On Incentives in Technology Policymaking:
What the EU can learn from U.S. developments

by Wolfgang Gick*

Abstract

This paper explores the incentives political and bureaucratic actors face in the institutional setting of EU technology policy. In examining the implications and assumptions of neoclassical and evolutionary theories of technological change, it tries to answer why certain theories do not obtain importance in the political world. By focusing on the positive approach to policymaking, the paper examines why policy learning does not occur in certain institutional settings. In referring to EU technology programs, I show which conceptual and functional shortcomings limit the policies in question. As evaluation and oversight mechanisms have not been sufficiently developed and accepted within the institutional setting, there is much room for inefficiency. I discuss this setting within a simple agency model using two political actors and two firms performing R&D. It is easy to show that when asymmetric information applies, the firms receive positive rents and the political agent gains reputation. The outcome suggests changing the evaluation practices and embedding results in political decisionmaking. Regarding this point, recent U.S. developments seem to have led to more efficiency. Moreover, the paper suggests delegating technology policy to other actors and discussing the empowerment of different principals on the political plane.

1. INTRODUCTION

This paper focuses on a simple observable fact. It tries to explain why policies can persist over time despite substantial shortcomings havimg been identified. In many political settings there are several areas waiting for change despite the presence of considerable criticism. Moreover, it is apparent that such political institutions admit in general to critiques of their operation and emphasize their awareness of having such shortcomings. It is even common that technology policies in the EU, while publicly maintaining that they should have overcome over the weaknesses of older programs, do not, in fact, change their instruments at all. This is even more astonishing because, during the past decade, there has been a growing literature focusing on innovation, growth, and technology policy.

Nonwithstanding the research to be done in the field of policymaking, my argument is that the persistence of old instruments and programs is due to the incentives that political and bureacratic actors face in certain settings. Although I focus on the EU issue, the model should be expandable to other constellations. In using a simple contractarian framework with two political actors and two firms I try to offer an explanation which follows the arguments of the theory of political interest, Wilson's (1989) theory of bureaucracy and the self-interest theory of regulation developed by Stigler (1971) and Peltzman (1976).

Regarding the viewpoint of the evolutionary theories of technological and institutional change, the contribution of this paper can be seen as an attempt to explain why in a certain setting no coevolution of political and bureaucratic institutions occurs. Implicitly, it tries to contribute to the discourse between modern policy analysis and evolutionary theories as developed by Nelson and Winter (1982). It finds that little is yet understood about the policymaking process and the incentives of the actors within it. In offering an extended viewpoint of transaction cost politics in a positive setting it follows Dixit's (1996) rationale on the imperfectness of the real world: "[T]he state of the world may not observable ex post, or even if observed by the parties of the contract, may not be verifiable to an outsider whose job it is to enforce it." This corresponds to Nelson's 1994 statement that learning processes in a technological evolution cannot simply be presumed to be effective enough and that human and organizational learning depends on incentives and pressures.

The practical issue of the paper is a special group of EU technology policy programs: the so-called "cost-shared actions" where the EU covers a certain percentage of the

funding of an R&D project if the different partners involved are located in different EU member states. Specifically, I focus on the resource-based approach subsidizing cooperative R&D.

The aim of the paper is to discuss solutions for overcoming the persistence described and modeled in it. Any solution has to cope with the incentives given in an existing institutional framework. My comparison to U.S. developments to embed evaluations within the policymaking process deliberately avoids the lines of any comparative institutional analysis.[1] Instead, this paper suggests the need to revise existing evaluation processes and to adopt their outcomes to the political and bureaucratic world.

The paper is organized into the following four sections. The second section examines the different theories of technological and institutional change. In the third, I refer to the policymaking process, the suitability of these theories, and the definition of political learning. The fourth section analyzes EU technology policy, the decision-making process, and the impact of evaluations; it also offers a simple principle-agent model with full and with asymmetric information. Subsequently, in the conclusion, I discuss the possibilities for institutional change.

2. NEOCLASSIC AND EVOLUTIONARY THEORIES OF INNOVATION AND TECHNOLOGICAL CHANGE AND THEIR OUTCOME[2]

2.1. New Industrial Economics

One of the central neoclassical contributions has been D'Aspremont's and Jacquemin's (1988) model on R&D spillovers using a two-stage oligopoly game with quadratic costs of R&D to display decreasing returns. In the first stage, two identical firms conduct research leading to a reduction in unit cost; the firms are Cournot competitors in the second stage. Thus, D'Aspremont and Jacquemin compare the magnitude of cost-reducing technical advances achieved when firms conduct R&D competitively versus cooperatively. The key point is that the two firms cooperating in the first stage may encounter a lack of incentive to undertake R&D due to a market failure stemming from uncertainty regarding the other firm's R&D activity. The solution that D'Aspremont and Jacquemin offer is the subsidizing of cooperative R&D. Moreover, social welfare is higher in any case in which subsidies apply.

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[1] I follow Eggertsson's (1996:18) statement *not* "[t]o visualize choice as being a different phenomenon from one culture to another." Instead, I strongly assume the given incentive schemes inside an institutional setting to be decisive.

[2] I limit myself to two different groups of theories. For useful discussions see Klodt (1995).

The basic model has been modified and extended to include information sharing (Beath et al. 1990 and Kamien et al. 1992) and the more general view expressed in Suzumura (1992). Other approaches like Katz (1986) examine the relationship between R&D cooperation and product market competition while Spence (1984) focuses on the possibility of internalizing externalities in Research Joint Ventures (RJVs). Commonly, these approaches treat R&D as a cost and correspond with the normative and market-failure approach discussed below.

2.2. Evolutionary theories and the knowledge-based approach

Evolutionary theories of technological change refer to broad issues of firm-specific questions. In general, evolutionary theories refer to the possibility of creating technological opportunities and the capabilities to exploit them. Thus, evolutionary theories go far beyond linear models of technological change. Their focus, in general, is on the dynamic performance of an economy. This in particular raises the question of whether equilibrium theory is the right framework for describing knowledge production. Schumpeterian theories focus on the fact that economic and technical progress occur in the carrying out of new combinations, which happens in out-of-equilibrium situations where innovative entrepreneurs are temporarily able to gain monopoly rents. Nelson and Winter (1982) focus on firm behavior and performance, on the nature of competition, and on the primary processes driving short- and long-run economic change. A central component of their view of innovation is the portrayal of the discovery of alternatives and the choice among alternatives. In this realm the following topics play a role:

• Technological trajectories and paradigms

Following Nelson and Winter, technological trajectories describe the cumulative and evolutionary features that mark the developments and changes experienced by technologies. Technological progress thus follows certain trajectories characterized by technological improvements. McKelvey (1996) attributes to this concept of a trajectory some predictive power, in that certain types of firms are more likely to develop certain types of technology than others.
Similarly, technological paradigms (Dosi 1982) embody a definition of the relevant problem and a pattern of inquiry. Innovative activities are strongly selective, finalized by precise directions, and cumulative in the acquisition of problem-solving capabilities. The solution is simply found inside the paradigm.

