CREMA

Center for Research in Economics, Management and the Arts

The US Research University – Systemic Limits of a Model

CREMA Working Paper No. 2014-15

CREMA Gellertstrasse 18 CH-4052 Basel www.crema-research.ch

The US Research University – Systemic Limits of a Model

Stephan Bieri and Franz Lehner

Stephan Bieri, Ph.D., former CEO of the ETH domain; Chairman of the board of visitors, University of Bayreuth, Jurastrasse 20, CH-5000 Aarau, swbieri@vt.edu.

Franz Lehner, Ph.D., Professor em., Ruhr-University Bochum, Paul-Klee-Strasse 9, D-45883 Gelsenkirchen, franz.lehner@rub.de.

October 2014

Abstract

The US research university is a very successful model of higher edudaction and research. We examine its core elements and follow the current discussion on a necessary reform. Focusing on the institutional structure, we review possible causes of shortcomings and frictions. During the last 50 to 60 years the environment of the research university changed. The single institution has become highly dependend on federal and industrial grants and of undergraduates' fees. This process has transformed the internal organization as well as the interaction with important stakeholders. It also had an effect on the relationship between university and faculty. As a result, the scientific production has grown reamarkably but not necessarily the overall competivity. We discuss the systemic challenges that threaten the US university landscape and its contribution to scientific progress and innovation.

JEL classification: D123

Keywords: Research university, US system of higher education, institutional structure

„Distributional coalitions slow down a society's capacity to adopt new technologies and to reallocate resources in response to changing conditions ..." (Olsen, 1982: 65)

1 Introduction

The US research university is a model for university development. It stands for leading-edge graduate education and academic research as well as for their systemic conjunction. As an institution it cultivates a specific scientific and organizational culture – committed to the education of elites and to international competition. But it is an *exception* within the vast US system of higher education.[1] Numerous (often rather negative) assessments on higher education in the US are not taking the situation of the research university into consideration. As a matter of fact, most universities understand themselves as institutions of professional education (Hoffmann, 2011: 4). Today, almost two thirds of all US high school graduates are enrolled "in college". There is a strong belief that the economic function of the universities needs to be reviewed (Finn, 2014).

Since the sixties many universities worldwide have transformed their organization and academic culture by following the exceptional model of the US research university. In a number of cases it was successfully copied, in others it was even improved by adding new elements such as increased dependable financing. But in other cases the imitation was less successful because the whole or parts of the model could not be adapted or did not work adequately in different environments.

While the US research university still is a global model, there is an increasingly skeptical and critical debate in the United States. It is argued that more and more institutions are losing their lead-ing position and the institutional features supporting this position. There is, as we will show, a need for reforms.

Against this background, we are interested in the institutional structure of the US research university and its evolutionary dynamics. We examine three interrelated questions: First, what are the specific institutions that create or created the strength of the US research university; second, what are the main causes of recent problems in the development of the US research university; and third, how could the US research university model be developed under realistic socio-economic and political conditions?

[1] We use the term "US research university" to describe the types of US universities that still are considered international leaders and the leadership of which is based on strong research activities. The Carnegie Foundation regularly publishes a "List of research universities in the United States" with the two main categories "very high research activities" (currently 107) and "high research activities" (currently 98). We neither discuss the methodology of the study nor the relevance of other international rankings.

2 A systematic approach

This article aims at a systematic analysis of major changes of the US research university. The basis of the analysis is an evolutionary explanation of the interaction of institutional structures. We understand universities as complex institutional structures which interact with the even more complex institutional structures of their environment. By complex we mean that institutional structures are composed of separable parts which emerge from different interactions. They are governed partly by different principles and / or extend differently into space and time. In contrast to conventional definitions, we do not define structure as being complex simply because it exhibits emergent properties for in the evolutionary perspective underlying this article; this is an attribute of all social systems. A social system, here, is defined as a separable set of interconnected institutions which are coherently organized around certain specific principles. Institutions are defined as knowledge, understandings, rules and resources that actors can only evade at the expense of significant costs (Lehner, 2011).

The university as an organization is a social system whose institutions are designed to make binding decisions and to perform a hierarchical coordination. In contrast, the university as a culture is a social system whose institutions emerge spontaneously and are designed for spontaneous coordination. The systems are governed by different principles which are not always fully compatible. Government rules imposed on universities as organizations, for example, are often in conflict with established academic culture.

If we consider a university as a complex institutional structure, we analyze it as a number of distinct but interacting social systems. Some of the systems form the university; others are part of the university's environment. Among the systems that constitute the university are graduate schools. Graduate school can be understood as a specific institutional structure which reflects both the institutions of the university and those of specific academic disciplines. Systems in the environment of the university are rules and resource allocations of regulating agencies or research foundations, for example. Systems in the university and systems in the environment interact. Moreover, the development of different systems is often interdependent – systems coevolve. As we will argue in this article, the problems which the US research university is facing today are rooted in the coevolution of the universities and their graduate schools within a specific environment.

To distinguish a number of relevant systems is not only a convenient way to cope with the fact that universities include a variety of different institutional structures which may be conflicting or at least inconsistent. Much more importantly, however, it allows for an evolutionary understanding of social systems. In this perspective social systems are produced and reproduced in an evolutionary process. The process is driven by variations in the institutions which, in turn, are caused by the agents in the realm of the system or in its environment, and by the system's response to variations. Moreover, the process is self-organizing. Self-

organization is governed by the basic principles of a system in question. Therefore, we distinguish systems according to their basic principles. This is the understanding of modern evolution theory repre- sented in economics by Ulrich Witt (2003, 2008, 2011) and in sociology by Niklas Luhmann (1990, 1995,1997).[2] In scientific research, Stephen Toulmin (1972) advances a similar theory. We will come back to these theories at a later point in this article.

In order to illustrate this approach, we study a department's decisions on new appointments. From a theoretical point of view, decision-making by departments is not a spontaneous process. Yet, the institutions (rules, routines, knowledge and resource allocations) installed by a department form a spontaneous system. A number of independent appointments of faculty members, for example, over time lead to a changing pattern of resources and reputation. Let us assume that each decision is taken by the department as an organization with the intention to reinforce the departments established structure. But the new faculty members unintentionally change the department's culture. They build new personal or professional relations within the faculty, stimulate new debates and form new formal or informal structures of cooperation among faculty. This will be reflected in the faculty's acquisition of grants, in its foci on publication and in its communication with the profession and the scientific community. A new pattern of resources and reputation may emerge from this and might not fit or even contradict the department's intentions and goals. Moreover, it may increasingly limit a faculty's choice of new members, its capabilities to establish new research centers or other activities. This may have a negative impact on the most important systems of universities, namely knowledge systems of its schools, departments and other research facilities. Knowledge systems embody the scientific knowledge which schools, departments and other research facilities produce and use. They are both the key product and the basic resource of research and teaching. They are also contributing to the reputation of schools, departments and other research facilities within academia and other important fields.

