

## Basics of Time

Faber, M., Frick, M., Zahrnt, D. (2019) MINE Website, Basics of Time, accessed on 20 January 2019, [www.nature-economy.com](http://www.nature-economy.com)

### Abstract

Whereas our concept of space seems well established, perhaps ‘hard-wired’ into our brains, time is altogether more elusive. Since Aristotle (or even before), the nature of time has been a source of contention among philosophers, both pure and natural.

Mainstream Economics employs a restricted view of time, which in turn leads to a simplified analysis of long-term developments. This holds particularly for the interplay between nature and the economy. Ecological Economics, in contrast, employs a wider view of time.

This concept introduces several conceptions of time, tracing the line from ancient philosophy to political decision-making. *Chronos*, which can be found in Aristotle’s and Newton’s writings, reflects a linear, objective understanding and is at the core of the modern scientific world view. *Kairos*, adopted from the name of a Greek God, signifies the right moment to act, meaning a subjective interpretation of when to act with limited knowledge or even in the face of ignorance. Both *chronos* and *kairos* are important to understand and make use of the inherent dynamics of evolutionary processes.

This concept argues that this broad view of time culminates in a stocks perspective which provides an indispensable tool for political advisors and decision-makers.

Our first example comes from Tolstoy’s *War and Peace* in which patience and time lead to an outcome that seemed impossible at the outset. The second example concerns German water policy where a slow build-up of production stocks leads to social support of the innovative policy and ultimately to the long-term protection of water.

Related concepts: IRREVERSIBILITY; EVOLUTION; BASICS OF LIFE; IGNORANCE; ENVIRONMENTAL POLITICS

## 1. History

Human beings nowadays have little or no problems with the notion of time. Most of us have a watch, and time can be easily measured. Time, however, has been an object of human thinking for centuries.

Since Aristotle (or even before), the nature of time has been a source of contention among philosophers, both pure and natural. Aristotle (384 – 322 B.C.) dealt systematically with time, taking an objective view on its notion. He defines time as “a number of motions with respect to the before and the after” (Fourth book of *Physics*). This insight is the reason that all familiar clocks basically possess some kind of movement that we think of being as regular. Time is considered a countable and measurable unit that moves in one direction. Time in this sense is called *chronos* in Greek mythology; Chronos is the god of time. Motions have a duration, a beginning and an end. This means that all motions, e.g. the life of a flower, have a time that is *inherent* to them.

In contrast, Augustine (1988, book 11), who lived from 354 to 430 A.D., views time subjectively. Augustine squarely grapples with the substance of time by asking, what is time? To provide an answer, he takes recourse to the memory of a human being. As Scott Horton puts it, “[h]e struggles with the idea of time, making many seemingly contradictory statements, but his objective is plain enough: to create a bridge between the philosophical conceptualization of time and that implied by sacred texts. Aristotle presents us time as a sort of vanishing point, the fleeting instant of the present which is in some sense real, whereas what is past and what lies in the future are illusory. But Augustine is concerned about the two lives of creatures with souls—the one of the temporal world (literally, the world of time), and the other of a spiritual world for which death marks a bridge” (Harpers Magazine Online, accessed on 23.10.2018).

It turns out that Aristotle is the founder of time in a scientific sense, while Augustine regards time in a spiritual way. Scott Horton continues, “for the scientifically oriented, it was essential to escape the paradox of time through the development of a system of measurement that allowed a steady reckoning forwards and backwards and even of the present.

As the age of faith faded and the age of reason took hold in Europe, first in the Renaissance and then in the Enlightenment, it is no coincidence that this found expression in the development of mechanical approaches to the measurement of time: the clock. The utility of the clock was first seen in fixing the hours of prayer and religious services. Nevertheless, over time its essential role for science was discerned. Mastering the concept of time, and

measuring time, was essential to an understanding of the heavens and to guiding the movement of vessels on the seas. Time might stand still for the theologian, but the universe was and is a place of perpetual motion.

But Augustine's perspective continues to have a firm hold on the world of philosophy; it reminds us that we live not for the past or the future, but always for the present moment" (Harpers Magazine Online, accessed on 23.10.2018). This view is conceptualized in the concept of time as *kairos*, the Greek word for right, critical, or opportune moment.

In his poem 'the Moment' ('Betrachtung der Zeit'), the poet Andreas Gryphius (1616 – 1664) touched upon the bridge between Aristotle and Augustine:

Mein sind die Jahre nicht,  
die mir die Zeit genommen;  
mein sind die Jahre nicht,  
die etwa mögen kommen;  
der Augenblick ist mein,  
und nehm ich den in acht,  
so ist der mein,  
der Zeit und Ewigkeit gemacht.

Mine are not the years  
that time has took from me;  
mine are not the years,  
that likely are to be;  
this twinkling is yet mine,  
and if I seize it carefully,  
then He is mine,  
who made time and eternity.

(Translated by Suzanne and Nikolaus von Engelhardt)

The treatment of time has found much attention in physics since the beginning of modern times. The time of Newtonian physics is *chronos*. In his work on mechanics, Isaac Newton (1623 –1727) employed the concept of reversible time. "For example, the orbits of the planets around the sun run in a particular direction. If time were to 'run' in the opposite direction, the rotation of the planets would appear reversed. However, such a reversal would be quite compatible with Newtonian mechanics" (Faber and Proops 1998: 84).

With the rise of thermodynamics [see concept THERMODYNAMICS], the irreversibility of time [IRREVERSIBILITY] received the attention it deserves, for many natural processes are of irreversible nature.

A great breakthrough in our understanding of time occurred when Albert Einstein introduced his theory of relativity. It revolutionised our thinking about time and space. Relative physics has given up the Newtonian view of time, that time is an independent variable. Instead, it depends on other variables such as movement and gravitation. But relativist time is still, like Newtonian time, homogeneous and mathematically ascertainable.

Finally, we mention Martin Heidegger's (1889 – 1976) seminal book *Sein und Zeit* (*Being and Time* 1996). Human beings are aware of their mortality. Thus, a fundamental characteristic of human beings is their sorrows; with sorrow comes planning; planning inherently involves a temporal dimension.

## 2. Theory

First, we describe different approaches to conceptualise time (Section 2.1). We then introduce three distinct conceptions of time, chronos, kairos and inherent time (Sections 2.2, 2.3 and 2.5). Our focus will be on the practical dimension of time, namely decision making, for we are interested in helping decision makers and people in general develop a special awareness of temporal structures, which we will denote by a “sense of temporality” (Klauer et al. 2017: 119). To this end, we will introduce the notion of a *heuristic* in Section 2.4 which will be employed in Section 2.6 to use a stocks framework [BASICS OF LIFE] as a heuristic. The latter is the art of finding something that cannot simply be concluded or deduced from our knowledge, such as a scientific law, a solution to a problem, or a good decision (Klauer et al. 2017: 108).

### 2.1 Conceptualising time

In contrast to space, time is much more difficult to conceptualise: “Whereas our concepts of space seem well established, perhaps ‘hard -wired’ into our brains, time is altogether more elusive. Since Aristotle (or even before) the nature of time has been a source of contention among philosophers, both pure and natural” (Faber and Proops: 1998: 64).

“There is a wide range of views on what ‘time’ means; there is even one school of thought which regards time as an illusion. Perhaps our difficulty in understanding time is that time is not a ‘thing’, but rather the underlying prerequisite for there to be ‘things’. To that extent, perhaps all discussions of time must be about ‘no thing’, and therefore to a greater or lesser degree about ‘nonsense’.

This implies, however, that all discussions about things are about nonsense because all things can be conceived only in time (cf. Kant 1956). So perhaps our aim should be to make this ‘nonsense time’ as sensible and plausible as possible” (Faber and Proops 1998: 64).

Let us start by examining how we deal with time in our everyday life. “We see and experience ourselves constantly as temporal beings. We automatically arrange events according to whether they occur earlier or later in time. We can measure time and we can compare segments of time with one another, having no fundamental difficulty with saying whether they are shorter, longer, or equally long in comparison to one another. We see ourselves in the present. We remember the past and look into the future, often worrying about what it will bring. So, seeing ourselves in terms of time comes more or less naturally.

