever ploy they can to get the defendant convicted. Engel and Pluta (2011) model the situation as a sequential game and test it in the lab. If, but only if they frame the situation as criminal procedure, the willingness to exploit an ambiguous rule to tilt the odds in favor of conviction is significantly and substantially reduced. At least in the lab, prosecutors are not the people's hired guns (do also see van Aaken, Feld et al. (2010): on prosecutor independence as a safeguard against corruption).

Sometimes the institute is the locus of friendly, but lively academic debate. The law of evidence is an instance. Mark Schweizer has joined the institute with a stipend from the Swiss National Science Foundation to finish his habilitation on the law of evidence. In his book, he forcefully argues in favor of a Bayesian approach to the assessment of disputed and incomplete evidence. Engel (2012b) invokes a series of largely undisputed solutions to standard legal cases to argue that, quite often, the legal order deliberately neglects the base rate. Schweizer (2012) counters that, if he forces triers to assess the probative value of each individual piece of evidence separately, and if he uses Bayesian network analysis to aggregate these assessments into an overall assessment of guilt, the bias in the assessment of the evidence resulting from being coherent with one's own decision largely disappears. (This is, however, not how trials are organized, and as a practical matter it seems hard to imagine how they could be reorganized along those lines). The debate between the two approaches is likely to remain lively.

3. Institutional Design

Over the last years, we have become more active in the area of institutional design than before. Casella, Llorente-Saguer et al. (2012) model a proposal that keeps being made. If a committee decides by vote, votes tend to be non-transferable. In particular, it tends to be forbidden to trade votes against other goods, be that money or favors. From a normative perspective, the ban on trading votes is not obvious. If the valuations for the outcome of the vote are heterogeneous, arguably trade improves welfare, in that those with low valuation for the issue may get something in recompense for letting those with high valuation have

their will. In theory, this intuition only tends to get it right under special circumstances. If agents hold standard preferences, in equilibrium a single agent always becomes a dictator. If the committee is not small, this reduces welfare, since the probability of being pivotal is larger than the probability of being dictator. The authors test the predictions of the model in the lab. There is less dictatorship than predicted. Choices and thereby outcomes are influenced by the fact that the majority of participants is risk-averse. Yet, with these qualifications, the model is supported (see also Bade (2011b): on electoral competition if parties are averse against uncertainty).

Bouton, Castanheira et al. (2012) study both theoretically and experimentally the properties of plurality and approval voting. They consider a case in which the majority is divided between two alternatives as a result of information imperfections, and the minority backs a third alternative which the majority views as strictly inferior. The majority thus faces two problems: aggregating information and coordinating to defeat the minority candidate. They show that, under plurality, voters may have to concentrate all their strength in fighting one of these problems. With approval voting, voters can address both problems simultaneously.

Statements made during election campaigns are often accused of merely being cheap talk. Corazzini, Kube et al. (forthcoming) use a lab experiment to cast doubt on this skeptical position. They let two out of seven participants run for office and give them the possibility to make non-binding commitments in a campaign stage. Commitments are predominantly in the interest of voters, and the one candidate winning the election predominantly keeps her word.

There is an old debate over representative versus direct democracy. This debate usually discusses the issue in normative terms. Towfigh, Glöckner et al. (2013) add an experimental perspective. In an online vignette study, they present voters in the wake of regional elections with plausible decisions taken on three hotly debated issues, and elicit acceptance scores. The subjective importance of the issue turns out to be a critical moderator. Acceptance is higher if the decision is taken by referendum only if the individual classifies the issue as one of highest importance for herself.

In a theory paper, Grechenig and Kolmar (forthcoming) add one argument to the justification of internal sovereignty. It provides individuals with a commitment device. They need not engage in a war of ever more powerful, but also more costly, devices for the protection of their property.

In the ordo-liberal tradition, antitrust is not only propagated as a means for preventing customers from being exploited. Ordo-liberals also expect economic power to corrupt democracy. Using the fact that many countries have adopted antitrust over the past decade, and exploiting deeper lags in the development of a well-established democracy index for the country in question as an instrument, Petersen (2013a) demonstrates that the introduction of antitrust does not have a significant effect on the level of democracy (while it has a beneficial effect on economic growth).

In a doctrinal piece, Petersen (2013c) shows that the German Constitutional Court uses legislative inconsistency as a signal that the justification brought forward for a legislative intervention is not sincere and hides illegitimate motives.

In a series of papers, political scientist Philip Leifeld demonstrates the power of his methodology for the analysis of political discourse, using concepts from graph theory. Leifeld and Schneider (2012) introduce the methodology and demonstrate in which ways it reflects the theory of political discourse. Leifeld applies his methodology to American climate politics (Fisher, Waggle et al. 2013a; Fisher, Waggle et al. 2013b), to the European conflict over software patents (Leifeld and Haunss 2012), and to the German debate over pension reform (Leifeld 2013).

4. Meta Questions

a) Social Sciences and the Law

The lawyers among us openly adopt methods from the social sciences. While this approach would seem quite natural in a good US law school, it still bears explanation, if not justification, in Germany (and most other European countries, for that matter). We therefore cannot avoid engaging ourselves in the legal debate over methodology. Petersen (2013b) advocates empirical methods from the social sciences as a safeguard against the constitutional courts that fall prey to widespread, but erroneous beliefs. In his contribution to the upcoming Oxford Handbook of Behavioral Law and Economics, Engel (2013b) discusses the pros and cons of field data, survey data, vignette studies, and incentivizing lab experiments. Engel (2013d) is a systematic account of the most prominent objections against lab experiments on legal issues, and demonstrates in which ways they can be addressed by the design of the experiment and of experimental papers.

Further contributions demonstrate the fruitfulness of economic theory for understanding and interpreting fundamental freedoms (Engel 2012c) and economic law (Lüdemann 2013).

Finally, two empirical papers turn legal academia into an object of study. German legal scholars tend to think that the discipline specific type of training is effective. Using the complete data from all mock exams written in a large German law faculty over an entire year, Glöckner, Towfigh et al. (2013) find an interesting non-linearity. Over the course of the year, candidates' performance does not improve monotonically. Rather, they undergo characteristic dips, which are likely caused by drops in motivation.

Engel and Hamann (2012) investigate another non-linearity. Observers have long suspected that the supply of law professors is irregular in a rather specific sense: if there have been too many good candidates, some of whom had a hard time becoming professors, some years later, low and behold, there is a dearth of candidates. Likewise, if universities have had a hard time for a while finding convincing candidates, a few years later there are too many of them. It seems that the supply of law professors has the characteristics of a hog cycle. Using data about individuals passing the entry barrier of habilitation, the authors demonstrate that the suspicion actually holds true. The supply of law professors is negatively correlated to the supply of eight years ago.

b) Experimental Methodology

Since the group predominantly uses the experimental method, it also seemed natural to make a few contributions to experimental methodology. Cleave, Nikiforakis et al. (2013) test whether participants with particularly pronounced social preferences self-select into laboratory experiments. Overall, they do not find signs of selection bias. But participants who are less likely to send a substantial amount in the trust game are significantly more likely to participate in later experiments.

Jekel, Fiedler et al. (2011) introduce a technology for classifying judgment and decision-making by choices in diagnostic tasks, and demonstrate how the resulting data can be analyzed.

c) Data Analysis

We finally make contributions to the techniques of data analysis. The data generated by our experiments are frequently censored. The standard statistical approach to analyze such data is the Tobit model. In the frequent case of censoring at zero, the Tobit model assumes that a fraction of the observed zeros would actually have been negative, had the design of the experiment not made this impossible. In the case of

punishment, one must therefore assume that participants who have not punished would actually have wanted to reward other participants. Depending on the nature of the game, this can be a fairly strong assumption. It may be more plausible to assume that participants who do not punish just do not want to contribute to the second-order public good. If that assumption is correct, a two-part of model is appropriate. One first explains why participants do not want to punish at all. Conditional on their decision to engage in punishment, one separately explains severity. If this is the appropriate statistical model, one can estimate a logit or probit for the first part, and can use OLS for the second part. The only adjustment is for the truncated distribution of the error terms in the second part of the model. Yet, this still requires a fairly strong assumption. If a participant does not punish, this implies that said participant would have punished under no circumstances. Yet, why should a participant punish another participant who seems to have behaved well? If one wants to make room for that, one needs a statistical model that allows for two types of zeros: those resulting from the unwillingness to punish in the first place and those resulting from local conditions, and in particular the amount contributed to the public good by the would-be recipient. Engel and Moffat (2012) work out the theory of such a double-hurdle model, program separate versions for cross section and panel data in Stata, and demonstrate the power of the approach with a long-standing bone of contention among experimentalists: the house money effect (see also Leifeld: on a software tool to export tables in R into LaTeX or HTML).

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C.II.2 Independent Research Group: Intuitive Experts

Head: Prof. Dr. Andreas Glöckner

PostDoc
Dr. Marc Jekel (Psychology, project funded by the German Science Foundation)

Doctoral Candidates
Dr. Nathan Ashby (Psychology) (left the institute August 2012)
Dr. Susann Fiedler (Psychology)
Felix Henninger (Psychology)
Angela Dorrough (Psychology)

Visiting Scholars and Guests
Dr. Benjamin Hilbig (Psychology, guest status)
Dr. Mark Schweizer (Law, visiting scholar)

Student Research Assistants
Ramona Allstadt Torras (Psychology)
Marie Hellmann (Psychology)
Marie Oehmen (Psychology)
Jeronim Morina (Computer Sciences)
Florian Knauth (Economics)

C.II.2.1 Introduction

The temporary research group *Intuitive Experts* was installed at the institute in 2007 to complement the scientific work on collective goods and legal institutions undertaken by the two permanent economic and legal groups, with a third perspective of psychological decision research. After six wonderful, inspiring, and very productive years, the group ran out in the fall of 2013. The report of the group will therefore necessarily be backward-looking. Psychological decision research will, however, be continued at the institute, since previous members of the group remain affiliated. Most importantly, and to our greatest pleasure, Susann Fiedler, who completed her dissertation with the Intuitive Experts, will establish a new psychological group at the institute.

The group started with the aim to improve the understanding of the complex interplay between intuitive and deliberate processes in decision making and to use the expertise we acquired to investigate economic and legal decision making and behavior in social dilemma situations. A particular focus was set on developing and testing *parallel constraint satisfaction models*. In the last two years, the research of the group has been extended beyond this basic work. Studies have increasingly focused on applied and more general questions concerning economic, legal, and strategic decision making, and this extended research involved investigations of various kinds of models and phenomena in relevant domains of *Judgment and Decision Making*. Some of the most important pieces of research are summarized below.

Overall, the work of the group in the last two years resulted in the publication of 36 articles in international peer-reviewed journals (including the papers that are currently in press) and our work was presented in 69 scientific talks and poster presentations. Young researchers were promoted, resulting in two successful dissertations and one submitted *habilitation*. Furthermore, external funding was raised from the German-Israeli Foundation for a three-year project on the effect of similarity on cooperation (funding amount:

€ 199,000). Finally, we applied insights from public-good research to recent methodological problems discussed in the scientific community. We organized an international, interdisciplinary workshop on "Efficient Science", in which issues of detected scientific misconduct were analyzed (also) from a public-good perspective and several measures were developed to counter them (Glöckner, Fiedler, Fiedler, Engel, & ... in preparation).

C.II.2.2 Background and Research Framework

The work of the Intuitive Experts group has progressed along three lines of research over the last six years: 1) model development and testing, 2) methodological developments, 3) application to legal issues, economic decision making, and public-goods provision. Important developments from the last two years are summarized in the following.

Model development and testing

In the beginning of the group, core parts of the theoretical work were devoted to developing an integrated interactive-activation model for intuitive and deliberate decision making, the parallel constraint satisfaction (PCS) model (Betsch & Glöckner, 2010; Glöckner & Betsch, 2008). According to the PCS model, individuals make decisions by automatically constructing coherent interpretations based on the information provided to them. Initial tendencies for a certain interpretation are accentuated, whereas contradicting information is devalued. The decision maker becomes aware of the resulting (coherent) mental representations of the decision task, without being aware of the underlying automatic processes. Additionally, deliberate construction processes efficiently interact with these automatic construction processes to improve decision making. They can be used to generate new information, to restructure the mental representation, and to consider alternatives.

In the last two years, we have solved three weaknesses of the PCS model concerning specification and flexibility. First, we have included a free parameter in the model that now allows to capture inter-individual variability concerning sensitivity to probabilistic cues (Glöckner & Betsch, 2012; Glöckner, Hilbig, & Jekel, in preparation). Including this sensitivity parameter enhanced the model's capabilities to cross-predict behavior on an individual level. Second, we have developed a probabilistic version of PCS that has the advantage over the previous deterministic implementation to explicate reasonable assumptions concerning errors (Glöckner, Heinen, Johnson, & Raab, 2012). The third extension concerns the inclusion of a learning rule in PCS, so that the theory now also models learning over time and goes beyond the previously used static perspective (Jekel, Glöckner, & Bröder, in preparation).

An evolutionary plausible model of human cognition should, on average, lead to good choices. In a comprehensive simulation study, we show that PCS fulfils this criterion. PCS allows the approximation of the rational solution to probabilistic inference problems very well, and better than prominent competing cognitive models of decision making (Jekel, Glöckner, Fiedler, & Bröder, 2012). This lends further support to the PCS model. Along a different line of research, we continued to test directly how well PCS can account for decisions in probabilistic inference tasks. Testing a critical property of serial integration models, we show that decision time does not necessarily depend on the amount of information available for the decision. In contrast, and in line with the predictions of PCS, providing more comprehensive information leads to quicker decisions in some situations than providing less (Glöckner & Betsch, 2012). In further empirical work, limiting conditions for the PCS as a model for decision making were identified. Specifically, it was shown that the prevalence of PCS usage reduces with increasing costs for information search in some presentation formats (Söllner, Bröder, & Hilbig, 2013).

Aside from improving PCS, the focus has been broadened to develop and test alternative models also, based on evidence accumulation approaches (Ashby, Dickert, & Glöckner, 2012; Glöckner, Fiedler, Hochman, Ayal, & Hilbig, 2012). The Biased Evidence Accumulation Model (Ashby et al., 2012), for example, assumes that choices can be predicted as linear accumulation of affective responses to each outcome, fixated with deviations from rationality being due to attention biases.

Methodological Developments and Debates

In the last two years, researchers in psychology have become increasingly interested in issues of methodology, and there have been various lively methodological debates. Members of the group were involved in two core debates.