Schools and departments also encompass the systems in which the everyday teach- ing and research institutions are produced and reproduced. Although these institutions are unlikely to overtly contradict relevant formal rules set up by the university, they may lead to practices which increasingly deviate from formal rules. One important reason is that departments, schools or institutes are also systems that link the university to disciplines and other systems in the university's environment.

Disciplines both in the form of organizational systems and as knowledge systems are major elements of the environment of the university. They often produce specific institutions concerning both teaching and research which may differ considerably from institutions in other disciplines. If such differences are transported into the university's decision-making and rule

[2] We are aware that the theories of Luhmann and Witt are not fully compatible. However, they share major ideas and may fruitfully be related to each other.

application, university rules may be lead to inconsistent practices. This is likely to feed-back into the university's decision-making and governance capabilities. Similarly, departments and schools link the university to particular industries and markets. This links again may produce different institutions and may create inconsistent practices.

Through their interactions, universities are embedded in a variety of systems and in their environment. In our context, a particularly relevant aspect of these interactions is the universities' role in the knowledge and innovation process. Technological and economic change are by no means guided by market institutions alone, but rather the result of selection processes involving a number of different systems with different selection criteria, including product markets, financial markets, companies, marketing networks and universities (Nelson & Winter, 1982). Universities often play a crucial role in these interactions. The success of the German synthetic dye industry in the second half of the 19th century, for example, is the result of the coevolution of patent law, educational institutions, and industry-university relations, as Murmann (2003) in an outstanding empirical application of evolutionary economics shows. And the strong global position of Switzerland's economy is mainly due to a high innovation rate which depends on the complementarity of dominant small and medium enterprises that feature a considerable "incorporated technical progress" and a stable basic research that is to a large extent financed by state and federal universities (Bieri 2014).

3 Structures and driving forces of the US research university

The rise of the US research university is the result of processes driven by various endogenous and exogenous factors. It began with the emancipation from the British college model and continued through the introduction of elements of the Humboldt model. It was made possible by an intensive interaction with the rapid growing indus- try and the inflow of highly creative immigrants during the first half of the 20th century. The Second World War as well as the confrontation with the communist regimes had their impacts on the institution building – directly through specific R&D topics and indirectly by influencing the academic culture. Finally, the demographic change within the American society had and still has an eminent impact on both the functioning and the culture of the research university and on the entire system of higher education. But here the dynamics are higher and goal conflicts appear to be deeper, more fundamental. Today, the research university continues to play its leading role: as last resort of intellectual liberalism, and, at the same time, as obedient servant promoting national initiatives from cancer research to innovation policy to diversity.

In his famous Tokyo speech, Nathan Rosenberg described the superiority of the US research university in a very simple way:

"The most important reason for US post war leadership in graduate education is the ... intro-

duction of new material into the curriculum. There has been development of completely new disciplines, especially where it may have practical application." (Rosenberg, 2001)

His view is focused on graduate education, because this is the institutional leverage producing portfolio changes and, subsequently, innovation. The advantage of the model is the fact that the same people who are teaching are doing research at the graduate level. At the graduate level, new research programs and disciplines with novel approaches, better methods and unexpected interfaces create a dynamic, quasi endlessly self-renewing culture of change. By that, Rosenberg says, the US research university tends to be very responsive to changes in economic conditions, too. He especially believes that the intellectual leadership of top American institutions is secured by the high degree of decentralization and the competitive climate – externally and intra muros.

Rosenberg's argument points at the crucial importance of departments and schools as universities' links to their environment which we have sketched out above. This is, however, not specific to the US research university alone. Rather, this seems to be a universal principle of the university often labeled as unity of teaching and research. Yet, in the US research university, this universal principal is institutionalized in a specific way. Working with graduate students is not only a teaching activity, but also a core element of faculties' research. It is on one side integrated into faculty members' own research activities in research groups and centers, but, on the other side, it complements these activities. This core element was and still is efficiently generating technical progress and innovation in the broadest sense. We will come back to this below.

The US research university has an organization which differs significantly from those of most European universities. It is, first of all, an autonomous institution acting in a highly competitive environment. Autonomy not only means academic freedom, but also self-reliance. The US research university is responsible for generating its own funds. In order to secure its funds, it must compete in "markets" for students, sponsors and grants, but also for reputation, scientific and practical impact, and patents. A self-dependent university needs efficient management, on one side, and on the other side structures that allow for flexible adaptation to the different "markets" of the university. In order to meet these requirements, the US research university combines a strong but flat hierarchy with strong decentralization.

The hierarchy consists of the President, the Board and the Deans. The president normally is and acts as a leader and manager. Often his or her general staff is a kind of brain trust. The Board of Visitors mostly works like an industrial Board of Directors: the members have strong industrial, commercial, and political-administrative ties. Their positions are pragmatic and closer to the President than Federal administration, founder's family or other stakeholders' positions.

Deans run their departments or schools; they are selected to leave footprints and to have an

impact on the scientific profile. Their position is strong due to long-term contracts and administrative power. There is an efficient, well organized infrastructure handling grants, knowledge and technology transfer, start-ups, and industrial contracts. For many decades now, IP management has been a field of high priority to university presidents – certain institutions regularly earn sums of two-digit million USD a year from patents and licenses.

Graduate teaching and research is performed in departments and programs which are coordinated by graduate schools. The Graduate School is a horizontal organization with a high impact on the curriculum. Normally, it disposes of its own resources and has formal and informal influence on the graduate education at the level of departments and to a certain extent also at the level of large university institutes. An important source of flexibility is the existence of a large variety of research institutes and centers. New institutes and centers can be easily established if funding is secured. If existing centers and institutes cannot adequately cope with new issues and fields of research, a new institution may be established.