Our experience of time, then, is determined by what is obviously and fundamentally a sense of taken-for-grantedness. And yet upon further consideration, we can see that something else is taking place. As noted above, Augustine put it like this:

‘What then is time? I know well enough what it is, provided that nobody asks me; but if am asked what it is and try to explain it, I am baffled.’

Augustine confirms that we do indeed approach time unquestioningly because it is precisely when we do not question it that we believe we know what it is. This means that we apparently never need to question the nature of time in the same way we question what action is correct in any given situation. Unlike when we act in specific situations, we only have a problem with time when someone questions us about it. And for Augustine this problem is a philosophical one. It includes the difficulty, as yet unresolved, of how to comprehend the act of measuring time. To put it simply, the difficulty lies in the fact that we measure time by means of a clock, be it an egg-timer, a pendulum-driven clock or a clock whose function is based on the vibrations of an atom. Thus, all clocks basically possess some kind of movement that we have to think of as being *regular*, for otherwise the clock would not be able to provide any reliable measurements. But how do we know that the movement of a clock is regular? This could only be confirmed by another measurement using another clock, of whose regularity we again require assurance, and so on *ad infinitum*” (Klauer et al. 2017: 120-121).

Since we are interested in the practical dimension of time, we shall show that this dimension is particularly important when using the stocks framework [BASICS OF LIFE and Section 2.6 below], for the stocks framework can help us recognise the right time for action. To this end, it is expedient to take recourse to three perspectives on time: chronos, kairos and inherent time or inherent dynamics.

## 2.2 The time of classical science – chronos

The scientific dimension of time, i.e. chronos, goes back to Aristotle and Newton. We therefore begin “with an understanding of time that is taken as given in the classical sciences but that also corresponds to our everyday experience. This understanding is based simply on the idea of time as it presents itself to us directly – or appears to do so.

The scientific understanding time – like space – is a continuum that encompasses all things and all events. Just as things and events exist or take place next to one another in space, so too does time place them in the context of a sequence consisting of an earlier time, the same time and a later time. Things and events can be identified by a space-time location: Events are ‘dateable’ (Heidegger 1996: 407). However, whereas space just sits there motionlessly, as it were, time ‘moves’. It *passes*. Whatever is happening now – the present moment – is soon past, and whatever is in the future will sooner or later be here now, in the present and, later still, in the past.

We can represent time in a diagram as a timeline on which we can enter the individual dates as *points* in time. The representation of time using a timeline highlights yet more characteristics of time. Time seems to us to be *homogeneous*: Every segment of time, wherever it lies on the timeline, can be compared in quantitative terms to every other segment. Each individual span of time – an hour, a minute or a second – is exactly as long as every other previous or later hour, minute or second. Whether we spend two hours today on a particular activity or one today and one tomorrow – in quantitative terms it remains the same span of time, namely, two hours.

This concept of time can be described as that of Newtonian physics – it is a concept of time which can be described and comprehended fully in mathematical terms. The variable  $t$  in equations always represents the homogeneous and quantifiable time that corresponds to this concept.

We note in passing that the theory of relativity has relinquished the Newtonian assumption of time being the same everywhere. Here, time is no longer an independent variable but is dependent on movement and gravitation. But even the time of relativist physics is homogenous and mathematically ascertainable. Otherwise, the various times in coordinate systems moved against one another would not be able to be related to one another using the formulas of the Lorentz transformation.

Newtonian time, however, is also the everyday time we share when communicating with one another. It is the clock time according to which we set appointments, arrange to meet, and so on. We assume that a job that will take half an hour today will, all else being equal,

take just as long tomorrow, and that half an hour today is just as long as half an hour tomorrow. We shall call this homogenous, uniform, dateable time by the Greek term *chronos*” (Klauer et al. 2017: 121-122).

### Philosophical understanding of *chronos*

“Time as *chronos* can be interpreted in a number of ways philosophically. We can understand time, as Newton himself tended to, as something that is objectively given, as an inevitable precondition of our existence and of our actions. In this view, time is there even if we are not. Kant, however, who wrote the first part of his *Critique of Pure Reason* to give Newtonian physics a philosophical foundation, interprets time subjectively. According to him, time is a representation, one that we cannot avoid making. ‘Time is a necessary representation, lying at the foundation of all our intuitions’ (Kant 1855: 28). We have to imagine anything we imagine at all as existing in time (and in space). We cannot say that time exists outside our faculty of knowledge and representation. This is why Kant calls ‘time [...] the formal condition à priori of all phenomena whatsoever’ (Kant 1855: 30). Time is *transcendental* because it is not an empirical given and therefore its concept is “not an empirical conception” (Kant 1855: 28); thus, we have to assume time is a ‘pure intuition’ in every (empirical) experience.

As noted above, time must always be perceived by a subject. But the various points of access to time imply different locations of the subject: The ‘chronicler’ of *chronos* lists events without studying their internal connections to one another (causality, interaction). His or her approach to time consists in allocating a temporal marker to events, and order is achieved by establishing a temporal sequence of facts” (Klauer et al. 2017: 122).

## 2.3 The time of fulfilment – *kairos*

“For Newton and Kant alike time is ‘empty’. Thus, in his *Critique of Pure Reason* Kant speaks of ‘pure intuition’ (1855: 22) which must first be filled with things, events or ‘phenomena’. This conception of time is readily apparent, yet it is also one-sided and abstract. It contains no reference to the subject in his or her actual everyday life or capacity to act. In contrast to this and with specific regard to action, there is an idea of time that is central to the philosophy of antiquity and especially to the New Testament, namely, the ‘right time’ for doing something; it is qualitatively different from other kinds of time. The Greek language calls this kind of time *kairos*, a term we wish to adopt here.

The expression *kairos* serves to emphasize that certain times stand out qualitatively from others. When we look at *kairos*, time is not homogenous as it is when we look at *chronos*, absolute time which always stays the same. It is *kairos* we have in mind when we say, ‘The time to sow is now and not in one- or two-months’ time’. *Kairos* – the right moment– is what is good or ‘useful’ about time, as Aristotle says in his *Nicomachean Ethics* (2014: I, 4; 1096a26 f.). Because the meaning of action always lies in goodness or in striving for goodness, the person acting must heed the goodness of time and always stay alert to the demands of this ‘right moment’ (Aristotle 2014: II, 2; 1104a8 f.)” (Klauer et al. 2017: 122).

### The subjective component of *kairos*

“Thus, unlike the absolute time of *chronos*, *kairos* is always related to action. To this extent, it always has a subjective component. If there is no person acting with certain goals or purposes, there is no *kairos*, no right moment. But *kairos* is not only subjective. When we speak of *kairos*, we are speaking about the fact that when we establish purposes and pursue goals human meaning encounters a world that is itself meaningful and objective. It is for this reason indeed that there is such a thing as the right or wrong time. Either we act at the right moment or it will be too soon or too late; we do something for too short a time, or for the right length of time, or for too long. All these are determinations make no sense in the absolute time of Newtonian physics.

The time we call *kairos*, then, is non-homogenous as it distinguishes between the right and the wrong moment. But it is more than this: Different moments (*kairoi*) themselves differ qualitatively from one another to the extent that different times are the times for different actions. This meaning is captured in the following lines found in the Book of Ecclesiastes (the words of ‘the Philosopher’).

‘To everything there is a season [*chronos*, MF], and a time [*kairos*, MF] to every purpose under the heaven: a time to be born, and a time to die; a time to plant, and a time to pluck up that which is planted; a time to kill, and a time to heal; a time to break down, and a time to build up; a time to weep, and a time to laugh; a time to mourn, and a time to dance; a time to cast away stones, and a time to gather stones together; a time to embrace, and a time to refrain from embracing; [...] a time to keep silence, and a time to speak; a time to love, and a time to hate; a time of war, and a time of peace’ (Bible, Ecclesiastes 3, 1–8).

