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Links between Creative Behavior and National Innovation Systems: How to Integrate Motivational Factors into Policy Considerations

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1. INTRODUCTION, KEY OBJECTIVE AND STRUCTURE OF PAPER

The interest in innovation activities is driven by the fact that investment in technology can influence economic growth. In the last decades, numerous researchers have therefore analysed innovative behavior in macroeconomic or mesoeconomic settings. Insights into conditions for national or regional economic growth have gained in importance and with them technological or knowledge spillovers in the context of diffusing embodied technology, mobile labour or learning effects in agglomerations.

Effects like spillovers take place in a multi-actor context with systemic interlinkages and this brings up the decisive question why and how much actors are motivated to behave innovatively. Motivational factors for innovative behavior remain a 'hidden' factor even in standard microeconomics and all the more in systemic approaches on public policy approaches to shape (inter-)national or regional innovation systems. Theoretical schools that discuss determinants for innovative behavior like market or competition theory still only focus on so-called extrinsic motivation while self-motivation and its partly conflicting relationship with incentives set by third parties are not dealt with. Thus, there is still a 'marriage gap' to find an interdisciplinary and, as a first step, eclectic approach to explain microeconomic creativity in the context of national innovation systems. The following paper aims at closing this gap.

The paper is based on a comprehensive and integrative overview on literature-based theory on research and innovation activities as well as corresponding public policy. The literature is highly heterogeneous in its reflection on individual creativity and ranges from modelling representative average behaviour to using methodological individualism. And the literature is highly interdisciplinary, also including the recent attempts to integrate psychological insights into general economics.

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Key objective of the paper is to define and contrast different theoretical approaches on innovation systems and state action, to classify public policy instruments with their effect on the motivational structure of creative players within the innovation system as well as to assess potential conflicting relationships between different public policy instruments and innovative behavior itself. The character of research and innovation, which is focused on in this paper, is mainly general purpose technology and its spillover effects. The paper concludes that the risk for crowding out individual motivation for innovative behavior increases with the degree of non-conformity of state action with the economic constitutional framework given. As framework, market principles are used which is based on the empirical results that market economies have empirically proved to be technologically more progressive than non-market economies (Hemmer 2002: 117). Assumption is also to have the environmental conditions of an industrialized country like Germany which substantially differ from conditions in technologically catching-up systems.

2. CREATIVITY RESEARCH AND ECONOMIC THEORY

Given the wealth of approaches on technological progess in academic literature, it seems surprising that creativity as the source of all innovations still seems to be a hidden factor in economic theory. Yet, as incentives set by public policy aim at stimulating innovative behavior, economic models have to accord recognition to what is creativity, who is considered to be creative as well as to why and how can the state interact with the creative world in an efficient way.

How is creativity understood by those who studied it? According to Sternberg (2006: 2), one of the leading researchers in this field, it is rather uncritical to describe creativity as a form of thinking which leads to something relatively novel and compelling, based on domain-general as well as domain-specific capabilities and which is partly measurable. Yet, this is where uncritical discussion already ends.

Science is still in search of a clear and unequivocal definition because disciplines perceive and approach creativity differently. According to Simonton (2006: 491f.), focus in research could be on mental operations which underlie creative processes (cognitive psychology), on determinants for individual variations in creative potentials (differential psychology), on family circumstances and educational experiences in childhood and adolescence which contribute to creative growth (developmental psychology), or on general sociocultural environments and conditions that shape and stimulate creativity (social psychology).

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Economic theory has benefited from insights in creativity especially with regard to approaches to foster the creativity of employees (industrial psychology like in Kirchler 2008: 23ff. with Meier-Pesti and Hofmann) and which has also become a cornerstone of idea and innovation management. As to general economics, the insights of creativity research have not yet fruitfully spilled over apart from some remarkable approaches (like Smith 1991, 2000; Frey 1997) on the motivational forces of individual market behavior. As a new tendency, insights from neuroscience back the focus on bounded rationality as brain research proves new cognitive limits in human reality (McCabe et al. 2005: 74ff.). In this paper, concentration is on research insights into technological creativity, i.e. a creativity that underlies the process from invention to innovation (commercialized invention) and diffusion which is shown in figure 1.

Creativity in terms of an innovation leads to "a product or service with a bundle of features that is – as a whole – new in the market, or that is commercialized in some way that opens up new uses and consumer groups for it" (Westland 2008: 6). The broadest definition of an innovation is by Schumpeter (1934: 66) who includes as output not only „(1) The introduction of a new good ... [but also, *author*] (2) The introduction of a new method of production ... (3) The opening of a new market ... (4) The opening of a new source of supply ...[as well as] (5) The carrying out of the new organization of any industry ...". It is essential to note that this definition goes well beyond orthodox approaches and creates an early link between innovative activities and diffusion processes especially with its relevance for new industrial organizations like networking activities. This is important because it is diffusion which creates the link between innovation and economic growth. As will be discussed later, this has led to a shift in public policy in favour of those agents which stimulate transfer processes within national innovation systems. It would be interesting to discuss if this shift in state preferences has been at the expense of those who are the creators.