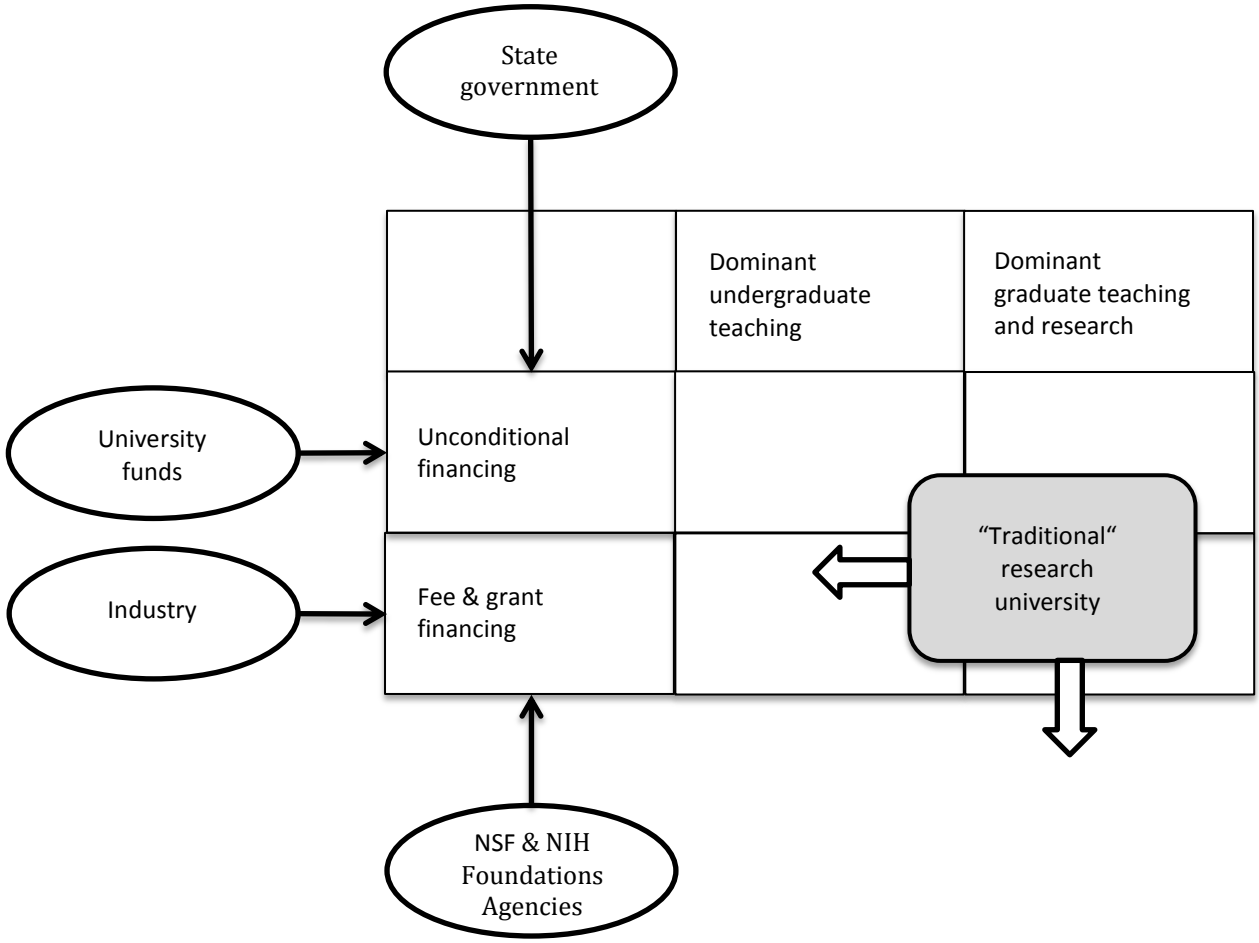
Alumni organizations play an active role – financially, but also in many cultural fields, and, of course, in sports. They are an important link to the universities' environment. They often create a strong and lifelong identification with the university. Many former students are proud to serve their university and show it in public.

The organizational structures of the US research university reflect the fact that it highly depends on external research funding. Grants are the key to success, both individually and collectively speaking. The main actors are the National Science Foundation (NSF), the National Institutes of Health (NIH) and some large private foundations – all of them having their own strategies and programs. The federal government disposes of large funds to finance competitive programs that challenge universities. Today, the Department of Defense (DOD), the Department of Energy (DOE) and some federal agencies (like NASA or EPA) play an important role. During the last decades, the financial pressure on research universities has grown, and, in general, the percentage of fee and grant revenue has become larger. Figure 1 illustrates this dependency in a schematic way.

The National Academies of Sciences (NAS) also plays an important role as pressure group and think tank – defining new scientific goals and influencing professional organizations and politicians. But there is no national master plan which tries to coordinate all funders and their administrations.

The quality management of US research university research is highly developed, successful PI's are well treated, and – here again – output performance is made public mostly in the form of "scoreboards". Lately, there has been a discussion on the significance of traditional R&D measurement (Nelson 2012

Figure 1



This short overview does only partly describe the complexity of the US research universities' funding environment. This environment not only consists of a variety of different agencies with different goals and interests. Rather, decision-making in most of these agencies contains a considerable element of fragmentation because it concerns a variety of different academic disciplines and sub-disciplines with different methodologies, structures and standards. Funding agencies mirror this variety by installing a variety of organizational links to relevant disciplines, such as specialized programs, administrative entities, committees and expert groups.

The competitive environment certainly enhances the scientific output of the US research university and has done so in the past to a large extent. It motivates faculty and is the driving force for the on-going selection process – starting with the undergraduate program and ending with the tenure-track-system. At the same time, however, it constitutes a difficult condition for university organization. In order to successfully cope with the complexity of the funding environment and the interactions with this environment, acquisition of grants and other fund-raising activities must be highly decentralized and left to a large extent to departments, institutes, research groups, or even to individual scholars. While this increases the universities'

capabilities in fund raising, it may unleash considerable centripetal forces. The university may become a rather loose association of departments and institutes without a distinct profile of its own. This would be detrimental to another foundation of the US research universities' ability to secure its financial base, namely its high profile and reputation. There are growing doubts whether, in practice, successful granting means scientific excellence too.

US research universities are not only organizations, but brands. Brand management is considered an important task of the university, in particular of its central organization. Brand management implies that the university as a whole maintains a profile and reputation of its own. Profile and reputation are not only the "sum" of the departments' profile and reputation (as it is the case in German universities). Rather, they are the result of a university's purposeful policy. This includes definition and implementation of goals and standards for the whole university. Standards are, for example, set up and controlled for education, particularly for undergraduate education. Brand management also includes provision of attractive conditions and infrastructures for students. Moreover, brand management includes Deans' activities to sharpen the profiles of the different schools. Beyond that, brand management includes a numer of activities to "sell" the brand in various situations. Last but not least, brand management includes efficient support structures for fund-raising and "selling" activities of schools, departments or institutes.