These times, or *kairoi*, are not comparable with one another, as they are the right times or moments to do different things: The time for gathering stones is not the time to throw them away. What these right times do have, however, is a certain duration; they have their place within *chronos* and to this extent can be compared with one another, namely, in relation to their respective duration and to what occurs earlier and what later. We know that *kairos*

has a particular meaning in the New Testament, referring to the fullness of time brought about by Jesus Christ. The Apostle Paul in particular called upon people to allow their actions to be determined entirely by this *kairos* and to ‘redeem’ the time of *kairos* (*exagorazein*; Ephesians 5, 16)” (Klauer et al. 2017: 122-123).

Before we turn to a third notion of time, the inherent time or dynamics of time, it is useful to introduce an art of finding, the heuristics.

## 2.4 Heuristics and bridging principles

How can we find the right moment? To answer this question, we have to turn to the faculty of Power of Judgement. Regarding power of judgement [POWER OF JUDGEMENT], we noted that judgement cannot be taught, in fact it cannot be deduced, but it seeks and finds. But how do we find? “‘Find’ in Greek is *heuriskein*, and this is where the word heuristic comes from. Heuristics is the art of finding something that cannot simply be concluded or deduced from our knowledge, such as a scientific law, a solution to a problem, or a good decision. A heuristic always contains certain rules or principles – basic statements and rules of thumb – that can guide judgement on its search. Such rules form bridges between our knowledge of the general and the specific. So, we might see these rules as bridging principles. Later on, we shall see that even the concept of stocks [BASICS OF LIFE and Sections 2.6 and 3.4 below] can be conceived of as such a bridging principle. Those who seek knowledge must use their judgement; in doing so, says Kant, they always proceed heuristically, i.e. they apply such principles.

### Universal principle of judgement as a basis for specific heuristics

On this basis, Kant formulated a *universal principle* of judgement. Each specific heuristic derives from this principle and renders it concrete for a particular situation or set of situations. The universal principle of judgement says, to put it simply: When using judgement, people assume – as a cognitive necessity – that the world is structured in a way that is accessible and comprehensible to them. This is the only reason it makes any sense to search for principles, rules or laws. The domain where individual specific cases exist is not total chaos to the faculty of judgement, but has some kind of order.

Tellingly, Kant explicates the role of this universal principle by reference to modern science, thus showing that the acquisition of scientific knowledge also requires judgement or practical knowledge (Kant 2001: 13-15, 67-68, 69-71). Science, which looks for laws in reality, must already possess the conviction and the notion that such laws exist (or may

exist) in the first place. Kant names the domain of individual specific cases ‘nature’, and this is why he says that judgement assumes nature *a priori* to be a well-ordered whole. According to Kant, the universal principle of judgement [POWER OF JUDGEMENT] is expressed in certain ‘rules whose necessity cannot be demonstrated from concepts’ (Kant 2001: 69), namely in rules that cannot be derived from anywhere and that certainly do not reside in the concept of nature itself. Naturally, however, we take these rules as a basis for every act of investigating nature:

- ‘Nature takes the shortest way’ (*lex parsimoniae*);
- ‘it makes no leaps, either in the sequence of its changes or in the juxtaposition of specifically different forms’ (*lex continui in natura*);
- ‘the great multiplicity of its empirical laws is nevertheless unity under a few principles’ (*principia praeter necessitatem non sunt multiplicanda*);
- ‘and so on’ (Kant 2001, cf. 14-15).

It is by all means plausible to interpret these rules as heuristics; ‘unity under a few principles’ is a maxim Newton used to unite the law of falling bodies with Kepler’s laws of planetary motion into a ‘universal law of gravitation’.

#### Discussion of the bridging principles of a heuristic

A number of points are important in relation to the bridging principles of a heuristic. They are not simply assertions about the world but rather guidelines by which judgement proceeds. Thus, they are essentially procedural rules. It is characteristic of the principles and rules that exceptions to the rule are permitted. Whatever is correct in terms of the individual principles also applies to heuristics in general: In some situations, a heuristic can be helpful, in others perhaps not” (Klauer et al. 2017: 107-109).

We wish to examine the characteristics of heuristics in more detail using the concept of homo oeconomicus and the example of an organism.

#### A bridging principle: the homo oeconomicus

“The concept of homo oeconomicus describes human action in terms of maximising one’s own utility under restricted conditions [HOMO OECONOMICUS & HOMO POLITICUS]. Neoclassical economic theory is based on this model and uses it to find ways of explaining economic processes. This has sometimes meant that homo oeconomicus has been seen as an ‘image of the human being per se’, that is, as an ontological principle according to which people really are always utility maximising homines oeconomici. This then formed

the basis for what has been called ‘economic imperialism’ (Radnitzky and Bernholz 1987) which examines all spheres of life on the basis of the *homo oeconomicus* model as well as for the claim that this model alone permits meaningful analyses of human action and behaviour.

This claim has provoked intense debate in economics in which critics of neoclassical standard economics have proven in empirical studies that in many situations people do not behave as *homo oeconomicus*. As a result, the school of business ethics founded by Karl Homann has proposed that *homo oeconomicus* should be understood ‘as a heuristic’ (Suchanek 1993). This is because as a heuristic the *homo oeconomicus* model does not involve making any ontological assertions about the reality of economics and politics but rather serves merely to render visible typical traits and tendencies, to reveal structures and to inspire policy recommendations. ‘The *homo oeconomicus* model serves to render comprehensible the behaviour of people confronted by certain incentives’ (Suchanek 2001: 146). It can be used ‘to solve important problems without necessarily believing that every person is (nothing but) a *homo oeconomicus*’ (147). If we go along with this and regard the assumption of humans as rational maximisers of their own utility, not as an assumed regularity but rather as a heuristic, it is but a short step to add another heuristic to that of *homo oeconomicus* – for example that of *homo politicus*. The heuristic of *homo politicus* is also valuable in spheres that are a special domain of economic political theory, namely bureaucracy and administration (Petersen and Faber 2000) [see also RESPONSIBILITY, *Homo Oeconomicus & Homo Politicus*].

Terms such as *homo oeconomicus* and *homo politicus* have more than just a heuristic function, however. They also play a constitutive role in scientific descriptions and explanations. In other words, they formulate propositional knowledge.

### A second bridging principle: the organism

The way a term functions solely as a heuristic principle – that is, without simultaneously playing a role in scientific explanations – can thus be seen by looking at a term that Kant himself sees as being linked inextricably to judgement, namely that of the organism, or the ‘organized being’ (Kant 2001: 244).

We regard an organism as a purposively organised whole in which the individual parts reciprocally maintain one another as well as the whole itself. Kant therefore calls the organism a ‘natural end’ (Kant 2001: 242). However, precisely because the concept of purpose plays a crucial role here, the concept of the organism cannot be an element of scientific knowledge of nature or of reality. This is because there is no such thing as

‘causality based on purposes’ in scientific explanations of natural phenomena. Thus, no explanation of natural phenomena can make use of the concept of purpose.

For example, the sentence ‘This plant is an organism’ does not reflect scientific insight. At the same time, though, we cannot do without the concept of organism when it is a matter of ‘researching the particular laws of nature’ (Kant 2001: 280) because it is only by looking at natural beings as organisms that we are led during our research of them to the correct questions. The concept of purpose states the ‘principle of unity under which causal processes have ordered themselves to become a natural purpose. It is only thus that we become aware of phenomena of the organic as particular ones’ [Spaemann and Löw 1985: 136; see also BASICS OF LIFE]. We can grasp ‘organic beings’ ‘given the constitution of the human understanding’ only as purposively organised (Kant 2001: 282), and it is only this concept of a ‘natural purpose’ that enables a science to formulate fruitful questions about living things, in whose explanations the concept of purpose no longer appears and indeed must not appear. Purposes exist only in Aristotle’s physics, which is no longer a science of nature in the contemporary, modern sense.