Figure 1: The innovation process

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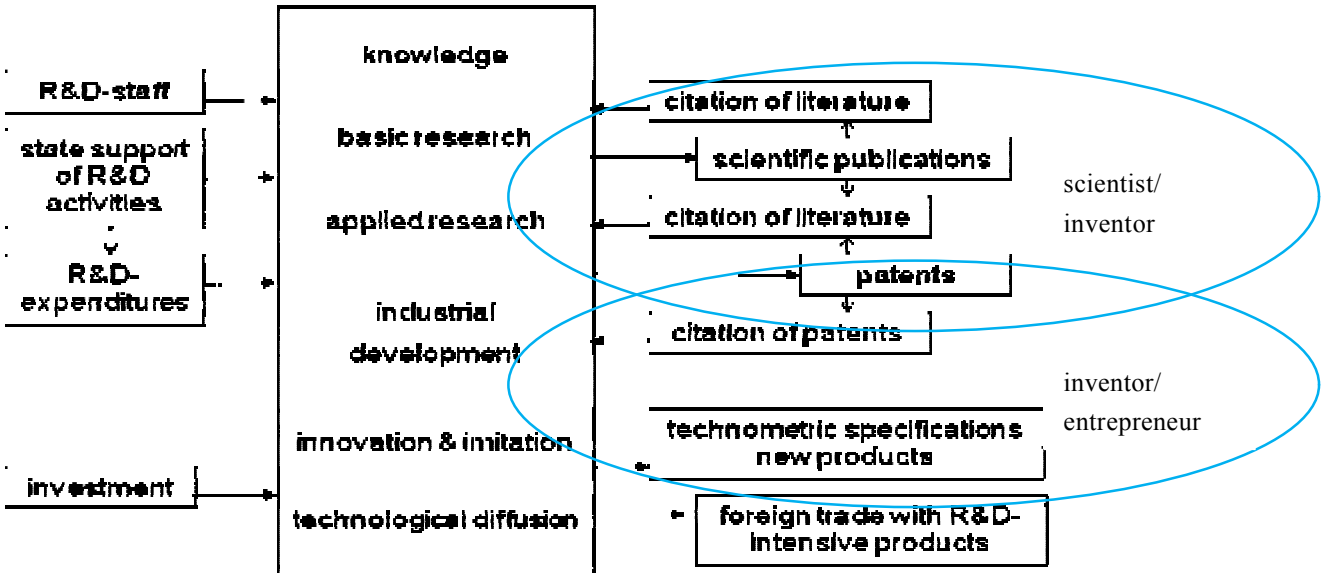

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Who are creators and what drives them? According to Ellen Winner in the context of gifted children (in Westland 2008: 300) "creators are hard-driving, focused, dominant, independent risk-takers". In the context of creative professionals, also a variety of personality traits has been associated with these individuals like imagination, independence, intelligence, intuition, originality, sensitivity, self-suffiency or suspicious nature (Genovard et al. 2006: 88). The professionals characterized like that are actors, artists, designers, inventors as well as entrepreneurs – and let me add - scientists because creativity is one aspect of a human's unique capability for abstract thought which scientists are usually gifted with to a high extent. Shi (2001: 61) even links scientists to entrepreneurs by describing a scientific innovation as "essential for the entrepreneurial activity of a scientist".

What drives people to be creative? Creativity as an invidual act is transformed into a goal-driven action through motivation which according to Huczynski and Buchanan (2001: 240) is "the cognitive decision-making process through which goal-directed behavior is initiated, energized and directed and maintained". Motivaton can be triggered extrinsically or intrinsically. While extrinsic motivation is usually conditioned by rewards (and not punishment), intrinsic motivation is driven through the action itself. Heckhausen (1989: 456ff.) characterizes intrinsic motivation mainly through a need for personal growth with a continuous impulse; through the goal itself and not through the consequences of success; and through self-determination which allows an immediate sensation of competence and is accompanied by a complete devotion to the activities (flow effect).

As to motivation research, the relationship between intrinsic and extrinsic motivation is a complex one. Intrinsic motivation might be crowded our or enhanced through extrinsic incentives depending on the conditions given. Kirchler refers to a meta analysis of 128 studies by Deci, Koestner and Ryan (1999 in Kirchler 2008: 325 with Walenta) which confirms that activities that attract a person per se have less appeal when combined with rewards (especially monetary rewards) or coercion but also potentially through critique, control, rebuke or timely conditions. This is confirmed for special aspects by Preiser (2006: 194) who refers to the charta of the German Association for Creativity which states that "fear and lack of freedom in a work environment can heavily obstruct creativity". Frey and Neckermann (2008: 9) back this by concluding on awards as follows: "Awards are less likely to crowd out intrinsic motivation of the recipients than monetary compension. Typically, awards are perceived as supportive rather than controlling" and might therefore even enhance a creative drive to tackle difficult challenges. There is experimental evidence that such challenges can also be better resolved by intrinsically motivated individuals (Frey 1997: 96).

Intrinsic motivation can therefore be considered as a powerful force in creative achievement like technological progress. Activities, however, which have not been attractive to a person might gain in appeal if combined with extrinsiv incentives. Research on new paradigms like open innovation profit from these insights and point to already existing managerial practice where a company hires "external contract inventors for the sole purpose of ensuring that creativity was maintained without being hampered by corporate norms and bureaucratic burdens" (Corelli O'Connor 2006: 73). In general economic theory, however, individual creativity is still a somehow hidden factor although more and more an endogenous one.

Market theory models have traditionally focused on extrinsic motivational factors which are monetary or non-monetary incentives set by third parties through market signals (like potential profit, image) or through external environment (like public subsidies, reputation). Innovative processes are assumed to be especially triggered through competitive processes, i.e. the so-called innovation function of competition, because it is the actual or expected pressure from other companies which makes an entrepreneur willing to undertake expensive and high-risk projects and survive the selection process through successful creative performance (Herdzina 1999: 24). Goal is to achieve temporary monopoly profits until imitators are attracted to the market. By market definition, the group of relevant competitors is identified as the "group of sellers or of close-substitute outputs who supply a common group of buyers" (Bain 1968: 6), a definition which has entered German and European as well

as U.S. antitrust law (test of 'reasonable interchangeability' or 'peculiar characteristics and uses').