The first debate concerns weaknesses of currently used methods and the development of improved, new methods. As a part of this debate, Andreas Glöckner and Benjamin Hilbig edited a special issue on *Methodology in Judgement and Decision Making Research*, which collected recent controversies and perspectives (Glöckner & Hilbig, 2011). Here, we developed, among other things, a method to select tasks that allow us to test and compare efficiently all kinds of models based on Euclidian Diagnostic Task Selection (Jekel, Fiedler, & Glöckner, 2011). Taking a somewhat different approach, Benjamin Hilbig established and applied multinomial process-tree models in various papers for investigating the usage of decision strategies (Hilbig, Erdfelder, & Pohl, 2011, 2012; Pohl, Erdfelder, Hilbig, Liebke, & Stahlberg, 2013) and negativity biases in judgments of truth (Hilbig, 2012a, 2012b). Furthermore, our work on using eye-tracking to investigate decision processes in a more fine-grained and none-invasive manner (Ashby, et al., 2012; Fiedler & Glöckner, 2012; Fiedler, Glöckner, Nicklisch, & Dickert, 2013; Glöckner, Fiedler, et al., 2012; Rubaltelli, Dickert, & Slovic, 2012) has increased interest in the method and inspired constructive debates. Nathan Ashby is currently editing a special issue on eye-tracking methods and applications that aims to collect recent perspectives.

The second somewhat different debate concerns issues of scientific misconduct and possibilities to counter them. Susann Fiedler has been particularly involved in this debate. In a comprehensive online survey, she and her co-workers found that people indeed use questionable research practices to a surprisingly high degree (Fuchs, Jenny, & Fiedler, 2012). Furthermore, Susann Fiedler was engaged in recent large-scale projects on testing and improving replicability of findings (Alexander et al., 2012; Asendorpf et al., 2013a, 2013b). Finally, in a recent paper (Glöckner, Fiedler, et al., in preparation), we analyze scientific misconduct from a public-good perspective and develop suggestions to counter them.

Application to Legal Issues, Economic Decision Making, and Public-goods Provision

As mentioned above, and in line with the group's overall research agenda, much research of the last two years has been devoted to applications that will be summarized in the following.

Legal Judgments

Traditionally, PCS models have been developed for and most strongly applied to legal judgments. In two investigations of legal judgments, we show that individuals revaluate evidence in the decision process (i.e., coherence effects), as predicted by PCS. While the underlying intuitive processes do not undermine the effects of varying standard-of-proof instructions, they reduce individuals' sensitivity to changes in the probabilities of guilt, if the general constellation of facts (the story) remains constant (Glöckner & Engel,

2013). Taking roles in the judicial process (prosecution vs. defense) leads to coherence effects that individuals are not able to correct for, even if there are motivated to do so (Engel & Glöckner, 2013). In his submitted *habilitation* thesis, "Evidence evaluation and standard of proof: rationality and intuition", Mark Schweizer provides a comprehensive legal and psychological discussion of PCS approaches as a descriptive model for evidence evaluations, contrasting them with normative Bayesian networks. Mark Schweizer also shows empirically that the application of Bayesian networks can reduce some of the negative side-effects of intuitive, coherence-based decision making by counteracting coherence effects and preserving the epistemic uncertainty inherent in weak cases (Schweizer, in press).

Along a different line of research, we investigated the development of legal expertise and effects of legal expertise on judgments. In an interdisciplinary paper (Glöckner, Towfigh, & Traxler, 2013), we analyze more than 70,000 grades from test exams conducted by law students at the University of Münster for the three areas of law (public, civil, and criminal law). The results indicate that there are both area-of-law-specific and area-of-law-unspecific learning effects caused by taking test exams that involve case-solving practice. While good initial performers profit more from area-of-law-specific training, the poor initial performers profit more from area-of-law-unspecific exam practice. In a second paper, we demonstrate differences in how persons with advanced legal training (i.e., experts) and lay persons make legal judgments (Dickert, Herbig, Glöckner, Gansen, & Portack, 2012). We confirm that legal training increased judgment accuracy and confidence in the judgment. More importantly, we found that, for individuals without legal training, providing more information increases emotional reactions to legal cases. For individuals with legal training, however, adding the same pieces of information leads to less emotional reactions. This interaction seems to be caused by fundamental differences in the way people construct their mental representations of the cases. While experts construct mental representation using abstract legal terms, lay persons rely stronger on exemplars and similarity to known cases.

Risky Choice

In four papers, we investigated process models for risky choice. In a first paper, we show that Cumulative Prospect Theory is well able to cross-predict individuals' choices, whereas heuristics perform much worse and are barely better than chance level (Glöckner & Pachur, 2012). Given that Cumulative Prospect Theory remains at an "as-if" status and does not describe cognitive processes, there is a need for developing and testing more complex process models for risky choice. In a comprehensive eye-tracking paper, we investigated predictions derived from various kinds of models (Fiedler & Glöckner, 2012). Results indicate that individuals take into account all pieces of information and still make decisions very quickly. Information search varies systematically with the properties of the task. In line with the predictions of evidence accumulation models and PCS, attention to outcomes increases with their probability. Furthermore, within each decision, trial persons increasingly focus on the option chosen later on. This so-called *gaze-cascade effect* can hardly be explained by any existing model, but is in line with the prediction of PCS. A second eye-tracking study (Glöckner, Fiedler, et al., 2012) investigated risky choice processes in decisions from description (i.e., probability information of outcomes is explicitly provided), as compared to decision from experience (i.e., probabilities of outcomes have to be learned from experience). The results indicate remarkable differences between the presentation formats concerning information search and arousal, implying that different kinds of process models seem to be necessary to account for decision making under the two conditions. In a third eye-tracking paper, we investigated persons' valuations of risky prospects against the backdrop of evidence accumulation models (Ashby, et al., 2012). We identified systematic biases in attention, depending on the perspective (i.e., being a buyer vs. a seller of a good), and found that these attention biases mediate endowment effects.

Cooperation and Public Goods

In the last two years, we extended our fine-grained analyses of cognitive processes that are based on eye-tracking to decision tasks with consequences for others. Specifically, we investigated the cognitive processes in strategic decisions (i.e., one-shot public good, repeated public good) and simple interdependent decisions (i.e., money allocation tasks) (Fiedler, et al., 2013). Individuals show gradual instead of qualitative differences in information search patterns, providing support for single-strategy models based on automatic processes such as evidence accumulation models and PCS. The results speak against the standard assumption that individuals rely on qualitatively distinct simple strategies that differ between persons.

In much of his recent work, Benjamin Hilbig has investigated the influences of personality factors on cooperation in social dilemmas, and he has particularly investigated person x situation interactions (Hilbig, Zettler, & Heydasch, 2012; Hilbig, Zettler, Leist, & Heydasch, 2013; Hilbig, Zettler, Moshagen, & Heydasch, 2013; Zettler, Hilbig, & Heydasch, 2013). Overall this work a) highlights that honesty-humility, a broad personality trait that is missing in the standard Big 5 models for personality and is crucial to predicting strategic and interdependent decision making, and b) it supports a strong interactionist perspective, in that behavior is shaped by an interplay between persons' honesty-humility and situational cues.

Further support for such an interactionist perspective comes from a paper on repeated prisoner's dilemma games. Specifically, we found that there is an interaction of situational factors and persons' risk aversion in predicting cooperation (Glöckner & Hilbig, 2012). Persons who are more (vs. less) risk-averse cooperate more in cooperation-friendly environments (i.e., high cooperation index). The effect, however, reverses in cooperation-unfriendly environments. This indicates that risk aversion goes along with following the "usually expected" behavior (i.e., the norm), whereas risk seekers accept the risk of violating norms. Hence, risk is perceived relative to the structure of the environment.

C.II.2.3 Concluding Remarks

We hope that the research of the Intuitive Experts group has contributed to the cumulative development of knowledge concerning decision making in legal and economic domains, as well as in social dilemmas. We further hope that the work has contributed to the overall goal of the institute to improve our understanding of public goods and the efficient design of legal institutions. Many new ideas concerning models, methodology, and application have been developed. We would be delighted if some of the ideas were followed up, if they provided inspirations for further work, and if they were devised towards further independent, critical testing. We thank the Max Planck Society for providing this extraordinary opportunity to realize our research agenda. Finally, we are particularly grateful to the directors, Christoph Engel and Martin Hellwig, and to all scientific and administrative members of the institute for their fantastic support and for providing such a friendly, constructive, and inspiring environment for undertaking research.

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C.II.3 International Max Planck Research School: Adapting Behavior to a Fundamentally Uncertain World

Partners: Max Planck Institute for Economics, Jena (Güth)
Max Planck Institute for Human Development, Berlin (Gigerenzer)
Faculty of Economics, University of Jena (Cantner)
Faculty of Psychology, University of Jena (Mummendey)
Rationality Center, Jerusalem (Kareev)
Workshop in Political Theory and Policy Analysis, Bloomington (Ostrom)
Psychology Department, Bloomington (Todd)

1. Decision-making in a (Sufficiently) Certain World

How should one make a decision? The answer seems obvious: figure out what you want, check your options, and choose the option that comes closest to your desires. Neoclassical economics has developed this program to near perfection. It is the program of optimisation under constraints (Feldman 1980). From this starting point, it is natural to see uncertainty as a problem of information. If more information is available, rational decision-makers use it. If full information is not to be had, rational actors replace it by the best available proxy. In the most comfortable case, the set of possible events is finite and known. Both the range and the distribution of each possible event within the range of possible realizations may be estimated. There is, for instance, reason to believe that the unknown event is taken from a well-defined class of events, and that there is data from a representative sample. If so, the present value of the option may be calculated. If there is no hard data, decision-makers may still be able to come up with educated guesses. The rational choice program still works if they rely on merely subjective probabilities, and on a merely subjective definition of the action space.

The program takes into account information cost. If the acquisition of additional information is costly, decision-makers make an investment decision. They estimate the expected value of improving decision quality, and compare it to the cost. If, ex ante, it is uncertain whether costly search will lead to success, the benefit is multiplied by the (if necessary only subjective) probability of success. By the same token, the solution space for the meta-decision about search may be extended. First, the decision-maker constructs the space of potential outcomes of search. Each outcome is the product of two factors: the probability finding the solution, and its value. Summing up over all weighed outcomes gives the expected value of engaging in search.

The same way, one may introduce decision cost. This is easiest to see if the decision-maker relies on the services of an intermediary. The cost of entrusting the actual decision-making to an outsider is justified in either of two cases. In the first case, the decision-maker could have made the decision herself. But decision-making effort saved on this task may be invested in other, more profitable tasks. In the second case, bringing in the third party is a way to overcome the decision-maker's own limitations. Either meta-decision rests on comparing expected benefit to cost.

In this (neoclassical) program, decision-making under certainty is the conceptual starting point. Decision cost, complexity, and uncertainty are added as complications. By the steps sketched above, these complications become tractable, provided computational capacity is not bounded. Once the necessary estimations have been made, the actual decision is a mere matter of calculus. Given the right estimates, the right decision is unquestionable. If outsiders accept the estimates, one may prove that one has taken the correct decision.

These features of the neoclassical program have made it attractive to psychologists and lawyers as well. In psychology, the anomalies and biases program has turned what is a mere analytic tool in economics into

norms. In experiments, subjects have been tested against the predictions of rational choice theory. Systematic deviations have been dubbed as biases. Indeed, long lists of such biases have been found. Legal scholars have bought into this program from two angles. In law and economics, legal institutions are reconstructed from the perspective of actors who follow the rational choice program. In most of behavioral law and economics, legal institutions are reconstructed as decision aids, helping individuals overcome the empirical deviations from rational choice norms, i.e., biases.

2. Decision-Making in a Fundamentally Uncertain World

There is a radically different way of construing decision-making. It starts from the assumption that the problem is either ill-defined, or complexity transcends decision-making abilities. Of course, not all problems fall into one of these categories. Actually, one of the main purposes of institutions is to narrow down problems such that they become tractable in rational choice terms. Take decision-making in Parliament. At the outset, the factors potentially relevant for making political decisions are overwhelmingly rich. But all that is needed to make a decision on behalf of the entire country is sufficient votes in Parliament. This institutional intervention is already a response to the fact that complexity had been extensive in the first place.

The domain of the alternative approach is extended by the fact that not all decision-makers dispose of perfect cognitive abilities. Yet nonetheless they have to take decisions. Others have to divide their limited cognitive resources among multiple tasks, or to decide in limited time. Yet others cannot afford training or the help of decision-making intermediaries with larger cognitive resources. For all of these reasons, decision-makers might want to content themselves with a more parsimonious method of decision-making under uncertainty, provided the expected results are at least satisfactory.

Once one introduces human interaction into the definition of the situation, further reasons for fundamental uncertainty become visible. People possess the power of creativity. They can use it for mere technical or institutional innovation. But they may also creatively circumvent what would be a restriction for a mere utility maximiser.

Finally, if the situation is not exceptionally simple, actors must engage in sense making. To that end, they construct mental models. Uncertainty can also be said to be fundamental if actors lose confidence in their mental models.

If uncertainty is fundamental for one of these reasons, decision-making is no longer a matter of calculus. Search must be stopped at some point, and often early on. The decision-maker must take on personal responsibility. It is clear at the outset that the decision may turn out to be suboptimal, after the fact. It does not make sense to strive for the perfect decision. A good illustration is what is known as the secretary problem, i.e., a search problem where former options are foregone. Here one may learn after the fact that a former option would have been preferable. But one has no chance to revert on one's earlier decision not to seize the opportunity. In such situations, the normative goal shifts to coming up with an appropriate move, given the limited abilities of the decision-maker. Depending on the situation, avoiding bad mistakes (e.g., hiring the worst secretary) may be more important than missing theoretical opportunities (e.g., hiring the theoretically optimal secretary). In other situations, taking the risk of small mistakes may be conducive to gradually improving decision quality, and to preparing for situations where decision quality matters more. In the same vein, it may be preferable to split an important decision into small steps, thereby gaining an opportunity to redirect one's course in light of intermediate experiences. It always pays to remain open to surprise. Making good use of feedback becomes paramount.

The hallmark of rational choice theorising is strategic interaction. Many real life problems fall into this category, the two main exceptions being the direct interaction between man and nature, and behavior in markets if competition is workable. The tool for analysing problems of strategic interaction is game theory. If some actors have a chance to design rules for future interaction, game theory takes the form of principle-agent theory and of mechanism design. If the uncertainty is fundamental, this does not make the strategic element and anticipation disappear. Yet if neither actor optimises, strategic interaction takes on a different flavour. Generating predictability is a precondition for gains from cooperation. Complex cascades of mutual anticipation become unlikely. Simple interaction heuristics are more likely to be employed by one's interaction partner. On the other hand, too much predictability is dangerous when "predators" are on the loose. In such situations, a decision-rule must help the individual choose between the prospect for gains from cooperation and the ensuing risk of being exploited.