Reputation and profile of the university are important with respect to some major sources of income of the university, in particular to fees of undergraduate students and to donations. Moreover, profile and reputation of the university as a whole are also an important precondition of departments', institutes' and individual scholars' competitiveness on the "markets" for grants and contracts. Brand management, hence, is vital for the US research universities' financial performance.

The organization of the US research university was highly successful in the past. It was not only a successful part of the US higher education system with respect to fundraising, but also in regard to innovation. In recent years, however, the organization and its adaptive performance, seems to have become a source of problems which jeopardize future success.

Stephan (2013) shows how the granting systems changed. Initially, the agencies were established and funded to recruit research proposals from faculty, and to receive fellowship and scholarship applications from students:

"By the 1960s the tables had begun to turn and universities had begun to push for more resources from the federal government for research, support for faculty salary and research assistants and higher indirect costs. The process transformed the relationship between universities and federal funders; it also transformed the relationship between universities and faculty." (ibid.: 3)

4 The US research university's organization: A success story

In order to explain the success story of the US research university more systematically, we will start with some basics on the evolution of scientific knowledge systems. According to Toulmin and Luhmann, the principles underlying self-organization of these systems are the methodological and theoretical principles of the discipline in question. Variations occur when new ideas are introduced into the established system of knowledge. In the Darwinist model of evolution which we find in the theories of Luhmann and Toulmin, selection results in acceptance or refutation of a novelty (a new empirical finding, a new method, or a new theory). In both cases, systems have to be destabilized. If a novelty is accepted, systems have to be adapted to the novelty. A new accepted method, for example will be integrated into the disciplines' methodological toolbox. If the novelty is refuted, systems have to be reinforced by a justifi- cation of the refutation. If a method is refuted, for example, justification of the refutation may be based on a better explication of the established methodology. According to Luhmann, failure of selection and restabilization lead to disruption of the evolution of a system. The system may split into different systems or systems with a different evolution. If a new method is refuted and the justification of refutation is not accepted by the members of a discipline (or a department or school), two competing methodological camps may develop in the discipline (or in the department or school).

The Darwinist explanation of evolution of science as a knowledge system (e.g. Hull, 1988; Luhmann, 1990) resembles more a philosophic understanding of science than reality in many disciplines. In economics, sociology, physics and other disciplines, we find usually neither a fully consistent and stable knowledge system nor a strong competition among alternative theories and methodologies. Instead, we observe coexisting theories which are not fully compatible or which are even contradictory. Examples are: Keynesianism, monetarism, evolutionary economics and neoclassic economics; systems theory, the theory of structuration, behavioral theory, phenomenology and hermeneutics in sociology; classical mechanics, relativity theory and quantum theory in physics. Some of these theories methodologically represent refutations of earlier theories. Relativity theory and quantum theory, for example, refute basic assumptions of classical mechanics. Institutional and evolutionary economics refute basic assumptions of neoclassical economics. Yet, the refuted theories are still used and have their special domains of applicability. The resulting structure of knowledge systems in many disciplines neither reflects strong selection nor strong competition among incompatible theories. This may also apply to departments and schools where different methodological or theoretical camps coexist and even cooperate.

More generally speaking, in the development of science, selections in the strict sense seem to be the exception not the rule. Moreover, there is little restabilization, in the sense that after selections take place a coherent knowledge system is reestablished. In the evolution of science,

variations induce selection processes which, in turn, rarely result in strict selection or in the reestablishment of coherent knowledge systems.

This situation can be explained with Witt's (2003) theory of cultural evolution. In contrast to the Darwinist model, Witt argues that there is no or little final selection in cultural evolution. In cultural evolution, variations lead to temporary selections which, in turn, induce processes of learning. The reason is that human intelligence enables actors to anticipate selections and to respond to anticipated or observed selections by producing new variations. In order to illustrate Witt's theory, we may look at a situation where a research project empirically falsifies knowledge which is well established in a discipline. This will create a debate in the relevant discipline. Some scholars will accept the new insight and may build further research on it. Others will refute it and may design research to empirically support their refutation. Moreover, there may be some scholars who refute both the new finding and the response of the defenders of established knowledge. They may develop a third or a fourth alternative. This process will rarely lead to selection and restabilization of a system in the Darwinist sense. It is more likely that a number of different subsystems representing different methodological and theoretical approaches and different sides in debates and controversies will coexist.

Introduction and selection of novelty and restabilization of knowledge systems is not only an abstract process in an abstract system. Rather, the process operates through organized activities and institutionalized communication. It is supported by various agencies. In what is called the knowledge society, scientific knowledge is produced in a huge machinery and with high speed. More than half of all scientists which existed in the history of mankind are active today. If we take academic publications as an indicator, scientific knowledge doubles every seven to ten years – in some fields or sub-disciplines it happens even faster. This enormous production is only possible in highly specialized structures. The result is a fragmentation of knowledge – knowledge has, as Peter Drucker (1998) points out, become knowledges. In most disciplines, different knowledges are interlinked through various research activities and debates. But long before the different kinds of knowledge in the discipline are reasonably integrated into a methodologically and theoretically coherent body of knowledge, a lot of new knowledge is produced.

In this process, not only new methodological and theoretical approaches are generated, but whole new sub-disciplines or disciplines. Indeed, the rise of new disciplines, as we observe it in life science, has become a field of great importance – as internal leverage and a means of international competition. Life science more and more develops an own theoretical and methodological base, an own identity, and new professional organizations which are not bound to a single college, department or school. Similar developments may be observed in many other fields. In economics, institutional and evolutionary economics, for instance, are also moving towards a methodologically and theoretically demarcated subdiscipline.

This process feeds back to the machinery which feeds the process, and to the various agents that finance the machinery. Moreover, it is mirrored in the interests of potential students. As a result, the machinery with its supportive structure becomes more complex and so does the demand of prospective students.

The situation described so far in this section, has a strong impact on universities' competition for grants, contracts, donations, students and reputation. They find themselves in a permanent process of transition. In many universities, however, the adaptation to transition faces considerable structural and process-related impediments. This is particularly true if adaptation requires a renewal of the portfolio. Even if the faculty may be open to novelties, organizational structures often lack the flexibility to carry faculty's openness into effect. The structures of the US research university are different. Since the sixties, one of the strongest points of the US research university has been that it *maintains* structures and institutions which facilitate rather than hinder adaptation to change, in particular concerning renewal of portfolio. As we will explain below, this strong point also has a critical downside.