• Variety and selection

Another key concept in evolutionary theory is the generation of variety. Following Saviotti (1996) firms try to differentiate themselves from rivals through a series of innovations. Selection processes limit this ability of the firm. As the firm consciously tries to improve its adaptation to the environment, the selection mechanisms involved might be Lamarckian.

• The role of knowledge

Knowledge is often a public good to which access by other users cannot be restricted. This does not, however, mean that access is cost-free. Networks, tacit knowledge and innovation are interrelated topics.[3] Knowledge important to product or process innovation is not usually embodied in blueprints or operating manuals and, hence, is "tacit". The flows of tacit knowledge are important to firms, not only for their access to technical information problem-solving, but also for access to new knowledge generated through research. Saviotti distinguishes a range of variation of types of knowledge with industrial applications between two boundaries.[4]

• Networks

The centrality of research spillovers in the process of innovation is at the root of formal or informal "networks". In general, cooperation may cause serious appropriability problems if an information transfer is not compensated for. Thus, the creation of networks and the management of science and technology policy can be important issues if certain restrictions are met.

• Path dependence

A powerful argument is the development of path dependence. Arthur (1994) and David (1985) argue that under certain conditions a single technology may achieve a decisive advantage over competing ones—independently if it proves to be the most efficient one in the long run. Arthur's explanation involves a series of assumptions, including learning effects and adaptive expectations. Explanations of why the QWERTY keyboard or the VHS video cassette made the grade are within this argument.

• Absorptive capacity and the role of research spillovers

In the evolutionary literature research spillovers have been defined to "[i]nclude any original, valuable knowledge generated in the research process which becomes publicly accessible, whether it be knowledge that fully characterizes an innovation, or knowledge of a more intermediate sort."[5]

The concept of "absorptive capacity," developed by Cohen and Levinthal (1989), relies on the firm's ability to assimilate and integrate new external knowledge into its knowledge base in order to use a large amount of the knowledge available. In doing so, one firm might then be more successful over a certain period than another firm that produces only one technological success over time.

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[3] See Senker and Faulkner (1996).
[4] Saviotti (1996: 171).
[5] Cohen and Levinthal (1989:571).

• **National Systems of Innovation (NSI)**

An extensive approach to cover and describe a country's future chances is the concept of a National System of Innovation which is based on two main conceptual foundations. The first covers the importance of macro-level institutions and "[t]he characteristics of the principal education, innovation and investment-related institutions, the degree of coherence between these and the way they link together". In many countries, governments are the largest purveyors of economy-wide externalities[6]. Another line of inquiry focuses on linkages between inventive activity and the economy, especially the extent and manner in which inventive activity affects economic development and competitiveness.[7]

In a geopolitical setting inventive activity often transcends national boundaries. There have been extensive studies on the impact of strategic alliancies and extent to which firms perform research abroad. Schott (1994:27) defines a transnational system as an institutionally regulated activity performed by actors who are significantly related within and across national boundaries. Section four examines the extent to which EU member states form such a system and, in consequence, whether or not EU technology policy will be able to create stable regional networks.[8]

The second foundation concerns the conditions defining how private agents can capture particular returns stemming from successful interaction among institutions. This, of course, leads again to the concept of the distribution of knowledge in a society and the particular capability of a firm to exploit these processes over time.

3. THE REALM OF POLICYMAKING

Before beginning, it is necessary to make clear the issues of policymaking and the role of incentives which lead to the outcomes in question. Except for the direct influence of coevolution and learning, I will not draw direct conclusions from evolutionary theories of instrumental choice in policymaking, as they do not use significantly different instruments. In fact, this might not be an issue at all. In my opinion there is a risk of misunderstanding neglect of instrumental choice as a tacit agreement for keeping up current instruments in any policy setting and for interpreting any instrumental environment as sufficiently good, since some degree of learning might occur.[9]

In general, to explain why some evolutionary theories—despite their ability to contribute substantially to a new understanding of the processes of innovation,

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[6] Coombs et al. (1992).
[7] Lundvall (1992).
[8] A concept of regional innovation systems is described in Braczyk (1997).
[9] For direct policy implications derived from evolutionary theories see OECD (1992).

economic change and technological performance of an economy—still have a weak impact on policy programs, it is necessary to focus on the fact that these theories do not involve political actors and the decision-making processes and thus cannot explain shortcomings inside the world of political and bureaucratic institutions. This has simply not been their goal. Many evolutionary theories do not focus on political actors at all. Political institutions may coevolve, but play only a low-key role in the dynamic process. Rather, evolutionary theories contribute much to the question of technological change in institutional settings where the traditional policymaker plays a subordinated role, if any.

3.1. Real world assumptions

The real world involves policymaking. Thus, any theory, if it wants to enter the realm of policy analysis, needs to create a realistic picture that is able to answer policy questions and to analyze the instrumental choices involved. The rationality criterion required by the practitioner is simply the fact that any critique of the existing political or instrumental setting needs to assume, to some extent, that there are rationally better policies applicable than the ones currently used to overcome certain shortcomings. Theories that are unable to contribute to this question at all are unlikely to achieve any results inside the realm of political institutions. They are simply not applicable.

- **Rationality criteria are not superfluous to political settings even if they are insufficient to explain overall technological change.**

One of the first and best publications referring extensively to the evolution of public policies in the framework focused in this paper has been Nelson's and Winter's (1982) evolutionary theory of economic change. Their thoughts on the evolution of politics and policy analysis within the framework explains the trade-off between evolutionary thinking and the incentives in political institutions opposed to the picture drawn above. Nelson and Winter admit having "[t]rouble with the concept of an objective public interest" and neglect pursuing an efficiency goal.[10]

The point is that, in turn, one cannot presume to device a better policy by neglecting efficiency criteria. This has been often disregarded in the way economists and evolutionary theorists deal with their policy implications. As long as they avoid grappling with political constraints they will not gain ground. A vague formulation on any possibility of policy learning based on an imagined better future where individuals and institutions cultivate elysian cooperation falls short of leading to better outcomes in the rules and acts of political institutions. Rather, I prefer to follow Nelson's (1994) conclusion "[t]hat one can not presume that individuals and organizations actually see or think their way through to an optimal behavior and then adopt it. Furthermore, neither learning processes nor selection pressures can simply be presumed effective enough so that behaviours actually observed at any

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[10] Nelson and Winter (1982: 380).

time can safely be presumed optimal. On the other hand, humans and organizations do learn, if the environment permits them to do so *and the incentives and pressures are there."*

The reason for this neglect is that evolutionary theories need to argue outside of rationality assumptions *if they want to explain when, in certain settings, the pursuit of rationality cannot lead to a shift in institutional settings.*[11] As Lemarié and Joly (1996) point out, rational models treating organizations as bodies of decision-making rules cannot analyze the transition between trajectories. If radical uncertainty applies, there is no policy conclusion to be drawn except the one that there is none.

The point is simply, the other way round; that impossibility of explaining certain technological trajectories by efficiency and rationality criteria cannot lead to the conclusion to tell policymakers to abandon the rationality criteria for politics as long as they accept political actors playing any role in technological developments. Instead, one has to explain which ill-suited behavior leads to which unwanted outcome. Policy analysts cannot suggest political actors adopt irrational behavior in order to achieve a better world. If it is essential for underlying processes to follow rationality assumptions, it is wrong to suggest their abandonment because other processes are only achievable outside the rational world.