The best machinery for implementing the traditional rational choice program is formal logic. Logic has its role in the alternative program. But it must be supplemented by different cognitive and motivational tools. On the cognitive side, the decision-maker must be able to comparatively assess the desirability of options on a thin factual basis. Most likely, there is not one all-purpose tool for this. In some contexts, simply repeating past success and avoiding past failure may be enough. In other contexts, it may be more promising to build a rough mental model of the situation, and to rank the options that come to mind along simple criteria. In yet other contexts, tracing patterns and matching their probabilities may be best policy, and so forth. On the motivational side, two elements are crucial. Decision-makers must be willing to take risks; otherwise they would be immobilised in the face of patent uncertainty. Conversely, decision-makers must feel pressed to change a course of action if there are sufficiently strong signals that they got it wrong. The relatively high willingness to trust others, coupled with fairly strong punishing sentiments, fit this picture well.

IMPRS Summer School 2012, Schedule

1st week	Sunday July 22	Monday July 23		Tuesday July 24		Wednesday July 25		Thursday July 26		Friday July 27		Saturday July 28	Sunday July 29
	GK+IMPRS	GK	IMPRS	GK	IMPRS	GK	IMPRS	GK	IMPRS	GK	IMPRS	IMPRS	IMPRS
8:00		Welcome Address Uwe Cantner											
8:15		**Gerlinde Fellner** Basic Game Theory UHG 145		**Gerlinde Fellner** Basic Game Theory UHG 145		**Gerlinde Fellner** Basic Game Theory UHG 145		**Gerlinde Fellner** Basic Game Theory UHG 145		**Gerlinde Fellner** Basic Game Theory UHG 145			
9:30												Exam Fellner MPI V 14	
9:45		Coffee		Coffee		Coffee		Coffee		Coffee			
10:00		**Kai Sassenberg** Creativity Research UHG	**Eyal Zamir** Economic and Behavioral Analysis of UHG 146	**Kai Sassenberg** Creativity Research UHG	**Eyal Zamir** Economic and Behavioral Analysis of UHG 146	**Hans Georg Gemünden** Keyperson in the innovation processes MPI V14	**Eyal Zamir** Economic and Behavioral Analysis of UHG 146	**Hans Georg Gemünden** Keyperson in the innovation processes UHG	**Eyal Zamir** Economic and Behavioral Analysis of UHG 146	**Hans Georg** Keyperson in the innovation processes UHG 145	**Eyal Zamir** Economic and Behavioral Analysis of UHG 146		
10:30												Exam Engel MPI V14	
11:15		Coffee		Coffee		Coffee		Coffee		Coffee			
11:30		**Sebastian Wilfling** JERW UHG	Coffee	JERW UHG	Coffee	**Simone Vanucchi** JERW UHG	Coffee	**Bronwyn Hall** Returns to R/D and innovation UHG 145	Coffee	**Hans Georg Gemünden** Keyperson in the innovation processes UHG 145	Coffee	Exam Zamir MPI V14	
11:45			Zamir Exercise: UHG 146		Exercise Zamir UHG 146		Fellner Exercise UHG 146		Group Assignment		Fellner Exercise UHG		
12:30		Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch		
14:00		**Kai Sassenberg** Creativity Research MPI V03	**Christoph Engel** Uncertainty and the Law MPI V14	**Bronwyn Hall** Innovation policy and its evaluation MPI V03	**Christoph Engel** Uncertainty and the Law MPI V14	**Bronwyn Hall** Returns to R/D and innovation MPI V03	**Christoph Engel** Uncertainty and the Law MPI V14	**Hans Georg Gemünden** Keyperson in the innovation processes MPI V03	**Christoph Engel** Uncertainty and the Law MPI V14	**Bronwyn Hall** Economics of the patent system MPI V03	**Christoph Engel** Uncertainty and the Law MPI V14		bike tour
15:30	Registration Senatssaal University of	Coffee	Coffee	Coffee		Coffee		Coffee		Coffee			
16:00		**Kai Sassenberg** Creativity Research MPI V03	**Theme Presentation** MPI V14	*joint lecture* **Kai Sassenberg** Creativity Research MPI V14		*joint lecture* **Luigi Mittone** Norms and trades: an experimental investigation MPI V14		*joint lecture* **Eyal Zamir** Seeing is Believing: the Anti-Inference Bias MPI V14		**Group Work** MPI V03	**Group Assignment Presentation** MPI V14		
17:00	**Ulrich Witt** "Innovations, Consumption and the Problem of Sustainability Senatssaal, University of											Welcome Tournament	
17:30		Break	Break	Break	Break	Break	Break	Break	Break	Break			
17:45		**Group Work** MPI V03	**Theme Discussion and Group Formation** MPI V14	**Group Work** MPI V03	Exercise Engel V14	**Group Work** MPI V03	Poster session	**Group Work** MPI V03	Engel Exercise: V14	**Group Work Presentation** MPI V03			
18:30	**Opening BBQ** Courtyard of the mainbuilding, University of Jena												
18:45		Dinner		Dinner		Barbecue		Dinner		Dinner			
19:45		**Group Work** MPI V14	Group Assignment	**Group Work** MPI V14	Group Assignment	**Group Work** MPI V14	Group Assignment	**Group Work** MPI V14	Group Assignment	**Group Work** MPI V14	Group Assignment		
20:30													

2nd week	Monday July 30			Tuesday July 31			Wednesday Aug 01			Thursday Aug 02			Friday Aug 03			Sat Aug 04		Sun Aug 05
	GK	IMPRS		GK	IMPRS		GK	IMPRS		GK	IMPRS		GK	IMPRS		IMPRS		IMPRS
8:15		**Akira Okada** Cooperation in Game Equilibrium Models MPI V14	8:15		**Akira Okada** Cooperation in Game Equilibrium Models MPI V14	8:15		**Akira Okada** Cooperation in Game Equilibrium Models MPI V14	8:15		**Akira Okada** Cooperation in Game Equilibrium Models MPI V14	8:15		**Akira Okada** Cooperation in Game Equilibrium Models MPI V14	8:15		8:15	
9:00	**Sohaib Hassan** JERW MPI V03			**Igor Asanov** JERW MPI V03			**A. Egbetokun** JERW MPI V03			**Ipsita Roy** JERW MPI V03			**F. Puppato** JERW MPI V03		9:30	Exam Okada MPI V14	9:30	
9:45	Coffee	Coffee	9:45	Coffee	Coffee	9:45	Coffee	Coffee	9:45	Coffee	Coffee	9:45	Coffee	Coffee	9:45			
10:00	Robert Jung Microeconometrics MPI V14		10:00	Robert Jung Microeconometrics MPI V14		10:00	Robert Jung Microeconometrics MPI V14		10:00	Robert Jung Microeconometrics MPI V14		10:00	Robert Jung Microeconometrics MPI V14		10:00	Exam Jung MPI V14	10:15	
11:30	Coffee	Coffee	11:30	Coffee		11:30	Coffee		11:30	Coffee	Coffee	11:30	Coffee	Coffee	11:30	Exam Olsson MPI V14	10:30 11:15	
11:45	**Emilio Raiteri,** Student presentations MPI V03	Exercise: Jung	11:45	**Virginie Maghe, Tim** Student presentations MPI V03	Exercise: Okada	11:45	**Denis turkanov,** Student presentations MPI V03	Exercise: Jung	11:45	**Jan Fagerberg** Innovation Studies MPI V03	Exercise: Okada	11:45	**Group work** Final presentation MPI V03	Exercise Olsson	11:30		11:30	
12:30		Lunch	12:30		Lunch	12:30		Lunch	12:30		Lunch	12:30		Lunch	12:30			
13:00	Lunch		13:00	Lunch			Lunch			Lunch			Lunch					
14:00		**Henrik Olsson** Formal modeling MPI V14	14:00		**Henrik Olsson** Formal modeling methods MPI V14	14:00		**Henrik Olsson** Formal modeling methods MPI V14	14:00		**Henrik Olsson** Formal modeling methods MPI V14	14:00		**Henrik Olsson** Formal modeling methods MPI V14	14:00			
14:15	**Group Work** MPI V03		14:15	**Jan Fagerberg** Innovation Studies MPI V03		14:15	**Jan Fagerberg** Innovation Studies MPI V03		14:15	**Group Work** 0:00 MPI V03		14:15	**Group work** Final presentation MPI V03					
15:30	Coffee	Coffee	15:30	Coffee	Coffee	15:30	Coffee	Coffee	15:30	Coffee	Coffee	15:30	Coffee	Coffee	15:30			
16:00	*joint seminar* **Stefan Ipach** **PostDoc Financing** MPI V14		16:00	*joint seminar* **Robin Cowan** **Network Structure** MPI V14		16:00	**Robin Cowan** Networks MPI V03	Exercise: Olsson Group Assignment	16:00	**Robin Cowan** Networks MPI V03	Group Assignment	16:00	**Robin Cowan** Networks MPI V03	**Group Assignment Presentation** MPI V14	16:00	***Keynote Lecture*** **Axel Ockenfels** Fairness under Uncertainty	16:00	
17:30	Break	Break	17:30	Break	Break	17:30	Break	Break	17:30	Break	Break	17:30	Break				17:30	
17:45	**Group Work** MPI V14	Group Assignment	17:45	**Group Work** MPI V14	Group Assignment	17:45	**Group Work** MPI V14	Group Assignment	17:45	**Group Work** MPI V14	Group Assignment	17:45	**Group Work** Final presentation MPI V14				17:45 18:00	
18:45	Dinner	Dinner	18:45 19:00	Dinner	Dinner	18:45	Dinner, BBQ		18:45	Dinner	Dinner	18:45	Dinner		18:45	**BBQ and Get together**	18:15	
19:45	**Group Work** MPI V14	Group Assignmement	19:45	**Group Work** MPI V14	Group Assignmement	19:45	**Group Work** MPI V14	Group Assignmement	19:45	**Group Work** MPI V14	Group Assignmement	19:45	**Group Work** MPI V14	Group Assignmement	19:45			
20:30			20:30			20:30			20:30			20:30			20:30		20:30	

3rd week	Monday Aug 6		Tuesday Aug 7		Wednesday Aug 8		Thursday Aug 9		Friday Aug 10		Saturday Aug 11		Sunday Aug 12
8:15	**Oliver Kirchkamp**	**8:15**	**Oliver Kirchkamp**	**8:15**	**Oliver Kirchkamp**	**8:15**	**Oliver Kirchkamp**	**8:15**	**Oliver Kirchkamp**	**8:15**		**8:15**	
8:30		8:30		8:30		8:30		8:30		8:30		8:30	
8:45	Introduction to R	8:45	Introduction to R	8:45	Introduction to R	8:45	Introduction to R	8:45	Introduction to R	8:45		8:45	
9:00		9:00		9:00		9:00		9:00		9:00		9:00	
9:15	MPI V14	9:15	MPI V14	9:15	MPI V14	9:15	MPI V14	9:15	MPI V14	9:15		9:15	
9:30		9:30		9:30		9:30		9:30		9:30	Exam: Kirchkamp	9:30	
9:45	Coffee	9:45	Coffee	9:45	Coffee	9:45	Coffee	9:45	Coffee	9:45		9:45	
10:00	**Peter Todd**	**10:00**	**Peter Todd**	**10:00**	**Peter Todd**	**10:00**	**Peter Todd**	**10:00**	**Peter Todd**	**10:00**		**10:00**	
10:15		10:15		10:15		10:15		10:15		10:15		10:15	
10:30	Search strategies in space and time	10:30	Search strategies in space and time	10:30	Search strategies in space and time	10:30	Search strategies in space and time	10:30	Search strategies in space and time	10:30	Exam: Berg	10:30	
10:45		10:45		10:45		10:45		10:45		10:45		10:45	
11:00	MPI V14	11:00	MPI V14	11:00	MPI V14	11:00	MPI V14	11:00	MPI V14	11:00		11:00	
11:15		11:15		11:15		11:15		11:15		11:15		11:15	
11:30	Coffee	11:30	Coffee	11:30	Coffee	11:30	Coffee	11:30	Coffee	11:30	Exam:	11:30	
11:45		11:45		11:45		11:45		11:45		11:45		11:45	
12:00	Exercise: Kirchkamp	12:00	Exercise: Berg	12:00	Exercise: Berg	12:00	Exercise Todd	12:00	Exercise: Kirchkamp	12:00		12:00	
12:15		12:15		12:15		12:15		12:15		12:15		12:15	
12:30		12:30		12:30		12:30		12:30		12:30		12:30	
12:45		12:45		12:45		12:45		12:45		12:45		12:45	
13:00	Lunch	13:00	Lunch	13:00	Lunch	13:00	Lunch	13:00	Lunch	13:00		13:00	
13:15		13:15		13:15		13:15		13:15		13:15		13:15	**Trip to Freyburg** (Rotkäppchen Wine Cellars)
13:30		13:30		13:30		13:30		13:30		13:30		13:30	
13:45		13:45		13:45		13:45		13:45		13:45		13:45	
14:00	**Nathan Berg**	**14:00**	**Nathan Berg**	**14:00**	**Nathan Berg**	**14:00**	**Nathan Berg**	**14:00**	**Nathan Berg**	**14:00**		**14:00**	
14:15		14:15		14:15		14:15		14:15		14:15		14:15	
14:30	Inconsistency Pays	14:30	Inconsistency Pays	14:30	Inconsistency Pays	14:30	Inconsistency Pays	14:30	Inconsistency Pays	14:30		14:30	
14:45		14:45		14:45		14:45		14:45		14:45		14:45	
15:00	MPI V14	15:00	MPI V14	15:00	MPI V14	15:00	MPI V14	15:00	MPI V14	15:00		15:00	
15:15		15:15		15:15		15:15		15:15		15:15		15:15	
15:30	Coffee	15:30	Coffee	15:30	Coffee	15:30	Coffee	15:30	Coffee	15:30		15:30	
15:45		15:45		15:45		15:45		15:45		15:45		15:45	
16:00	*invited talk*	**16:00**		**16:00**	*invited talk*	**16:00**		**16:00**		**16:00**		**16:00**	
16:15	**Werner Güth**	16:15	Exercise: Todd	16:15	**Matteo Ploner**	16:15		16:15		16:15		16:15	
16:30	An Axiomatic Approach to Legal Mechanism Design -	16:30		16:30	Experiments in Behavioral Finance: the Disposition Effect	16:30		16:30		16:30		16:30	
16:45		16:45	Coffee	16:45		16:45		16:45		16:45		16:45	
17:00	MPI V14	17:00		17:00	MPI V14	17:00	Group Assignment (possibly experiments)	17:00	**Group Assignment Presentation** MPI V14	17:00		17:00	
17:15		17:15		17:15		17:15		17:15		17:15		17:15	
17:30	Coffee	17:30	Group Assignment (possibly experiments)	17:30		17:30		17:30		17:30		17:30	
17:45		**17:45**		**17:45**		**17:45**		**17:45**		**17:45**		**17:45**	
18:00	Group Assignment	18:00		18:00	Group Assignment	18:00		18:00		18:00		18:00	
18:15		18:15		18:15		18:15		18:15		18:15		18:15	
18:30		18:30		18:30		18:30		18:30		18:30		18:30	
18:45		18:45		18:45		18:45		18:45		18:45		18:45	
19:00	Dinner	19:00	Dinner	19:00	Barbecue	19:00	Dinner	19:00	Dinner	19:00		19:00	
19:15		19:15		19:15		19:15		19:15		19:15		19:15	
19:30		19:30		19:30		19:30		19:30		19:30		19:30	
19:45		**19:45**		**19:45**		**19:45**		**19:45**		**19:45**		**19:45**	
20:00	Group Assignment	20:00	Group Assignment	20:00	Group Assignment	20:00	Group Assignment	20:00	Group Assignment	20:00		20:00	
20:15		20:15		20:15		20:15		20:15		20:15		20:15	
20:30		20:30		20:30		20:30		20:30		20:30		20:30	
20:45		20:45		20:45		20:45		20:45		20:45		20:45	

