Resilience Constructions: How to Make the Differences Between Theoretical Concepts Visible?

Stefan Böschen, Claudia R. Binder and Andreas Rathgeber

Resilience Constructions: Differences as a Problem

The concept of resilience has performed an amazing career. Starting out in some selected disciplines, such as psychology (e.g., Nöker and Petermann 2008) and ecology (e.g., Gunderson et al. 2010), it has been applied in a vast variety of disciplines including natural sciences, humanities, and social sciences (see Gabriel 2005; Günther 2009; Folke et al. 2010; Brand et al. 2011; Mergenthaler 2012; Endress and Maurer 2015; overview: Wink 2016). Resilience deals with the characteristics of individuals, units—more abstractly: entities—that enable them to not only maintain their identity in face of unusual or critical situations, but to potentially even emerge strengthened from such stressful situations. Its concurrent appearance seems to indicate the far-reaching impact of at present transformation processes. The concept of resilience comes into play when individual entities (no matter if these are individuals, groups or states) must prove their abilities and competences to face the challenges generated in the turmoil of contemporary

S. Böschen (✉)
Rheinisch-Westfälische Technische Hochschule Aachen, Aachen, Germany
E-Mail: stefan.boeschen@humtec.rwth-aachen.de

C. R. Binder
École Polytechnique Fédérale de Lausanne (EPFL), ENAC/HERUS, Lausanne, Switzerland
E-Mail: claudia.binder@epfl.ch

A. Rathgeber
Universität Augsburg, Augsburg, Germany
E-Mail: andreas.rathgeber@mrm.uni-augsburg.de

dynamics. Resilience is the ability to resist to these challenges. The way this ability plays out depends not only on the specific capacities of an entity but also on its context.

As the concept of resilience is used by many disciplines and for a wide range of purposes, different ways of theorizing resilience are observed. This is why there are different entities and challenges, many and very different disciplines have been using and interpreting the concept of resilience in a—from their own perspective—fruitful way. Thus, it has also been argued that resilience might be a useful concept for interdisciplinary cooperation (see Günther 2009; Wink 2016). However, although the interdisciplinary application could be seen as useful, the different conceptualizations of resilience suggest that it is too simple to claim the interdisciplinary function of the concept as such. We argue that first of all, the wide-spread usefulness of one and the same concept should make us suspicious and raise some questions. Why could this concept undergo such a career? More specifically with regard to the epistemological form: how is the conceptualization of resilience related to the different applications?

Scholars have shown that there are some relevant differences among the ways in which resilience is conceptualized. On the one hand, the different conceptualisations emerge because the respective studies have very different targets (e.g., Biggs et al. 2012). On the other hand, they depend on the theoretical-conceptual background of the respective reference discipline (see, e.g., Olsson et al. 2014). In addition, it has been reported that the differences do not necessarily imply that the theoretical concepts are totally distinct from each other—on the contrary, there are some remarkable similarities in the design of resilience concepts (see Barrett and Constas 2014). We postulate that the different constructions of resilience are based on different theoretical models. These vary not so much in relation to a specific discipline (as, e.g., Olsson et al. 2014 suggest), but rather in respect to the issues addressed in the scope of specific research projects (see Böschen et al. 2017). Moreover, we hypothesize that a limited number of different theoretical models can be identified.

The following considerations try to answer the double question of whether the projects of a research consortium (on resilience) differ based on the theoretical models they use, and if so how these differences can be classified with regard to specific theoretical features. To put it short, we find that these models can be described by two dimensions, first, the underlying theoretical conceptualization (structural versus process-related) and second, whether relations to the context are part of conceptual considerations or not (context-resilience versus self-resilience). In light of this, our argumentation follows four steps: The first step shows that something like a shared core can, in fact—contrary to the assumptions of differences among the concepts—be found in the term of resilience (chap. 2). In the second step, in a quantitative analysis, we present the differences of theoretical models of projects of a research consortium (on resilience). To do so, we run a factor analysis based on a survey on the utilization of resilience aspects within the projects. We found that 5 factors explain the differences among the projects' conceptualization of resilience (chap. 3). Third, we further uncover these differences by analysing the results of the factor analysis in relation to the different groups of theoretical models found, and by highlighting one exemplary project per group (chap. 4). In the final fourth step, we bundle the results from these presentations by illuminating the connection between the theoretical models and the application of the term resilience. Finally, we develop perspectives for future resilience research while reflecting on the chosen theoretical presuppositions. This is also a prerequisite for being able to cooperate in trans- and interdisciplinary projects (chap. 5).

Theoretical Models of Resilience

The dynamic in the development of concepts of resilience has already led to a diversity that is difficult to oversee. This is reflected in the fact that a large number of studies was set up in the last decade to structure the discourses from various disciplines and to put them at a relationship to each other (see Olsson et al. 2014; Wink 2016). In light of the differences among the theoretical models as presented above, the following observations appear particularly relevant: On the one hand, specific individual indicators of resilience seem to make up the shared analytical core of the term as they are widely used, e.g. the bounce-back ability or adaptability or transformativity (see Keck and Sakdapolrak 2013). On the other hand, it becomes evident that the way in which these indicators are used is anything but consistent and that the architecture of these individual indicators varies as well. This leads us to the above mentioned hypothesis that there are different underlying theoretical concepts of resilience.

Analyses of the differences among the theoretical concepts of resilience have focused so far on normative motives (see, e.g., Olsson et al 2014) or varying goals of the analysis, e.g., enhancement of theoretical understanding versus practical application (see, e.g., Biggs et al. 2012). However, we consider that these explanations are not sufficient. The explanations may be plausible because the concept of resilience is relatively easy to apply in several disciplines and for manifold ways of problem constructions. However, doing so, they underestimate the problem-transforming quality of ways in which resilience is understood. Therefore, it seems to be much more promising to initially look at the constructional act of problem generation and to then take a close look at the theoretical architecture of resilience used by the scientists. We propose that this architecture is closely related to the selected theoretical model of resilience. A theoretical model thereby is defined is a basal analytical *form* for both opening up new areas of empirical research as well as offering explanatory interpretation of phenomena and which can be used independently of the specific object examined.