Intensive theoretical controversies are on what can be considered as workable respectively effective competition with regard to the output in innovations. The approach exemplary used in this paper due to its relevance for antitrust practice follows the strand of Harvard School (like Bain 1968, Scherer 1980) and its so-called 'Structure-Conduct-Performance' (SCP) approach. This approach has also become a widely accepted framework for business administration when Porter (1980) transformed it into an competition analysis tool. Basic idea of SCP is that a firm's success (performance) will be determined by a bundle of conditioning factors like number of players in the relevant market, product's degree of homogeneity, adaption flexibility, market transparency, height of market barriers and so on (structure) which then determines a firm's strategy mix as well as its spirit of competition respectively its inclination to restrict competition (conduct). One strategic option of firm behaviour is to innovate in order to increase its relative competitiveness. Theoretical follow-up approaches concentrate on the interaction between the parties involved (network partners, competitors, suppliers, customers) from a game theoretical perspective (like Besanko/ Dranove et.al 2004).

Concluding, mainstream economics on market behaviour like Harvard or Chicago School with their impact on antitrust practice have concentrated on extrinsic motivational factors while pondering over the conditions for allocative and productive efficiency and regulatory needs. Yet, with the Austrian School there is one school of economic thought which has been close to the intrinsic character of something which is called 'spirit of competition' even if it questions the coherence of many results of behavioural economics (Caplan 2003). Hayek (2005:43ff.), famous representative of the Austrian School, analyses individual freedom and names it as the cornerstone of a creative society. He reasons that individual freedom is needed because majorities in society are stability-oriented and that individual freedom alone leads away from path-dependency into an unpredictable future. Entrepreneurs which are creators cannot operate with perfect knowledge because they are investigating the unknown in order to create a hitherto unknown problem-solution framework. With his discussion of the individual freedom of the creators, Hayek comes quite close to the insights of creativity research.

As could be seen in figure 1, the scientist/ inventor is also of utmost importance for technological creativity. And what does economic theory tell us about this group of creators? The tradition of modeling the scientist's world analogous to markets is long-standing (like Polanyi 1941; Rescher 1989). From an economic perspective, science is modeled like a

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market economy in which scientists are competitive producers who pursue their self-interests (economic gain, social recognition) by producing and selling scientific knowledge and where scientists fight with one another for the resources that society can provide for the production of scientific knowledge. According to Hull (1988: 323) one reason for that was a science rooted in an emerging individualist society in which personal property was of utmost importance, thus, the intellectual property of a scientific publication could stimulate the progress of science over the centuries. Here, the property right is the individual right of a scientist to exclude others from the use or benefit of e.g. a publication.

Unlike in the discussion on entrepreneurs, with the quasi-economic models of science the conflict emerged that rational scientists seek their utility outside of their (societal) mission which is to help to better understand the world we live in and to disseminate these insights as public goods which are characterized by non-exclusivity and non-rivalry. Extreme assumptions on this mission are that scientists experience such great satisfaction from their work that they would even like to ignore extrinsic incentives at all (Simpson 1978: 274). It would be interesting to discuss how much this mission and thereby public-good character would get transformed into a semi-public one (or even a privat one?) if some governments of today continue to enforce competition in the public research sector while parallelly cutting back the sector's budget, thus, making pulic research dependent on funding from industry and simulating the 'survivial of the fittest in the market'. What can be observed is that there is a partial backing away from ideals in science like allowing for thorough, time-consuming and confidential controversies before going 'public'. Koertge (1990 in Shi 2001: 19) confirms "the pessimistic story about how the lust for quick publications and citations discourages scientists from tackling difficult problems which would take a long time to solve but which are nevertheless important?". And Schöler (2008), director of the German Max-Planck Institute for Moleculare Biomedicine, states as one reason that today's pressure of having a quick transfer of scientific results into media makes scientists reluctant to communicate their results because they fear to be too quickly pushed towards presumably final results or to lose control on their property rights through imitation. As we will discuss later, not only the role of media but also state action can crowd out a scientist's intrinsic motivation.

Concluding, mainstream economics on the behavior of scientists also only offers an interesting starting point. Certainly the insights of Hayek can also be applied to the research context. Yet, the discussion certainly must be extended to cover interdisciplinary research and the multifaceted political and societal setting in order to grasp the motivational factors of

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scientists. The research challenges remain even higher for the subject 'scientist' than for the subject 'entrepreneur' because the mix of an altruist mission inside a material world could force true motivations to go 'underground' or to put it even stronger, i.e. the distinction itself could become a resource of strategic interaction.

Summing up, insights into interdisciplinary research demonstrate that a creative person is far from being the 'homo oeconomicus' that still dominates numerous areas of economic science, i.e. wherever rational utility optimization is assumed to determine human average behaviour. Profiting from the rich insights of psychology, the homo creativus is not a simple man but rather the 'complex man' of Schein (1980: 94f.) who states: "… adhering to rational-economic, social, or self-actualization assumptions … may be wrong in some situations and with some people. Where we have erred is in oversimplifying and overgeneralizing." The complex man is an attempt to integrate most of the aspects mentioned above and to lead to solutions which are specific to situations and individuals. The creative person does certainly not correspond with the average person but – coming back to economic theory - rather with the "homo oeconomicus maturus" suggested by Frey (1997: 113) which has an intrinsic motivation which is sensitive to being crowded-out by others depending on the conditions given. The conditions discussed in the next paragraphs are those of national innovation systems (NIS).