In not limiting themselves, many economists have thus been content to ignore the policy topic or to claim that it is sufficient to assume that policy learning will occur. The point is, however, that by observing coevolutions and organizational learning in general they cannot conclude that *any* coevolution determining the emergence of new policies is the right one. Instead, they have to develop a rationale that explains where the shortcomings preventing the right development come from. In any policy setting scholars should be aware that there is more scrutiny required than simply a general description of processes. Scholars set themselves too easy a task if they only tell practitioners that in the long run there will be some sort of organizational learning—if at the same time they close their eyes to inefficient outcomes or treat them as acceptable because unavoidable.

This, in turn, does not mean that policy learning does not matter. By focusing on incentives in political and bureaucratic agencies, this paper wants to contribute to an understanding of the question: *under what conditions does learning occur?* In doing so, the paper exceeds simple behavioral assumptions on the variability of information sets and assumes, following evolutionary theories, that the incentives and the objectives of actors can vary considerably.[12]

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[11] See also Hayek (1988).
[12] See Tisdell (1996: 302).

• Instrumental ignorance

The same thought applies to the instrumental debate. As we must start with the assumption that, in a market economy, the market approach leads to efficient outcomes, there is certainly a need to justify market interventions such as subsidies. Economists do not live in an instrumental vacuum. They have to speak about the instruments to be used in any policy framework as soon they enter the realm of politics. If, for example, a deregulation issue is more effective at furthering collaboration among firms and related research institutions, one cannot neglect this and simply suggest that subsidies be used to counteract the existing disincentives without analyzing the losses. An economist has to explain why other instruments offer no viable approach and why the proposed new approach leads to a second or even third best optimum. An economist cannot separate instrumental issues from efficiency.

This is a bridge that evolutionary scholars should never have crossed before knowing the impact of their words on the world of policymaking. In particular, scholars involved in consultation and evaluation processes and dependent on political actors should avoid giving rise to misunderstandings.[13] General arguments—e.g. that any subsidy is better than none because there will be at least some positive effects anyway towards the desired technological end—may create major intellectual confusion and are not helpful to the debate. However, to assume an everlasting existence of subsidies in the political world and to speak in favor of funding R&D programs and against "green money" hardly meets the need either.[14] Instead, economists should heed Smith's statement that high budget deficits in OECD countries feed into the drive for a more "effective" policy.[15]

• The theory of market failure politics

Regarding EU technology policy programs these settings have been widely neglected. Recall the policy conclusions derived from the D'Aspremont/Jacquemin model discussed above. The conclusion that subsidies are the solution is powerful precisely because it so well fits the market-failure approach adopted in politics.

Policy conclusions compatible with this approach gain further importance in the political world as the incentives involved in such a setting ensure meeting the incentives of the political and bureaucratic actors involved. Political and bureaucratic institutions prefer "market failure approaches" because they fit into their understanding of procedural rationality. Their long-lasting experience and their involved learning procedures show a close affinity to this approach.

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[13] Starbatty and Vetterlein (1994) make it clear: It is unlikely that scholars refuse cooperation if they can gain reputation, power, and money by being embedded in such a setting.
[14] See Pilorget (1995).
[15] Smith (1996:107).

This prompts the question of whether normative or positive approaches can explain the incentives of political actors and institutions. Curing market failures raises the power and budget of the involved governmental institutions. And, currently, Europe is looking back on several decades of "well-functioning" settings between government and markets in which a lack of comparison has been applied and the actors have been able to play their games under a veil of imperfect monitoring. The failure of political principals to engage in active oversight and control plays a major role in this issue.

In this way, D'Aspremont and Jacquemin are not at all to blame for setting up an incorrect model. The model is perfectly "right" in the sense that it is appropriate for the market-failure approach. It is applicable to the existing bureaucratic and political settings.

To make myself clear: the correct question to ask here would not be which coincidences among existing EU programs and the outcome of evolutionary economics might exist. Of course, the cost-shared actions in question refer to technological collaboration. But to argue that it would be the aim of any program subsidizing R&D cooperation to follow the evolutionary concept of networks and collaboration anyway would only set a seal upon existing shortcomings instead of moving technology policy towards the very consequences of evolutionary theories.

In this way one can argue of course that new EU programs and frameworks still work in the same way but use other—namely evolutionary—language. Since many evolutionary theorists do not develop their theories in order to lead to different instruments, it is likely in future that policymakers will not change their instruments if no other oversight mechanism occur. Thus, theorists should be more cautious in order to fine-tune strategic projects where monitoring plays a key role in ensuring success. There policymakers might be driven to efficiency. But in the widespread areas of overall technological collaboration, lax oversight concepts may persist.

Far more scrutiny is necessary in this field. As Metcalfe states, technology "[p]olicy makers must address complex questions of institutions and their connectivity", and "[t]he contrast between the theory which underpins policy and the implementation of policy will seem acute."[16] Thus, focus should not be on market failures but on institutional failures that refer to the myopia of the political bureaucratic system. In summing up our thoughts on evolution and learning, we must take note of institutional settings which do not learn.

In general, this refers to Pavitt's and Patel's (1988) notion of myopic systems. The distinction here is that there is no intention of criticizing systems which underinvest in R&D, but rather of referring to political actors who avoid control,

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[16] Metcalfe (1994: 941 and 931).

that is, to the *myopia in settings where learning could occur but the policymakers are constrained by political rules and interests.*[17]

3.2. The normative approach: the welfare agencies create

This old approach derives from social contract theory in which the government acts in favor of the people to maximize social welfare.[18] Applying this approach to the outcome of the D'Aspremont/Jacquemin model in policy perspective, it is apparent that by subsidizing R&D a government will be able to achieve a higher degree of social welfare. As long as a welfare function is applied where welfare increases with the utilities of the individuals, the result is straightforward.[19] As discussed above, the market-failure approach is based on this normative view. Despite its unrealistic reduction of policymaking to a technical problem, and its shortcomings in the results of many programs, the market-failure approach has been very successful in the past.[20]

3.3. The positive or contractarian approach

To examine the reason for this compatibility, it is necessary to leave the normative world. Theories of optimal outcome do not lead the acts that determine the policymaking processes.

A different approach to the normative one which rules out its argument, is the contractarian one. Buchanan and Tullock (1962) and later on Buchanan (1975) contrasted theories of social choice with the rules governing political processes. The distinction between rules and individual actions in policymaking lead to an outcome in which policymaking is constrained by the working of the process within the rules that were established[21].

Our key question—similar to Noll (1988:1271)—must be put as follows: Are technology policymakers driven by a desire to create an optimum policy or are they driven by their own objectives? The crude positive approach refers to the second leg of argumentation and simply concludes that there are no degrees of freedom in the realm of policymaking and that normative analysis is irrelevant inside these processes.