The concept of organism or ‘the principle of ends in the products of nature’ is therefore not a descriptive concept but rather a ‘heuristic principle’ (ibid.). Thus, to say, ‘This plant is an organism’ simply means, when understood correctly, ‘I only regard it or judge it as such an organism, that is, *as if* it were organised according to purposes’. When conducting research on this plant, I allow myself to be guided by this way of viewing” (Klauer et al. 2017: 108-111).

## 2.5 The time of Aristotle’s physics as a bridging principle – inherent time and inherent dynamics

We remember from Section 2.4 that “*kairos* is the right time, the ‘right moment’, for doing something specific. It is this that distinguishes it in qualitative terms from every other time and every other moment. But how can we recognise the right moment or know what is to be done at a certain time? This question poses a problem for the faculty of judgement, as it too is a matter of subsumption: *Kairos* must be subsumed beneath a certain activity. As ‘the Philosopher’ (Bible, Ecclesiastes 1-8) says, there is ‘a time to heal’ and ‘a time to kill’. Equally, *kairos* must be located within the all-encompassing universal time of *chronos*: The ‘time to heal’ is today, or tomorrow, or in a month, etc. That means we have to be able to date *kairos*.

There is no general way of saying exactly how this subsumption can be achieved. All we can do is look once again for bridging principles (cf. Section 2.4 above) that make it possible or easier to achieve such a subsumption and reach a correct judgement.

In the following we seek to provide a sound rationale for two hypotheses:

The Aristotelian conception of time can be understood as such a bridging principle. We refer to this using the terms *inherent time* and *inherent dynamic*, to which we turn below.

The stocks framework can be regarded as one aspect of this Aristotelian conception of time, which is related to action in a specific way. It is on the basis of this conception of time that we seek to elaborate the practical significance of the stocks framework, to which we turn in the next section, Section 2.6.

To 1., the Aristotelian conception of time as a bridging principle

Unlike Newton or Kant, Aristotle has no concept of an absolute time that is empty and has to be filled from the outside, as it were. His understanding of time assumes that we only become aware of time when we observe something moving or changing. Thus, time for Aristotle is essentially related to motion. In his *Physics*, he describes time as something that belongs to motion, as the (measured) number of the motion according to an earlier and a later time (Aristotle 1993: IV, 11; 219b2 ff.). Time relates relatively to motion because time is ‘not apart from alteration’ without motion and cannot exist without motion (ibid. 218b21). This is why time and motion are mutually related to one another – or to use Aristotle’s words: ‘Not only do we measure change by time, but time by change also, because they are defined by one another. The time defines the change, being its number, and the change the time’ (Aristoteles 1993: IV, 12; 220b15-18).

Aristotle’s *concept of motion* is rather unique, however. In comparison with today’s commonplace understanding it displays two peculiarities.

The first peculiarity is a terminological one. Motion for Aristotle refers not only to a localised movement but to any externally perceptible process of change, such as growth or decline, arising and passing – in other words, any change at all (cf. Spaemann and Löw 1985: 58 f.). In the debate about time, Aristotle makes no distinction between motion and change (see e.g. ibid.: 111). According to him, then, any dynamic of change is to be regarded as motion.

Unlike modern physics, Aristotle understands motion in consistently teleological terms [see for a detailed explanation of teleology TELEOLOGICAL CONCEPT OF NATURE; see also BASICS OF LIFE], that is, in terms of a goal that is either immanent to motion or is posited for it from the outside. Every motion conveyed to a body from the outside has its goal in a state of rest. Arising and passing away likewise have a goal, as do growth and decline and any

change in which something becomes something else and, in doing so, completes or perfects this change. Motions and changes are never endless. (According to Aristotle, one exception to this is the circular motion of stars and planets; see Spaemann and Löw 1985: 59). At the same time, their end is not random – or rather, it is random only when the motions are ended by some outside influence. This means that all motions have a time that is *inherent* to them. They have a certain duration whose length can fluctuate more or less and which at times occupies a quite specific place within *chronos*, as when plants blossom, or fruits ripen only at certain times of the year. We refer to this as the *inherent time* or the *inherent dynamic* of motions. A seed, for example, requires a specific amount of time to become a fully developed plant; grape juice always needs the same amount of time to become wine – and so on. To put it another way, in Aristotle's view all motions have their own temporal order; an inherent time which in turn has its place within *chronos*. Any action needs to be guided by this order because this inherent time determines the right time to act. This is why there is also a specific relationship between this inherent time of motions and the time of action related to the right moment, *kairos*.

#### The interaction between the natural and the social world

Both the natural world and the social world are, for Aristotle, a world of motions which mutually influence one another. These motions, as we have said, are conceptualised in teleological terms, that is, in terms of their end point. They are all determined by the act of striving towards a goal, and they can be facilitated, impeded or even blocked by other motions. For Aristotle neither the social world nor the non-human world is a set of interrelationships that is strictly determined. This is why they display not only regularity but also contingency; everything can be other than it is. Moreover, this is why this world is accessible to action with its goals and purposes – action can change things within it.

Among the motions mentioned by Aristotle is human action, driven by human striving for a good or for goodness per se. Human action can become incorporated into the motions of natural things or social relations in such a way that it relates meaningfully to the motions of things in nature and society. Or else it can fail whenever the good that is being sought or the way of striving for the good is not in accordance with these motions. It is not possible to sail directly against the wind, but it is possible to make use of an unfavourable wind direction by sailing diagonally to it ('tacking' in sailing terms).

As soon as the inherent dynamic or inherent time of motions comes into play, there is a right moment, a *kairos*. Fruits must be harvested when they are ripe, not before and not after they have become rotten. In contrast to this, there is generally no such *kairos* in completely uniform motions.

*Kairos* – the right time for the right action – thus depends on the inherent time of things or on the specific inherent dynamics by which they change; it also depends on the order in which these inherent times and dynamics are related to one another (on this point, cf. Klauer et al. 2017: Section 11.2.2). What needs to be borne in mind here is that action itself possesses inherent time. Statements such as ‘there is a time for everything [every action]’ and ‘there is a time for all things’ express this notion of order” (Klauer et al. 2017: 123-125).

## 2.6 The stocks framework as a heuristic / bridging principle

We now apply the Aristotelian concept of inherent time and inherent dynamics to two examples by using the stocks framework. Since the three temporary concepts developed up to now (chronos, kairos as well as inherent time and inherent dynamics) are not familiar to all of our readers, we have summarised them in a box below.

We mentioned at the beginning of the last Section 2.5 that we want to find a rationale for two hypotheses. Having dealt with the first one in the previous Section, that the Aristotelian concept of time, the inherent time, can be understood as a bridging principle, we now turn to the second hypothesis, namely that the stocks framework [BASICS OF LIFE] can be considered as one aspect of this Aristotelian conception of time. Temporal changes in stocks are an apt means to characterise the extent to which political action is possible. Hence, a stocks framework is a suitable basis for political action.

### Introducing the stocks framework

The concept of the stocks framework has not yet been explicitly introduced. However, the foundation of it was already developed in the concept BASICS OF LIFE – STOCKS, STORES & FUNDS. The interested reader will find a detailed and encompassing presentation of the stocks framework in Part II of the book by Klauer et al. (2017: 31-136). Stocks, be they natural, artificial, material or immaterial, allow objects to be represented in terms of their temporality, changeability and inertia. An analysis of the German water legislation from the 1960s to the 1980s illustrates how the stocks framework can be applied [ENVIRONMENTAL POLITICS].

We will show that stocks can “function as a heuristic that policy makers can use to structure the temporal issues they find in the actual, real-life environment with which they are dealing” (Klauer et al. 2018: 119). We will illustrate the stocks framework with two examples in Sections 3.1 and 3.2 below.

### The right time to act

The stocks framework will turn out to be crucial to determining when “is the right time and what time is appropriate for this or that. If we are to be assisted in our decision making, we need more than just a general principle, we need a specific heuristic. We will now show that the stocks framework provides just such a heuristic.