Typically, such a theoretical model results from taking a basic path for theory development, especially by selecting basic categories (e.g., specific indicators) and putting them into a coherent form. In physics, a relativistic perspective fundamentally differs from a classical one. In resilience research, a structural perspective differs from a process-related one, accordingly. Additionally, the context also differs in problem-oriented research, to which resilience research belongs to. Whether and how is this context considered and to which extent does it shape the theoretical model? An entity can be understood as a monad and thus with the status of a lone fighter against its environment—or vice versa, the resilience consideration may make the links and interdependencies between entities and their environment the core of a resilience analysis. Before we present this in detail, we want to note that there are important shared features in resilience analysis in spite of the postulated differences in theory-building in resilience research.

Basic Elements in Definition(s) of Resilience

Looking at an overview of attempts to define resilience (see Holling 1973; Adger 2000; Keck and Sakdapolrak 2013), none of them offers a comprehensive definition, but we can identify some common, basic elements. Resilience means the ability or characteristic of an entity (individual, actor, system) to react to crisis-like impacts in a way that maintains or even increases its ability to act while maintaining its own identity. This is shown in the following core elements of resilience definitions:

1. *Continuity of existence.* Initially, the further, i.e., future continuous existence of a unit, is considered a central aspect. It is by definition not possible for an entity to react resiliently by any form of self-destruction. The altruistic sacrifice for a community is typically not subsumed when we talk about resilience (Holling 1973; Walker et al. 2004), even if the altruistic sacrifice were the case from the point of view of the community itself (we refer to this duality as the differentiation between self- and context-resilience; see below).

2. *Preservation of core properties.* This criterion deals with the *form* of preservation of the entity. Preservation of identity hardly means that an entity will not change at all. Instead, independently on whether a resilient reaction simply takes the form of a bounce-back or a far-reaching system change, in any case the entity has to remain identifiable and therefore finally describable with selected properties (Walker et al. 2004).
3. *Event that acts or is interpreted as a disturbance*. Resilience mostly appears in reaction to a specific event that triggers a 'stress' for the entity. It is initially irrelevant whether this is a factual or a perceived 'stress.' Following the so called 'Thomas Theorem' (Thomas and Thomas 1928) things are factual in their consequences if they are seen as real by social actors. Therefore, obstacles are subject to a construction process, as well as strategies are to manage such obstacles.
4. *Situation-related management reaction, further development and reorganisation to create new options*. This criterion finally treats the form of resilient reaction options of the entity across all existing differences. The resilient reaction of the entity takes place based on certain properties. These are usually based on competences, such as media competence or interaction competence. Such competences offer the entity options to react on events, which may reach from bounce-back to adjustment, to transformation, in a then resilient way (Keck and Sakdapolrak 2013).

Therefore, resilience is always a relation with multiple points in which at least one triggering event, one entity and its reaction are linked to each other. Moreover, constructional moments are highly relevant. The perception of an event as a threat is a constructional process. Only in some cases, this can be condensed in a stimulus-reaction scheme and thereby in an essential way. The explicit design and examination of this relation, however, essentially depends on the respective specific theorisation of resilience. Which ways of constructing such theoretical models can be differentiated?

Two Dimensions of Theoretical Models

We consider two dimensions particularly relevant for the construction of theoretical models: The chosen theoretical concept and the contextualisation of the entity examined. The first dimension (structure/process-related consideration) of theoretical models refers to the theoretical perspective chosen that aligns the conceptualization. It can focus on the structure of a system or on its dynamics (processes). For sure, structures and processes are necessarily interlinked. This means, structures can also be understood as dynamic equilibrium within processes and the procedural change in a system can only be measured making reference to its structure. But, there is a decisive difference based on which of the both perspectives is exposed and analytically put at the focus. The *structure observation* puts the system at the focus. This perspective on resilience is often used in social-ecological research. This is about maintaining a system and its functions; the focus is put on preservation (Walker et al. 2004). The *process observation,* in contrast, puts the learning capacity of a system at the focus. In this case, resilience means analysing the design options that preserve the innovation capacity of a system (see, e.g., Folke et al. 2010). The focus is on process observation, referring to changes to be assessed as resilient (see Luthe and Wyss 2015).

The second dimension refers to the fact that resilience analyses necessarily relate entities to their environment(s) (Folke et al. 2010; Walker et al. 2004). It is often assumed that increasing resilience of one entity is aligned with an improvement of resilience for other or superordinate entities or units. However, what happens if increased resilience of one entity reduces the resilience of another one? Self-resilience ('first-order resilience') describes the resilience of an entity in the context of its directly related environment. As this perspective does not consider to which extent this entity promotes or impairs the resilience of linked entities, another type of context-relation has to be considered. We suggest to distinguish context-resilience ('second-order resilience') from the above-presented self-resilience. It describes the specific resilience qualities of an environment of an entity. The contrast between these two forms of resilience offers a measure for making visible whether the resilience of an entity is related to the one of its environment or is de-coupled.

An Empirical Test: Four Theory Models of Resilience

We performed a survey to explore which different interpretations of resilience were present in the different disciplines and projects. The survey was based on the "resilience questionnaire" for social-ecological systems SES (Walker et al. 2006), and was adjusted specifically to include key aspects of resilience relevant for social systems (see the concept of Lebel et al. 2006). The questionnaire was put together by the following sections: a first section elicited general project-related information (such as the disciplinary background and research focus). A second section focused on indicators indicating on how the projects framed resilience allowing for the differentiation of theory models (see Table 1).

Table 1 Important indicators typically used in concepts of resilience and their assumed indication for respective dimensions (we also report indicators in the questionnaire which turned out not being selective)

Indicator	Aim of question?	Structure/Process	Self-/Context-
Resilience of self, and context	Does it make sense to differentiate between self- and context-resilience?	–	High: context-resilience Low: self-resilience
Tipping points/thresholds	Are tipping points and thresholds important for the project?	High: structure Low: process	–
Risks	Are the risks conceptualized as measurable factor?	High: structure Low: process	
Actors	Are knowledges as well as motifs of activity relevant for actors?	–	–
Diversity	Which importance is laid on the diversity of entities related to the entity under consideration?	–	High: context-resilience Low: self-resilience
Connectivity	How important is the interrelation between the different entities looked at?	–	High: context-resilience Low: self-resilience
Adaptability	Where and how adapts the analyzed entity to a change in environment?	–	–
Institutions	How important are institutions in the theoretical model of the research project?	High: Structure Low: Process	
Scales (geographic + social)	Differentiation by type and number	–	–

It has to be noted that the relationship between theoretical models and indicators is only possible if the indicators can be allocated to a specific component of the theoretical model. Indicators are interpreted as information providers. This means, for example, that the indicator diversity does not measure the diversity of components of an entity (as interpreted by Folke et al. 2010), but determines the diversity of the setting surrounding an entity. Finally, some indicators cannot be related to a specific dimension or expression of it.