One has, however, to point to the fact that it is more a Western perspective to attribute personally meaningful and intrinsic motives as a driver for creative behavior. In the research in Korea and other Asien countries, "negative conceptions of creative individuals" make creators more "concerned about social responsibility, harmony and ethics" although the new generation might go for a slightly different avenue as a new field of research (Choe, I.-S. 2006: 414). A similar phenomenon is confirmed for African settings where creativity has a social-group basis rather than showing individual characteristics (Mpofu et al. 2006: 471). Yet, also Africa sees a pattern of change where "innovation, adaptation, and replication for successful participation within an ecocultural setting (i.e., modern, transitional, and traditionalist) calls for redefinition of the self at both the individual and the collective (e.g., clan or community) level" (Bekker 2001; Franchi and Swart 2003; in Mpofu et al. 2006: 461).

As a consequence of an interculturally diverging estimation of creativity and the creative being, a non-Western research on technology policy might end up with different conclusions than its Western counterpart. This paper is representative for the Western approach without

denying that innovative process may also include substantial interaction as discussed in the next chapter.

APPROACHING CREATIVE BEHAVIOR IN THE CONTEXT OF NATIONAL INNOVATION SYSTEMS

Given the importance of human creativity in terms of technological progress, it comes as no surprise that governments have strong traditions in their attempt to influence it, as already indicated in the previous chapter. Landes (1969: 151) describes this attitude by exemplary using the Prussion state of the late 19th century which set up a large educational system – including non-teaching academies – in order "to introduce new techniques and diffuse them through the economy" and which used a variety of means from technical advice and assistance, subventions to inventors and immigrant entrepreneurs, to duty-free imports of industrial equipment and gifts of machinery. "Some of this was simply a continuation of the past – a heritage of the strong tradition of direct state interest in economic development. Much of it, in Germany particularly, was symptomatic of a passionate desire to organize and hasten the process of catching up." This quotation highlights two aspects:

an early awareness of the state concerning the role of scientists/ inventors/ entrepreneurs for knowledge creation and diffusion; and

a wide variety of instruments used by the state in order to stimulate technological progress which does not reveal a structured approach at first sight.

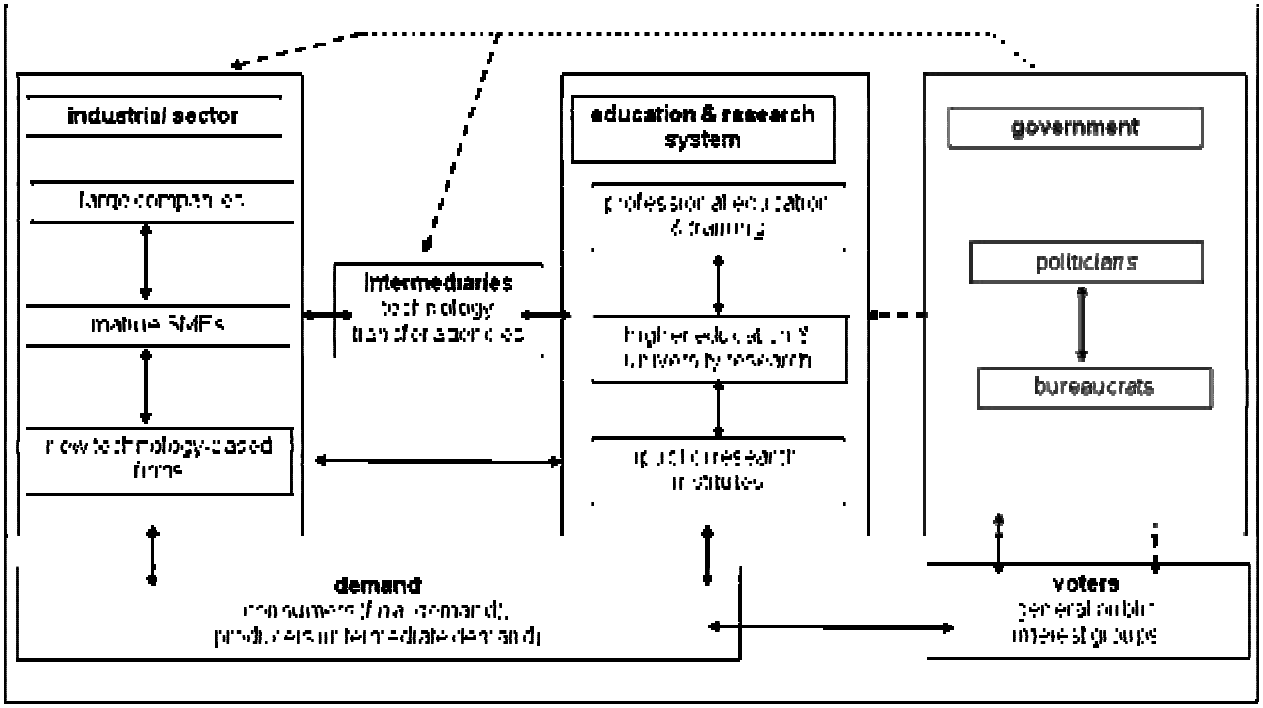
With reference to the motivational drivers of creativity, understanding the reasoning, structure and consequences of public policy is critical in order to derive at consistent conclusions for state action in the framework of technological creativity and innovation systems. Yet, theoretical discussion on that topic is still in flux and consists of numerous explanatory approaches which are broadly facetted.