The refined version of this approach, which is developed here, is that in the process of technology policymaking the political actors have their own incentives and

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[17] This refers in general to the second case May (1992:349) describes.
[18] Dixit (1996:6).
[19] Quirk/Saposnik (1968:105). For a further discussion of the political consequences of the Greenwald-Stiglitz theorem see also Dixit (1996:8-11).
[20] Laffont/Tirole (1993:5).
[21] See also Dixit (1996:13).

pursue a state of the world in which their power increases. In any setting involving bureaucratic and political agents, one must be aware that agents may behave opportunistically, "[p]ursuing their own interests subject only to the constraints imposed by their relationship with the principal."[22] In a later analysis, I will focus on the incentives that involve "shirking" and "slippage" in the behavior of the agents.

As long as the overall institutional setting allows political agents to pursue their goals and no pressure is applied to these agents to change their behavior as empire builders, this state of affairs will continue. Concretely, the persistence of inefficient programs is merely a lack of monitoring that attributes more power to these agents than is necessary for them to have in order to fulfil their tasks. The solution thus consists of a sort of policy learning process that can be adopted or developed by the principal toward lowering costs of control and clipping such agent's wings.

3.4. Understanding economic policymaking as a political process

There are several other general remarks pertinent to an assessment of incentive problems. Incentive problems do not arise in an Arrow-Debreu world in which individuals as well as organizations perform in the contracted way. Here a theory of incentives in policymaking needs to be applied in order to show how the political process performs a political action. Rules and acts and their adaptation cannot be analyzed in depth within simple positive settings.

Laffont and Tirole (1993:475) contribute to the process of policymaking and focus on the constraints policymakers face in their actions. They extend their general thoughts by including information asymmetries and referring to agency relationships between politicians and their delegates in the bureaucracy. Their contribution to the process is the focus on the constraints policymakers face in their actions.

• Informational constraints

Laffont and Tirole (1993) offer a very realistic view of policy processes in which political actors and firms are involved. They limit themselves to the realm of regulation and procurement, but their view can be extended to larger fields.

The classic argument that refers to an endogenous action is known as *moral hazard*. It applies when the acts of an agent cannot be sufficiently controlled by the principal. The agent faces an informational advantage over the principal. Technically speaking, the agent's *effort* is not observable.[23]

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[22] See Pollack (1997:108). Another explanation I do not follow here is the normative view that agencies and political organizations exist because of the need to obtain information about the state of the world. See Laffont and Tirole (1993).
[23] See Laffont/Tirole (1993:1).

• Transaction costs

It is worth adding that the notion of transaction costs is strongly related to the former argument. If the reason for the emergence of moral hazard lies in ill-structured incentives, this implies the existence of inefficiencies. In other words, if moral hazard applies, there is a need to structure the contract in such a way that the agent bears the consequences of his actions. Implementing incentive schemes by changing the existing contracts in this way may lead to better results.

The point is that in political settings contracts are difficult to change in the way required because the transaction costs are very high. North (1990) explicitly connects the state and the persistence of political settings to the lack of instrumental rationality of the participants.[24] Williamson's (1995) approach to transaction costs refers in general to future contingencies.

• Administrative and political constraints

Related to transaction costs is the question of credibility which has been explored by Persson and Tabellini (1990). In exceeding Williamson's concept they define economic policy as a game in which credibility constraints apply. They distinguish this case from transaction costs and define political constraints as applying when there is a conflict of interest between the policymaker and the citizens because of disagreement over the final goals of politics. In a manner similar to Kydland and Prescott (1977) they analyze political constraints that coincide with the interest of the society only to some extent. The reason for many developments in the political world lies in the policymaker's possibly being subject to a binding incentive constraint. When time inconsistences apply, this may lead to a lack of credibility.

To these views Dixit adds the realistic notion of "real time" to the policy process in order to overcome some of its overly rigid settings and to combine elements of a contractarian view to explain why rules and acts differ. In this way Dixit, in extension of the pure contractarian view, offers a dynamic and, in a sense "evolutionary" approach: Policymaking is seen as a dynamic game with changing and uncertain conditions in which the rules are made by the participants.

• Lack of comparison of political actions

One addendum is of further importance and, despite its having been discussed in different political theories, needs to be analyzed in greater depth: many government agencies sustain a monopoly position. Their performance is hard to assess.[25] One could even argue that bureaucratic institutions in general try to bias oversight mechanism. In many settings, other actors from outside, other governments or their counterparts, may overcome the control problem and introduce competition.

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[24] Dixit (1996:32)
[25] Tirole (1994:5)

3.5. Bounded rationality, political learning and the coevolution of political institutions

This concept also meets partially the evolutionary perspective proposed by Metcalfe (1994). His notion of the adoption of a behavioral theory of the firm and its focus upon learning processes cast the policymaker "[a]s a behaviourist engaging in adaptive policy making, seeking improvements in the technological performance of the economy in the context of immense micro complexity."[26]

Herbert Simon's concept of bounded rationality refers to the notion that individuals lack cognitive capacities. This basically entails a critique of the neoclassical assumption of rationality. Though Simon's work changed over time, together with his critique of neoclassic theory, it is useful to examine which concept of "bounded rationality" should be applied to the behavior of political agents that we accept for our framework. We need to assume at least that the possible states of the world are very complex and the actors know little about it. Following Dixit (1996) it must be assumed that "[a]ll feasible contracts are necessarily incomplete".[27] Thus, analysis should be specifically focused on the decision process in organizations. The rational choice approach assumed here is an extended one and follows the less strict assumption that "[i]ndividuals act consistently with their preferences when faced with alternative opportunity sets."[28]

Agency relationships are more complex in the political context than firms are. It is necessary to face the fact that any policy selection occurs more slowly than market selections do and it is important to ask about the circumstances.[29] This fact can be explained by the very complexity of regulations and actions. In particular, the lack of oversight mechanisms and of observability ex post may entail adaptations to be very incomplete over time.[30]

• Policy learning

Strongly linked to the notion of learning processes and adaptive behavior is the concept of coevolution of political organizations. Here Smith's (1996) notion that policy changes rarely follow a coherent rationale and, instead, often narrow approaches to the aims they seek to achieve leads to the argument presented here.

In general, I follow May's (1992) notion that political learning consists of policy advocates' changes in policy strategy. May distinguishes between two different types

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[26] Metcalfe (1994:933).
[27] Dixit (1996:53). See also Groenewegen and Vroomen (1997:45-48) and their distinction between Williamson's and Simon's notion of bounded rationality.
[28] T. Eggertsson (1996:18).
[29] Niosi and Bellon (1995).
[30] See also Dixit (1996:53).

of political learning. Instrumental learning encompasses the technical plane. Here optimization can take place, through improvement of policy instruments, better understanding of implementation, the adaptation of instruments used. In contrast, social learning refers to the social construction of the problem on an institutional plane.[31]

Technology policy issues refer to both types of learning. As May states, both types are interconnected, and of course the adoption of new policies involves learning. But the question is still, to what extent subsequent policy changes reflect learning, and if the mimicking of policies is undertaken, since some political actors might achieve reputation in copying programs from other governments. This latter issue has been known especially in the area of technology policy. MITI is an impressive example of how a bureucratic and political actor can gain power by imitating technology policy programs. The EU has, like other governments, intentionally tried to follow its achievements.