4th week	Monday August 13	Tuesday Aug 14	Wednesday Aug 15	Thursday Aug 16	Friday Aug 17
8:15	**René Levinsky**	**René Levinsky**	**René Levinsky**	**René Levinsky**	**René Levinsky**
8:30					
8:45	Introduction MAPLE	Introduction MAPLE	Introduction MAPLE	Introduction MAPLE	Introduction MAPLE
9:00					
9:15	MPI V14	MPI V14	MPI V14	MPI V14	MPI V14
9:30					
9:45	Coffee	Coffee	Coffee	Coffee	Coffee
10:00	**Reid Hastie**	*invited talk* **Peter Noack**	**Lael Schooler**	**Lael Schooler**	**Lael Schooler**
10:15					
10:30	Foundations of Judgment and Decision Making	Educational Inequality	ACT-R	ACT-R	ACT-R
10:45					
11:00	MPI V14	MPI V14	MPI V14	MPI V14	MPI V14
11:15					
11:30	Coffee	Coffee	Coffee	Coffee	Coffee
11:45	Exercise: Reid Hastie	Exercise: Levinsky	Exercise: Levinsky	Exercise: Schooler	**Reid Hastie**
12:00					Foundations of Judgment and Decision Making
12:15					MPI V14
12:30	Lunch	Lunch	Lunch	Lunch	
12:45					
13:00					
13:15					Lunch
13:30					
13:45					
14:00	**Reid Hastie**	**Lael Schooler**	**Reid Hastie**	**Reid Hastie**	
14:15					
14:30	Foundations of Judgment and Decision Making	ACT-R	Foundations of Judgment and Decision Making	Foundations of Judgment and Decision Making	Exam Levinsky
14:45					
15:00	MPI V14	MPI V14	MPI V14	MPI V14	Break
15:15					Exam Hastie
15:30	Coffee	Coffee	Coffee	Coffee	
15:45					
16:00		**Lael Schooler**	*invited talk* **David Budescu**		Break
16:15					Exam Schooler
16:30		ACT-R	Effective Communication of Uncertainty in the IPCC Reports / A model-based approach for the		
16:45					
17:00	Group Assignment	MPI V14	MPI V14	**Group Assignment Presentation** MPI V14	**Free time**
17:15					
17:30		Break	Break		
17:45		Exercise: Schooler	Exercise: Hastie		
18:00					
18:15					**Graduation Ceremony**
18:30					
18:45	Dinner	Dinner	Barbecue	Dinner	
19:00					
19:15					
19:30					**Dinner and Farewell Party**
19:45	Group Assignment	Group Assignment	Group Assignment		
20:00					
20:15					
20:30					
20:45					

IMPRS Summer School 2013, Schedule

1st week	Sunday July 14		Monday July 15			Tuesday July 16			Wednesday July 17			Thursday July 18			Friday July 19			Saturday July 20	Sunday July 21
			GK-EIC	IMPRS		GK-EIC	IMPRS		GK-EIC	IMPRS		GK-EIC	IMPRS		GK-EIC	IMPRS		IMPRS	IMPRS
	GK+IMPRS	8:00	Welcome Address Uwe Cantner																
8:15		8:15	Oliver Kirchkamp		8:15	Oliver Kirchkamp		8:15	Oliver Kirchkamp		8:15	Oliver Kirchkamp		8:15	Oliver Kirchkamp		8:15		
8:30		8:30	Workflow of statistical data analysis		8:30	Workflow of statistical data analysis		8:30	Workflow of statistical data analysis		8:30	Workflow of statistical data analysis		8:30	Workflow of statistical data analysis		8:30		
8:45		8:45			8:45			8:45			8:45			8:45			8:45		
9:00		9:00	MPI V14		9:00	MPI V14		9:00	MPI V14		9:00	MPI V14		9:00	MPI V14		9:00		
9:15		9:15			9:15			9:15			9:15			9:15			9:15		
9:30		9:30			9:30			9:30			9:30			9:30			9:30	Exam	
9:45		9:45	Coffee		9:45	Coffee		9:45	Coffee		9:45	Coffee		9:45	Coffee		9:45	MPI V14	
10:00		10:00	Mikhail Anufriev	Tobias Regner/ Sven Fischer	10:00	Mikhail Anufriev	Tobias Regner/ Sven Fischer	10:00	Group work	Tobias Regner/ Sven Fischer	10:00	Tommaso Ciarli	Tobias Regner/ Sven Fischer	10:00	Dietmar Harhoff	Tobias Regner/ Sven Fischer	10:00		
10:15		10:15	Heterogenous agent models	Theories of social preferences and other-regarding behavior	10:15	Heterogenous agent models	Theories of social preferences and other-regarding behavior	10:15	MPI V14	Theories of social preferences and other-regarding behavior	10:15	Innovation and environment	Theories of social preferences and other-regarding behavior	10:15	Patent research	Theories of social preferences and other-regarding behavior	10:15		
10:30		10:30	MPI V14		10:30	MPI V14		10:30			10:30	MPI V14		10:30	MPI V14		10:30	Exam	
10:45		10:45			10:45			10:45			10:45			10:45			10:45	MPI V14	
11:00		11:00			11:00			11:00			11:00			11:00			11:00		
11:15		11:15	Coffee	MPI V03	11:15	Coffee	MPI V03	11:15	Coffee	MPI V03	11:15	Coffee	MPI V03	11:15	Coffee	MPI V03	11:15		
11:30		11:30	Matthias Piontek	Coffee	11:30	Igor Asanov	Coffee	11:30	Diego d'Andria	Coffee	11:30	Tina Haußen	Coffee	11:30	Tommaso Ciarli	Coffee	11:30		
11:45		11:45	JERW	Exercise: Kirchkamp	11:45	JERW	Exercise: Regner/Fischer	11:45	JERW	Exercise: Kirchkamp	11:45	JERW	Group Assignment	11:45	Innovation and environment	Exercise: Regner/Fischer	11:45		
12:00		12:00			12:00			12:00			12:00			12:00			12:00		
12:15		12:15	MPI V14	MPI V03	12:15	MPI V14	MPI V03	12:15	MPI V14	MPI V03	12:15	MPI V14		12:15		MPI V03	12:15		
12:30		12:30			12:30			12:30			12:30			12:30	MPI V14		12:30		
12:45		12:45	Lunch		12:45	Lunch		12:45	Lunch		12:45	Lunch		12:45			12:45		
13:00		13:00			13:00			13:00			13:00			13:00	Lunch		13:00		
13:15		13:15			13:15			13:15			13:15			13:15			13:15		
13:30		13:30			13:30			13:30			13:30			13:30			13:30		
13:45		13:45			13:45			13:45			13:45			13:45			13:45		
14:00		14:00	Frederico Frattini	Fabian Winter	14:00	Mikhail Anufriev	Fabian Winter	14:00	Group work	Fabian Winter	14:00	Dietmar Harhoff	Fabian Winter	14:00	Dietmar Harhoff	Fabian Winter	14:00		Trip to Dresden
14:15		14:15	Presentation		14:15			14:15			14:15			14:15			14:15		
14:30		14:30	MPI V03	Communicating sciences with graphics	14:30	Heterogenous agent models	Communicating sciences with graphics	14:30		Communicating sciences with graphics	14:30	Patent research	Communicating sciences with graphics	14:30	Patent research	Communicating sciences with graphics	14:30		
14:45		14:45	Group work and assignment		14:45			14:45			14:45			14:45			14:45		
15:00		15:00			15:00			15:00			15:00			15:00			15:00		
15:15		15:15	MPI V03	MPI V14	15:15	MPI V03	MPI V14	15:15	MPI V03	MPI V14	15:15	MPI V03	MPI V14	15:15	MPI V03	MPI V14	15:15		
15:30		15:30	Coffee		15:30	Coffee		15:30	Coffee		15:30	Coffee		15:30	Coffee		15:30		
15:45		15:45			15:45			15:45			15:45			15:45			15:45		
16:00	Registration	16:00	Mikhail Anufriev	Theme Presentation	16:00	joint lecture		16:00	Group work	Exercise: Winter	16:00	joint lecture		16:00	Group work presentation		16:00		
16:15		16:15			16:15	Gerd Gigerenzer		16:15		MPI V14	16:15	Dietmar Harhoff		16:15			16:15		
16:30	Senatssaal, FSU Jena	16:30	Heterogenous agent models		16:30	Risk vs. Uncertainty		16:30			16:30			16:30			16:30		
16:45		16:45			16:45			16:45		Group Assignment	16:45			16:45			16:45		
17:00	Opening Lecture	17:00		MPI V14	17:00			17:00	MPI V03		17:00	Entrepreneurship, finance and IP		17:00	MPI V03	Group Assignment Presentation	17:00		
17:15	Frederic M. Scherer	17:15	MPI V03		17:15	MPI V14		17:15			17:15			17:15		MPI V14	17:15	Welcome Tournament	
17:30	Uncertainty in the Economics of Innovation	17:30	Break		17:30	Break		17:30	Break		17:30	Break		17:30	Break		17:30		
17:45		17:45	Group work	Theme Discussion and Group Formation	17:45	Group work	Poster session	17:45	Group work	Group Assignment	17:45	Simone Vanuccini	Exercise: Winter	17:45	Group work presentation		17:45		
18:00		18:00			18:00			18:00			18:00	JERW		18:00			18:00		
18:15	Senatssaal, FSU Jena	18:15	MPI V03	MPI V14	18:15	MPI V03		18:15	MPI V03		18:15	MPI V03	MPI V14	18:15	MPI V03		18:15		
18:30		18:30			18:30			18:30			18:30			18:30			18:30		
18:45		18:45			18:45			18:45			18:45			18:45			18:45		
19:00		19:00			19:00			19:00			19:00			19:00			19:00		
19:15	Opening Barbecue	19:15			19:15			19:15			19:15			19:15			19:15		
19:30	Courtyard Main Building, FSU Jena	19:30			19:30			19:30			19:30			19:30			19:30		
19:45		19:45	Group work	Group Assignment	19:45	Group work	Group Assignment	19:45	Group work	Group Assignment	19:45	Group work	Group Assignment	19:45		Group Assignment	19:45		
20:00		20:00	MPI V03		20:00	MPI V03		20:00	MPI V03		20:00	MPI V03		20:00			20:00		
20:15																	20:15		
20:30																	20:30		

2nd week	Monday July 22		Tuesday July 23		Wednesday July 24		Thursday July 25		Friday July 26		Sat July 27	Sunday July 28
	GK-EIC	IMPRS	GK-EIC	IMPRS	GK-EIC	IMPRS	GK-EIC	IMPRS	GK-EIC	IMPRS	IMPRS	IMPRS
8:15	**Tommaso Ciarli** Innovation and environment *MPI V03*	**Maria Bigoni** Introduction to zTree *MPI V14*		**Maria Bigoni** Introduction to zTree *MPI V14*		**Maria Bigoni** Introduction to zTree *MPI V14*		**Maria Bigoni** Introduction to zTree *MPI V14*		**Maria Bigoni** Introduction to zTree *MPI V14*		
8:30												
8:45												
9:00			**Group work** *MPI V03*		**Sohaib Hassan** JERW *MPI V03*		**Josefine Diekhof** JERW *MPI V03*		**Group work** *MPI V03*			
9:15												
9:30											**Exam** *MPI V14*	
9:45	Coffee		Coffee		Coffee		Coffee		Coffee			
10:00	**Thomas Kessler** Cooperation and conflict within and between groups *MPI V14*		**Thomas Kessler** Cooperation and conflict within and between groups *MPI V14*		**Thomas Kessler** Cooperation and conflict within and between groups *MPI V14*		**Thomas Kessler** Cooperation and conflict within and between groups *MPI V14*		**Thomas Kessler** Cooperation and conflict within and between groups *MPI V14*			
10:15												
10:30											**Exam** *MPI V14*	
10:45												
11:00												
11:15												
11:30	Coffee		Coffee		Coffee		Coffee		Coffee			
11:45	**Tommaso Ciarli** Innovation and environment *MPI V03*	Exercise: Bigoni *MPI V14*	**Bastian Paetzold** Student presentation *MPI V03*	Exercise: Kessler *MPI V14*	**Marianna Gilli** Student presentation *MPI V03*	Exercise: Bigoni *MPI V14*	**Group work** *MPI V03*	Exercise: Bolton *MPI V14*	**Group work** *MPI V03*	Exercise: Kessler *MPI V14*		
12:00												
12:15												
12:30		Lunch		Lunch		Lunch		Lunch		Lunch		
12:45												
13:00												
13:15	Lunch		Lunch		Lunch		Lunch		Lunch			
13:30												
13:45												
14:00	**Group work** *MPI V03*	**Gary Bolton** Social preference theory: How it developed and what it is trying to achieve *MPI V14*	**Andreas Chai** Dimensions of demand innovation *MPI V03*	**Gary Bolton** Social preference theory: How it developed and what it is trying to achieve *MPI V14*	**Andreas Chai** Dimensions of demand innovation *MPI V03*	**Gary Bolton** Social preference theory: How it developed and what it is trying to achieve *MPI V14*	**Andreas Chai** Dimensions of demand innovation *MPI V03*	**Gary Bolton** Social preference theory: How it developed and what it is trying to achieve *MPI V14*	**Group work** *MPI V03*	**Gary Bolton** Social preference theory: How it developed and what it is trying to achieve *MPI V14*	**Hiking**	
14:15												
14:30												
14:45												
15:00												
15:15												
15:30	Coffee		Coffee		Coffee		Coffee		Coffee			
15:45												
16:00	**Sandra Kublina** JERW *MPI V03*	Group Assignment	*joint seminar* **Klaus Wälde** Stress, appraisal and coping - An economic approach *MPI V14*		**Group work** *MPI V03*	Exercise: Bolton *MPI V14*	**Group work** *MPI V03*	Group Assignment	**Group work** *MPI V03*	**Group Assignment Presentation** *MPI V14*		*Keynote Lecture* **Christine Jolls** The New Behavioral Law and Economics *Senatssaal, FSU Jena*
16:15												
16:30												
16:45						Group Assignment						
17:00	**Su Tong-Yaa** Student presentation *MPI V03*											
17:15												
17:30		Break	Break		Break		Break		Break			
17:45	Break		**Group work** *MPI V03*	Group Assignment	**Group work** *MPI V03*	Group Assignment	**Group work** *MPI V03*	Group Assignment	**Group work** *MPI V03*			**Keynote Barbecue** *Botanical garden*
18:00	**Group work** *MPI V03*	Group Assignment										
18:15												
18:30												
18:45												
19:00												
19:15												
19:30												
19:45	**Group work** *MPI V03*	Group Assignment	**Group work** *MPI V03*	Group Assignment	**Group work** *MPI V03*	Group Assignment	**Group work** *MPI V03*	Group Assignment	**Group work** *MPI V03*	Group Assignment		
20:00												