The results of the cluster analysis, combined with individual project analyses, permit an initial typology of theoretical models of resilience. The first dimension in the topology defines the basic orientation in the concept, with either stability (structure) or growth (process) being the issue to be theorised. The second dimension defines the relevance of context for the resilience concept and distinguishes between self-resilience and context-resilience. Based on this, four theoretical models of resilience can be distinguished (see Table 2).

In order to analyse and interpret the differences between the groups, a principal component analysis was conducted as well. In the scope of this, the most important factors for the different projects are identified (see Hartung and Elpelt 2007). The basis comprised all groups of questions as given in Böschen et al. (2017), with the exception of the questions regarding the scales. The latter were not used, as in Böschen et al. (2017), because these questions were based on a different scale. For this, the answers to the groups of questions were transformed into factors using a principal component analysis. It becomes evident that five factors are sufficient to explain 86% of the variance of the answers. These five factors were rotated in the second step, in order to provide better interpretation opportunities. The loading matrix resulting according to the Varimax rotation is presented below. It indicates which answers are included in the calculation of each individual factor and how strongly.

Table 2 Typology of Theoretical models of resilience

Perspective to Context	Theoretical Concept	
	Structure	Process
Closed (Self-Resilience)	*Focus of research*: entities, their form and stability **Stability Model** (Gr I)	*Focus of research*: entities, their reaction and change **Expansion Model** (Gr III)
Open (Context-Resilience)	*Focus of research*: entities, their stability in relation to a specified context **Interference Model** (Gr IV)	*Focus of research*: entities, their co-stabilization in relation to the context **Transformation Model** (Gr II)

Table 3 shows that the first factor is strongly characterised by the difference between the *context and conceptualisation perspective*, or more specifically: positively dependent *on the resilience order and negatively on tipping points/thresholds*. Similar findings can be made for the second factor. Again, the context perspective (here: the *diversity*) is applied positively and the conceptualisation perspective (*risks*) negatively. The third factor is strongly determined by entity, adaptability and connectivity and negatively affects the context variables with the latter. While the fourth factor is not characterised by the two perspectives, the conceptualisation perspective is relevant for the fifth one. This primarily negatively affects the institutions and positively affects the thresholds. All in all, factor 1 and 2 reflect the differences between the perspectives, while factors 3 and 5 are assigned to one perspective each (rather negatively charged). Even though the fourth factor cannot be assigned to the perspectives, it is a factor that helps distinguish the projects. It positively affects time and negatively affects normativity.

Table 3 Rotated loading vectors for the first five factors (Method Varimax)

		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
		0.03	−0.10	0.34	−0.04	−0.06
Entity		0.04	−0.05	0.35	0.03	0.13
Order	Context	**0.66**	0.16	0.16	0.13	0.31
Time		0.13	0.14	0.17	**0.45**	−0.03
Risks	Concept	−0.01	**−0.80**	−0.02	−0.13	0.12
Tipping Points	Concept	**−0.68**	0.14	0.17	0.07	**0.33**
Actors		−0.25	0.01	−0.08	0.39	−0.07
Diversity	Context	0.01	**0.48**	−0.27	−0.27	0.13
Institutions	Concept	0.00	0.06	0.05	0.05	**−0.85**
Connectivity	Context	0.15	−0.18	**−0.43**	−0.12	0.00
Adaptability		−0.03	0.02	**−0.61**	0.14	0.07
Normativity		−0.04	0.13	0.17	**−0.70**	−0.07
	Direction	Context-concept	Context-concept	Context		Concept
	Most important	Order	Diversity	Besides adaptability	Normativity	Institutions
	Factors	Tipping points	Risks	Connectivity	Time	Tipping points

In the last step, the values of the factors in the four theory models are determined. For this, the values of factors 1–5 for the individual projects are calculated (Table 4).

They are determined and then the arithmetic average is calculated across all projects that were assigned to a model in the cluster analysis at Böschen et al. (2017) (Table 5).

Against this background, the first important question is whether the identified factors can be related to the four theory models of resilience highlighted before. By grouping concepts and factors, one can first state that the process-related concepts have a positive value of factor 5 while the structure-oriented concepts have a negative one. Similarly positive values of factor 3 coincide with a context-resilience whilst negative value are in line with the self-resilience. The results related to factor 1 and 2 seem to be a bit more puzzling. This is why this factor combines contrasting elements. Therefore, the extreme values positive are related to a contextual and process related perspective and vice versa. By emphasizing specific qualities one gets the following connection between models and the main factors (cf. Table 6).

Table 4 Value of the factors for the different projects. (In bold are the sample projects analyzed in detail)

Projects	Group	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
2	I	0.03	−0.67	0.50	0.06	−0.55
9	I	**−0.27**	**0.07**	**0.90**	**0.71**	**−1.00**
8	II	0.16	0.48	0.07	0.10	−0.55
11	II	**−0.02**	**0.17**	**0.20**	**−0.55**	**−0.25**
3	III	0.57	−0.90	0.60	−0.23	0.07
4	III	−0.40	−0.11	0.37	0.38	0.23
7	III	0.62	−0.07	1.00	0.91	0.70
12	III	0.60	0.09	0.17	0.78	0.31
13	III	**0.33**	**−0.04**	**0.02**	**0.41**	**0.07**
1	IV	**−0.64**	**−0.25**	**−0.07**	**0.17**	**0.44**
5	IV	−1.00	−0.73	0.00	0.70	−0.51
6	IV	0.16	−1.00	−0.10	1.00	−0.57
10	IV	−0.39	0.18	0.21	0.26	−0.32
Mean		−0.02	−0.21	0.30	0.36	−0.15
Standard Deviation		0.50	0.47	0.36	0.46	0.49

Table 5 Value of the factors for the different projects. (Depicted in bold are the groups with the highest and lowest values)

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Gr III	**0.34**	−0.21	0.43	0.45	**0.28**
GR IV	**−0.47**	**−0.45**	**0.01**	**0.53**	−0.24
GR I	−0.12	−0.30	**0.70**	0.39	**−0.78**
Gr II	0.07	**0.33**	0.13	**−0.23**	−0.40