• **Incentives to further imitation may form a substitute for control**

One has to reinterprete the Commission's tendency to gain reputation by imitating programs from its foreign counterpart (MITI). In general, playing the role of a powerful agent inside Europe creates more distance and reduces the risk of being evaluated in a field where evaluation procedures are difficult to apply.

Second, imitation fits into the incentives of the specific political and bureacratic world[32] in which the agent is allowed to pursue an optimal technology policy and in this way reduces rigorous evaluations. The search for similar agents and for institutions which perform similar issues results in protection.

• **What "political learning" means in the context of technology policy**

The often cited Japanese VLSI project highlights the difference between mimicking and policy learning. VLSI is well-known as the principal vehicle enabling Japan to join the leading players in the semiconductor industry at the end of the 1970s. In reality, the VLSI program adopted many elements of the Research Association system in the UK.

Suzumura and Goto (1997) explain some of the substantial modifications that were added to the UK version. First, Japanese Research Associations (JRAs) were organized to solve specific technological problems and second, they were dissolved after having performed their task.

The third and crucial point is that the JRAs usually do not perform their research jointly. This approach runs the risk of wasting resources in multiple discoveries, but

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[31] See Oltra (1996:12).
[32] See Spiller (1990).

ensures clearly the appropriability of the firm's effort and offers an institutional solution for this perennial problem of any R&D policy.[33]

In other words the very "political learning" in the VLSI case has not been the mimicking of the former UK program. It has been MITI's realization of the need for special RJV contracts to be included in the Japanese R&D setting that has been to ensure the firm's appropriability. As shown below, one can doubt if the EU programs in the RJV contracts adopted are concerned about this fact at all.

4. THE MAKING OF TECHNOLOGY POLICY IN THE EU

Indeed, at the EU level there is a mix of technology policies ranging from large-scale interventionist programs to those furthering generic research. As Sharp and Pavitt (1993:136) posit, the political success of ESPRIT in the mid-1980s lead to a mushrooming of similar programs based upon the principle of precompetitive, collaborative research. Since 1987 the Single European Act, as a revision of the EEC treaty, introduced Article 130f, which stipulates the need for competence in the field of technology policy.

I henceforth refer to the indirect actions in the EU Framework programs that have been drafted as "cost-shared actions" at the beginning of the 1980s. It is worth noting that these initially strategic EU concepts remain unchanged and are readily observable. As mentioned at the beginning, the EU in its Framework programs supposedly has been driven to concentrate on a few but more effective single programs. Regarding the Third Framework program the Commission tried to reduce the specific programs. However, this is not true. By analyzing the Council's decision it is easy to show that all earlier existing programs have been continued in the new Framework program. [34]

From the practitioner's point of view cost-shared actions came to dominant importance because the allow the Commission to:

• perform different programs without increasing bureaucratic effort;
• give financial incentives to certain industries; and
• avoid being controlled by the Council in certain circumstances, and not coordinate programs in other instances.[35]

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[33] See Suzumura/Goto (1997:208-210).
[34] See Starbatty and Vetterlein (1994:47).
[35] As for the competences of the Commission see Starbatty/Vetterlein (1994:50-52).

By focusing on informational and transactional constraints in policymaking, I want to explain why inefficient policies persist. Again, I specificly refer to the EU concept of "cost-shared actions" that subsidizes R&D cooperation among the different member states.

4.1. EU Technology Programs and observable shortcomings.

• The pork barrel argument

As stated earlier in this paper, many incentives in the area of technology policy actions can be described from a pork barrel perspective.[36] The argument might still have an influence here, but the political power of interest groups to further specific programs is higher in other, strategic areas.

The reason why I do not adhere to the pork barrel argument as an explanation for the emergence of EU technology policy programs is simple: cost-shared actions furthering R&D cooperations have a broad impact throughout the EU and offer a rather small payoff to interest groups compared to special programs furthering leading-edge technologies.

Moreover, the application procedures are particularly costly to the firms. Following different studies in the EU member states[37] this has been a significant reason why many firms abstain from applying. Instead, what exists is an *organizational constellation in which the Commission's interest in enhancing its reputation in the field of technology meets the firms' interest in subsidies.* The initiative, however, could hardly be attributed only to the industry or its pressure groups. Rather, Schmidt's notion that EU policy formulations balance business interests might illustrate to some extent the technology policy case.[38]

• Can multiple goals and divided structures further efficiency?

Next we must note that the EU tries to meet regional and structural objectives. However, cohesion and cooperation might only be wishful thinking that seldom achieving any measurable result in a general regional framework. Agents with power to deviate from group interests and superpose their own objectives over existing national settings cannot do better when they want to create an empire.
Another point refers to the internal organization of technology policymaking. The EU Commission's structure and the tasks of its different DGs (Directorates General) are highly heterogenous.[39] The above cited and highly praised ESPRIT program has

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[36] See Cohen and Noll (1995).
[37] See, e.g., the German IMPACT study done by Reger/Kuhlmann (1995).
[38] Schmidt (1996: 169).
[39] See Starbatty/Vetterlein (1994: 22).

been allocated to DG III, while most of the other programs are administered by the recently reorganized DGs XII and XIII.[40]

• Disincentives created by shortcomings in RJV contracts

Many R&D programs in the EU are far from efficient; because of bad contractual settings in the function-performance link they risk disincentives. Kastrinos (1996) refers to shortcomings in the standard contract used in EU R&D programs regarding intellectual property rights. The key point is that each partner cannot prevent other partners from exploiting knowledge generated within the project. Here a trade-off between function and performance applies if the contract does not take into account the costs of adoption when performance criteria are determined.[41] In refering to practical RJVs, Kastrinos subsequently shows that appropriability considerations have not been sufficiently encompassed in the Commission's contracts.

In one example contractual shortcomings lead to severe problems in a generally successful RJV when a small firm, depending on two large software houses which have been able to keep control of the specifications of the innovation, was not able to appropriate the result of the RJV, as the software houses were enabled by the incomplete contract to exploit the knowledge generated within the RJV against the firm. After the end of the RJV, the user firm had to buy an expensive new system from its former partners who, in the meantime, had commercialized a new version and left the user firm with a slower and less effective product.

• The stability of networks

As referred to at the beginning of this paper, I focus on the interrelation among national and transnational networks. Let us first assume that the EU might be able to establish a new network, with links accross the entire Community. Then the question arises: what conflicts between the National Systems of Innovation and the EU network will occur, and to what extent will the efforts of the EU be balanced by other forces allocated at the NSI level. As Stubbs and Saviotti (1994) put it, we have to ask whether the EU networks will ever be stable across the entire community. This is of course a question of opportunity costs and to what extent the resources allocated at the EU level might impair the performance of NSIs.[42]

• Does it make sense to encourage research collaborations?