Let us return to the general principle ‘to everything there is a time’ (see Sections 3.4 and 3.5 above). We can understand this in two ways, depending on whether we are focusing on *kairos* or on the inherent dynamic of things. On the one hand it means that things have their own very specific point in time, their *kairos* – sowing has to be done in the springtime, harvesting in the autumn – and on the other hand they have their (own inherent) *span* of time, as when the Riesling grape requires a hundred days from flowering to ripening in order to develop its full aroma. In this case we say that the development of the Riesling has a particular inherent dynamic or inherent time. As we have already noted, *kairos* and inherent dynamic do not exist independently of one another (see Section 2.5 above). Rather the right moment, *kairos*, always depends upon a web of relations among things and their own inherent times and dynamics. This insight emerged from Aristotle’s discussion of time and it is why, in order to hit upon the right moment in time, these inherent times need to be estimated correctly. This is precisely what the stocks framework does, it focuses on these inherent times and on the inherent dynamic of things.

### Applying the stocks framework

The stocks framework was initially introduced as a theoretical concept (Faber et al. 2005 a; 2005b). This concept can be used to study and describe all objects, material or immaterial, in terms of their quantitative and qualitative dynamics over time. We shall now focus on this general perspective that we adopt when working with this framework. This perspective is directed at stocks and persistence, that is, towards the temporal dynamic of things. All stocks have their own inherent dynamic, namely, their own time which is beyond our capacity to control or manipulate, e.g. the orbital period of the moon. Perhaps we can influence the intractability of inherent time, but we cannot ignore it, let alone overcome it or eliminate it.

Conversely, the inherent time of stocks is of crucial significance in relation to our actions: Not only does it determine what the right action is at the right time, it can also help or hinder that action and the process of achieving its purposes. In other words, the inherent times or dynamics of various things – be they material stocks of natural resources or pollutants, be they institutions or capital stocks – determine *kairos* by virtue of the web of relationships in which they exist. They determine when we need to do what in order to achieve a certain goal. The stocks perspective provides a kind of grid of coordinates in which such temporal

structures become clear. For this reason, it is especially well-suited to ascertain the conditions and the options for our action in temporal terms. It can thus be understood as a heuristic with a practical element. This is the essence of what we referred to above as the *practical dimension of the stocks framework*.

The proposition ‘to everything there is a time’ expresses a perspective on the world which we might think of as being a *sense of time*. This sense of time or, as we might also say, this feeling is the prerequisite for being able to adopt the stocks perspective. Conversely, testing this perspective is one way to school and develop this sense of time. A sense of time is of fundamental importance to decision making in all kinds of areas. In the following Chapter 3 *Practice*, we present two examples that illustrate this sense of time (as along with an implicit stocks perspective)” (Klauer et al. 2017: 125-127).

To summarise our main three concepts of time, we identify them and show how they are related to the practical dimension of the stock framework:

“*Chronos* is a conception of time that guides us in our everyday lives and is the foundation of modern science. Time here is a homogenous continuum: It contains uniform moments and spans periods – in other words, an hour today is just as long as an hour at any other time. This continuous, homogenous time can be represented on a timeline with events assigned to a date.

*Kairos* refers to the time for action and means the ‘right moment’, the ‘right time’ to act. *Kairos* differs fundamentally from *chronos* in that it is non-homogenous and discontinuous: Times and moments in time differ qualitatively from one another. The right time (or temporal structure) to act is distinct from all other times. Different *kairoi* for different actions are all unique. Each *kairos* can be dated on the timescale of *chronos*.

*Inherent time and inherent dynamic* refer to typical spans of time or temporal structures of processes of change relating to objects. This concept of time goes back to Aristotle who links time inextricably with motion. It includes every form of change, e.g. the growth of a plant. In the Aristotelian view, change is always also teleological, i.e. it is directed towards a goal. All ‘motions’ – processes of change – have their own times, natural sequences and spans of time. These are referred to as ‘inherent time’ and ‘inherent dynamic’.

The stocks framework has a *practical dimension* which is related to the temporality of action. The important point when engaging in action is to find the *kairos*. To the extent that *kairos* always refers to the particular and *chronos* to the general aspect of time (all moments in time and spans of time are qualitatively the same), we are faced here with a problem of subsumption in relation to the faculty of judgement. In order to solve the problem, a *sense of time* which allows the person concerned to recognise the *kairos* is

helpful. In other words, a sense of time is helpful for recognising when, how and within what time limits a set of actions needs to be planned.

A sense of time is developed by contemplating stocks. Stocks act as a heuristic and are a bridging principle for purposes of judgement in relation to time. Why is this so? *Kairos*, the right time to act, depends on the inherent times of the circumstances affecting an action, on the inherent dynamics according to which these circumstances change, and on the order in which inherent times and dynamics are related to one another. If we look at the circumstances of an action or set of actions within the stocks perspective, then these inherent times and dynamics become visible in terms of their relationship to a possible *kairos*. This is the practical dimension of the stocks framework” (Klauer et al. 2017: 128).

### 3. Practice

We have selected two examples that lend themselves particularly well to examining the notion of a sense of time. One of them is taken from the world of literature, namely, the example of Marshall Kutusov from Leo Tolstoy’s *War and Peace*. (Section 3.1). The second example comes from more recent German environmental politics (Section 3.2). Conclusions from these two illustrations are drawn in Section 3.3.

#### 3.1 Field Marshal Kutusov in Tolstoy’s *War and Peace*

“Leo Tolstoy’s (1828-1910) novel *War and Peace* (1952) describes the life of a number of Russian noblemen and women in the years between 1805 and 1813 when, apart from some short breaks in hostilities, Russia was at war with Napoleon Bonaparte’s France. This description of individuals’ destinies is intertwined in the novel with descriptions of the war itself, which forms not only a backdrop but is an object in itself to which Tolstoy devotes no less attention. The Russian campaign conducted by the French army in 1812 takes up the largest part of the story in this description. The novel portrays this campaign as a dispute between two men. On the one side we have the French Emperor Napoleon Bonaparte – a man for whom Tolstoy feels neither sympathy nor respect – hurriedly surging forwards; and on the other side we have the elderly Russian Field Marshal Mikhail Illarionovich Golenishchev Kutusov (1745-1813), Supreme Commander of the Russian Army, who is despised by Napoleon and is subject to derision even in his own circles.

##### Kutusov’ strange passivity

In Tolstoy's story, neither Napoleon nor Kutusov himself are heroes in the conventional sense – that is, as individuals engaged in *action*. While Napoleon always seems to have the upper hand, in reality he is merely a man driven by events and is – unlike Kutusov – blind to the real situation. Meanwhile Kutusov who, unlike Napoleon, sees what is really going on, does not act at all: He neglects to do things that the situation seems to demand. And whenever he actually does do something, his intention is to make others *not* do these apparently obvious things rather than to actively do something. Kutusov's main preoccupation lies in keeping his generals from engaging in battle as far as he is able to. He 'employed his whole strength to restrain the Russian Army from useless engagements' and 'to restrain his troops from attacking' (Tolstoy 1952: 565).

We are no historians and cannot really assess Tolstoy's descriptions and judgements about the warring parties. Nor is this important for our purposes here. Tolstoy's portrayal is, of course, stylised. And it is precisely in this stylisation that the things we are especially interested in with regard to Kutusov's behaviour come to the fore.

Kutusov constantly causes others to be disgruntled with him. And this disgruntlement appears well-founded because his strange passivity seems not at all to suit a field marshal. When Napoleon marches with his troops on Moscow, the Russian Army under Kutusov's command repeatedly withdraws, leaving Moscow at the mercy of the French. Unlike his generals, Kutusov does not want to do battle with Napoleon. The Battle of Borodino on August 26, 1812 just a few miles outside Moscow comes about against Kutusov's will: He stands and faces the enemy here – according to Tolstoy's portrayal – only because the Czar and the generals urge him to do so. After the battle, in which the Russian Army at least manages to avoid defeat, he withdraws further and ultimately cedes Moscow to the enemy without a fight. When the French Army eventually leaves Moscow, Kutusov limits himself to pursuing it with his own army, but so sluggishly that one could hardly call it a hot pursuit: 'When they reported to him that Murat's troops were in retreat, he ordered an advance, though at every hundred paces he halted for three quarters of an hour' (Tolstoy 1952: 570).