Table 6 Typology of theoretical models of resilience and the related factors

Perspective to Context	Theoretical Concept	
	Structure	Process
Closed (Self-Resilience)	*Focus of* research: entities, their form and stability *Factors*: (negative Values for factor 2), positive value of factor 3, almost positive factor 4 and negative value of factor 5 **Stability Model** (Gr I)	*Focus of research*: entities, their reaction and change *Factors*: about zero for factor 2, slightly positive value on factor 3, positive value for factor 4 and slightly positive value of 5 **Expansion Model** (Gr III)
Open (Context-Resilience)	*Focus of research*: entities, their stability in relation to a specified context *Factors*: about zero value of factor 2 and negative value of factor 3, (almost positive value for factor 4) **Interference Model** (Gr IV)	*Focus of research*: entities, their co-stabilization in relation to the context *Factors*: positive value of factor 2, (slightly negative for factor 3) and negative value of factor 4 **Transformation Model** (Gr II)

We saw within this section that there is a plausible correlation between the models and selected factors. Nevertheless, we found that the references between factors and models are not conclusive in all cases. Therefore, a deeper analysis seems to be appropriate.

Theoretical Models and the Construction of Resilience

Such a deeper analysis should shed light specifically on the contrasting values of the factors discussed above. Some of the inconclusive findings seem to be related to the fact that the factors in some cases combine conceptual as well as contextual indicators. Therefore, the interpretation of specific values of factors becomes a difficult task. We assume that it might be helpful to look at the different theoretical models while doing two things. First, to discuss in an overview the different cases (i.e., specific projects) found in the collaborative research program. Thereby, the specifity of the different factors is reflected in an overarching way. Second, one selected project is discussed exemplarily per theoretical model. This is done to offer an insight why there are obvious inconsistencies in the relation between factors and theoretical models. Our assumption is that relations between models and factors are resulting in a more difficult picture as the indicators behind influence these. Thus, the four theoretical models of resilience are specifically detailed based on a qualitative analysis of selected projects from the examined research cooperation, highlighting the relevance and effectiveness of this theoretical-conceptual model formation.

Expansion Model (Gr III)

Projects from this group have a procedural understanding of resilience and examine the reactions of the entities in change. Their object of study is the entity itself and its ability to react. Self-resilience is at the focus. All the projects have a positive value of factor 3, which is related to a negative value of the context-resilience indicator 'connectivity' (see Table 1 and Table 3). This matches not only with the perspective of self-resilience in this model, but also indicates a clear contrast to Gr IV—which is positioned diametrically opposite to Gr III. This is also indicated by a low factor 2. Looking at factor 5, one can see a positive value indicating a process-oriented view. Moreover, the groups Gr I and Gr III (both following a self-resilience perspective), which at the same time differ in the theoretical concept, are distinguishing most with regard to factor 5. Finally, looking at the aspect of the theoretical perspective, with one exception, the value of factor 1 is slightly positive, meaning that in these cases the indicator 'threshold' is low as there is a minus (see Table 1 and Table 3). This relates to a process-related concept for theory. Examples from the research cooperation are studies on the change of the media system (P7; Meyen et al. 2014), the change of the work organisation towards team-based work (P3), change of specific corporate structures under internationalisation conditions (P4), change to consulting structures from foreign policy (P12), and changing cascade use of forests (P13).

For a more detailed analysis, we look at the project 13. In the scope of this project, a clear field of transformation is put at the focus, which WBGU (2011) also dealt with in its World in Change study: sustainable use of wood. WBGU recommended to support cascade use of wood from sustainably managed and certified forests (see ForChange 2017, p. 257). In light of this, the project turned to the question of how transformation paths could be identified in the scope of a defined wood use and forest system and which factors could strengthen or weaken these.

Factor 4, which includes the order of time positively and that of normativity negatively, is particularly relevant for this project. In this case, it appears particularly noticeable that both aspects are of high importance for the conceptualisation of the project. Although the project raises a specific normative demand, it transfers it into analytically-empirical issues to specifically include the aspect of normativity only as a justifying background assumption. Furthermore, the project analyses long periods of time, asking about the conversion-critical relevance of time. This results specifically from dealing with transformation paths.

Factor 1 indicates a process-related perspective as the indication of thresholds is low. This is why, as it has to be noted, that one selected research strategy seems to have led to this specific loading of the factor. This is based on the conceptualization of change within a model of interrelated systems, "[…], one is a socio(political)-ecological system under forest management while the other is a socio(technical)-economic system under industry management" (Bobar and Winder 2017, p. 194). This interrelatedness in the empirical situation corresponds to a theoretical model based on a process-related perspective. At the same time, several influences from the context were used to describe changes of the wood use and forest system. In describing the cascade use of wood, possible thresholds (indication for self-resilience) were given less attention in order to characterise the transformation processes in this.

All in all, the project showed on the one hand that the forms of sustainable forest use and wood management did only multiply but also spread. On the other hand, it showed that this process was brought about by "institutionalisation of networking and innovation promotion" (ForChange 2017, p. 258) which also stabilised it.

Stability Model (Gr I)

Projects of this group have a structural understanding of resilience and combine this with a closed context perspective (focus on self-resilience). This corresponds to an analysis of preservation and stability of the entity. It differs from group IV in particular in factor 3 (context factor), which refers to connectivity. The central difference from group III can be found in the context perspective of factor 5.

Factor 5, which loads on institutions and thresholds, is negative in case of Gr I, whereas it is positive or group III. Group I differentiates itself from Gr II in factor 2, which contains both the context and conceptualisation perspectives in diversity and risks. Typical examples for this are the ecosystems (Holling 1973), development of economies under special consideration of the system transformation of Communism into a market economy or the conversion of legal systems (Frensch 2015). Both projects from the consortium that fall into this group treat issues of stability, in one case based on international economic disturbances leading to weaker legal prerequisites for an economic equilibrium (P2), and in the other case from digital change leading to growing relevance of media competence as a resilience resource (P9).