As we already mentioned in the previous section, the US research university has a highly decentralized and differentiated organizational structure. There is a large variety of different programs and institutes, some of them in narrowly defined fields, others covering a whole discipline. Compared to the simply structured and coherently organized universities in Germany, Switzerland and other European countries, the organization of the US research university seems to be quite chaotic. This form of organization allows quick adaptation and often even innovative organizational responses to changes in the environment of the university. The US research university has increased and still is increasing its internal complexity in reaction to external complexity.

In organizational terms, this allows the US research university to respond with a focused effort, even to quite far-reaching changes of its environment. In response to changes, it builds new organizational sub-systems (institutes and programs) or changes sub-systems outside of the core organization, whereas the core organiza- tion remains stable over long time. The graduate school in particular can quickly adapt to changes in its environment by introducing new programs which are offered by new or changed institutes, while its organization and culture evolve steadily over long periods of time.

The explanation in this section may provoke the question why then the organization of, say German (public) universities, is much less complex than that of the US research university. Obviously, both the funding environment and the interests of students, employers, and other stakeholders are no less complex than in the U.S. The answer to the question is simple: The funding environment and the students are much less important for the success and survival of German universities. They are principally financed by government and grants, contracts and donations are merely an add-on to the universities' finances. Moreover, it is the institutes, the

research groups and the individual scholars who profit from grants and contracts, rather than the university as a whole. Students are not an important source of income, nor are teaching an important source of a university's profile and reputation. Last but not least, the German university lacks the powerful central organization that is necessary to keep a university on tracks in spite of its "chaotic" organization.

The US system is very sensitive to external changes. The global financial crisis and the domestic recession both have negative impacts on the financial situation of the US research university. Budget cuts at the state level have direct impacts on the basic financing of public universities; a share of less than 20% of state funding is not uncommon for these US research universities. Private universities make losses on their endowments because of losses on shares and financial products. Covering full cost – financing overheads – is a dominant goal of university management and leadership.[3]

High adaptability of a system inevitably also means that the environment has a considerable influence on the system's performance and development. Adaptive systems that regularly interact coevolve – they mutually adapt their structures to structural changes happening in other systems. This generally reinforces a system's ability to respond to its environment according to its basic principles. In some cases, however, this ability may decline over longer periods of time. This may happen if a system is strongly dependent on its environment and if basic principles of important systems in the environment deviate considerably from the system's basic principles. In such a situation, a system's behavior may increasingly be shaped by basic principles of systems in the environment even though this ultimately damages its performance. If universities compete hard for undergraduate students who are capable and willing to pay high fees, strong features of consumerism may occur. In the long run, this may damage the quality of education and a university's reputation. Likewise, if an institute or center receives its funds predominantly from applied research, it may shift its structures and institutions gradually towards applied research. With time, this may result in declining capabilities for basic research and damage a university's profile. There is a debate in the United States which suggests that this exactly what is happening to the US research university.

[3] Industrial contracts are lagging, especially due to the fact that US firms close single plants or shift to foreign places; the strategy of "insourcing" in the pharmaceutical and in the biotech or IT industry fundamentally affects long-term collaboration with US research universities. This trend opens new opportunities for start-ups and spinoffs, but it also tends to a certain shift of long-term risks away from industry towards the university. At the same time, well-known think tanks and industrial labs are disappearing. Finally, national research institutes like Brookhaven, Jefferson or Fermi Lab suffer from a low investment rate.

5 The shady side of high adaptability: The education problem

Eleven years after Rosenberg's statement, different, more sceptic voices can be heard. The dynamic forces are diminishing and the model appears to be less brilliant. At least, it is no guarantee for scientific excellence or self-sustaining innovation. So, what has changed, the way of application, the competitive situation, or both?

To be sure, the worldwide transformation of academic organization and culture represents the success of the US research university as a model. However, the excellence of foreign institutions climbing up the ranking of the Shanghai or the Times Higher Education ranking must have *additional* causes. In general, the main cause is a higher basic endowment financed by governments, but there are other elements such as a richer scientific infrastructure or a closer cooperation with leading global firms, especially in long-term clinical research. The changes and their possible caus- es are discussed in the US as well as in Europe where leading countries show diffi- culties in reforming their higher education sector (Wissenschaftsrat, 2013; Garçon, 2011). America's perception of the whole process is quite different; one side-effect of it is a broad discussion on the value and the limits of university rankings.[4]

The academic discussion about the value and quality of higher education is focused on two main topics: first, the situation of undergraduate teaching with the need of "modernizing" the curricula, adapting learning technologies and increasing the involvement of students simultaneously (Arum and Roksa, 2011; Titus, 2012), and second, the impact of the exploding fees[5]: a direct impact due to the growing debt risks for graduates (Quirk, 2013), an indirect impact in the form of a central element of consumerism (which is already a strong element of US university management).

Most US research universities are confronted with the ongoing demographic diversification and major social changes (the pressure on the middle class, for instance), which largely influence the university's demand side. The result is a cumulative process due to financial constraints, especially the dependence on fees and grants, and the socio-cultural change we mentioned earlier. It may be exemplified by the following interactions (see Figure 2):

These points are discussed in scientific journals and, partly, in the U.S media. Some authors think the difficulties have to do with the decline of the US economy, and, just as importantly, with the country's unsolved political problems (Friedman & Mandelbaum, 2011: 103-112).

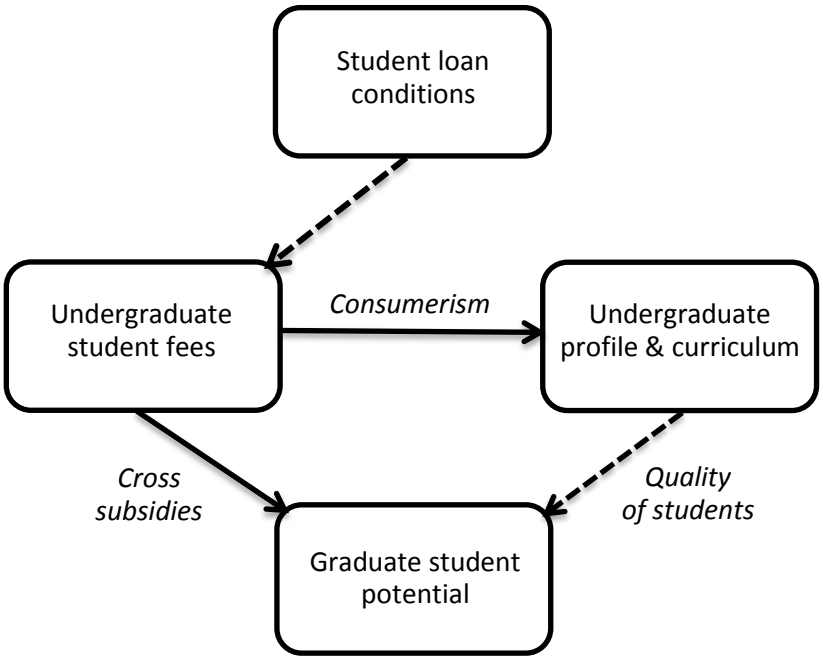
---

[4] An interesting detail is the difference between international and homemade US rankings. The Princeton Review's 2013 Best Valued Colleges, for example, brings all the well-known names but shows very strong performances of niche institutions like Swarthmore or Williams College, too. The main goal of such rankings lies in advising potential consumers, but their political impact is nevertheless high.