What can we learn from economic theory so far? A traditional approach to model state intervention in market processes is market failure which is widely accepted for conditions of natural monopoly, information asymmetries, externalities and public goods but still controversially discussed with regard to its consequences for public policy (Fritsch/ Wein/ Ewers 1999: 91ff.). In the area of R&D, the need for state action is assumed to be high due to the cost-intensity of a time-consuming process which at the same time has a high potential to spill over to multiple areas and is therefore hardly appropriable especially for fundamental

science. Difficulties in appropriability have been confirmed by studies although R&D indicators (compare figure1) do not allow an exact picture. As Link and Siegel (2007: 51) put it: "private returns to R&D investment appear to be positive and statistically significant across nations and during most time periods [but also that] ... firms are under investing in R&D from a social perspective". These scientific insights into externalities stem, among others, from new growth theory (like Romer 1986, DeLong/Summers 1991, Barro/Sala-i-Martin 1998). Conditions of imperfect competition, increasing returns to scale and endogenous technological change leave substantial room for investment into R&D and knowledge as well as for their being the source for technological or knowledge spillovers through factors such as diffused embodied technology, mobility of labour as well as supplier- or customer-driven agglomeration effects.

This theoretical discussion has been one of the starting points for so-called national innovation systems (NIS) that have turned out to be the new political "mission" and thereby ended decades of centralized national-champion policies where until the early 70s diffusion was "of minor importance or actively discouraged" (Freeman/ Soete 2004: 415). Metcalfe (1995: 212) defines national innovation systems as "…a system of interconnected institutions to create, store, and transfer the knowledge, skills, and artifacts which define new technologies". Fact is, that systemic approaches are based on decentralized control mechanisms in a large community of players including local, regional and (inter)national politicians and bureaucrats. The importance of lobby groups in the NIS context is confirmed by Freeman and Soete (2004: 395). The following figure gives a short overview on the main players:

Figure 2: Players within the National Innovation System (NIS)



Own figure based on Kuhlmann 2001 in BMBF 2004: 88

The new mission also included complementary policies which were considered to be vital for success such as infrastructural conditions, institutional factors or organizations because these advantages as well as a country's endowment in scientific and technical personnel and skills stem from a bigger context of natural resources, historical development and social, cultural and political factors (Freeman/ Soete 2004: 363). This has paved the way towards a broader discussion including insights of institutional economics (like Richter/ Furubotn 2003; Rutherford 1996), diffusion research (like Perez 1997; Rogers 2003) or evolutionary economics when it comes to the dynamics of changing conditions (Nelson 2007: 8 f.): "The new evolutionary growth theory that is emerging sees economic growth as the result of the co-evolution of technologies, firm and industry structures, and supporting and governing institutions. I propose that a satisfactory theory of the processes involved in economic growth must consider all three of these aspects, and that the driving dynamics involves their interaction."

Policies which were typically associated with the state like providing infrastructure, education and science have been redefined and/ or enlarged. On the agenda are now issues like the enforced knowledge dissemination especially from science to industry, a relaxation of antitrust enforcement related to collaborative research, or the role of the state as opinion leader and change agent when it comes to demonstration strategies like e-government. Yet, "it should not be forgotten … that 'regional systems of innovation' and 'economies of

agglomeration' have always underpinned national systems from the beginning of the Industrial Revolution" (Arcangeli 1993 in Freeman/ Soete 2004: 315). Therefore the importance of local originality and diversity must be stressed. On a territorial basis, systemic approaches concentrate on industrial districts/innovative milieus/local production systems, new industrial spaces, learning regions, collective efficiency, spatial cluster of innovation (like Hotz-Hart 2001, Porter 1998) or recently virtual clusters driven by digital innovation (like Passiante et al. 2002, Burger-Menzel/Cabero Tapia 2007).

As an empirical result, there is a big variety of local, regional and national innovation systems worldwide with partly extreme contrasting features especially between industrialized and industrializing countries. And even within a relatively homogeneous group, systemic conditions differ substantially and all the more in times where formerly domestic companies have gone global in outsourcing, production and sales and countries have started to strategically use their locational advantages to attract multinationals.

Concluding, one must state that theoretical approaches help to understand how innovation systems and diffusion works. Yet, even if theoretical insights seem to be appropriate for state intervention, empirical differences blur the picture due to e.g. a lack of precise indicators, specific characteristic of countries and cultures, sectors and relevant markets, different types of companies and competitive spirit, an unclear role of new principles like open innovation as well as – at the core of it all – diverging incentive structures of all the players concerned.

In the context of this paper, the decisive question is how the state can mold the incentive systems for scientists and entrepreneurs in a way which efficiently stimulates technological creativity without abstracting from the complex systemic approach given. Here, theory still lacks and could certainly not be elaborated in this paper. A future approach will, however, need a conceptual cornerstone to start with. A first attempt to go for such a cornerstone is to discuss where and how freedom (F), transparency (T) and norms (N) enter the political conditions set to stimulate technological creativity. By doing so, a basic match with the insights on creative individuals discussed above could be reached.

While freedom to go for the unknown has been explicitely named in creativity research as a precondition for implicit motivation, transparency has not. Here, transparency is a proxy for all additional information insecurities apart from what creators investigate as technological challenges. It therefore covers situations when creators are hampered by timely constraints or fear of rebuke (compare above) when having to get informed on policy contents and/ or on the consequences of their action. Politicians and bureaucrats are gatekeepers to this information

on current and future directives, on sanctions involved and are seekers of own interest which makes policy actions even less predictable (information power). Therefore, in cases of an unknown technological future, norms and values must guide the way towards an open discussion and self-responsible but liable citizens, including state employees.