Lichtenberg (1997) concludes that, in general, the idea of strenghtening R&D networks may be unnecessary. Policies attempting to encourage international research parterships may be ineffective or misguided. Studies on knowledge transfer

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[40] For a description which scrutinizes the interest mediation and decision processes inside the Commission see Starbatty/Vetterlein (1994).
[41] Kastrinos (1996:194).
[42] Stubbs/Saviotti (1994:168).

show that industries tend to cluster if knowledge spillovers are prevalent. This, in turn, suggests that, in other industries where knowledge spillovers play a less important role, a technology policy supporting networks might not even be necessary.

• The low importance of EU regions in a geopolitical link

To the above mentioned question about how the EU might establish a stable network, Schott (1994) offers an interesting answer. He focuses on the extent to which collaboration among nations is embedded in a geopolitical link and measures this link through its particular intensity of trade. Schott then tests the hypothesis that collaboration in invention among nations is embedded in and promoted by the geopolitical links among them. Subsequently, he identifies six geopolitical regions where such an integration could be measured and found out that collaboration among EU member states was at the lowest range of all the six cases of geopolitical integration he was able to identify.[43] This, of course, is a strong argument against the hypothesis of embeddedness of the EU regions in the contest of technology policy.

• Does any widespread R&D subsidizing matter at all?

Verspagen (1997) offers a convincing analysis: simply subsidizing research in all EU regions does not lead to measurable success. Verspagen shows that, during the 1980s, different European "regional clubs" existed, each of them differentiated by productivity, GDP per capita, and unemployment. Interestingly, Verspagen found that these clubs were essentially identical in terms of their technological variables. He concludes that in the EU advanced technological clusters are much smaller in terms of number of regions than advanced economic clusters. Second, his results show that an advanced technological cluster as a set of centers within individual countries is not geographically connected to other regions. The results of his analysis is striking: It is nearly impossible to stimulate innovation in regions that are relatively backward economically. In his words "[m]any of the 'less favoured regions' are caught in a virtual circle of low innovation and low productivity/GDP per capita. Simply subsidizing (private or public) research in those regions would not solve the problem because one cannot develop (high-)technology from scratch."[44] He concludes that policymakers would better off concentrating on one or a few central regions, where facilities such as public research institutes or universities are abundant.

• Avoiding wasteful research versus ensuring appropriability

As just mentioned in the VLSI case, a crucial element of RJV contracts is to ensure appropriability. There is still no evidence that the desire to avoid wasteful research can meet this requirement. The EU Commission's attitude on coordinating and

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[43] Schott (1994: 45)
[44] Verspagen (1997:15)

bundling Europe's technological resources can be considered an outdated one and refers to the resource-oriented thoughts of earlier innovation theories mentioned above.

• Globalization and the limits of policies

There is another stark argument against the EU philosophy of broadly furthering R&D cooperation across EU borders. R&D and production are becoming increasingly geographically fluid. This renders long-term employment objectives encompassed by EU TP more and more useless and undoubtedly raises questions over the efficacy of EU-funded pre-competitive R&D that has been in operation since the beginning of the 1980s.[45]

• Subsidiarity and the role of the EU Commission

This raises the question of the role of subsidiarity at a technological plane. Sturm (1996) posits that there is a rising risk of deliberately misunderstanding the subsidiarity principle in allocating programs. This generally leads to the choosing of ill-suited instruments and objectives. As bureaucracies are unable to foresee technological developments, they consequently incur to inefficiencies when funds are allocated to the programs.

The outcome of further debates on subsidiarity at the technological plane is uncertain: the amendmends contained in the Maastricht treaty (Art. 130h, 2) now read that "[t]he Commission may take any useful initiative to promote the coordination...". Starbatty and Vetterlein (1994:60) thus argue that an existing power of the EU Commission will create a shift in the debate. National ministries and the EU Council might have to accept the Commission's tendency to attract more power and to rule out implicitly existing competencies of the member states. Sectors like the aeronautical and space industry, especially, which achieved successful cooperation without the EU Commission in the past might be an unprotected "delicacy" for the Commission which could develop a new concept of necessary actions in this field.

In the past the EU Commission has been clever enough to gain technological competency in return for granting them funds. This supports the above mentioned statement that EU technology policy issues do not encompass the crude "pork barrel" issue but instead entail a *constellation in which missing oversight allows a stable, mutually beneficial relationship of reputation and monetary benefits between the Commission and the firms.*

The Commission's role in identifying critical areas in EU technology policy has often been noticed. Citing the "extraordinary" importance—which is of course

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[45] Niosi and Bellon (1996:144) focus on the precompetitive character of EU intra-Community collaboration.

unmeasurable — the EU Commission can easily gain power over large areas of technology policy.[46] Following Caswill (1996:48-49) we might conclude that the Commission continues simply to maximize its budget and its own scientific program with the result that most of the impact of European funding is little more than "important rhetoric."

4.2. Oversight and evaluation: When and why political actors do not want to accept the outcome.

• The current evaluation practice in the EU Commission

"[T]he gap between the outcome of evaluations and political ideologies is remarkable."[47] Although evaluations are often initiated by ideological debate, it will take far more to integrate the outcome of these evaluations into the political decision-making process. Similarly, to the design of policy programs, evaluation also generally takes place in a too isolated manner, motivated by concerns of ideology rather than efficiency.

Europe is well known for having a large gap between its expansion of research programs and the empirical evidence that underlies these actions. Following Roessner (1989:311) evaluations often focus on objectives which are not under the control of the decision-makers. This, in turn, leads to behavior that favors political action that remains stable rather than one in which evaluation plays a critical role in the political process. Despite Roessner's conclusion citing the need to integrate the evaluation of R&D programs, one must note that political organizations seldom accept their results if they conflict with the existing incentive scheme the organization offers.

Since 1992 evaluations encompassing the EU Framework programs as well as single projects have been binding, they began with the evaluation of the Second Framework program (1987-1991). The EU Commission recently published its evaluation of the Third Framework program. However, these evaluations currently do not have any influence as a ceiling for current or future fundings, and bear the character of an ex-post evaluation without further importance.

• Decision-making

Contrary to the general description by Pollack (1997:119) the oversight mechanisms for controlling EU technology policies are more complicated. His idea to "clip the Commission's wings" via revision of the Council does not apply because the default condition is not the expiration of the regulation. The principal cannot wait thus simply for any built-in pressure to apply.

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[46] See especially Starbatty's and Vetterlein's (1994) description of the decision-making process
[47] Meyer-Krahmer (1989,330).

Second, the rule of unanimity only applies to the Framework program. Since the Single European Act was enacted, the rule of unanimity has been replaced by a qualified majority voting for single programs. Since log-rolling is a procedure often used in the Council's decision-making processes, we must realistically conclude that any politically less important issue from the viewpoint of the member states will not be altered at all. Technology policy issues will unlikely be "clipped" if the responsible member states have to pay a high price. Moreover, the voting member states often do not want to join a losing minority or for ideological reasons be regarded as blocking an European idea. Thus, curious as it may appear at first glance, the Council often votes unanimously on these issues.

• The role of evaluations in the political process

It is also necessary to refer to different mechanisms of member-state control, in particular the Commission of the European Communities and the various oversight mechanisms available to the political principals. We must see that the institutional framework by accepting the pursuit of old goals of technology policy and not interacting if certain requirements are not met, leads to persistence over time. The reason for this sort of "locking in" has much to do with the incentive the actors face when they set up a program. If the agent cannot be put into an incentive scheme because the final outcome is hardly measurable, much space arises for inefficiencies.