[5] Of course, there are differences. While state government support is decreasing, public universities have less flexibility to compensate rising costs. Well-funded private colleges, like Stanford, are able to compensate and even to slightly reduce the total cost of attendance compared to the situation in the mid nineties.

Others – without denying the contextual threads – see an institutional crisis, or at least the necessity of a fundamental reorientation of higher education.

Figure 2: The "Fee-Quality-Trap"



We mentioned earlier that there is a tendency to accept a higher percentage of undergraduate relative to graduate students. This may contradict the core principle of the US research university which puts graduate education at the core of its activities. However, universities earn money with undergraduate education which they may use to cross-subsidize graduate education. There are, therefore, strong incentives for the US research university to engage in undergraduate studies and to increase undergraduate admissions. If many of the US research universities do so, they have to admit a larger proportion of potential US undergraduate students, or else they need to attract more foreign students. At least the first option may result in a reduced selectivity at admission and in quality issues. In order to maintain admission standards, US research universities have to compete harder for good students. Harder competition for undergraduate students is likely to increase universities' responsiveness to "market" conditions, responding to the perceived interests of potential undergraduates. This enhances the already growing consumerism.

The established structures of US research universities contain a strong quality control which is institutionalized and culturally embedded. A reduction of admission standards faces considerable institutional und cultural impediments. Therefore, established mechanisms and insti-

tutions are likely to maintain quality standards. While established structures impede the reduction of admission standards, they constitute a favorable condition for consumerism. The highly differentiated structures of the US research universities traditionally enclose a large variety of different undergraduate programs. These structures make it quite easy to introduce new programs or to change existing programs. They are adaptive to new knowledge, but also to a changing demand on the "markets" for undergraduate students.

Under strong competitive pressures, this may invite consumerism. Universities attempting to increase graduate education as an important source of their financing put the higher education system as a whole under strong competitive pressure. Moreover, this pressure is transferred to departments and programs. The reputation and position of departments and programs within the university are likely to be influenced by undergraduate numbers. In order to increase the amount of undergraduate students, departments and programs may be tempted to introduce courses and clas-ses which mirror the assumed preferences of potential undergraduates more strongly than the scientific profile of departments or programs.

7 The downside of high adaptability: The innovation problem

A similar problem exists in relation to research and innovation. The problem is that, in the past years, the role of universities in the innovation process has changed significantly. The US research university traditionally has been committed to further innovation. But traditionally this has been a process of spontaneous discoveries and unplanned innovation. Universities' basic research produced novel results which then were transferred over to business. The transfer process was and is generally well organized by universities. This enabled the US research university to play a central role in the US innovation system.

As we mentioned earlier in this paper, a crucial aspect of this role was that flexible organization enabled even far reaching changes of portfolio. "I wanted to give up conventional biochemistry, which I believed incapable of telling us how genes work", Nobel Laureate Watson said and continued: "Instead I told them that I now knew that X-ray crystallography was the key to genetics" (Watson, 1968). For-front developments are occurring at intersections, for instance between physics and biology. This has a profound impact on the development of science and technology. Such interfaces seem to be very productive spaces, and new, unexpected meeting places can be found all over the campus. Often, a leap takes place going from application to support, and from there back to "pure" science. Infrastructures like Light Sources, MRI or Clean Rooms are able to produce their own theoretical contributions, being definitively more than simply "accompanying" research or teaching.

But in recent years, this situation was turned upside down. The credo of increasing excellence and originality seems to have only one major goal: to produce invention and to commercialize

it. Academic institutions become plants where – with enough money and the right organization – research produces innovation. And they have become more uniform plants too. Novel approaches by one university, reaching from topics such as clean energy initiatives to "urban health", are imitated instantly by other universities. Most importantly, however, the innovation process of the US research university ceases to be a process the universities are pushing. Rather, it is becoming a process pulled by industry and government agencies.

For many years, we have been observing that the innovation process has changed from a linear to an interactive process (Lundvall, 1992). The linear process is characterized by a clear sequence of scientific inventions from basic research to applied research that is built up on these inventions all the way to product development. It is pushed by science. In contrast, the interactive process is often pulled by markets. Basic research, applied research and product development are performed in parallel and are interactive. While the linear process still exists in new fields of research, the interactive process dominates established fields of research. In these fields, a high scientific output supports the pull process – the higher the scientific output of the US research university, the more pull forces from outside will occur and the less push activity by the university is necessary.

Pull forces bear the danger that organized innovation displaces spontaneous scientific progress. Organized innovation is a process in which the goal is determined a priori. Basic and applied research are aligned to that goal. This narrows the scope of research and often focuses it on solutions which are in principle already known. This development is associated with a change in the understanding of innovation which affects the role of research universities. Innovation used to be a by-product of higher education and research. Then it became a field of specialization, administrative "care" and political influence. Finally, innovation is moving to the core of the US research university's activities.

Innovation and management of intellectual property (IP) has become a focus of universities' policy. Since deans and institute directors with their administrative back offices usually do not have the vision, scientific depth and management power to manage innovation policy and intellectual property, a specialized central organization for IP-management has been established in many universities. But this creates an organizational problem. The problem is that higher education, research and the realization of innovation often need different structures and layouts. They are systems with different basic principles. Although they are different, these principles are not necessarily in conflict. For years and decades the systems built on these principles have coevolved in a mutually reinforcing way. The systems developed in close relation to each other. At first glance, it might appear that the switch from a linear to an interactive process of innovation changed the relationship between the systems. But this hypothesis is misleading. The innovation process changed globally, but in other countries the change did not affect universities' performance so strongly. Leading universities in Switzerland and Germa-

ny engage more strongly in innovation activities, but these activities are not growing at the expense of spontaneous basic research. Rather, spontaneous basic research is growing too – and it is advancing the innovation performance of universities.