(F)reedom

Creativity research has shown that it is especially fear and lack of freedom which could crowd out intrinsic motivation. The group of public policy instruments which by nature do not aim at a direct control but at enabling self-organization and self-coordination are framework conditions (Hermann-Pillath 2002: 27) provided that normative individualism is being assessed as a political principle and implemented as such. These framework conditions should be based on trust which gives individuals the sensation of being self-determined and not the one of being considered a threat by society (Frey 1997: 49ff.). If framework conditions are such that they substitute freedom for control, the devotion to creativity might get disturbed and lead to crowding out. One example is the aggressive exercise of intellectual property rights by universities which contradicts the long-standing tradition of open science and training. Bekelman et al. (2003: 456) found out that in U.S. biomedical research, scientists who had co-funding from industry and were engaged in corresponding technology transfers produced studies that were likely to have conclusions with their sponsors' interest. Additonally, the Bayh-Dole Act made universities give generous promises of intellectual property to sponsors for funds which made fellow scientists more secretive in giving away new knowledge than those not involved in technology transfer. The lack of freedom can thereby transform open science into a 'closed' one.

Discretionary policy as the second group of instruments is less favourable for intrinsic motivation because it is usually an intervention based on rule of reason instead of per-se rule and therefore characterized by low predictability. Due to these characteristics, discretionary policy has always been a topic of controversies. In market economies, this policy should only be used to increase transparency of framework conditions [discussed next] and to ease structural adjustment processes caused by (OECD 1983: 7f.): (i) attitudes and institutional developments from other periods of technical development, (ii) a rapidly grown public sector and state action like social programmes, regulations with unintended side effects on incentives to work, save and invest, (iii) government attempts to preserve given production and employment structures; or (iv) a slow growth itself which hampers structural adjustment. And let me add Nelson and Winter (1982: 120) and therewith externalities because "technical

change is continually tossing up new 'externalities' that must be dealt with in some manner or another".

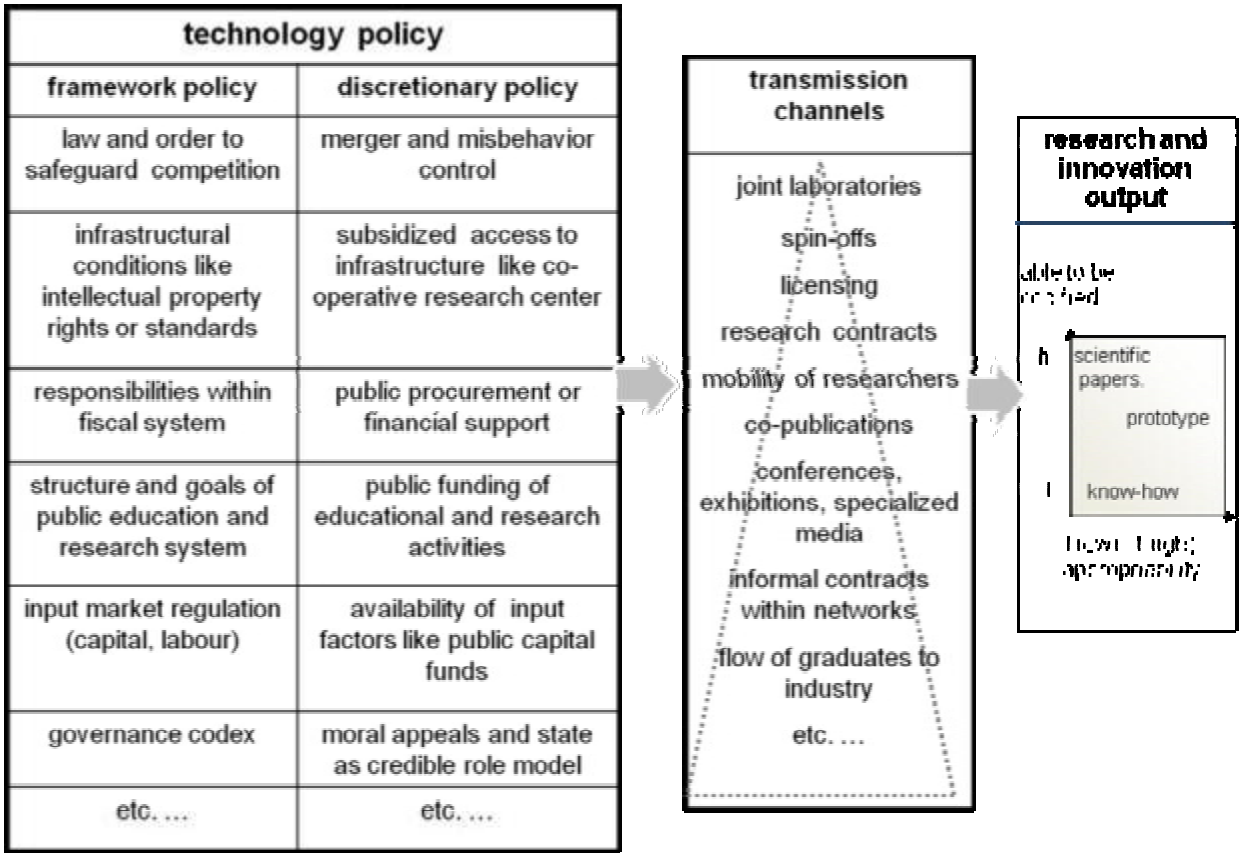
If handled cautiously, discretionary policy might not be that critical to technological creativity because positive adjustment as described by the OECD could also open up new windows of opportunity if e.g. attitudes, institutions and state actions were adapted to new paradigms or unintended side effects were reduced. And one might expect that a diffusion approach with a large number of involved agents would foster politics where state control would be reduced or at best be decentralized with the consequence that there would be more room for individual decision-taking.