3rd week	Monday July 29	Tuesday July 30	Wednesday July 31	Thursday Aug 1	Friday Aug 2	Saturday Aug 3	Sunday Aug 4
8:15	**Matthew Adler** Social choice and social welfare *MPI V14*	**Matthew Adler** Social choice and social welfare *MPI V14*	**Matthew Adler** Social choice and social welfare *MPI V14*	**Matthew Adler** Social choice and social welfare *MPI V14*	**Matthew Adler** Social choice and social welfare *MPI V14*		
9:45	Coffee	Coffee	Coffee	Coffee	Coffee	**Exam** *MPI V14*	
10:00	**Christoph Engel** Experimental law and economics *MPI V14*	**Christoph Engel** Experimental law and economics *MPI V14*	**Christoph Engel** Experimental law and economics *MPI V14*	**Christoph Engel** Experimental law and economics *MPI V14*	**Christoph Engel** Experimental law and economics *MPI V14*	**Exam** *MPI V14*	
11:30	Coffee	Coffee	Coffee	Coffee	Coffee	**Exam** *MPI V14*	
11:45	Exercise: Adler *MPI V14*	Exercise: Engel *MPI V14*	Exercise: Adler *MPI V14*	Exercise: Keller *MPI V14*	Exercise: Engel *MPI V14*		
12:30	Lunch	Lunch	Lunch	Lunch	Lunch		**Guided tour Weimar**
14:00	**Johannes Keller** Psychological models of motivation and self-regulation *MPI V14*	**Johannes Keller** Psychological models of motivation and self-regulation *MPI V14*	Group Assignment	**Johannes Keller** Psychological models of motivation and self-regulation *MPI V14*	**Johannes Keller** Psychological models of motivation and self-regulation *MPI V14*		
15:30	Coffee	Coffee	Coffee	Coffee	Coffee		
16:00	Group Assignment	*invited talk* **Luigi Mittone** Social Esteem versus Social Stigma: The role of anonymity *MPI V14*	Group Assignment - Experiments	Exercise: Keller *MPI V14*	**Group Assignment Presentation** *MPI V14*		
17:45		Group Assignment		Group Assignment			
19:45	Group Assignment	Group Assignment		Group Assignment	Group Assignment		

4th week	Monday August 5	Tuesday Aug 6	Wednesday Aug 7	Thursday Aug 8	Friday Aug 9
8:15	**Alexander Morell**	**Alexander Morell**	**Alexander Morell**	**Alexander Morell**	**Alexander Morell**
8:30	Introduction to legal decision making	Introduction to legal decision making	Introduction to legal decision making	Introduction to legal decision making	Introduction to legal decision making
8:45	*MPI V14*	*MPI V14*	*MPI V14*	*MPI V14*	*MPI V14*
9:00					
9:15					
9:30					
9:45	Coffee	Coffee	Coffee	Coffee	Coffee
10:00	**Peter DeScioli**	**Peter DeScioli**	**Peter DeScioli**	**Peter DeScioli**	**Peter DeScioli**
10:15	Alliances and morality	Alliances and morality	Alliances and morality	Alliances and morality	Alliances and morality
10:30	*MPI V14*	*MPI V14*	*MPI V14*	*MPI V14*	*MPI V14*
10:45					
11:00					
11:15					
11:30	Coffee	Coffee	Coffee	Coffee	Coffee
11:45	Exercise: Morell	Exercise: DeScioli	Exercise: Morell	Exercise: DeScioli	**Oliver Kirchkamp**
12:00	*MPI V14*	*MPI V14*	*MPI V14*	*MPI V14*	Bargaining theory
12:15					*MPI V14*
12:30	Lunch	Lunch	Lunch	Lunch	
12:45					
13:00					
13:15					Lunch
13:30					
13:45					
14:00	**Oliver Kirchkamp**	**Oliver Kirchkamp**	**Oliver Kirchkamp**	**Oliver Kirchkamp**	
14:15	Bargaining theory	Bargaining theory	Bargaining theory	Bargaining theory	**Exam**
14:30	*MPI V14*	*MPI V14*	*MPI V14*	*MPI V14*	*MPI V14*
14:45					
15:00					Break
15:15					**Exam**
15:30	Coffee	Coffee	Coffee	Coffee	*MPI V14*
15:45					
16:00	Exercise: Kirchkamp	*invited talk*	Exercise: Kirchkamp		Break
16:15	*MPI V14*	**Micha Werner**	*MPI V14*		**Exam**
16:30		Bad intentions and lucky			*MPI V14*
16:45	Group Assignment	coincidences -- how rational are	Group Assignment	**Group Assignment Final Presentation**	
17:00		ordinary ascriptions of intentionality?		*MPI V14*	**Free time**
17:15		*MPI V14*			
17:30		Group Assignment			
17:45					
18:00					
18:15					**Graduation Ceremony**
18:30					
18:45					
19:00					
19:15					
19:30					
19:45	Group Assignment	Group Assignment	Group Assignment		**Dinner and Farewell Party**
20:00					

C.III Applied Topics: Network Industries and Financial Stability

The Institute also continues its tradition of investigating applied topics concerning collective goods. This research is complementary to the more fundamental research summarized in Sections C.I and C.II: On the one hand, the principles that emerge from the more fundamental research provide guidance for the analysis of applied issues; this guidance is needed to avoid the danger of provincialism in studying special applications. On the other hand, the applied issues themselves serve as a proving ground for abstract ideas, also as a source of new ideas. The latter is particularly likely when different applications turn out to involve common themes.

As applied topics we have chosen in the past are:

- Sector-specific regulation and competition policy in network industries;
- Financial stability and the regulation of financial markets and financial institutions.

Our choice of these topics was to some extent motivated by considerations of comparative advantage, based on past research expertise, as well as the scope for interdisciplinary research by jurists and economists. Apart from making progress on these topics in their own right, we are also keen to explore the parallels and links between them.

The choice of these topics was and is not meant to be exclusionary. Indeed, in some of the work on which we report under the heading of network industries, we have crossed boundaries and studied questions that properly "belong" to other topics, in particular, competition law and competition policy and the law and economics of innovations and intellectual property rights.

C.III.1 Network Industries: Sector-Specific Regulation and Competition Policy

C.III.1.1 Introduction

"Network industries" such as telecommunications, electricity, gas, rail transportation and postal sectors have the common feature that the provision of services to customers presupposes the use of a fixed network infrastructure, the costs of which are by and large sunk. Traditionally, these industries have been organized as vertically integrated monopolies under state ownership and/or subject to sector-specific regulation. However, the past two or three decades have seen a paradigm shift concerning the organization and regulation of such industries.

The paradigm shift was due to the recognition that not all parts of the vertically integrated monopolies are "natural" and that, for example, long-distance telecommunication services or electricity generation exhibit no technological features which would preclude workable competition. Developments in telecommunications have also given rise to the notion that some natural monopolies may be transient as technical progress makes room for the establishment of competing networks.

The change in views of network industries has induced a change in views concerning the role of regulation. Whereas in the past, regulation was mainly seen as a constraint on the exploitation of monopoly power, under the new paradigm, it has come to be seen as a promoter of competition – competition in downstream markets, as well as competition among networks themselves, where such competition is feasible and economically sensible. A key tool for this purpose is *access regulation*, the government imposed requirement that the network owner open his network for use by other firms. Such access regulation provides other firms with a basis for offering their services in downstream markets, even against the wishes of the incumbent. It also provides other firms with a basis for building competing infrastructures piecemeal, using their own pieces of infrastructure where they have already built them and relying on the incumbent's infrastructure where they do not yet have their own.

The organization and regulation of network industries under the new paradigm raise important economic and legal questions. Important *economic questions* are:

- What is an appropriate system for determining access prices?
- What is an appropriate system of governance for the use if the network infrastructure by the various activities in downstream markets?
- What is an appropriate system of governance for the coordination and funding of investments in network infrastructure and in downstream activities?

The first question is closely connected to the issues discussed in C.I concerning the tension between efficiency in access and the need to cover the costs of the network infrastructures. (In principle, we can think of a network infrastructure as an excludable public good, the use of which serves as an input into the provision of final outputs, which themselves are private goods.) Access prices above the marginal costs of use would entail some inefficiencies of exclusion; access prices equal to marginal costs would preclude the recovery of fixed and common costs. In this case, there would be insufficient incentives to invest in the network infrastructures at all. By contrast, if access prices contained a very generous allowance for fixed and common costs, especially one that is based on a cost-plus calculation, investment incentives could well be excessive.

The second question concerns the organization of the industry as well as the organization of statutory oversight over upstream and downstream activities. For the organization of the industry, the key question is what degree of vertical integration is desirable. In the electricity and gas industries, we have for some time had a requirement of legal unbundling of networks from production and sales. Given the lack of competi-

tion in these industries, the European Commission has proposed to go further and to require ownership unbundling of the transmission grids. This proposal raises the question how the presumed pro-competitive effects of unbundling compare to the efficiency gains (lower transactions costs, reduced holdup problems) that are usually associated with vertical integration. Because of vehement opposition from Member State Governments, as well as the industry itself, the Commission's proposal was not enacted, but, remarkably, at least some firms in the industry decided to sell their transmission grids anyway. The reasons for these decisions are as yet unclear.

For the organization of statutory oversight, the key question is how the relation between sector-specific regulation and antitrust law should be organized. Which activities should be subject to sector-specific regulation and which activities should be subject to antitrust law? How should one deal with the tradeoff that arises between competition downstream and competition upstream because the attempt to promote competition in downstream markets by imposing access requirements upstream reduces incentives for competing companies to build their own upstream facilities? Should submission to sector-specific regulation pre-empt the application of antitrust law? If not, should antitrust law be applied by the sector regulator, or should the two systems of law be applied by separate authorities? The latter would make for some competition between authorities, but there might be a loss of coherence in the policy that is applied to the industry.

The third question, which was already raised in Chapter C.I, is particularly important in industries where network infrastructure investments require substantial funding and in industries investments in infrastructure and investments in downstream activities exhibit important complementarities. The first concern is central in railways. It is also becoming important in electricity as the replacement of nuclear energy by wind energy requires substantial new investments in grid capacity and in generation capacity for regulating energy. The second concern is important in the electricity sector where the location of power plants determines the need for transmission grid capacity.

On the legal side, the new paradigm for the organization and regulation of network industries raises the following questions:

- What are appropriate provisions for administrative and legal procedures?
- What is an appropriate system of governance for the firms in question?
- What is an appropriate system of governance for the regulatory authorities?
- What is the relation between European law and national law in the regulation of network industries?

Most substantive issues in regulation involve an important dose of judgment, rather than the straightforward application of a predetermined rule. Thus, it is well known that the allocation of fixed and common costs to the various services that are being provided and charged for is to some extent arbitrary. From the perspective of welfare economics, as well as management science, the different costs of allocation systems have their advantages and disadvantages, but there is no way of saying *a priori* that one system is best. Given the importance of judgment, one can ask whether the choice should be taken by the political institutions, parliament and the government, whose powers are derived from democratic elections, or whether it should be taken by the regulatory institution, which presumably has greater expertise in assessing the industry in question. If it is taken by the regulatory institution, what recourse to the courts is available to the parties concerned? If the incumbent network owner contests an access pricing decision of the regulatory institution, to what extent does the court procedure focus on the specific price that is being contested? To what extent does it consider the place of this one price in the overall system of prices, which together should permit the recovery of common costs? Which side bears the burden of proof for the appropriateness or inappropriateness of the individual access price or the pricing system? What kind of evidence is accepted as proof in court? Given the need to rely on judgment, rather than predetermined principles, in regulatory decisions, the effective scope of regulation can depend on such procedural issues.

Given that hard evidence in either direction may not even exist, in a court proceeding, the side that has the burden of proof is likely to be in a hopeless position from the very beginning.

At this point, the economist is likely to recommend that the regulator be given a significant amount of discretion to exert his judgment where this is necessary and that he bear the burden of proof in legal proceedings only when he can reasonably be expected to do so, e.g., when the question is whether a given rule for allocating common costs has been correctly applied. For the lawyer, this recommendation raises fundamental questions of constitutional legitimacy. From the perspective of constitutional law, it seems problematic that important substantive choices should be taken by an administrative authority, rather than the democratically elected legislature and government. It also seems problematic that legal protection of network owners against abuses by the regulatory institutions should be undermined by the institutions' having a great deal of discretion, without much of a burden of proof for the appropriateness of their decisions.

Some of these issues are well known from discussions about competition law and competition policy. For close to a decade now, the European Commission has been promoting "a more economic approach". For the implementation of abuse-of-dominance control under Article 82 EC, this reform has been more difficult and more controversial than for other areas of competition law and policy, and is by no means complete. The reason is precisely that a more economic approach to the assessment of a given practice requires the authority to have more discretion in assessing the practice; such discretion is subject to the objection that it exposes the parties to the risk of wilful intervention without sufficient protection by the legal system.

The discussion about abuse-of-dominance control in the European Union is not only paradigmatic for the more general issue of how to deal with the tradeoff between the need to provide the authority with a measure of discretion and the need to provide the private parties with legal protection. This discussion is also directly relevant to the organization of statutory oversight over network industries in Europe. The reason is that sector-specific regulation is implemented under national law, which can void the application of national antitrust law but is itself overruled by EU law, in particular, the antitrust rules of the Treaty. Thus, a few years ago, the Commission ruled – and the European Court of Justice confirmed the ruling – that a certain price that had been charged by Deutsche Telekom – and that had been approved by the national regulator – was in fact predatory and therefore in conflict with the Treaty. At this point, the technical legal question of how to assess the relation between European law and national law in the regulation of network industries is joined with the substantive economic and political question of what is the proper relation between sector-specific regulation and competition law and policy.

C.III.1.2 Completed Research

With the departure of Carsten Burhop, Felix Höffler, Jos Jansen, and Susanne Prantl from the institute, and with the increased focus on financial stability, research output in this area has gone down significantly. The following account serves mainly as documentation showing how past preprints have made it into academic journals, usually with significant lags due to the time taken by the refereeing process. However, we do want to take this area up again in th efuture.