#### Kutusov's strategy: an application of the stocks framework

Kutusov's passivity meets with Tolstoy's unequivocal approval. Why? Kutusov sees something which eludes most of the officers around him and even the Czar himself. What he sees are temporal dynamics, their inertia and their resistance to influence. There is no way Kutusov can put up an army as strong as the French Army which, according to Tolstoy, is 800,000 men strong at the start. The Russian Army is far inferior to the French one in

terms of numbers, discipline and experience. And Kutusov knows that nothing of this will change up to the end of the entire campaign – recruiting, arming and training so many men takes time. This inertia and slowness of processes which impedes action is up against unpredictable dynamics that are barely capable of being influenced. The huge French Army can do nothing other than march on Moscow and eventually take it – not even a battle will prevent it from doing so.

‘And meanwhile, the very next morning after the battle, the French Army advanced of itself upon the Russians, carried forward by the force of its own momentum now seemingly increased in inverse proportion to the square of the distance from its aim.’ (Tolstoy 1952: 471)

At the same time, Kutusov knows that the *Grande Armée* will be decimated by the difficulties of the march – disease, hunger and cold – and that it will lose far more soldiers that way than through any battles:

‘Why fight, why block the road, losing our own men and inhumanly slaughtering unfortunate wretches? What is the use of that when a third of their army has melted away on the road from Moscow to Vyázma without any battle?’ (Ibid Tolstoy 1952: 587)

And he knows that time is against Napoleon and in his own favour. An attacker needs success in a relatively short period of time – either capitulation or at least an offer of peace from the enemy. Since neither is forthcoming Napoleon is not able to reap any benefits from taking Moscow. Ultimately, he has to withdraw, leaving Russia defeated, even though he has not lost a single battle.

### Time as the defeater of Napoleon

What ultimately defeated Field Marshal Napoleon was not the Russian Army nor Kutusov but time. And it is Kutusov, ‘whose motto was “Patience and Time”’ (Tolstoy 1952: 620), who recognises this and is therefore victorious in the end. Kutusov displays that sense of time about which we spoke above. It is this sense which distinguishes Kutusov from his generals (at least, if we are to believe Tolstoy’s narrative).

‘They must understand that we can only lose by taking the offensive. Patience and time are my warriors, my champions,” thought Kutuzov. He knew that an apple should not be plucked while it is green. It will fall of itself when ripe ...’ (Tolstoy 1952: 584).

### Two aspects of the description of Kutusov in *War and Peace*

There are two aspects of the description of Kutusov in *War and Peace* that we would like to highlight:

The generals differ from Kutusov not in the fact that they judge the inherent dynamic of things any differently from him. They do not expect Napoleon to need longer to reach Moscow or to be able to hold the city for longer. It is not that Kutusov judges the temporal dynamic of the campaign correctly and the generals wrongly; in fact, they fail to judge it at all – they do not even consider these kinds of things. They have no ‘sense of time’, or else they make no use of it if they do. They think in terms of troop strength, equipment and weaponry. For them, victory and defeat depend on battles won or lost, on discontinuous moments, and not on the duration of time. They are not sensitive to time *as time*. But Kutusov is.

It is possible to judge temporal dynamics rightly or wrongly. We can either make a correct judgement or be mistaken. But to be able to judge at all as Kutusov judges, one needs a sense of time. This sense – unlike a judgement made about temporal dynamics themselves – cannot be either true or false: Either one has this sense of time or one does not (Wieland 2001: 122).

A sense of time comprises an aspect of the faculty of judgement as feeling [POWER OF JUDGEMENT]. It is that part of the faculty of judgement that is pre-conceptual or non-conceptual and which therefore cannot be communicated directly. For this reason, Kutusov cannot make himself properly understood to those around him. He does not tell them what he sees and knows. ‘He could not tell them [his officers] what we say now’ (ibid.: 587). Why not? And why do we ‘say it today’? Kutusov could not assume that his officers would understand the notion that temporal dynamics are the decisive factor in a war against a far mightier enemy. And he was not able to prove that this is so. Yet we are able to say this today because history in the sense of real and contingent events has shown (according to Tolstoy’s portrayal) that Kutusov was right. When it comes to issues that involve judgement, we are reliant on examples from which we can learn. Such examples are often the key to awakening our understanding of temporal dynamics” (Klauer et al. 2017: 128-130).

### 3.2 German policy on water pollution control in the 1970s

“We now turn from a work of 19<sup>th</sup> century literature to real-life environmental politics of the 1970s. During the 1970s, strenuous efforts were undertaken in the western industrialised countries to make marked improvements to the condition of soil, air and water – with

varying results. The endeavours made in the US and in West Germany regarding water pollution control are particularly instructive in relation to our concerns here (for the following discussion, cf. Brown and Johnson 1984; Faber, Niemes and Stephan 1983).

#### Water legislation in the U.S.A.

Environmental policy in the US had particularly ambitious goals. In 1972, the Clean Water Act came into force, its aim being to ensure that surface waters should be largely free of pollutants within a very short period. The regulations contained in the law, however, proved to be impracticable. Two things led to a failure to implement the law. One was resistance to the ambitious regulations put up by powerful interest groups. This resistance might have been overcome had it not been for the other factor, namely, that the necessary water pollution control technologies – a prerequisite for the law to be effective – were not available. The law was revised for the first time in 1977. This revision was so far-reaching that it effectively constituted a withdrawal of the original law: The original legal requirements were now so diluted they were barely recognisable.

#### Water legislation in the Federal Republic of Germany

German environmental policy was somewhat more cautious in its approach. In 1976 the *Wasserhaushaltsgesetz* (Federal Water Act) was revised, in the course of which the *Abwasserabgabegesetz* (Waste Water Charges Act) was adopted which stipulated that pollutants emitted into bodies of water would be subject to a financial charge. This charge was to be levied for the first time in 1981, however, after a period of five years. Furthermore, the level of the charge was quite reasonable to begin with; it was gradually to increase, starting at 12 German Marks per unit of pollution in 1981 and reaching 70 German Marks in 1997.

The Waste Water Charges Act of 1976 prompted critique from many environmental economists who demanded that the charges should be set on the basis of the polluter-pays principle: Those who emit pollutants should have to pay the actual environmental costs involved. The Act fell far short of this standard, however. One reason for this was that the pollutant charge did not follow the cost-covering principle because the external effects of pollutant emissions on the environment were not included when calculating the level of the charge. Another was that this charge itself was initially not even levied to its full extent; and, finally, investments in purification plants could be set off against the charges owed. From an environmental economics point of view, then, the waste water charge was inefficient as the polluter was not given sufficient incentives to reduce harmful emissions.

### Appraisal of German water legislation

Environmental economists' widespread critique of the West German government's tentative and half-hearted water pollution control policy might make the government seem something of an 'environmental Kutusov', failing to take a decisive stand against water polluters and instead pulling back in the face of their lobby's onslaught. Yet the introduction of the waste water charge was by no means ineffective; in fact, it led to a marked reduction in water pollution – even prior to the charge being levied. The 5-year grace period proved to be beneficial: Local authorities and industry undertook great efforts and invested considerable sums of money in constructing purification plants so that they would have to pay as little charges as possible from 1981 onwards. Between 1975 and 1979 for example, Baden-Württemberg's industry reduced its emissions by 40% (Faber et al. 1989: 56). The comparatively long grace period and the initially moderate level of the charge also helped in overcoming resistance to the law and fostering acceptance for a new economic instrument of environmental politics.

Taking a less favourable perspective, one could describe the water pollution control policy of the 1970s as a compromise among different interests that was achieved at the expense of the environment. And this is indeed what happened. However, it would almost certainly not have been possible to introduce a cost-effective charge straight away. As it was, water pollution control policy was a compromise that achieved a great deal in the long term and averted the failure that befell the ambitious US Clean Water Act.