Yet, reality does not show a backing away from discretionary policy but rather the contrary which is a state intervention that exceeds positive adjustment. In recent years, industrial policy interventions within the NIS framework have increased dramatically, i.e. an active intervention into sectors and regions to control the reallocation of resources and, thereby, structural change. Extensive EU programs such as ESPRIT, FLAIR, ERASMUS or SPRINT have been launched to stimulate technological creativity and to provide participants with substantial and goal-driven extrinsic incentives (Schmidt/ Schmidt 2006: 9 ff., 185). And there is no end to this tendency because on a global scale active governments build up pressure for less active ones to intensify their interventionism and create national advantages at the cost of other countries' prosperity (Burger 1999: 103). Hereby, it also becomes clear that the lack of freedom through increasing control usually goes along with increasing intransparancy.

(T)ransparency

The policy development discussed above have led to a complex instrument mix (figure 3) where a variety of policy fields on different levels involves substantial informational needs as well as the risk of trade-offs and governance gaps (Schmidt/ Schmidt 2006: 163 ff.; BMBF 2004: 91).

Figure 3: Classifying instruments of technology policy



Own figure based on OECD (2000: 165)

It seems even to be the case that direct government involvement in innovation tends to favour the "creation and maintenance of powerful, conservative, expensive scientific bureaucracies which rob would-be innovators of scarce talent" (Landes 1998 and Seabright 2004 in Westland 2008: 304). Let me use the example of the European Union (EU) where, unless its member countries, the European Commission is allowed to grant public support without being controlled for biasing competition within the internal market (Schmit/ Schmidt 2006: 242). Thus, transparency through decentralization is turned upside down and central bureaucracies are allowed to live up to own interests. Pure decentralized creativity would mean e.g. self-organisation on a codex basis as it is valid for the voluntary Linux community which monitors its members' behavior on the basis of subtle codes of conduct to foster order and productivity.

How can the problem of lacking transparency in state action be tackled? A first step is to detect the areas where government itself increases informational insecurity for creative individuals through technical 'helplessness' or on purpose.

Politicians and bureaucrats face an informational disadvantage when it comes e.g. to diagnosing which technology has a big potential in the future, to assess the right means to adequately reach the target group or to forecast policy effects (Burger-Menzel 2005: 59).

Additionally, state action is limited in its approach to know the 'right' instrument for stimulating technological creativity because as to Kirchler (2008: 321 with Walenta) this creativity in itself is hard to measure because there can be a mix of motives underneath, some even unconscious ones. When the instrument has been decided upon, state action has substantial time-lags from the moment of diagnosing the need for an intervention until the measure gets implemented, checked and possibly corrected. These time-lags are quite critical with regard to the dynamics in knowledge advances. Given the technical problems which accompany public policy, it seems therefore impossible to design and implement one which matches the specific sources of underinvestment in research and innovation. Yet, equipped with taxpayers' money it seems within an easy reach of the state to willingly push forward developments which creators might not have chosen without intervention. Thus, state actors create additional 'noise' in the information channel towards an unknown future.

Informational insecurity is used on purpose by government actors to protect themselves against outside control and pressure and to create room for selfish behavior and bargaining processes with well-organised interest groups. In the political market, intransparency usually goes along with information asymmetries before and after the 'principal-agent' contract is set up. This situation leads to ex ante and ex post opportunistic behavior of political agents which have the right to change property rights unilaterally and, unlike in economic competition, do not face a law against collusion or concentration in the political market (Burger-Menzel 2005: 57f.). For bureaucrats, theory discovered early, that they also feel protected through intransparency which minimises self-responsibility especially in the case of multi-source investment (Behrends 2001: 46 ff.) thereby contradicting that "... to some extent government is a form of voluntary cooperation, a way in which people choose to achieve some of their objectives through governmental entities because they believe that is the most effective means of achieving them" (Friedman/ Friedman 1990: 27). Yet, if conditions are favourable, state actors have a tendency towards log-rolling with those interest groups which can offer win-win situations. As creativity research shows personality traits like independence, one can doubt whether creators tend to organize themselves and be active in such lobby groups. These activities which occur under the umbrella of intransparency certainly call for a discussion of norms.

(N)orms

Norms are "established behavior patterns for the members of a social system" (Rogers 2003: 26). Usually, creative technology is directed against common sense, i.e. against established

norms. Therefore the process of developing and diffusing these new ideas is time-consuming and accompanied by intense conflicts. Creative people tend to endure these hardships because they feel intrinsically driven to move on. Von Mises (1927: 48) describes this phenomenon which in literature has later been discussed as technological lock-in as follows: "All progress of mankind always took place because a small minority started to move away from the ideas and costumes of the majority. …If you give to the majority the right to dominate the minority in questions of what the minority should think, read and do, progress is being prevented forever." Mokyr (1991 in Westland 2008, p.298) empirically confirms that technological creativity is highly sensitive to culture and can fade dramatically when social and economic institutions turn rigid and act against it like in late medieval Islamic and Chinese societies.

A society where individual creators can thrive therefore needs an openness towards change which is accompanied by a transition in beliefs and practices and positive conceptions of creative individuals. And the stronger a moral conviction like trust in others is, the higher the probability that it is transferred to and applied in other areas of everyday life (Frey 1997: 43). And technological creativity certainly is not limited to direct economic or utilitarian gain but also includes values like personal growth. To this background, Simonton (1975 in Wiswede 2007: 121) stresses the empirical importance of role-model availability for creators like entrepreneurs. Positive role models stimulate tolerance and imitation, thus, spreading the values perceived.