Exemplarily, we focus on P9. Project nine asks a central research question regarding resilience: How does media competence develop from the teens into the young adult age? Is media competence an important resilience factor? (See Gralke et al. 2017a, b) The main proposition is that media competence is a (protective) resilience factor that protects from potential risk factors such as the rapid media change and negative media effects, while at the same time serving to utilise the positive potential of media. It can be recorded as a central result that media competence correlates positively with positive development factors and negatively to inhibiting factors. However, a relationship between media competence and the scope of resilience according to Connor and Davidson (2003) could not be found, which is particularly due to the construction of the measure. Project 9 also showed that media competence correlates positively with the interest in politics in the model, which in turn influences the self-concept of young recipients. This provided initial evidence for media competence being a resilience factor for youths and young adults.

Braun et al. (2018) describe resilience as a resistance fed by various resilience or protective factors. From a developmental psychological point of view, a protection factor is a measurable characteristic of persons or environmental conditions that predicts a positive development during the transition to adulthood. These factors ensure a healthy and successful development in spite of possible risks and dangers of the environment. The research project is thereby based on the seminal work by Werner et al. (1971), according to which resilient children were successfully integrated into the community in spite of harmful initial conditions.

Project nine thus generally focuses on resilience of the entity and therefore on first-order resilience. Resilience factors therefore are personal characteristics. Media competence positively correlates with these protective factors, such as intelligence, mathematical skills, success at school, media diversity, interest in politics, self-concept, taking different perspectives, reading comprehension and speed and negatively with risk factors such as addiction to computer games or TV consumption. The latter is also due to the construction of media competence, which includes the difference between fiction and reality as an essential component. This interpretation aligned with self-resilience is strengthened by the interpretation of the factor analysis. Here, it becomes clear that factor 3 is very high in relation to other projects. The latter strongly includes connectivity.

The resilience concept in this project can generally be viewed as structure-preserving. The focus is on the resilience factors observed at one point in time, such as mathematical competence or school grades from the academic area, or resilience factors such as an interest in politics from the social area, which preserve the structural characteristics of the entity. These factors may generally change over time. However, the change is not immanent in the theoretical model. They are only viewed in the scope in which cross-section analyses are made at different times. This is also evident in the answers to the open questions of the survey according to Böschen et al. (2017). Thresholds are only viewed as relevant there as far as the entity is no longer resilient at a point of time. This view is increased when looking at factor 5, which is positively influenced by thresholds and that has the lowest value in project nine. The second component of the factor 'institutions,' however, only has limited indicative strength based on the answers to the open questions, since the institutions meant here are not part of the underlying theoretical model. To the contrary, they only serve as exogenous social institutions such as educational institutions.

Looking at the further factors, project nine shows a lower value for factor 1. The latter positively affects the resilience order and negatively affects the thresholds. Specifically assessment of factor 1 clearly presents the focus on self-resilience (resilience order) and dominance of the structural perspective (thresholds). Interpretation of factor 2, however, is not clear. The value here is extremely high, which indicates context-resilience as well as a process-related perspective. However, the responses to open questions show that the item of risks was answered from the point of view of applied methodology rather than from that of the underlying theoretical concept. The value therefore is only partially indicative. It is also of interest that normativity is rather unimportant and that time is rather relevant. The latter is interpreted based on the methodology as well. All in all, it can be recorded that in spite of certain indications of context-resilience and process-related perspective, the term of resilience used must be interpreted as a near-prototypical stability model especially from the theoretical point of view.

Transformation Model (Gr II)

Projects from Gr II have a procedural understanding of resilience and examine the entity and its co-stabilisation in context. The difference between Gr II and Gr I as well as Gr II and Gr III can be related to factor 2. Hereby, projects of group II have a positive value of factor 2, while the ones of Gr I are related to a negative one. This is in alignment with the fact of a context-sensitive perspective (context-resilience). Interestingly, the projects of this group show a negative value of factor 4. This indicates a highly normative perspective as this factor is negatively correlated to the indicator of normativity (see Table 1 and 3). Projects from Gr II analyse, e.g., phenomena such as resilience and transformation of individuals, groups and their effects on society. These are projects where resilience of transformation or, as Olsson et al. (2014) call it, "the resilience of a new direction" comes to the focus (see Binder et al. 2017). This is addressed when theorisation takes place with a view to relevant contexts, i.e., when it is 'context-open.' In the consortium, this dedicated co-stabilising perspective is found in a project on basic questions of the ability to act in changing environments (P8) and a project on the relevance and specification capacity of normative orientation in basic conversion processes (P11).

For a more detailed view, we look at the project P11. The question of transformation of society under the impression of global environmental changes moves to the focus under a specific assumption in this project. It is assumed that the previous strategies of problem solution, specifically the "socio-technical management" (ForChange 2017, p. 221), will not be sufficient to solve the problems that currently occur. Instead, the "future of our civilisation will only (be) possible through pervasive change to our life- and economic style" (ForChange 2017, p. 221). The contribution of the project to answering these questions is in exploring forms and the relevance of normative questions for design of this kind of transformation while focusing on the "correlation between pioneering groups in the civil and entrepreneurial society, value change and politically-legal institutions" (ForChange 2017, p. 222): "How (can) transformation of the current economic model and lifestyle be achieved (?) What may be leading ideas for this?" (ForChange 2017, p. 226).

In the scope of this project, factor 2 is designed following the assumptions. The concept of risks is not relevant here. The concept of risk is specifically based on assumptions that are viewed as in motion and as changing in the scope of the project. Even more: it is specifically assumed that the previous assumptions of a management of transformation by science and technology must be questioned. In contrast to this, the aspect of diversity, which positively affects factor 2, is given a very high relevance. This aspect is in fact a central item for the project. It not only takes resilience as a fixed concept, but specifically explores the different interpretations and their productivity for solving problems in society. Additionally, the project assumed that "impulses for sustainable transformation of society … depend on many different actors, not least on the civil society and on pioneers and practitioners of cultural change" (ForChange 2017, p. 226).

The two indicators of normativity and time specifically influence the factor 4. The factor of normativity is decisive in the scope of this project. The project is virtually based on a theory model. "The normative content of the resilience concept that is in the tension field between system preservation and context stability, between adjustment and transformation, requires basic clarification in the scope of interdisciplinary dialogue" (ForChange 2017, p. 226). Questions of normative orientation centrally characterise the theory model, with the project looking for answers in two directions. On the one hand, it exports all normative sources available for this, which not only comprise ethical, but also religious knowledge. On the other hand, the project sees a central result of own considerations in developing arguments for a "reflexive resilience" that is able to respond to challenges with a situation-related development of alternative actions and the corresponding flexibility of action (Schneider and Vogt 2017, p. 179). For the structure of the project, addressing basic conversion processes and conversion requirements for which it is assumed that they require a new manner of thinking and that new orientation guidance must be developed for people. At the same time, such orientation guidance come from a practice that has already been in use, but is not yet generalized (ForChange 2017, p. 228 ff.).