Topics in Sector-Specific Regulation

A systematic overview over the issues arising in sector-specific regulation and competition policy for network industries is provided in Hellwig (2009). The paper provides first an abstract discussion of the comparative advantages and disadvantages of the two policy regimes, with competition policy as a system

of prohibitions, with policy interventions taking place *ex post*, in a piecemeal, somewhat *ad hoc* fashion and sector-specific regulation as a regime which focuses on an industry as a whole, in systematic fashion *ex ante*, but with material choices taken by the regulator, rather than market participants. The basic reasoning is applied in discussions of how to determine which parts of an industry should be subject to sector-specific regulation and which ones should not, as well as questions of how to deal with issues of policy consistency when the same industry is subject to both, sector-specific regulation and competition policy, and to both, European law and national law.

Höffler and Kranz (2011 a, 2011 b) analyse the economic implications of legal as opposed to ownership unbundling of networks and other operations. Whereas, so far, the discussion on vertical integration versus unbundling has mainly focused on technical synergies and exclusionary abuses, Höffler and Kranz focus on the incentives that are driving the incumbent's activities in downstream markets. In their analysis, legal unbundling dominates ownership unbundling because, under legal unbundling, the incumbent retains a financial interest in the network. Because of this interest, the incumbent's subsidiary in downstream markets takes account of the fact that, from the perspective of the mother company, the marginal costs of network use to make additional sales are given by true marginal costs rather than the access price per unit: whereas the downstream subsidiary is paying the access price per unit, the margin of the access price over true marginal cost accrues to the network owner and therefore, under legal as opposed to ownership unbundling, to the mother company as well. In this analysis, legal unbundling appears as a device to overcome the well-known problem of double-marginalization in vertically separated industries.

Prantl (2012) provides empirical studies of entry regulation on entry activities and survival of entrants. The entry regulation they consider is the requirement of a "master" qualification for artisans who want to set up shop as independent entrepreneurs. They use the natural experiment provided by German unification in order to provide sufficient identification. Within a given system, say the system of the old Federal Republic before 1990, identification would be difficult because decisions to acquire the relevant human capital would already be determined by the existing set of regulations. For entry behavior after 1990, this endogeneity of human capital is at least to some extent reduced because human capital acquisition pre-1990 was hardly affected by West German regulation. The studies find strong restrictive effects of the regulation on entry, without any significant compensating advantages in terms of market outcomes, suggesting that the regulation serves mainly rent-seeking purposes.

Topics in Competition Policy

Cartels are an important object of antitrust analysis. Their study is not directly related to network industries (but see Höffler 2009). However, it provides an important application of the theory of collective goods. For the cartel members, the lack of competition which results from the cartel agreement has the features of a collective good. Compliance with the agreement is the analogue of a contribution made to the provision of this collective good. It is therefore of some interest to ask what implications can be drawn for the study of cartels from recent developments in our understanding of collective goods, in particular, from the experimental evidence showing that free-rider problems in collective-goods provision may be less prevalent than neoclassical economic theory would seem to suggest. This question had been treated by Engel (2007) with a comprehensive and systematic meta-study of oligopoly experiments, asking what factors are most responsible for the sustainability of collusion in such experiments, characteristics of products (e.g., homogeneity versus heterogeneity), markets (e.g., market size), properties of demand and supply functions, specifics of the strategic interaction (e.g., simultaneous versus sequential moves) and the information environment. Engel (2011a, 2011d) provides systematic assessments of the implications of theory and experimental evidence for the practice of competition law and competition policy. Engel (2011b) discusses

implications of experimental evidence for the design of research guidelines for R&D agreements. (The experimental work on antitrust is covered in greater detail in section C.II.1.2, b).

Economics of Innovation and Intellectual Property Rights

The law and economics of intellectual property rights are considered in Engel (2011c). Following previous work (Engel 2008), the paper argues that there are limits to the need for protection of intellectual property rights as an incentive to innovation.

Engel and Kurschilgen (2011) present experimental evidence on the implications of a new legal rule in Germany, which requires books publishers to provide authors with an improvement of contractual terms *ex post* if the book in question turns out to be a bestseller. The law stipulates that, if *ex post* negotiations do not lead to agreement, there should be an adjudication by a third party. The experiment investigates to what extent third-party adjudication of fairness *ex post* takes account of *ex ante* investment risks. The idea is that the publisher does not know beforehand which book will be a bestseller and therefore he needs bestsellers in order to cover the costs of losers. The experiment finds that willingness to take account of *ex ante* investments in assessing fairness *ex post* is in fact weak. The experiment also finds that this leads to a substantial reduction in *ex ante* investments. (The experimental work on intellectual property is covered in greater detail in section C.II.1.2, d).

The extent of the right to a trade secret is a focus of Bechtold and Höffler (2011). This paper was motivated by a case in the electricity industry where one company sued against outsiders installing devices underneath its transmission lines in order to find out which power plants were working and which were not, with a view to using this information by taking actions in the wholesale market. From this case, Bechtold and Höffler distil the problem of how to deal with the tradeoff between the supplier's investment and production incentives on the one hand and the efficiency implications of information asymmetry between the supplier and the demanders on the other hand. A simple result asserts that, unless the supplier is actually willing to spend resources in order to safeguard his trade secret, the efficiency implications of information asymmetry dominate concerns about the supplier's investment and production incentives. From this result, the paper infers that the right to a trade secret should not be accepted without question, but should at the very least be subjected to the test how much the supplier himself would be willing to invest to safeguard his secret.

Burhop and Lübbers (2010, 2012) study incentive contracting at seven leading chemical, pharmaceutical and electrical engineering companies in Germany in the late 19th and early 20th century. Burhop and Lübbers (2010) find that incentive devices were used, but no significant impact of incentives on innovations can be identified. For the same period, Burhop and Lübbers (2012) study the contracts by which these same companies obtained licenses to use the innovations of outsiders. Three quarters of these contracts involved individuals, one quarter other firms as licensors. Besides fixed payment components, contracts did involve significant variable payment components, most importantly profit sharing agreements.

Jansen (2011, 2012), Ganuza and Jansen (2013), and Filipini and Jansen (2011) analyse under what conditions firms actually have an incentive to maintain secrecy and under what conditions they are willing to disclose information; disclosure is of course a precondition for patenting. The key issue is that disclosure affects competing firms' beliefs about a firm's technology and thereby their behaviours. Disclosure may enable competing firms to acquire the same technology cheaply, but it may also signal the innovating firm's advantages and discourage them from even trying to compete. Depending on parameter constellations, voluntary disclosure can therefore be part of an equilibrium even if there is no patent protection. However, with sufficient asymmetry across firms, it is also possible that concealment is preferred because it has a greater discouragement effect on competitors (Jansen 2012). The choice between patenting (disclosure) and secrecy also depends on competitive pressures. Interestingly, incentives to patent go up when

competitive pressure takes the form of greater substitutability of products and down when competitive pressure takes the form of a greater number of competitors (Jansen 2011).

C.III.1.3 Research Questions

To make progress in thinking about the general issues discussed above, we intend to work on the following specific questions:

- To what extent is there a conflict between the requirements for regulation set forward in European law and in German Constitutional Law? Tension arises not only from concerns about the democratic legitimacy of regulatory decisions and about the scope of legal protection for the addressees, but also from concerns about the role of foreign institutions, in this case the regulatory authorities of other member states, in national regulatory decisions.
- Are there modes of procedure that satisfy the economist's concern for efficiency as well as the lawyer's concern for due process in regulation? In 2002, the Monopolies Commission proposed a two-stage procedure whereby, at one stage, the authority determines, e.g., a system for allocating fixed and common costs, and at the second stage, the authority determines the individual price, the idea being that, at stage 1, the addressee can question the appropriateness of the chosen system, and, at stage 2, he can question the way the system is being applied, without, however, questioning the appropriateness of the individual price on substantive grounds.
- In some network industries access regulation is complicated by the fact that access can be provided at several stages of the value creation chain. This raises a question of the consistency of different access prices. If one believes that it is unrealistic to suppose that regulation can get the system of access prices right, one must ask which types of error are more important: errors that hurt entrants further upstream, who partly build their own infrastructures; or errors that hurt entrants further downstream, who don't build much of an infrastructure at all.
- What is an appropriate procedure for calculating capital costs? The 2003 report of the Monopolies Commission shows that currently applied rules involve inappropriate measures for risk premia and an inappropriate treatment of corporate and personal income taxes. The implications of this critique need to be developed formally. To the extent that an appropriate treatment of risk premia imposes unrealistic information requirements on the regulator, suitable proxies must be proposed.
- If grids need to be vastly expanded in order to take account of the replacement of nuclear and fossile generation by generation from renewable sources, what needs to be done to ensure that the regime for access regulation will not destroy the necessary investment incentive, and how can appropriate funding be assured without generating moral hazard from subsidization?

C.III.1.4 References

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C.III.2 Financial Stability and the Regulation of Financial Institutions and Financial Markets

C.III.2.1 General Overview

Discussions of collective goods do not usually refer to the financial sector. However, collective-goods aspects play an important role in arguments about statutory regulation in this sector. In most countries, financial-sector regulation is more stringent than the regulation of other sectors. A first line of argument justifies this regulation by referring to problems of asymmetric information and moral hazard in financial relations, but that raises the question why the regulator should be able to handle these problems better than the parties themselves. A second, more solid line of argument then refers to the systemic, collective-goods aspects that arise because the handling of asymmetric-information and moral-hazard problems by the contracting parties has repercussions for the rest of the system.

Such collective-goods aspects can be due to *domino effects* or to *confidence effects,* acting alone or in combination.[1] *Domino effects* arise when outcomes in one set of financial relations or financial transactions have implications for the participants' relations with third parties. In a simple case, the insolvency of a firm or a set of firms brings the firms' banks into difficulties, and this has repercussions for the banks' depositors and other financiers. A recent example was provided by the 1997 crisis in Thailand, when the devaluation of the Baht induced defaults by many Thai firms that had borrowed in dollars. These defaults in turn compromised the solvency of the Thai banks that had lent to these firms and caused problems for the international banks that had lent to the Thai banks. Another important example occurred n September 2008, when the Lehman Brothers bankruptcy caused the Reserve Primary money market fund to "break the buck", so that the value of a share went below $1, inducing a run of depositors on Reserve Primary and other money market funds.

Domino effects can also arise through markets. A financial institution that gets into difficulties may be forced to sell its assets. By putting the assets on the market, it may depress asset prices. The decrease in asset prices in turn may put pressure on other financial institutions that have also invested in them. A domino effect arises even though there may be no contractual relation at all between the first institution and the others. Thus, in 1998, the Federal Reserve Bank's organization of an operation to rescue Long Term Capital Management (LTCM), at least for the time being, was motivated by fear that an immediate closure and liquidation of LTCM's assets would have a drastic effect on the prices of long-term bonds to the detriment of all financial institutions that were holding these bonds. As discussed in Hellwig (2008/2009, 2010a, 2010b) and again in Chapter 5 of Admati and Hellwig (2013 a), such "fire sale effects" also played a central role in 2007 and 2008, with a slow downward spiral of asset values and bank balance sheets from July 2007 to September 2008 and a dramatic downturn after the Lehman Brothers bankruptcy.

A final domino effect concerns the macroeconomy. A financial institution that gets into difficulties is usually unable to continue its financing operations on the same level as before. Its clients may find it expensive or difficult to get funds elsewhere because nobody else knows them as well as their previous partner. If many financial institutions get into difficulties at the same time, there may then be a "credit crunch", leading to an overall decline in external investment finance and in aggregate investment activity, with further repercussions on aggregate demand and employment in the economy. These kinds of "multiplier effects" of financial crises on macroeconomic investment played a major role in the Great Depression, as well as the banking crises and macroeconomic recessions of the early nineties in the Scandinavian countries. Remarkably, such effects have been much weaker for stock market downturns (1987, 2001) than for real-estate and banking crises (early 1990s and since 2007).

[1] For a systematic discussion, see Staub (1998), Hellwig (1998 b) and, more recently, Hellwig (2008/2009, 2010a, 2010b), Wissenschaftlicher Beirat (2010), Admati and Hellwig (2011, 2013 a).

Confidence effects are important because the willingness to participate in financial relations depends on confidence, which in turn depends on what one sees happening in the financial system. If one bank goes under, another bank's depositors may become apprehensive and start to withdraw their funds, putting pressure on that bank's liquidity. With deposit insurance, nowadays, depositors may be less fidgety. However, several episodes of the financial crisis show that the effect is still very relevant for non-bank institutions such as money market funds and hedge funds. When, as mentioned above, the Lehman Brothers bankruptcy caused the Reserve Primary Fund to "break the buck", there was a run not just on Reserve Primary but on all money market funds, forcing these funds in turn to reduce their lending, to European banks such as Dexia, as well as US investment banks, which themselves were also affected by a drop of confidence from the Lehman bankruptcy. If the different banks' or funds' asset positions are correlated, such behaviour is fully rational, reflecting the information provided by the first institution's difficulties.

Similarly, somebody's wanting to sell an asset may contain information about the asset. If people are thereby induced to be apprehensive, market liquidity is greatly reduced. In the LTCM crisis, the price effects of immediate closure and liquidation were deemed to be incalculable because market participants were apprehensive about the prospect of a crisis, and the closure itself might have provided a bad signal, making people unwilling to buy the assets that LTCM would have had to liquidate, except at greatly depressed prices. In the financial crisis of 2007 – 2009, similar effects caused the markets for mortgage-backed securities and collateralized debt obligations to freeze and contributed to the downward spiral and eventual implosion of the system.

In the LTCM crisis, concerns about the impact of an insolvency was a major reason for at least temporary forbearance. The Federal Reserve Bank induced a consortium of major creditors to bail LTCM out, making room for an orderly liquidation over time, rather than a Chapter 11 bankruptcy. At the time, there was no desire to do experimental research on the systemic effects of such a bankruptcy in a situation of market nervousness as well as legal uncertainty about the treatment of complex contractual structures with many large counterparties in multiple jurisdictions. Ten years later, the experiment was carried out anyway with Lehman Brothers and the domino effects were such that governments all over the world found themselves forced to put taxpayer money at risk for bank guarantees and recapitalizations. The collective bads of domino effects and confidence effects were eventually reined in, but by that time, much damage had been done.

The experience of the crisis demonstrates the importance of having collective-goods concerns bear on the decision making of bankers and supervisors. In contrast to the network industries, the collective-goods concerns here are not associated with any one good that is bought or sold, but concern the functioning of the overall system of institutions, contracts, and markets. The actions that individuals take and the contracts that groups of individuals write have repercussions for the functioning of the system, but people do not consider these repercussions. Actions are taken from the perspective of the individual person or institution in question, contracts are written from the perspective of the participants – how they affect the system is of little interest to them.