Creators have to live up to their role-model function by carefully dealing with the risks of technological change and its externalities. Yet, the "most innovative member of a system is often perceived as a deviant from the social system and accorded a status of low credibility to the average members of the system" (Rogers 2002: 26). A radical technical creation would therefore need someone else to enhance its diffusion. Government might act as both, opinion leader and change agent. Initiatives like e-government aim at influencing the citizens' attitude as desired through communication and application while being highly conform with societal norms. Yet, it would be interesting to discuss how this opinion leadership might suffer from the governance gaps and increasing intransparency discussed above because both developments could put the state's political credibility at risk.

Economic policy therefore not only reflects changes in objective conditions but also shifts in values or understanding. In addition to that, there is the political process itself with its actors (Nelson and Winter 1982: 372): "Change over time in the relative power of different interests

and groups within society likely will pull changes in policy in their wake. ... Sometimes the institutional machinery for making policy seems to take on a life of its own."

3. CONCLUSIONS ON TECHNOLOGY POLICY AND OUTLOOK

Approaching creativity in the context of innovation systems is difficult when it comes to conclusions for state action because the success of innovation processes depends on a wide variety of conditions and of behavioral patterns of various actor groups. As a first step, three factors have been discussed which seem to have the closest link with creativity research:

Freedom respectively lack of control as a main driver for creators;

Transparency as a requirement to not get 'side-tracked' in creative behavior;

Norms as a guide for what members of a societal system tolerate as behavior.

One outcome was that the concept of freedom is best approached through framework conditions. However, this would only be possible if technology policies were successfully decentralized in order to avoid intransparency and governance gaps. Clearly political parties, bureaucrats and interest groups determine part of the allocation here with regard to R&D activities. As those who do politics usually do not reform themselves, guidance must come with the help of conscious normative changes which usually go deep to the heart of social and cultural structures of a country. Thus, there is only a first set of guidelines and no easy answer for the design of a technology policy which preserves intrinsic motivation.

As to FTN factors, help for policy guidance comes from the original discussion of market principles. Market economy in its extreme form does not go along with the existence of an intervening state while an ideal planned economy is based on an omnipotent government. The interval of freedom with these forms ranges from total to none at all. In reality, there is no pure form but a mix of voluntary agreements (market) and command structure (state) and the constitutional form is defined by the dominating principle (Friedman/ Friedman 1990: 11). If the market principle dominates, then government acitivities has to safeguard at least the relative freedom of choice and action for the individual as discussed by von Eucken (1952: 255). The other so-called system-immanent functions enhance a transparent political environment if respected by government because it is not allowed to bias prices, primary income or power conditions for the players concerned. Thus, the risk of political bargaining is reduced and backed by the function of liability which also qualifies as a norm.

The highest conformity of technology policy instruments with these functions is given if state action provides general law and order conditions. Specific law and order conditions are already less conform because they usually create exemptions from rules for groups, sectors or regions and they tend to lower competitive pressure if they do not only focus on supporting factor mobility (Meißner/ Fassing 1989: 161ff.). Even less conform with the system immanent functions of market processes are discretionary policies where governments influence the individual optimization calculus. Examples are public procurement, subsidies and other interventions that directly or indirectly influence individual decisions and, thus, potentially also intrinsic motivation. Empirical research shows that economic constitutions temporarily tolerate to a certain extent non-conformist state intervention (Peters 1996: 137). Yet, shaping a steady culture of non-conformist state action will bring a market economy system down and create a state dominated economy.

In order to increase awareness on the goal- and market-conformity of state action, the system-immanent functions have been transformed into a checklist by the German Commission on Deregulation (in Hotz-Hart 2001: 210). If all questions are answered with 'yes', the probability increases that there could be net utility of state action:

- Does market really fail in the case concerned?
- Is there an arrangement to prevent government from failing?
- Is it possible for new participants to enter the market?
- Does price mechanism still work effectively?
- Does the state refrain from entrepreneurial activities?
- Is regulation restricted to a minimum?
- Are governmental activities quickly and effectively implemented?

When compared to the original discussion of von Eucken's functions, it gets clear that the Commission has certainly enhanced transparency conditions because it checks for state failure. To the background of public choice and institutional economics, a lot of measures are named to reduce this risk such as decentralization, a political reform of state size as well as leaner bureaucratic procedures with a better control through external experts and through competition between bureaucratic units (Hemmer 2002: 380ff.). The scope for extensively discussing these measures here is, however, limited. As to norms, they are only implicitely given in the checklist. Yet, as the list is valid for state and market participants as well as for

scientists in the case of market failure, the mindset for discussions is a broad one. A normative role-model function should not only be associated with creators but with all players concerned because guidance through innovation systems is finally based on norms. Putting freedom and liability in the midst of this discussion, will certainly revive the fruitful and elaborate work of researchers like Hayek.

Let me close with Sternberg (2006: 2f.) whose creativity research has been the starting point of this paper: "Governments say they want creativity, but their actions belie their words. … The last thing these governments [also in democracies, *author*] want is critical and creative thinking that would threaten their existence." Thus, as one reasons for the relatively poor systematization given in his discipline Sternberg does not only name the multifaceted phenomenon itself but also the incentives for researchers to deal with something which has been a less prestigious academic topic because governments have been relatively reluctant to fund it. Hopefully, this experience from creativity research does not 'spill' over to interdisciplinary research on innovation systems.

Creativity research has certainly been helpful to understand more about the interaction between creators and government in the context of innovation systems and about the potential risk of crowding-out effects associated with it. Yet, it is clear that the contribution of this paper is realistically small and eclectic. A theory still needs to be developed if possible at all. Not only increased technological dynamics and globalization turn this intention into a scientific challenge – as well as a creative one.

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