### Why was the German water policy successful?

Thus, German environmental policy was successful at this point and was obviously the right one. Why is this so? This is not immediately apparent from the perspective of neoclassical environmental economics. Yet by applying the stocks framework, it is possible to show why this policy was able to achieve its goals. The charge was designed as an economic instrument to create an incentive to reduce harmful emissions, yet it took effect even before it was introduced. The emitters built a *stock* of purification plants which allowed them to considerably reduce the amount of pollution emitted. This in turn fostered acceptance of the charge. The policy can be further interpreted as reflecting the policy makers' realisation that, in creating a charge for pollution emissions, they were effectively creating a new institution which first had to prove its worth. It takes time for institutions to be fully accepted and thereby able to guide people's actions and behaviours as a matter of habit. From this point of view, it was a clever move not to levy the charge in full at first and keep resistance to a minimum.

### The importance of patience and time in German water pollution control policy

Patience and time, Kutusov's two 'brothers-in-arms', also seem to have been the two main champions of German water pollution control policy. How so? We hesitate to put the relative success of German policy down to German politicians and environmental officials being cleverer than their US colleagues— this would surely be impolite and is hardly a workable research hypothesis. Nonetheless, we can mention a few factors which proved favourable in terms of a *sense of time*. First, German administration officials across the board possess considerable quality and expertise; this is essentially due to institutional circumstances and itself constitutes a kind of stock. In addition, though, another institutional stock can be seen as having contributed to this success: German politics is characterised by a high degree of interpenetration between different levels of decision making [Petersen and Faber 2000; see POWER OF JUDGEMENT and RESPONSIBILITY]. This means that whenever policies are formulated, the process includes representatives of all the relevant interests involved, both public and private, in some manner. This leads to two outcomes:

- The ministerial administration, which occupies a central position in the structures of political/policy coordination (*Politikverflechtung*), has access to all the relevant information.
- When policy is formulated (a task largely accomplished by the ministerial administration), the potential objections of other stakeholders are anticipated and taken into account. This results in preliminary policy documents which are generally capable of commanding a consensus; this in turn makes resistance to them as low as possible while at the same time ensuring that the capacity for consensus is stretched to its limits.

The complex structures of political/policy coordination in Germany obviously favour policy making that proceeds patiently and hesitantly, rather like Kutusov the 'falterer'. Equally, these structures of policy coordination encourage politicians to wait for the right moment to undertake certain initiatives. Viewed from a less favourable standpoint, however, they can also be held responsible for a certain ponderousness and a relatively static mode of politics" (Klauer et al. 2017: 130-133).

We like to note that the last conclusion emphasizes that, in retrospect, the 'right moment' may be either not only too late, it may also be too early. Thus, the argument runs in both directions.

### 3.3 What can we learn from these two examples?

### General observations

“The two examples just discussed outline a mode of action which is guided above all by circumstances and persistent factors relating to time. When a situation demanding action is affected by such circumstances and resistance, the response is one guided by the virtue of patience. Patience does not simply mean putting things off or hesitating [POWER OF JUDGEMENT]. A patient individual is prepared to act, but he or she will wait for the right moment to do so, for the *kairos*. Recognising this moment demands attentiveness especially towards those things which the stocks perspective [BASICS OF LIFE] brings to the fore. When this perspective is adopted, questions such as the following suggest themselves in relation to the situation at hand: Where is there persistence or stability that is durable enough to constitute a decisive factor within the time span of one’s own actions? What kind of time spans, what kind of duration should we reckon with for certain processes and changes? Can we influence this duration in any way? Or do we need to go along with these processes and the pace at which they occur and merely try to adapt to them?

### The stocks perspective employed as a heuristic principle

Of course, we are not claiming that Tolstoy’s Kutusov or the officials responsible for German environmental policy were explicitly adopting the stocks perspective. But we can say that, through their actions, they provided answers to questions that would also have been suggested by a stocks perspective. At any rate it ought to have become clear that, within the practical dimension of the concept of stocks, the stocks perspective is not a scientific model; rather, it is a kind of prior principle which guides both action as well as scholarly research, much as Kant (2001: 280) speaks of a ‘heuristic principle’. It is a principle pertaining to judgement and would, in the terms of Karl Popper’s *Logic of Scientific Discovery* (2005), be considered a part of epistemic psychology.

### Employing the stocks perspective for environmental politics

The concept of stock, the stocks perspective and the stocks framework thus play a dual role in sustainability policy [SUSTAINABILITY & JUSTICE; ENVIRONMENTAL POLITICS], namely, as a kind of instrument and as an internal principle, a *bridging principle* for purposes of judgement (Section 5.4) in relation to time.

- In its theoretical dimension the stocks framework is an instrument of judgement. In this regard judgement considers which aspects of a given situation are the ones to which the concept of stock can be applied. These might be pollutants, resources, goods or possibly institutions and patterns of behaviour. Equally, judgement must

determine which of these aspects – as-stocks are relevant to the actions required to achieve a given purpose – are conducive (or not conducive) to this purpose. The theoretical – one might say scientific – stocks framework is then applied to these stocks. Judgement draws on scientific analyses of stocks in order to determine the temporal dynamics involved as precisely as possible and then to make the right decisions. Judgement itself does not play a part in these analyses, however.

- The situation is different with regard to the practical dimension of the stocks framework. Here, as we have seen, the stocks framework explicates the sense of time. Using this sense, we can select an appropriate temporal span within which we can relate our own goals of action to objective temporal processes and developments in a meaningful way. For example, the temporal span of German water pollution control policy with regard to establishing the waste water charge was based not on years but on decades; it was this that enabled the policy to be successful. By contrast, the US environmental policy that produced the 1972 Clean Water Act and was based on much shorter timescales encountered severe setbacks (Brown and Johnson 1984).

#### The stocks perspective as an education in a sense of time

Thus, the stocks perspective is capable of developing and schooling a sense of time. In doing so it clearly leads to better decision making” (Klauer et al. 2017: 133-134).

### 3.4 Stocks: an education in the art of long-term thinking

As the American psychologist Kurt Lewin (1890-1947) maintained, “[t]here is nothing more practical than a good theory.” This is the reason that many of our considerations about time have been theoretical: They are a guide to practical action. We shall illustrate this claim by using our analysis of time in the example of sustainability [SUSTAINABILITY & JUSTICE]. The latter concept is the main issue of environmental policy [ENVIRONMENTAL POLITICS].

#### Begin with things as they are

“The idea of sustainability ultimately calls for action in society, politics and academia. Sustainability demands that we take precautionary action to ensure the well-being of future generations, that we dismantle existing conditions of injustice between the rich and the

poor and that we treat the natural environment with care. These demands are extremely demanding both ethically and intellectually:

- From an ethical perspective, each person, society as a whole and above all those who represent certain groups of people conditions. This means striving to live life [HOMO OECONOMICUS & HOMO POLITICUS; INDIVIDUAL, COMMUNITY & ENTIRETY; BASICS OF LIFE] in such a way that it does not endanger the natural environment upon which human survival, or indeed nature as a whole, depends. When doing so, each person needs to ask themselves whether what they are doing right now is beneficial in the long term as well. In other words, they need to put all the things they do in their everyday lives to this test. In doing so they will probably discover that many of their actions – if not most of them – do not do justice to the demands of sustainability. Unlike ordinary citizens, politicians have an additional responsibility for collective action [RESPONSIBILITY].
- Intellectually speaking, sustainability demands that we are aware at all times of what is beneficial and how it can be achieved. Furthermore, any decisions that are made need to prove their worth over very long periods of time.