This is where statutory regulation and supervision of financial institutions and financial markets come in. In principle, this regulation is intended to induce participants to adjust their behaviours so that collective-good aspects are duly taken into account. Thus, traditional asset allocation rules and capital adequacy requirements are meant to protect the solvency of financial institutions and to eliminate the possibility of domino effects even before they have a chance to get started. Publicity rules for listed securities, as well as rules against insider trading regulations of market microstructure, are meant to protect the orderly functioning and the liquidity of markets by eliminating the worst instances of asymmetric information leading to market breakdown. In the context of banking, rules for the resolution of banks in difficulties must also be considered.

However, the incidence of statutory regulation is not always clear. Poorly designed rules may well be counterproductive. Thus, statutory deposit insurance seems to have played a role in exacerbating the crisis of the savings and loans industry in the United States in the nineteen-eighties. The enhancement of depositor confidence by deposit insurance may avert destabilizing bank runs, but it also worsens the incentives of depositors to monitor the institutions in which they deposit their money and, by implication, the incentives of these institutions' managers to avoid exposing their institutions to excessive risk. In the eighties, this latter effect prevailed when institutions close to insolvency were "gambling for resurrection", using advertisements of high interest rates on "federally insured deposits" to expand their deposit base and thereby the funds they had available for such gambling.

Capital adequacy requirements, which, over the past two decades, have become a mainstay of banking regulation, have also been questioned. Initially, in the early nineties, discussion focussed on incentive distortions due to inappropriately chosen "risk weights" in capital requirements. In the late nineties, discussion has turned to the procyclical macroeconomic implications of more finely tuned capital requirements, as well as the implications of such requirements on the actual risk exposure of the financial system. The financial crisis has confirmed these concerns and triggered a quest for suitable "macroprudential" rules. As yet, however, there is little understanding of the difference between macroprudential rules that focus on macroeconomic flow variables such as new lending, aggregate investment and aggregate demand and macroprudential rules that focus on the problems of system adjustment to a misalignment of stock variables when writedowns on assets reduce bank capital and the ensuing deleveraging induces further price declines.

For the lawyer, financial regulation raises even more questions than the regulation of network industries. The concerns about democratic legitimacy and the rule of law that were discussed above for the regulation of network industries must also be raised here. Democratic legitimacy is in doubt because the "Basel process" for developing rules for capital regulation has not really been controlled by any institutions whose legitimacy was based on democratic elections. While the individual members of the Basel Committee on Banking have been appointed by their respective national governments, the Basel Committee as such has worked as a committee of experts with little outside interference, except for pressure from the industry lobby, and has presented its accords for individual countries, or the European Union, to adopt. Parliamentary involvement in legislation was practically non-existent. This was as true for "Basel III" as previously for "Basel II"; the process of legislation for the Capital Requirements Directive IV/Capital Requirements Regulation (CRDIV/CRR), which is supposed to implement "Basel III", suggest that, with the European Commission's monopoly on initiating legislation, a similar deficit exists in that context.

At the level of rule implementation, i.e. of banking supervision, concerns about the rule of law arise with respect to the handling of the model-based approach to determining required capital and with respect to the valuation of a bank's assets and the assessment that the bank is in difficulties. Within the model-based approach, the assessment of the model used by a bank involves an important element of arbitrariness. Backtesting of such models could be helpful if the underlying data exhibited sufficient stationarity. In practice, however, they do not; this is a problem for the banks themselves and even more so for the bank supervisors. Important elements of arbitrariness are also involved in the valuation of loans that the bank has made and in the supervisory assessment that a bank is in such trouble that it ought to be closed. If loans are not traded in open markets, there is no extraneous measure of borrower solvency and, hence, no "objective" valuation standard.

All of these assessments require judgment and can hardly be codified so as to lend themselves to sensible court proceedings. Even if a court review of such administrative decisions was feasible, it would hardly be effective. By the time the courts rescind an unjustified regulatory intervention, the damage may be beyond repair. The major damage is likely to involve reputation and depositor confidence. These are difficult and sometimes even impossible to restore once they have been impaired. Given the role of discretionary

judgment and given the substantive importance of supervisory intervention for a bank, the question how such decisions can fit into the framework of German constitutional and administrative law is even more puzzling than for the regulation of network industries.

Some of these issues are bound to come up with the single supervisory mechanism (SSM) for the euro area. Under this mechanism, ultimate responsibility for banking supervision will rest with the European Central Bank (ECB), which is given the task to apply and enforce all relevant EU law. However, in the case of directives, which are not directly applicable, the ECB will have to apply the national laws that implement the directives, subject to national judiciary review. Most of the issues involving discretionary judgment ("Pillar 2" of the Basel Accords) are dealt with in directives rather than the regulation. Moreover, on these issues different member states have different legal traditions. There is thus a lot of room for frictions and conflict.

C.III.2.2 Completed Research

"The Bankers' New Clothes" and "Fallacies,…"

The main product of the past two years has been the book "The Bankers' New Clothes: What's Wrong with Banking and What to Do about It", by Admati and Hellwig (2013 a), which appeared in the spring of 2013. The book has three purposes. First, it debunks flawed arguments that are used by bankers and others to fight against banking regulation. Second, it provides an overview over the history of banking and banking regulation during the past century, including the recent crisis. Third, it makes a contribution to the policy debate, arguing that much higher equity requirements for banks would be appropriate and, moreover, the use of risk weights should be abandoned.

The book originated from discussions on what to do with Admati et al. (2010/2013), which is too long for a journal article and too short for a monograph. Our experience in policy discussions about banking regulation had suggested that it would be more useful to pursue a more ambitious comprehensive treatment of banking problems, which moreover ought to be addressed at a general audience rather than professionals such as academics, regulators, and bankers. The final product combines material from previous work, such as Admati et al. (2010/2013) or Hellwig (2008/2009, 2010 a) and Admati and Hellwig (2011), with more basic material about the concept of equity, the role of banks in the economy, and the development of banking in the 20th century. The material comes in two different modes, the main text, which tries to communicate the issues to the general reader, and a set of extensive notes, which gives references and which takes up the details of the various academic and political disputes.

The first part of the book develops basic notions of equity as a residual on the right-hand side of the balance sheet and as a mode of funding, leverage, illiquidity and insolvency, deposit banking, and maturity transformation. It also explains the history of banking crises, regulation and deregulation, and the demise of the Glass-Steagall system in the United States, the different kinds of risks in banking and the different kinds of contagion mechanisms, in particular, as they played out in the crisis.

The second part of the book considers banking regulation and regulatory reform, expressing scepticism about the scope for eliminating the too-big-to-fail status of banks and about the scope for containing systemic risk (and eliminating the need for taxpayer support of failing institutions). This part also explains the focus on equity regulation as a way of improving the banks' ability to absorb losses, of improving liability of bank owners and managers, and of reducing contagion from fire sales after losses. (If equity accounts for 2 percent of total assets, a loss on the order of 1 percent of assets wipes out half the equity, so 50 percent of the assets must be sold to re-establish the 2 percent equity ratio; if equity accounts for 20 percent of assets, only 5 percent of assets must be sold for this purpose.)

This second part of the book provides a systematic explanation of the different objections to equity requirements that Admati et al. (2010/2013) characterized as "fallacies, irrelevant facts, and myths" – statements that are conceptually flawed, such as a confusion between equity and cash, statements that are correct but irrelevant for welfare assessments, such as the finding that more equity funding and less borrowing would increase the bank's corporate tax bill (and raise the government's tax revenue), and, finally, theoretical models that claim to explain the use of deposits for bank funding and are inappropriately used to justify keeping equity requirements low.

Whereas the discussion of theoretical models of bank finance in the original version of Admati et al. (2010/2013) had mainly focused on models of debt as a means of imposing discipline on bankers, the discussion in Admati and Hellwig (2013 a) focuses mainly on models of bank deposits and other short-term debt as a means of providing customers with "liquidity".

We criticize this literature, most importantly Gorton (2010, 2012) on two grounds. First, the explanation of the crisis of 2007 – 2009 as a result of a pure liquidity breakdown overlooks the severe solvency problems that arose because banks were poorly capitalized; it also overlooks the contagion effects that were due to poorly capitalized banks scrambling to deleverage through asset sales. These omissions are facilitated by a sometimes selective, sometimes inaccurate use of empirical material. For example, the breakdown of funding for shadow banking institutions holding mortgage-backed securities and collateralized debt obligations in the summer of 2007 is interpreted as a liquidity problem. However, all that happened was that the regulated banks which had sponsored these institutions were forced to make good on the guarantees they had given and to take the toxic assets onto their own balance sheet. These banks then were squeezed for equity, and some would have been insolvent without government support, but they did not have liquidity problems. Second, the liquidity literature fails to consider the possibility that having more equity reduces the vulnerability of banks to losses and thereby actually enhances the liquidity of bank debt.

By contrast, the "debt-as-a-disciplining-device" literature, which was at the center of the discussion in Admati et al. (2010/2013) receives only a cursory treatment in the book because people from the political, regulatory, and banking communities had told us that "this was an academic thing", of little interest to the actual political discussion. A critique of this literature is, however, presented in Admati and Hellwig (2013 b), posted on the web as an "omitted chapter" from the book. Ironically, the two literatures that consider short-term funding of banks to be highly desirable, even if there is a risk of liquidity crises, are based on contradictory assumptions about the role of information. The literature on bank debt as a disciplining device assumes that depositors and other short-term creditors are constantly on their toes, monitoring everything the bank's managers do, and ready to run whenever they see something untoward. In contrast, the literature on liquidity provision by banks is based on the idea that debt is "information insensitive" in the sense that, under normal circumstances, debt holders do not care about the bank's assets because, in contrast to shareholders, the returns they will get do not depend on the bank's returns on its assets.

The third part of the book proceeds to a discussion of policy issues, beginning with the debate about "BaseL III", developing our own recommendations, and commenting on the political debate so far, political economy and convenient narratives that can be used to deflect calls for regulatory reform. This part calls for substantially higher capital requirements than are stipulated in "Basel III". It also calls for abandoning the reliance on risk weights, in particular, under the model-based approach, which is highly manipulable. Problems with risk weights had previously been raised in Hellwig (1008/2009, 2010). In his doctoral research, Markus Behn provides empirical evidence of the problem; see Behn et al. (2014).

The books was widely reviewed and discussed. Many reviews were favourable, some unfavourable. Many of the unfavourable reviews repeated arguments about banks that actually had been discussed and dismissed in the book, without however engaging on substance. This observation motivated the writing of Admati and Hellwig (2013 c), "The Parade of Bankers' New Clothes Continues: 23 Flawed Claims De-

bunked", a series of short pieces taking up one claim after the other and giving the essential arguments about them.

By now, a Spanish and a German translation of the book have also come out. Japanese, Chinese and Italian translations are in preparation.

In the meantime, Admati et al. (2010/2013) has also been thoroughly revised. Relative to the original version, which was extensively discussed in the report two years ago, major changes involve (i) a more precise discussion of issues concerning debt overhang and asymmetric information (see below), (ii) a more extensive discussion of the liquidity argument for the importance of debt finance of banks, and (iii) an extensive discussion of the proposition, often heard in policy debate, that higher equity requirements would harm bank lending and growth. An important point here concerns timing: If a bank is indeed unable to raise more equity today, a stricter equity requirement reduces the amount of loans and other investments it can make today, but at the same time, this requirement is likely to increase the amount of loans and other investments the banks can make a year from now if, in the meantime, it has incurred losses; after all, the biggest downturn in lending and growth since the Great Depression of the 1930s occurred in the fourth quarter of 2008, after the Lehman Brothers bankruptcy. For the reasons given above, final publication of this paper continues to be in limbo but meanwhile the number of downloads on SSRN has risen over 4000.

Analytical Contributions: Debt Overhang

Whereas Admati et al. (2010/2013) as well as Admati and Hellwig (2013 a, 2013 b, 2013 c) can be regarded as pieces of synthesis, we have also moved forward with new analytical contributions.

Admati et al. (2012) and Admati et al. (2013) consider the dynamics of bank funding in the absence of binding commitments about future recapitalizations. These papers argue that shareholder resistance to increases in equity mainly due to the effects of debt overhang along the lines of Myers (1977). This is in contrast to the literature, which mostly attributes such resistance to the effects of asymmetric information that were treated in Myers and Majluf (1984). However, the Myers-Majluf argument cannot explain shareholder resistance ot increases in equity that take place through retained earnings or through rights offerings. In fact, Myers and Majluf claim that retaining earning is a cheaper form of funding than debt. Moreover, if new equity is raised through rights offerings,, incumbent shareholders of highly profitable companies can avoid the asymmetric-information costs of dilution because they can exercise their acquisition rights and hold the additional shares until the profitability of the firm is recognized by the market.

By contrast, the debt overhang argument applies to all forms of increases in equity. IN its simplest form, the argument starts from the original propositions of Modigliani and Miller that, in the absence of distortions and frictions, the value of a firm and the cost of capital of a firm are independent of its financing mix. As discussed in the fallacies part of Admati et al. (2010/2013), this proposition implies that, ex ante, before any securities have been issued, a corporation's owners are indifferent about the choice of funding mix. Subsequently, however, after some debt, and possibly some outside equity, has been issued, they are no longer indifferent. At this time, a recapitalization that lowers the probability that the firm might go bankrupt provides a benefit to debt holders. The Modigliani-Miller Theorem implies that the total value of the firm is unchanged. Unless debt holders can be made to pay for the benefits they obtain, it follows that shareholders must lose. Debt holders can perhaps be made to pay if the recapitalization involves some kind of collective bargaining. If instead there is simply a debt buyback in the open market, the price at which the buyback occurs will already reflect the increase on the value of the debt that is due to the reduction in the bankruptcy probability, a phenomenon that is well known from experiences with buybacks of sovereign-debt, such as Bolivia 1988 or Greece 2012. The reason is that, if debt holders can choose whether to hold

on to the debt or to sell it, they will only sell if the price is high enough to compensate them for the benefits from holding the debt, taking account of the improvement in these benefits from the buyback itself.

In this setting, debt holders fully appropriate the benefits from a debt buyback, and shareholders resist such a buyback. Indeed they will resist an increase in equity no matter what form it might take. Like the effects of taxes and bailout subsidies, This is a private cost of additional equity funding that does not reflect a social cost. Indeed, the debt overhang effect generates resistance to a recapitalization even when such a recapitalization would be beneficial to the firm and to society as a whole. It might actually do so even if the benefits from avoiding bankruptcy were very large. By contrast, in Myers (1977), the debt overhang effect works only if benefits from new investment are sufficiently small.

Admati et al. (2012, 2013) show that the effect of debt overhang on shareholder preferences with respect to additional debt and equity issues is very robust to changes in the structure of the model. They argue that this effect can make for a "leverage ratchet" where debt goes up if negative shocks require additional funding but fails to go down if positive shocks generate additional earnings.