Interference Model (Gr IV)

Projects of Gr IV mostly combine a structural understanding of resilience with the perspective of context-resilience. This group seems to be quite specific with regard to the factors and their values. Factor 1 is negatively loaded, i.e., thresholds are very relevant. This fits well with the structural perspective and the high relevance of the context. Factor 2 is also negatively loaded, suggesting a dominance of risks over diversity. Again there is a clear correspondence to the main theoretical conceptualization of this group. A structure-based perspective presumes that there are risks to keeping the current state of the system. Also factor 4, time, is relevant as these projects address the dynamics of a system under changing boundary conditions (context). In contrast, the results for factor 3, the context perspective, are not conclusive. In this case, we would argue that this situation is fuelled by the fact of combining the extremes of values in factor 1 and 2.

The differences to other groups seem to be more relevant. Gr IV differs from group III in particular by factor 1, which contains both the context and conceptualisation perspectives (order and thresholds). It differs from Gr II in factors 2 and 4, which makes interpretation difficult. Typically, Gr IV spans projects for which several actor levels are relevant and that view extended time scales. 'Nested' systems are often addressed. How can the stability of a system, e.g., an energy system or economic system, be preserved in interaction with its context? In contrast to the stability model, change is not primarily viewed as a pointed interference, but as one that continues over time. Such projects deal with preservation of the function of an entity subject to transformation of the environment (Hecher et al. 2016). Projects from the consortium that fall into this group address paths of resilient energy system transformation (interference space regions; P1), examine operational structures at preservation of workability (interference space between employee and company; P5, Hurtienne et al. 2014), analyse the changes to legal regulation in contemporary societies (interference space between law and organisations; P6), or study stability conditions of highly volatile finance and raw material markets (interference space market and society; P10).

For a more specific analysis, we looked at project P1. This project deals with the energy transition at the regional level, i.e., the Allgäu, a rural region in Southern Germany. The regional level is relevant as it provides innovative impulses for local design of the energy transition and for establishing new governance forms (Kunze 2013; Gailing und Röhring 2016). At the moment, regional initiatives and actors are, however, facing changed framework conditions, in particular regulatory changes on federal and state levels, that slow down the development of renewable energies and that make local implementation of the energy transition difficult (Klagge et al. 2016; Müller et al. 2015; Ohlhorst 2016). Regional actors therefore are confronted with the challenge of finding practices and strategies for successfully handling changing framework conditions.

In light of the important role of the regional level for the energy transition on the one hand, and the current obstacles in the transition process on the other hand (see Sect. 2.1), the question about dynamics and resilience of regional energy transition arises. Thus, the research project particularly focused on the role of adjustment and transformation capacity in dealing with system interferences (Walker et al. 2004). An indicator-supported approach was developed to analyse the resilience of transitions in energy regions. The latter assumes that the energy system as such must be resilient (i.e., it must meet its function of supplying energy at any time in the course of the transformation process-structural perspective). Tipping points, therefore, play a central role. The aspect of how actors can create resilient regional governance structures that permit adjustment to changing framework conditions (context-resilience) is relevant as well. Stability and flexibility are identified as central characteristics of resilient governance structures. From the analytical perspective pursued in this paper, the following observations can be made:

Factor one, resilience order and thresholds, is negatively charged, implying that thresholds play a central role in the transition itself. It is, however, not the same for both components of the socio-technical system. The technical system is less robust against changing external framework conditions than the social system. While the development of renewable energies quickly dropped as a consequence of changes in the regulatory framework, the social structure continued in the form of networks, organisations and responsibilities.

The second factor links risks and diversity. This is also negatively charged in project 1, i.e., the risks play a central role. Again, there is a difference between the social and the technical systems. While the social system is characterised by a strong diversity of actors, increasing flexibility and reduced risks, the technical system (electricity) shows a low diversity—due to high energy imports. This low diversity in the technical system, connected to the financial dependence, is a risk to the resilience of the energy transition.

The third factor that puts connectivity and adaptation capacity at the focus, has a neutral effect. This sounds counter-intuitive, nevertheless it indicates a relevant form of stability. The stability of the governance structure was centrally influenced by the connectivity between the actors and by the modularity of the actors groups. Structures were created in the Allgäu that permitted a stable framework for coordinated collective action while being flexible enough to integrate new actor groups and action modes. Only in the most recent phase can a growing instability of the governance structures be found that slows down the transition.

In addition to the aspects mentioned, the context-resilience plays a central role. The development in the Allgäu region illustrates the creation of autonomous regional energy systems. Both the technical-material and the social dimensions of the regional energy transition are embedded into supra-regional structures that have had a supportive or impairing effect on the transition process itself.

Discussion and Outlook

What can we interpret from our findings? In short, we can see that the four models differ in a relevant way, not only with regard to the formal factors, but also by looking at the different projects more concretely. The deeper empirical analysis of four projects has shown that the differentiation into the specified theoretical models is valid and that the factors represent a sensible additional dimension of analysis. The charge of the factors permits further specification of the theoretical model formation. Therefore, we would like to sum up the main differences between the groups—asking whether the four identified theoretical models correspond to a specific application perspective.

Looking at the differences between the groups, there are two relevant forms of contrasting the groups. One strategy is the one of diametrical opposition. Thereby, we look at the differences between the Gr III (expansion model: self-resilience and process-oriented) and the Gr IV (interference model: context-resilience and structure-oriented) and the differences between the Gr I (stability model: self-resilience and structure-oriented) and the Gr II (transformation model: context-resilience and process-oriented). With regard to Gr III and Gr IV, there are key differences in factor 1 (Gr III = 0,34 and Gr IV = −0,47) representing at the same time the extreme values. Moreover, it is the factor 3 indicating a clear contrast to the Gr IV diametrical opposite to the Gr III (Gr III = 0,43 and Gr IV = 0,01) and finally the factor 5 (Gr III = 0,28 and Gr IV = −0,24). With regard to Gr I and Gr II, there are key differences in the factor 2 (Gr I = −0,30 and Gr II = 0,33). Moreover, it is factor 4 which points towards a relevant difference in the theoretical model (Gr I = 0,39 and Gr II = −0,23). There are two arguments. First, this factor is related to the indicator of time and this category is used in the Gr I of stability model. Second, this factor is related to the indicator of normativity, whereby the Gr I projects are related to a perspective of objectivity (therefore the indication of normativity is negative) and the projects of Gr II have to take the normative dimension into consideration as typically different views on transformativity are part of the game.