On a control engineering plane, uncertainties about what works and what does not work in innovation programs can be particularly favorable to support a "lock in". Developing an evaluation system that delivers useful results is difficult.

On an ideological plane, even when an evaluation exists, the given incentive schemes inside the setting of political institutions prevent the actors from choosing a better regulation.[48]

4.3.   The model

This explanation seems rather undeveloped at first sight. However, adjusted to the requirements of the institutional setting it can show in a principal-agent model that the incentive design plays a key role. Using a model may offer more scrutiny, identify "[g]aps in the verbal stories" or "[s]uggest new theoretical storylines to apply."[49]

As Noll (1989:1262) states, the fact that a theory of policymaking is embedded in the concepts of transaction costs and information imperfections suggests one should examine this theory in a suitable principal-agent framework. Indeed, there is much

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[48] Stubbs and Saviotti give an excellent example on how the evaluations in smaller and less effective programs are performed, including the general difficulties to assess the pay-off to Framework R&D in financial terms.

[49] Nelson (1994:155).

proximity to the theory of incentives in procurement and regulation as developed by Laffont and Tirole (1993). Many issues are similar: the agent (EU Commission), controlled by the principal (EU Council), wants the industry to perform an action that otherwise would not occur. In order to perform the action (R&D), the industry receives a subsidy.[50]

In general, following Pollack's expression, the EU Commission is accountable to the Council, which is made up of national ministers, and to the EP, which scrutinizes legislation and the drafting and execution of budgets. This exemplifies Pollack's (1997:106) belief that the EU Commission has been provided with an important agenda-setting power.

The model I use has a similar outcome as the first part of the Spiller (1990) model. Spiller states that "[a]gency problems between politicians and regulators arise because regulation's actions are intrinsically unobservable."[51] In contrast to the Laffont/Tirole (1993) regulation model, whose lines I try to follow, there is no observable price. With respect to this model, my example has more affinity to a procurement framework. I use the consumer's welfare function only to respect the distortionary taxation due to the R&D project.

I assume the simple case of an indivisible RJV project involveing two firms, a regulator or agent (EU Commission) and a political principal (EU Council, though other institutions should be discussed in the text). The two firms might be supposed to be in a Cournot duopoly according D'Aspremont/Jacquemin (1988) and face the following cost and utility functions:

$C_i = A - x_i - \beta x_j$

where β denotes the spillover firm i gets from firm j.
We assume $x_i = x_j$ and $x_i + x_j = x$.

$U_i = t_i - \delta(x_i)$

where t denotes the net monetary transfer to the firms, $\delta(x)$ the disutility due to the R&D effort of the firms, and $U_i + U_j = U$.

Contrary to the regulatory game we assume that no price effect will be observable after the RJV. Instead, a successful program of R&D cooperation shows a positive spillover parameter β.

The probability of achieving success in R&D depends extensively on the investment in R&D. We assume $\delta'(x) > 0$ and $\delta''(x) > 0$ where the function satisfies $\delta(0) = 0$ (similar

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[50] Also Pollack (1997) in his overview of principal-agent theories in the EU context, and Caswill (1996:51), even more related to the question of technology policy, refer to the principal-agent framework.
[51] Spiller (1990:65)

to Grossman/Shapiro 1987 and Beath et al. 1990). We also assume the IR constraint of the firm to be U≥0.

Case 1: We assume that C and U are observable.

Following the two-type case we assume that $\beta \in \{0, \beta^*\}$ depending on whether the RJV showed any positive result or not.

The principal learns β and maximizes the full information welfare when the principal dislikes leaving rent to the firm.

The agent has the utility function V=B-B*≥0   .

Case 1a:

In this case we assume $\beta=0$ and the principal pays no t (t=0). Thus, by exclusion, the solution covers simply B* as the principal has to pay only the agent for effort expended.

Case 1b: Full information about the firm's activity and $\beta > 0$

If $\beta=\beta^*$ applies, the principal can deprive the firms from extra rents (U = 0 or t = $\delta(x)$).

The principal maximizes

$$W = [S(q)+\lambda P(q)q] - (1+\lambda) [B^* + (A -(1+\beta) \frac{x}{2}) q + \delta(x)] -\lambda U-\lambda V$$

with C= A -(1+β) $\frac{x}{2}$, U = t-δ(x) and V = B - B* .

Following Laffont/Tirole (1993:481) the "generalized consumer surplus" must be subtracted 1+λ times the cost which denote the second term in square brackets and λ times the rents left to the firm and the agent.

In order to obtain this welfare, the principal maximizes

$$\max_{\{x,t\}} \{[S(q)+\lambda P(q)q] - (1+\lambda) [B^* + (A -(1+\beta) \frac{x}{2}) q + \delta(x)] -\lambda U-\lambda V \},$$

subject to V=B-B*≥ 0 and U ≥ 0.

This involves a constrained optimization problem with the solution:

$$\delta'(x) = \frac{q}{2}(1+\beta), \quad x \equiv x^*, \qquad U=0, \qquad \text{and } t = \delta(x).$$

As a result, the principal can prevent the firms from getting any positive utility.

Case 2: Asymmetric information

We now assume that the principal cannot monitor the firm's R&D and has to leave a reputation index r (t) to the agent who performs and controls the entire R&D program. This reputation index corresponds to the relationship mentioned in the text above and ensures that the agent gains some power by performing the action. The agent has the character of an empire builder and requires

V= B - B* + r (t) ≥ 0, with r'>0 and r(0) = 0.

We also assume that the firm's effort, utility and cost function is not observable by the principal.

The welfare function now denotes

$$W = [S(q)+\lambda P(q)q] - (1+\lambda) [B^* - r(t) + (A - (1+\beta)\frac{x}{2})q + \delta(x)] - \lambda U - \lambda V.$$

The principal maximizes

$$\max_{\{x,t\}} \{[S(q)+\lambda P(q)q] - (1+\lambda) [B^* - r(t) + (A - (1+\beta)\frac{x}{2})q + \delta(x)] - \lambda U - \lambda V\},$$

subject to V=B-B*+ r (t) ≥ 0 and U ≥ 0.

The solution of this second case denotes

$$r'(t) = \lambda, \qquad \delta'(x) = q\frac{1+\beta}{2}(1+\lambda), \qquad U>0, \qquad \text{and thus } t > \delta(x).$$

Given the above mentioned properties we have in this case the following change compared to the first one discussed:

$$U'' \rangle U^I$$
$$\delta'' \rangle \delta^I, as \quad \delta^{\omega} \rangle \delta^{,I}$$
$$t'' \rangle t^I$$

The result is simple but clear. As an outcome of asymmetric information the principal cannot control the firm's activities and prevent it from obtaining a positive utility. The agent gains reputation from this setting and is able to gain a higher utility too. The model suggests the need to find an incentive scheme where these shortcomings do not apply.