Admati et al. (2012, 2013) also consider shareholder preferences over different modes of dealing with a regulatory requirement to raise the ratio of equity to assets. In the simplest formulation, they obtain a striking neutrality result: If there is a single class of debt, a single homogeneous asset, and the price of the asset is equal to the expected present value of returns taking account of tax and bankruptcy cost effects, then shareholders are indifferent between (i) asset sales used to reduce debt, (ii) an equity issue used to retire debt, and (iii) an equity issue used to buy more of the asset. The neutrality result breaks down if the price of the asset Is not equal to the expected present value of returns taking account of tax and bankruptcy cost effects, or if there are multiple classes of debt and/or multiple classes of assets, and the operation can be used in discriminatory fashion to make some incumbent debt holders worse off. For example, with multiple debt classes and multiple assets, a sale of relatively safe assets and reduction of junior debt makes senior debt holders worse off and will be preferred by shareholders. Predictions from this analysis are much in accord with experiences in Europe over the past few years.

Analytical Contributions: Liquidity Provision and Equity Funding

In a forthcoming new paper, Hellwig (2014) considers the question whether liquidity provision and equity funding of banks are substitutes or complements. This research was triggered by DeAngelo and Stulz (2013) following Gorton's line of argument and claiming to show that banks should fund with deposits only because any equity funding would detract from liquidity provision through deposits. The DeAngelo-Stulz paper has two major shortcomings. First, it considers bank optimization for a given assumed constellation of interest rates for deposits and loans, but fails to do the requisite equilibrium and welfare analysis. Second, it assumes that bank returns and deposits are riskless, so there is no reason to worry about default.

Hellwig (2014) develops a general equilibrium model with many consumers and many banks in which deposits provide liquidity benefits by a "warm-glow" effect on their holders, the details of which are not analysed. However, the warm-glow effect occurs only if the bank is not in default. Three sets of models are analysed, first a model without uncertainty, then a model with uncertainty and full commitment of banks to their funding policies, finally a model with uncertainty and a lack of commitment of banks to their funding policies. For the model with uncertainty, the analysis shows that there are two types of equilibria: If consumers' savings are small enough, any savings will go into bank deposits. There may be a threshold however, above which it would be inefficient to have additional savings go into deposits because the additional costs exceed the additional benefits. In this case, equilibrium deposits are equal to the amount

where marginal costs and marginal benefits are the same and any additional savings go into shares or bonds, with a Modigliani-Miller indeterminacy result for the mix of the two.

For the model with uncertainty and full commitment, the distinction between equilibria involving deposit satiation and equilibria without deposit satiation remains relevant. However, even the equilibria without deposit satiation typically involve share finance; indeed they must do so if the marginal cost of deposit provision is constant (e.g., zero). By reducing the default probability, equity funding enhances the liquidity of deposits. Whereas bond finance is undesirable, the choice of an equity-deposit mix involves a trade-off between having more liquidity providing deposits providing liquidity and having better liquidity providing deposits. The case of constant returns to scale is one where, in equilibrium, the banks' charter value is zero and, in the absence of equity funding, default would occur with probability one, i.e. there wold be no liquidity benefits from deposits at all.

If the liquidity benefit function is linear, i.e., the product of deposit size times the marginal liquidity benefit is equal to the total liquidity benefit, equilibrium allocations in the model with commitment are efficient. If instead the marginal liquidity benefit function is decreasing, equilibrium allocations involve too little equity finance. The reason is that, in the trade-off between having more liquidity providing deposits providing liquidity and having better liquidity providing deposits, the banks neglect part of the gain in consumers' surplus from deposit liquidity that results from increasing equity and lowering the default probability.

In the model with uncertainty and no commitment, the lack of commitment creates what is probably a more important source of inefficiency. In this model, a combination of the debt overhang effect discussed in Admati et al. (2012, 2013) and the Coase conjecture for durable-goods monopolists leads to the conclusion that equity funding is always inefficiently low. Indeed, with constant returns to scale in deposit provision, banks will end up with 100 percent funding by deposits, a 100 percent probability of default, and no liquidity benefits from deposits at all. A version of the Coase conjecture implies that, in this model, banks behave as price takers and do not consider the effects of changing their funding mix on the interest rates they have to pay. Without even considering the need for consumer protection or the systemic fallout from bank bankruptcies, in this model, statutory requirements for bank equity are called for as a mechanism to compensate for the effects of banks' not being able to commit their future borrowing.

The contributions by Admati et al. (2012, 2013) and Hellwig (2014) point to an important methodological issue. Ever since Jensen and Meckling (1976), economic theory has pursued the research program of "explaining" observed contracts and observed institutions as efficient way to deal with some information and incentive problems. This research program has been very fruitful but it has also introduced a bias into our welfare assessments. If we "explain" what we observe with reference to some optimization problem under information and incentive constraints, we are bound to find that equilibrium outcomes are efficient and any government intervention would be harmful.

However, any such efficiency assessment depends on the commitment technology that is assumed. If commitment possibilities are weak, observed leverage of banks may reflect the desire of bank managers and new creditors to conclude new debt contracts at the expense of incumbent creditors rather than any efficiency-enhancing effects of debt finance. In practice, commitment problems are evident in the creation of contracts such as repo borrowing and lending that are specifically designed to jump maturity and priority queues – and that, presumably, have such collateral that creditors do not invest in information as would be required for debt as a disciplining device.

Analytical Contributions: Liquidity Provision and Government Debt

Two forthcoming papers by Luck and Schempp (2014 a, 2ß014 b) consider the liquidity provision by banks in a standard Diamond-Dybvig model with the modification that the short-term storage technology of Diamond and Dybvig (1983) is replaced by third parties providing banks with the resources needed to satisfy liquidity needs, receiving claims on future earnings instead. In the absence of government intervention, the model now gives rise to the possibility of twin runs, from withdrawals of deposits and a third-party refusal to provide new loans. In this setting, each kind of run can be triggered independently, but if one is triggered, the other will follow automatically.

Government intervention can sometimes improve upon the situation. One possibility is for the government to provide insurance of all creditors. Another would be for the government to step in itself, along the lines of Holmström and Tirole (1998), issuing long-term debt to acquire resources, investing these resources with banks, allowing the banks to make long-term investments only and having the holders sell the government debt to third parties when they need to. These forms of intervention work if the government is known to be always solvent. If, however, a bank breakdown affects the government's ability to raise funds in order to repay its debts, the twin runs problem can apply with government support as well as without.

In a multi-country setting, with cross-border investments of financial-market actors, the twin crisis problem can be a reason why the government of one country might intervene to support the other country when this is necessary to avoid twin runs in the other countries affecting the seemingly stronger country through contagion.

Analytical Contributions: Equity Markets and Information

As mentioned above, models showing that callable debt induces discipline because managers fear a run by debt holders usually have no room for outside equity at all. Within the models, zero equity issue is optimal (as in the certainty version of Hellwig (2014)), and, if we are honest, we must admit that our profession has no really good model of outside equity at all. In the real world, however, corporations do issue outside equity to strangers who trade these securities on exchanges. Moreover, corporate managers have to some extent submitted to "market discipline" from shareholders, and "shareholder value" has become an accepted measure for management performance. In the real world therefore, there is a question as to how incentives from debt finance interact with incentives from equity finance.

This is in part a question about information collection and transmission. Given that equity is more information sensitive than debt, one would expect shareholders to invest more in information acquisition than debt holders, and one would expect debt holders to free-ride on the information contained in stock prices. Such behaviour would imply an absence of debt holder discipline in the upswing and a run of debt holders in the crisis, precisely the pattern that we have seen in 2004 – 2007 and 2007 – 2008, without much discipline when the risks were taken.

A full-fledged analysis of the issue has so far eluded us. However, a first step is taken by Gorelkina and Kuhle (2013) in a model of information acquisition by shareholders and information aggregation and transmission through stock prices. Creditors are assumed to condition their actions on stock prices. Firms are shown to internalize some of the externalities inherent in shareholders' investing in information and having the infomration communicated through share prices; this is possible because firms with a strong fundamental will issue more equity and less debt than they would without the informational spillover. In the larger market, more equity is traded, and incentives ro invest in information are stronger.

Analytical and Policy Contributions: Bank Resolution

Resolution of difficulties in financial institutions is a major problem for legislation. Existing institutions and rules for resolution have been largely inspired by analogies to insolvency law. As such they are not well suited to handling systemic risk, i.e., the risk that statutory intervention in the bank may trigger an avalanche of problems at other banks. Fear of such risk was a major reason why, in the fall of 2008, many governments intervened without using existing laws. Since then, there has been an ongoing debate about a reform of the legal arrangements.

Some countries, such as the US and the UK, have been very thorough and pragmatic, formulating the new rules so as to minimize systemic risk (Dodd-Frank Act in the US, Banking Act of 2009 in the UK). Others have been inactive or, like Germany, provided for legal reform that is so much wedded to old ways of thinking that it does not really address the problem. For a critique of the German Bank Restructuring Act of 2010 and a systematic discussion of the issues, see Hellwig (2010 b, 2012).

The subject is taken up again in three reports of the Advisory Scientific Committee of the European Systemic Risk Board (2012 a, 2012 b, 2013). The first of these reports begins by considering the role of forbearance in times of difficulties, forbearance of banks towards their debtors and of supervisors towards their banks. Concerning the former, the report notes that there is no way to distinguish "good forbearance" and "bad forbearance", since any decision to be patient with a debtor in the hope that the money will be paid later after all is a decision under uncertainty which can turn out badly or well without any way to tell beforehand which it is going to be. The proper distinction is therefore not between "good" and "bad" forbearance but between forbearance decisions that rest on standard entrepreneurial considerations and forbearance decisions that serve to arbitrage around creditors and supervisors. For example a bank might exert forbearance towards it6s debtors because it wants to avoid having a credit event and having to take a write-down on its claims. At that point, the question is why supervisors would tolerate such behavior. The answer of course might be that they do have confidence in the resolution regime and the ability of responsible authorities to deal with problems once they are brought into the open. The report then goes on to discuss difficulties in resolution that a viable resolution regime should handle. It also moves forward with a suggestion for a European banking union that would encompass resolution as well as supervision. The second report of the Advisory Scientific Committee (2012 b) reaffirms the need to deal with resolution as well as supervision.

The latest report considers the issue of bail-ins and systemic risk in resolution. Two major points are (i) the need to make creditors liable, as they would be under insolvency law, and (ii) the need to think about closing banks down as well as protecting them. The first point concerns the need to give the banks' creditors appropriate incentives to take care as to who they lend to. The second point concerns the need to allow for a downsizing of the industry if the underlying problem is one of excess capacity combined with artificial exit barriers, which may be enhanced by bailouts. The problem of excess capacity had previously been raised in Zimmer et al. (2011), which suggested that among the possible exit strategies for the German federal government's crisis-induced participations in banks, closing the banks down was to be taken very seriously since otherwise the necessary adjustment of market structure might not take place.

C.III.2.3 Research Questions

Like the organization and regulation of network industries, the financial sector provides research questions for both lawyers and economists:

- How will the governance of financial supervision be affected by the new European legislation. For financial supervision, the question concerns the relation between the European Central Bank as the su-

pranational supervisor in the euro area (and other countries that join) and the different national supervisors in a setting in which much of the law consists of national law implementing European directives. The question also concerns the relation between the euro area and the non-euro members of the European Union and the relation between euro area institutions and European Union institutions such as the European Banking Authority and the European Systemic Risk Board.

- In substantive terms, key questions concern the different approaches taken in different countries, and in the European Union as a whole, to the trade-off between the practical need for discretion and the legal concern about democratic legitimacy. To what extent is this trade-off affected by the observation that democratic legitimacy itself is compromised if impracticalities in existing legislation force the government to introduce shotgun legislation to provide remedies in emergencies? To what extent does the European umbrella make a difference? This question is also arising in the context of legal disputes about the European Central Bank in its own domain.

- How are we to assess the relation between supranational supervision, national or supranational resolution, and national or supranational fiscal authorities? Given that bank resolution requires funding, from bank restructuring funds or from taxpayers, activities of supervisory authorities and resolution authorities have fairly direct implications for fiscal authorities. In the European context, the question is to what extent resolution should be handled at the national or the supranational level and how the financial burden should be divided. This is both a question about the sharing of losses from past activities and a question about governance and funding for the future. Can resolution work without a backstop at the European level? And can such a backstop work without the power to tax? How are the constitutional problems to be handled?

- Financial regulation is motivated by a desire to protect the financial system. However, the addressees of financial regulation are the individual institutions. How do these things go together? Banking regulation and supervision is intended to eliminate systemic risks. For the economist, this raises the question by what mechanisms the regulation of individuals safeguards the functioning of the system. For the lawyer, this raises the question as to what precisely is being protected and how the desire for protection supports the rules that are imposed on individual institutions.

- Ongoing discussion about the role of macroprudential concerns highlights the issues. In the new institutional framework of the European Union, macroprudential concerns are in principle a charge of the European Systemic Risk Board (ESRB). The ESRB itself does not have responsibility for microprudential supervision. However, microprudential supervision has macroprudential implications, as can be seen by the sequence of events following the September stress test by EBA and the October Summit's call for a recapitalization by June 2012. The deleveraging that was induced here, purely as a matter of microprudential concerns, affects markets and prices and risks feeding right back into bank balance sheets, thereby destroying the very purpose of the exercise, following the pattern of 2007/2008. Similarly, countercyclical capital buffers as stipulated by Basel III, are microprudential measures that serve a macroprudential purpose.

- The notion of macroprudential concern itself needs clarification. Much of the literature fails to distinguish between concerns related to macroeconomic flows of new lending, investment and aggregate activity and concerns related to outstanding stocks, asset values, asset prices, and funding structures. The distinction needs to be made and supplemented with a distinction of regulatory and supervisory measures that are appropriate for dealing with them.

- What tradeoffs have to be considered in financial regulation? Relevant tradeoffs concern risk sharing and moral hazard through securitization, effectiveness of "market discipline" and vulnerability of institutions to market vagaries, efficiency gains and contagion risks from having more extensive markets.

- What are appropriate governance mechanisms for financial institutions? What scope is there for counteracting the yield bias of prevailing incentive systems, in particular those that are based on "market discipline" and "return on equity" (ROE)? Taking the notion of debt as a disciplining device seriously, what can be said about the respective roles of debt and equity in view of the incentives that come from stock markets, "shareholder value", and ROE?
- Is the kind of formula-driven system of capital regulation and supervision that we have the best way to counteract excessive risk-taking incentives? Are there mechanisms by which one can give effective "voice" to the concerns of creditors and tax payers in banking governance, e.g., by having compulsory deposit insurance and having the insurance institution represented on the board of the bank?
- If we do depart from formula-driven supervision, allowing e.g. for forbearance in times of stress, what governance measures should accompany such forbearance to avoid excessive risk taking as a means of "gambling for resurrection"? Whereas there are good reasons for forbearance, the experience with savings and loans institutions in the United States in the eighties indicates that forbearance must be accompanied by some form of interference with bank management.

C.III.2.4 References

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