Two conditions make the situation of the US research university different from leading German and Swiss universities. The first condition is the dependence on external funding. The second condition is the political instrumentalization of universities for innovation policy.

Dependence on external funding makes research centers and institutes at the US research university vulnerable to pull forces of industry and government. Collaboration with industry and government is often a relatively easy way to get funds. This is particularly true for institutes and centers that show a high performance in basic research. These institutes and centers produce the kind of knowledge toward which pull forces are directed. They are particularly attractive partners for industry and government. Consequentially, they are likely to conclude many contracts with industry and government. However, the more contracts they gain, the more their research systems are interlocked with industrial and governmental innovation systems and processes of organized innovation. The stronger and the longer they are interlocked, the more their institutional structures will be influenced by the institutional structures of innovation – rather than by those of spontaneous scientific research. This may induce increasing path dependencies which, in turn, limit development of research systems, in particular their capacities for spontaneous scientific research.

In the United States, this is enhanced by innovation policy. In 2012, the US National Research Council published a study on "Research Universities and the Future of America" (Committee on Research Universities, 2012) with the subtitle "Ten Breakthrough Actions Vital to Our Nation's Prosperity and Security". The important point here is that the US research university becomes an *instrument* of national policy – its status and its development are judged primarily from an (national) angle of socio-economic usefulness. There is, no doubt, the fear to lose global leadership in a more general sense. Nevertheless, the analysis does not go deep enough: the shortcomings are not considered in their social and historic context, dimensions that are crucial for understanding the innovation problem.

One might think that a successful research university is able to focus on its key tasks and then choose the adequate institutional solution. But too often management's intent and a well-balanced scientific structure do not go hand in hand. The evolution of complex organizational systems with a variety of different sub-systems is, as we may learn from theory as well as from practical research, cannot be controlled. If departments and schools, for example, only react to vertical incentives, horizontal initiatives may be insufficient. Horizontal initiatives, however, are an important aspect of the US research university's adaptability and creativity. To be sure, we know the other extreme too, the complex matrix organization where tasks and

competences are overlapping and free floating programs miss an adequate control.[6]

At this point, it should be understood that the problem we discuss in this section is not just the US research university's development with a strong focus on innovation per se. The problem is the interlocking of university research with organized research of industry and government. In contrast, IP-management as it has been established at several universities does not have negative consequences on the evolution of universities' research systems. Yet, that is not true for the numerous US research universities which concentrate their efforts on the creation of start-ups. These efforts build upon established basic research structures and on spontaneous research. The aim is to commercially exploit the results of this research as intellectual property. The question is whether this helps the universities' financing. A recent empirical study (Astebro et al., 2012: 663) shows "that the gross flow of start-ups by recently graduated students with an undergraduate degree in science or engineering is at least an order of magnitude larger than the spin-offs by their faculty, that a recent graduate is twice as likely as her professor to start a business within three years of graduation, and that the graduates' spin-off are not of low quality". In addition, the analysis highlights that the entrepreneurial success may be influenced in several ways, including the quality of teaching as such and – of course – the design of the programs. "Thus the role of top-level education in the success of entrepreneurial ventures by recent graduates appears to be of first order importance", the authors conclude (Ibid: 671). With such a strong educational base institutional support and peer advice seem to have a higher impact.

8 Conclusions

Following Witt, we understand evolution as a sequence of learning processes. In this understanding, the developments discussed in the previous sections are not unidirectional. On the contrary, theoretically speaking, we should expect that some of the US research universities will attempt to revitalize the traditional core profile "top graduate education and risky research". Indeed, there are some signs that the pendulum seems to be starting to swing back (Bieri 2013, Casper 2013). Yet, this does not mean that the US research universities may return to the status quo ante – evolution is an irreversible process. The traditional core profile may be reestablished, but only with institutional changes within the US research university and even more changes in its environment.

The problems which we have discussed above are not primarily caused by modifications of the US research university's institutional structures, but by changes in the environment and in

[6] For that, the university must have a culture enabling internal cooperation and the necessary structural agility. Since the nineties, there has been a similar entrepreneurial trend where companies are learning how to take a more creative approach to mobilizing existing knowledge and resources (Sull, 2010).

the university's interaction with the environment. Two points are crucial here. The first one is that the core of the US research university, the graduate school, is increasingly depending on cross-subsidizing from undergraduate education. The second one is that the US research university has become strongly dependent on the innovation process and its pull forces.

This has created fundamental goal conflicts and problems of governance at the university level. Increasing admissions of undergraduate students in a situation of strong competition among universities for undergraduates may conflict with a high quality profile of graduate education. Conflict may occur with respect to the allocation of personal resources: with larger numbers of undergraduate students, the dedication to undergraduate education may not coincide with the commitment to excellent research. Larger numbers of undergraduates are also likely to reduce the skills of students. This may affect the recruitment of skilled graduates.

A major conflict is the one between scientific excellence and efficient management. This is also reflected in the conflict between top down and bottom-up processes. Both efficient management and the involvement of the university in innovation systems rely on top down processes whereas scientific excellence is based on bottom-up processes. Efficient management often is associated with attempts to streamline the university's research portfolio according to the expected success in grant processes. This impairs both academic autonomy and decentralized organization which are cornerstones of scientific excellence.

Although these may be considered "internal" problems of the US research university, in the evolutionary view underlying this article they can hardly be solved by the university alone. The way the university and its subsystems are interlocked with each other and with the university's environment enhances their coevolution which is likely to produce and reproduce the structures in question. In order to secure performance and profile of the US research university, its relations with its environment needs to be modified. In effect, an academic competition policy is recommendable.

The mechanism of internal and external scientific competition is the very engine of each research university. It is an efficient, academically adequate way of steering the institution. It functions well if the interfaces with economy and society are properly defined and if the balance of interests with the "clients" is stable for a certain time. It is this condition which is currently unsound. A better balance between spontaneous basic research and research embedded in organized innovation must be achieved. We believe that this requires a more distinctive and long-term commitment of – federal or state – government; this cannot happen through agencies or departmental R&D grants, but needs to happen through government as a responsible stakeholder in education and basic research.