5. CONCLUSION: WHICH INSTITUTIONAL CHANGE COULD BE HELPFUL TO TECHNOLOGY POLICYMAKING?

The rationale leading to a solution must denote: Find an institutional framework with ensures more proximity between evaluation results and the incentive scheme inside the institutions.

5.1. What recent developments in the U.S. indicate

I do not want to be misunderstood with this comparison. As referred to at the beginning, I do not follow any comparative institutional analyses due to their mentioned shortcomings. This means that one cannot simply propose to adopt U.S. settings and to suggest that "political learning" should simply consist of focusing towards the result the U.S. has achieved in the recent decades. Such a proposal is highly unrealistic. Also, as described in Cohen and Noll (1991), many of the U.S. settings in general cannot simply provide further insights. There has not been any striking evidence in the past that U.S. developments have been much more efficient in general.

However, U.S. development offers an interesting picture of how to achieve institutional change in overcoming inefficient incentive schemes inside the political world. If the goal of the game is to improve efficiency, establish impact assessments, and create a relationship between evaluation outcomes and program redesign, there is indeed strong evidence that recent U.S. developments have been successful.

• First, in the case of the ATP program subsidies have been cut back significantly. Political forces inside Congress have been successful in arguing that market failure arguments do not play any role and that subsidies are inappropriate. This did not lead to a termination of a program; however, ATP funds have been cut back significantly. Currently, following officials, a "temporary equilibrium" seems to

have been established between the different Pros and Cons to ensure that the ATP can proceed in a restricted, but rather efficient way.[52]

• Second, evaluation is becoming an increasingly strong force in deciding on the funding of technology policy programs. The incentive structure inside the U.S. setting is more compatible with the outcome of evaluations. This has to do with the general observable commitment in the U.S. towards efficiency and budget control. As Roessner (1989) points out, this might be a legacy of the Great Society programs of the 1960s. During these programs, a percentage of program funds was spent for evaluation. In general, lock-ins ensuring agents' power and avoiding application of evaluation results are less likely in the U.S., as there is enough openness in the efficiency debate.

5.2. What the EU could learn

The change in U.S. settings leads us to the following points:

• **"Telling the truth" versus "wishful thinking": Establish platforms in the overall institutional setting where experts are allowed**

In general one can note, following Wilson (1989:130), that there is no openness in the consultation process observable inside the EU or within its member states. This is not new, but it is striking. Europe lacks reliable platforms where efficiency criteria are allowed to enter publicly the policy consultation process publicly. Even the European media of the late 1990s are still unable to offer a simple incentive scheme to change the setting. Therefore, political discussions still reveal the interest of the participants in wishful thinking, they do not refer to factual constraints. To express it in Wilson's words: the motivation between the latter is to insure "procedural fairness," whereas the former one "[f]avors certain interests over others."[53]

U.S. economists look back to decades of successful measurement developments starting with Griliches's (1958) paper on social returns in the hybrid corn case. As Tassey (1996:44) shows, there are now four different groups of particular metrics for economic impact studies commonly adopted in the U.S.. The difference with the EU is that these approaches gained ground inside the administrative world. Thus, ironically, one can expect that EU institutions will be increasingly forced to care about evaluations as a number of leading U.S. researchers focus clearly on EU technology policy programs.[54] During the last few years a growing interest on technology indicators and measurements can be identified at the EU level and inside the ministries in the different member states.

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[52] As Schacht (1997:13) points out, the 104th Congress tried consciously to eliminate or curtail many public R&D projects that had previously enjoyed bipartisan support.
[53] Wilson (1989:131).
[54] See e.g. Lichtenberg (1996), and Feldman and Lichtenberg (1997).

• **Delegate R&D issues to other agents**

To make my argument more precise: Greater oversight and more evaluation, if accepted by the political actors, will create more efficiency. This does not mean that it is feasible to empower the *current* principal, especially not in a case where the incentive structure is difficult to alter. Thus, it could be more promising to empower an outside actor.

It has been proposed[55] to attribute power to EuroHORCS, the European Heads of Research Councils, which could influence the decision-making process in EU technology policy. EuroHORCS have close contact with the European Science Foundation. The latter has faced a redefinition of its mission and has been trying to follow a more strategic role for the past few years. The first question is however, to which extent a new player will pursue more efficiency and if its power will be large enough to voice existing shortcomings publicly. The existing incentive scheme shown above suggests a stable relation between the Commission and other players.

Second, one has to respect political feasibilities. That the EU Commission might desist from parts of its program depends on the power of the the political principal. If in the long run budget restraints might become an important issue it might occur that EU technology policy could be altered. One might argue that EU technology policy is less important to the Commission than other pillars (e.g., Commom Agricultural Policy).

• **Empower a different principal**

Starbatty's and Vetterlein's (1994) conclusion suggests an empowering of the EU Parliament. They especially criticize the weak role of the Parliament and the attribuition of power to the Commission following Art. 189c of the Maastricht Treaty: A clever aging Commission can turn the EP's interest groups against those of the national research administrations by involving them in earlier stages of the decision-making process. This, in turn, weakens the Council's position in controlling the Commission. Their proposal is, thus, to enlarge the EP's power to supervise the decision-making process.

5.3. Extensions

In the model I only focused on two simply defined equilibria. Within the broader conceptual framework suggested here, it would be more interesting to analyze multiple-principal problems. Dixit's (1996) model refers to this topic and is able to explain the existence of low-powered incentives. Another interesting topic emerging from model would be the analysis of adverse selection processes between the agent and the firms.

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[55] See Fabisch (1996: 130).

Further research on the incentives in these and similar settings should be done. The conceptual framework has only tried to be a first outline and offers a very static view. It should be extended to cover more actors and to allow more specifications. Other extension could cover the allocation of control rights, decision rights and, in an extended political setting, with more actors. However, the contrast between the political settings and their incentives and the idea that the actors might simply coevolve to optimal policymaking seems stark. It is also worth remembering again that the instrumental debate has to continue. Technology policy in general should focus on other instruments such as patent protection, and legal ease of the ability to change researchers among firms and universities in EU countries.

I also want to note again that the EU Commission does not have the character of a particularly malevolent institution. Moreover, the Commission is not at all to blame for the shortcomings and overregulation of its member states. First, the instrumental shortcomings of the programs mentioned can be explained to a great extent by the fact that other instruments cannot be used at the EU level. Second, one could hardly believe that the incentive schemes would be automatically adjusted to a more efficient outcome at the EU level while there are even more institutional shortcomings persistent inside the most EU member states. Thus, it is simply the setting of the actors and the incentives within the constellation that lead to the outcomes observed. As Stubbs and Saviotti (1994) state, much of the critique regarding the practical shortcomings can "[h]ardly be laid at the door of the EC programmes, which account for only a very small part of *total* R&D effort across the companies and countries of the EC."[56]

Nevertheless, the examples given in the paper show how, by lacking incentives in embedding evaluation results into the decision-making process, inefficient policies can be persistent over time. The setting seems familiar and reminds one of the fable of the emperor's new clothes. Now the emperor is still proceeding along the road. But there is no child who tells the public that the emperor is unclothed—or the public does not want to listen.

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[56] Stubbs/Saviotti (1994: 165).

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