The other strategy is to compare the groups pairwise. This means to look at the differences between the class Gr I and Gr IV versus the class Gr III and Gr II, representing the overarching differences in the theoretical concept, as well as looking at the differences between the two classes Gr I and Gr III versus Gr IV and Gr II, representing the overarching differences between the perspectives to context.

Comparing the classes (Gr I/Gr IV) versus the (Gr III/Gr II), one can see the following specific features. In this case, the factor 3 is combining the extreme values in one class (Gr I/Gr IV) = 0,7 and 0,01 versus (Gr III/Gr II) = 0,43 and 0,13. With relation to factor I the classes are grouping highly consistent as (Gr I/Gr IV) = −0,12 and −0,47 and (Gr III/Gr II) = 0,34 and 0,07. This indicates a strong contrast with regard to the theoretical concept chosen. Moreover, there is an interesting contrast in the factor 2 as the two classes each include the two values mostly related: c(Gr I/Gr IV) = −0,30 and −0,45 versus c(Gr III/Gr II) = −0,21 and 0,33. This indicates that there are specific more options to construct process-related models depending on the specific problem-description constructed in the respective projects.

With regard to the second distinction (context dimension), there is the interesting fact that these groups each combines more or the less the extreme values of factors. E.g., with regard to factor 2, the classes spread as follows C (Gr I and Gr III) = −0,30 and −0,21 and C (Gr IV and Gr II) = −0,45 and 0,33. Or looking at factor 4, the classes are C (Gr I and Gr III) = 0,39 and 0,45 and C (Gr IV and Gr II) = 0,53 and −0,23. This can be interpreted that way that with regard to the contextual perspective the strategies of contextualization are highly specific and have to be related to the theoretical concept chosen.

Nevertheless, some unspecific and inconsistent charges of the factors show that there is a further need for research. The questionnaire that was used for analysis of the resilience in the respective projects was derived from the questionnaire used by Walker et al (2006), developed for social-ecological systems. Since we focused on social systems here, the questionnaire should be further revised based on our experience after this first application. It has become clear that many questions that can be answered clearly for social-ecological systems are not suitable for the analysis of the resilience of social systems. In particular, terms such as thresholds, self- and context-resilience or adaptability must be defined more clearly and adjusted to social systems.

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Appendix

List of projects from the research consortium ForChange (see Böschen et al. 2017, p. 227)

Topic	Question	
Background discipline	Which discipline(s) is (are) the basis for your own work (regarding prior assumptions and methods?	A1
Research focus and research question	Which central questions (tasks) are to be answered by resilience analysis? Why should resilience of an entity by analysed?	B1
Examined resilience entities (which system/object/entity does resilience refer to?)	Which system (or which entity/which object) does the resilience refer to?	C1
	In what or against which influences/factors/etc. must the entity be resilient?	C2
	Who are central actors/elements/functions?	C3
	Which role/task/function do these have in their system (their entity)?	C4
1st and 2nd order resilience	What kind of differentiation between 1st and 2nd order resilience is sensible in the scope of this project?	D1
	If so, please specify the level in the following questions, or state when the answer is about 1st or 2nd order resiliences.	D2
Time	What is the relevant time horizon for resilience analysis? (estimate if necessary)	E1
Risks, Uncertainties	Which risks/uncertainties influence resilience (of the entity)?	F1
	Can these be measured and evaluated, and how?	F2
	How can they be dealt with?	F3
Thresholds	What relevant system-internal/entity-internal thresholds (bifurcation points) or sensitive balances are there and what are they made of? Are these developments reversible?	G1
	Which attracting conditions (‘attractor,’ ‘Basin of Attraction;’ conditions that require a much higher effort to change) are there?	G2
	Which thresholds lead to total loss of resilience and/or identity (irreversibility) of the examined entity?	G3
	Can these be measured, how and according to which parameters?	G4
	How robust is the entity regarding changes to certain parameters?	G5
	Are there important path dependencies or any other relevant historical observations on tipping points?	G6

Topic	Question	
Knowledge of the actors regarding examined systems and their dynamics	What knowledge do the central actors/elements/functions have?	H1
	How does the present knowledge relate to that which is actually necessary or applied?	H2
	How is knowledge distributed (also within these actors) and which structures are there for the information flow?	H3
	What role do which communication processes play to spread knowledge and the flow of information?	H4
Driving moments of the actors	What drives the actors/elements/functions? Which values and leading images do these have (implicit/explicit if applicable)?	I1
	What standards and indicators (as operationalisation of the values and leading images) influence the actions of the actors?	I2
Options for action of the actors	Which options for action are there for which actor/element/function?	J1
	Which of these action options are actually implemented?	J2
	How can the action options or their implementation be improved?	J3
Diversity	How high is the diversity of functional groups/elements/actors/functions? How many G/E/A/F are there? How many action options do the G/E/A/F have and how diverse are they?	K1
	How does the existing diversity influence resilience? (Does it increase or reduce resilience?)	K2
	Can different groups/elements/actors take the same function in the system?	K3
	How does this redundancy influence resilience? (Does it increase or reduce resilience?)	K4
Types and functions of the institutions that prevail in the system	What are the most important institutions (within the system/entity)?	L1
	Is its performance appropriate for the task field/resilience of the relevant entity?	L2
	How may they need to be adjusted?	L3

Topic	Question	
Connectivity	Which other actors/entities/system components are relevant outside of the entity?	M1
	Which central interdependencies are there with them?	M2
	Where are there interdependencies between the scales and actors (if appl., divided into within and outside of the "system border")?	M3
	Is there any specified structure between scales/actors/elements or functions (governance) and what is it made of?	M4
	How are the actors to be weighed regarding interdependencies and resilience?	M5
	Where is there a need for action? Where should interdependencies be increased or reduced?	M6
	What roles do communication and connectivity and interdependence play for each other?	M7
Adaptability	Which of the entity under observation or any important actors show adaptability (incremental adaptability)?	N1
	Which of the entity or any important actors show transformability (fundamental adaptability)?	N2
	Which of the entity or any important actors show persistence (toughness/self-preservation/robustness)?	N3
Normative aspects of resilience	When is resilience good for other entities or systems? (see 2nd order resilience)	O1
	What is the normative evaluation framework (laws, values, etc.) of resilience?	O2
	When should resilience be promoted in an entity?	O3

Annex for factor analysis:

This covariance matrix Σ of the reduced (demeaned) responses X was decomposed with

$$\Sigma = \Gamma \Lambda \Gamma^{T}$$

into a diagonal matrix Λ of the eigenvalues of Σ and the orthogonal matrix Γ of the eigenvectors Σ (see here and below: Hartung and Elpelt 2007). While matrix

Λ contains the explained variances on the diagonal Γ, the matrix Γ shows the factor loadings; this means that it states how strongly a factor is determined by a group of questions.