Such a policy could also help compensating the *systemic* shortcomings. Many of the stresses that the single research university *and* the system are facing are caused by interrelated adaptations. Stephan concludes:

"Some of Bush's key insights regarding research and the research process got lost in the process of adaptation. To name but three: the importance of funding and conducting risky research at universities; the focus on fellowships as a method of supporting graduate students; and, implicitly, the need to strike a balance between support of the medical sciences and other fields of science and engineering." (Stephan, 2013: 37)[7]

This said, we do not plea for a hierarchical, government-controlled university system in the US as it exists in some European countries. The flexibility and diversity of the US solution has been an important advantage to this day. Government can assume a stronger role as a stakeholder without changing the model – it can put more money into the "markets" for education and basic research. This would decrease relative im-portance of research in organized innovation for university finances. Moreover, a long-range federal program supporting infrastructure for basic research and targeted financial aids for enabling infrastructures at all research universities could be established. Such an initiative could have three positive effects: firstly, it would encourage risky endogenous research; secondly, it could strengthen scale-effects in certain expensive fields of research like neuro-science or particle physics; thirdly, the research university would be less dependent on grants of certain federal agencies. Finally, government can regularly control if competition is working in practice or if federal regulation should approach oligopolies of leading institutions, including cartels con- trolling the access to scientific journals or informal coalitions between powerful federal agencies and "preferred academic suppliers".

With this kind of academic competition policy, government does not damage the university's autonomy and competition - on the contrary, it strengthens both. It could support a more balanced coevolution of the US research university and its environment. This would be beneficial for both sides. The innovation system could profit from spontaneous research again, creating less predictable and more original innovation than that resulting from organized innovation.

References

Arum, Richard & Roksa, Josipa (2011), *Academically Adrift, Limited Learning on College Campuses*, Chicago & London: The University of Chicago Press.

Astebro, Thomas, Bazzazian, Navid, Braguinsky, Serguey (2012), *Startups by recent university graduates and their faculty: Implications for university entrepreneurship policy*, Research Policy, vol. 41, p. 663-677.

Berger, Suzanne (2013), *Making in USA*, Cambridge MA: MIT Press.

Bieri, Stephan (2014), *Innovationspolitik: ökonomische und wissenschaftspolitische Herausforderung*, in press.

Bush, Vannevar (1945), *Science – The Endless Frontier*, A Report to the President, Washington D.C.: US Government Printing Office.

Drucker, Peter F. (1988), *From Capitalism to Knowledge Society*, in: Dale Neef (ed.), The Knowledge Economy,

[7] Stephan refers to a basic document of the US higher education after the Second World War (Bush, 1945).

Newton: Butterworth Heinemann.
Finn, Chester Jr. (2014), *Gifted, Talented, and Underserved*, National Affairs, No 18, Washington D.C.: National Affairs Inc., p. 50-62.
Friedman, Thomas L. and Mandelbaum, Michael (2011), *That Used To Be US*, New York: Farrar, Straus & Giroux.
Garçon, François (2011), *Enquête sur la formation des élites*, Paris: Perrin
Hennessy, John L. (2012), *Remodeling Our Curriculum for the 21st Century*, Stanford University Magazine, July/August 2012 (electronic edition).
Hoffmann, Rolf (2011), *US Higher Education*, in: Internationalisation of European Higher Education, EUA/ACA Handbook, Stuttgart: Raabe Verlag, F 1.3.
Hill, D.L. (1988), *Science as a Process. An Evolutionary Account of the Scoial and Conceptual Development of Science*, Chicago & London: University of Chicago Press.
Kenney, Martin (2012), *Reconsidering the Bayh-Dole Act and the Current University Invention Ownership Model*, Research Policy, vol. 38, p. 1407-1422.
Lehner, Franz (2011), *Sozialwissenschaft*, Wiesbaden: VS-Verlag für Sozialwissenschaften.
Luhmann, Niklas (1990), *Die Wissenschaft der Gesellschaft*, Frankfurt: Suhrkamp Luhmann, Niklas (1995), *Social Systems*, Stanford: Stanford University Press Luhmann, Niklas (1997), *Theory of Society*, Stanford: Stanford University Press.
Luhmann, Niklas (2011), *Organisation und Entscheidung*. 3 ed., Wiesbaden: VS–Verlag für Sozialwissenschaften.
Lundvall, Bengt-A. (ed.) (1992), *National Systems of Innovation*, London: Pinter.
Murmann, Johann P. (2003), *Knowledge and Competitive Advantage. The Coevolution of Firms, Technology, and National Institutions*. Cambridge & New York: Cambridge University Press.
National Research Council, Judith Anderson Koenig, Rapporteur (2011), *Assessing 21st Century Skills: Summary of a Workshop*, Washington D.C.: The National Academies Press.
National Research Council (2010), Committee on Research at the Intersection of the Physical and Life Science, *Research at the Intersection of the Physical and Life Sciences*, Washington D.C.: The National Academy Press.
National Research Council, Committee on Research Universities (2012), *Research Universities and the Future of America*, Washington D.C.: The National Academy Press.
Nelson, Richard R. & Sydney G. Winter (1982), *An Evolutionary Theory of Economic Change*. Cambridge-London: Harvard University Press.
Nelson, Andrew J. (2012), *Putting university research in context: Assessing alternative measures of production and diffusion at Stanford*, Research Policy, vol. 41, p. 678-691.
Olsen, Mancur (1982), *The Rise and Decline of Nations*, New Haven & London: Yale University Press
Quirk, William J. (2013), *Federal Student-Loan Sharks*, The American Scholar, Autom 2013, p. 32-40.
Rosenberg, Nathan (2001), *Conference given at the RIETI*, Tokyo, June 18, 2001, p. 3 (download from internet).
Sull, Donald (2010), *Competing through organizational agility*, McKinsey Quarterly, 2010/1, p. 48-56.
Titus, Jordan J. (2011), *Pedagogy on Trial: When Academic Freedom and Educational Consumerism Collide*, Journal of College and University Law, vol. 38, p. 107-166.
Toulmin, Stephen (1972), *Human Understanding: The Collective Use and Evolution of Concepts*, Princeton: Princeton University Press.
Watson, James D. (1968), *The Double Helix – The Structure of DNA*, New York: Touchstone, Reprint 1996.
Wissenschaftsrat (2013), *Perspektiven des deutschen Wissenschaftssystems*, Cologne: Geschäftsstelle des deutschen Wissenschaftsrates.
Witt, Ulrich (2003), *The Evolving Economy, Essays on the Evolutionary Approach to Economics*. Cheltenham: Edward Elgar.
Witt, Ulrich (2008), What is specific about evolutionary economics? *Journal of Evolutionary Economics*, 18: 547-575.
Witt, Ulrich (2011), Emergence and functionality of organizational routines: an individualistic approach. *Journal of Institutional Economics*, 7, 2: 157-174.