The matrix decomposition based on the idea that the first factor explains the maximum possible variance of the data. Graphically, this means that the first factor is a (straight) line through the set of data points of the answers to explain the maximum variance. The second line then is orthogonal to the first one and explains the set of data points second-best. After having placed one line in each dimension and thus determined one factor each, the same number of factors as groups of question in the individual projects results; however, they are differently suitable for explaining the data and therefore have a different amount of information content (explained variance to total variance). This case results in the following image (Fig. 1).

According to the Kasier-Guttmann criterion, it is evident that the first 5 factors suffice to explain 86% of the answer variance (Dunteman 1989). In order to better interpret the first five factors, the factors can be transformed. Therefore, the factor axes are rotated further, while keeping the origin of the coordinates the same. This technically corresponds to multiplication of the matrix of factor loadings with a transformation matrix T:

$$\Gamma^* = \Gamma T$$

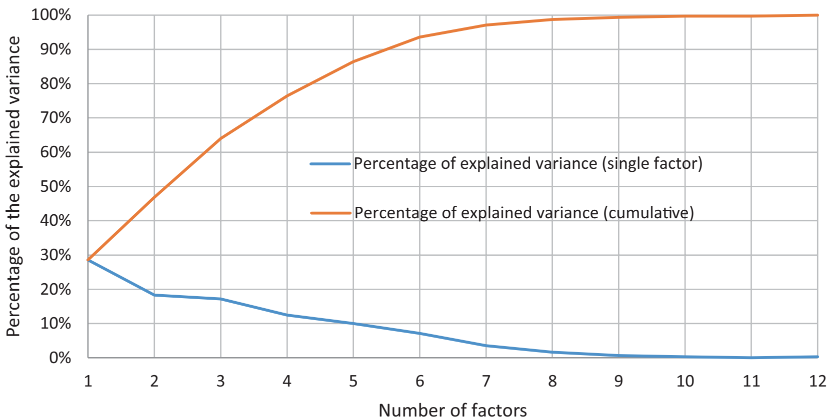

Fig. 1 Share of explained variance by the factors of a principal component analysis (percent variability explained by principal components number n in blue, percent variability explained by the first n principal components in red)

The criterion according to which the turn takes place is decisive for the interpretation. The Varimax is one of the most common procedures here (see Kaiser 1958), in which factor axes are orthogonally rotated until the variance of the squared charges per factors has reached its maximum. The loadings are the weights (shares) that individual groups of questions have in the respective factor. The process thus maximises the share of the respective groups of question.

In the last step, the factor variations in the four theory models are determined. For this, the variations of factors 1–5 for the individual projects Y (see Hartung and Elpelt 2007)

$$Y = \Gamma^T X$$

are determined and then the arithmetic average is calculated across all projects that were assigned to a model in the cluster analysis at Böschen et al. (2017).

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Böschen, Stefan (Prof. Dr.) is Professor for Technology and Society at HumTec, RWTH Aachen, Germany. He studied Chemical Engineering, Philosophy and Sociology, and holds a diploma in Chemical Engineering, a doctoral degree as well as a habilitation in Sociology. His current research focuses on Sociology of Science, Sociology of Modernity, Risk Sociology—with special emphasis to problem-oriented research, technology assessment, the analysis of risk politics and risk communication. *Relevant publications*: Böschen, S., Binder, C. & Rathgeber, A. (2017). Resilienzkonstruktionen: Divergenz und Konvergenz von Theoriemodellen – Eine konzeptionelle wie empirische Analyse. *GAIA 26 (S1)*, 216–224; Böschen, S. (2016). *Hybride Wissensregime: Skizze einer soziologischen Feldtheorie*. Baden-Baden: Nomos; Böschen, S. (2013). Modes of constructing evidence: Sustainable development as social experimentation—The cases of chemical regulations and climate change politics. *Nature and Culture 8 (1)*, 74–96.

Binder, Claudia R. (Prof. Dr.) studied Natural Sciences at ETHZ and holds a Ph.D. in Environmental Sciences and a Venia Legendi in Human-Environment Systems, both from ETHZ, Switzerland. She is holding the Swiss Mobiliar Chair for Urban Ecology at ENAC, EPFL and is the head of the laboratory for Human-Environment Relations in Urban Systems (HERUS). Her research interests lie in analysing, modeling and assessing transitions towards sustainability. For doing so she develops inter- and transdisciplinary methods which are able to depict the key aspects of the ecological and the social systems and their relations. Her application areas are in energy, phosphorous, water, food and land-use in the context of urban, peri-urban and rural development in Europe and Latin America. She has published over 50 peer-reviewed publications in renowned journals such as Ecology and Society, Ecological Economics, Environment Science and Technology and Industrial Ecology.

Rathgeber, Andreas (Prof. Dr.) holds a W2-Professorship for Finance and Information Management at the Institute for Materials Resource Management at the Faculty of Mathematics, Natural Sciences and Materials Engineering at the University of Augsburg. He is primarily concerned with resource management and finance and in particular the interface between these two disciplines. Amongst other journals, he published in Nature Materials and Journal of Industrial Ecology. Andreas graduated in Economics at the University of Hohenheim in Stuttgart and then studied Mathematics at the University of Augsburg from 1997 to 2001. He holds a Ph.D. with a work about “Multi Price Processes and Exercise Conditions for Option Pricing” since 2004. Between 2005 and 2008 he completed his habilitation thesis (topic: Determining Discount Factors). From 2009 to 2010 he was Professor of Financial Management and Taxation at UMIT in Austria. He was honored with the Science Award of the Kurt and Felicitas Viermetz Foundation in 2009.