Demands of this kind can easily tip over into a feeling of being overwhelmed which, rather than stimulating action, threatens to stifle it. It is not uncommon for them to be clothed in quasi-religious rhetoric accompanied by an appeal to the authority of science. This is often followed by a demand for immediate change – a fundamental, rapid transformation of our modes of production and consumption and of our way of life – because it is only this, so it is said, that can avert the disastrous and irreversible [IRREVERSIBILITY] consequences of climate change (to name an especially pressing sustainability problem). What we identify in such utterances is an over-exaggerated trust in academia, i.e. a lack of appreciation for its limitations, as well as an inflated estimation of the potential of our actions. On this basis, all attempts to solve serious problems of sustainability are doomed to failure from the start. The reality is too far removed from the ideal of a ‘sustainable world’ to be able bridge the gap within a short space of time.

The stocks framework developed in the course of this concept is intended to provide a realistic, accessible way of approaching sustainability problems. It does not think in terms of goals that ought to be achieved straight away. From the stocks perspective, sustainable action starts out not from a position of *what ought to be* – i.e. from an initially unachievable ideal – but from what a position of *what is*. It is from here that it strives to achieve what is possible and within reach [POWER OF JUDGEMENT].

Of course, even this kind of sustainability goal is guided by an ideal, which is why the countless academic and non-academic articles that seek to unpack that normative ideal of

sustainability and identify its constituent parts are necessary and valuable. Nevertheless, our own focus is not on ideas about what should or could be but rather on things as they are. This involves first honouring the present and the past as the initial conditions for action before looking at the future and what we want to achieve. The stocks framework illustrates clearly that although we may be able to achieve little in the short term, in the long term we can achieve a great deal. In this way it prevents us from lurching between overinflated optimism and doleful resignation.

### A focus on 'time'

The stocks framework starts from the current state of things in two respects: First, it aims at making existing knowledge – including imprecise, uncertain or subjective knowledge – as fully available as possible so that it can be used by those called upon to act. Second, reality is looked at in such a way that genuine options for action remain in focus. In this way, reality comes to be perceived as changing and changeable over the course of time [THERMODYNAMICS]. This approach complements those sustainability strategies which study issues of justice, in particular, because it stresses the aspects of time and the long term which, although they are essential to achieving sustainability, are at the same time especially hard to handle.

One essential feature of the stocks framework is that three different meanings of time are used that, at first glance, may appear to have little in common with one another but which, when placed in relation to one another, open up new perspectives. When we look at stocks in nature and society, we need to understand time in the way we usually do: as an objective entity measurable in terms of seconds, years or centuries. We have named this conception of time *chronos*. We assume that this conception of time is relevant when it comes to durable structures – *stocks* – and their dynamics.

Within the stocks framework, though, the 'way things are' appears at once as a limit to action as well as a space in which options for action exist. Therefore, in addition to the measurable time of *chronos* we also consider time in the sense of the 'right moment' or the right temporal structure for action – that is, as 'time to do...' something or as 'time for...' this or that action. The right time to act – which we call *kairos* – needs to be perceived by those called upon to act, and the opportunity to do so has to be grasped by someone who recognises it. Unlike *chronos*, this kind of time is not value-neutral, homogenous or quantitative in nature but rather qualitative: The right moment is, as it were, the window of opportunity which opens up at certain prominent points during the course of ordinary clock time – for those who look and are able to see it. This understanding of time is subjective because *kairos* depends on the purposes pursued by the person concerned.

We come to recognise *kairos* by looking at the third form of time, namely, the *inherent time* and *inherent dynamics* of stocks. By this we mean the typical dynamics and processes by which material and immaterial things around us develop and which therefore exert a powerful influence on our options for action. By setting our knowledge regarding the natural course of things alongside our awareness of the inertia of structures, we are able to spot the early signs of an upcoming window of opportunity, provided we have a little good fortune and a practised eye [POWER OF JUDGEMENT].

The stocks framework is a good way of creating an overview of diffuse situations so that the dimension of time can be viewed systematically. The aim is not so much to create new knowledge as to gain better access to existing knowledge and to make use of it. Working with the stocks framework may therefore often involve going back to existing, generally available sources of information whose knowledge is then integrated into an overall picture. Statistics and, above all, time periods are important sources of this kind. They provide information about material stocks and their trends over time. In many cases it is also possible to derive information from them about immaterial stocks such as patterns of behaviour and preferences. Other important sources of information are the study of history – not only political history but above all economic, social, legal and environmental history [HISTORY OF THOUGHT]. The history of institutions in particular offers important insights into both the inertia and the transformation of the broader setting in which action is taken. The stocks framework makes it possible to draw on so-called soft forms of knowledge – practical knowledge, experiences and intuition.

#### Judgement and developing a 'sense of what is essential'

The possibilities for sustainable action in the face of the fundamental incompleteness of knowledge and human inadequacies are referred to in the context of our stocks framework in terms of the faculty of *judgement*. Judgement is the human ability to place specific situations and general principles, rules or features in relation to one another [POWER OF JUDGEMENT]. It is needed to bridge the gap between the fundamental ethical requirements of sustainability and specific conditions for action. It is also needed to apply general knowledge to concrete states of affairs and situations. Judgement comprises the ability to define problems appropriately, to distinguish what is important from what is unimportant and what is conducive from what is misleading, and to integrate diverse elements into an overall picture. On top of this, one of the tasks of judgement is to perceive where there is a lack of knowledge and to deal with it in an appropriate way. It becomes apparent at this point that ignorance [IGNORANCE], or lack of knowledge, not only indicates the limited nature of our knowledge but also facilitates a certain open-endedness to our actions.

The role of the stocks framework is to provide guidelines for our faculty of judgement in respect to sustainability [SUSTAINABILITY & JUSTICE]. We have developed it into a guide for action – a heuristic – which is intended to help decision makers to grasp sustainability problems in terms of their temporal dimension. The heuristic is intended to provide a degree of guidance to them on the complex terrain of sustainability policy and to find paths leading towards successful policies.

### The art of long-term thinking

Given that the purpose of the stocks framework is to provide guidance for sustainable action, obviously it does not constitute a separate academic theory of nature and society aimed at illuminating any regularities or causalities in relation to sustainability. While the stocks framework regularly draws on the findings from such theories and feeds them into the overall picture of a given situation and its dynamics, it is not designed to contribute new insights to expert debates in these fields.

Even if the stocks framework is to be used as a heuristic, this does not mean that it can serve as a kind of recipe to be followed without critical thought yet expected to lead to reliable practical solutions. Equally, it cannot be used as a scientific instrument for conducting impact assessments. It is not a solution algorithm that could be used to programme a computer. Rather, the stocks framework constitutes a particular *perspective* on sustainability problems. It is intended to be attractive to decision makers who are capable of handling it in a free and playful way. Perhaps the framework is best understood as a *lesson in long term thinking*.

Anyone who has learned to work skilfully with the stocks perspective will acquire the ability to look at the world in a particular way – one in which the interplay of temporal structures in all the relevant spheres becomes visible and thus forms an overall picture. In the course of this, the stocks perspective proves particularly useful to identify developments surprisingly quickly which are very probably *not* sustainable.

Viewed in this way, the stocks framework exists at the boundary between theory and practice. It takes everything from theory that is important in relation to a given sustainability problem and processes that knowledge and information in such a way to produce a kind of ‘information handout’ for practitioners. As such it provides a basis for conceptualising sustainable action. What is taught above all in this ‘lesson in thinking’ is how to adopt a free and unencumbered perspective on the problem at hand and on the options for action. What is taught is not a science so much as an *art* – a faculty that enables timely, sustainable action. This is *the art of long-term thinking* (Klauer et al. 2017: 219-222).

## 4. Literature

The content of MINE originates from scientific work published in books and peer-reviewed journals. Quotes are indicated by a special typographic style.

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Furthermore, we want to express our gratitude to Bernd Klauer, Reiner Manstetten, Thomas Petersen and Johannes Schiller for supporting the MINE Project and granting the permission to use parts of the content of their book “Sustainability and the Art of Long-Term Thinking.”

We are indebted to Prof. Joachim Funke, Ombudsman for Good Scientific Practice at Heidelberg University and the legal department at Heidelberg University, for their advice and support.

**The main sources this concept are the following publications:**

Faber, M. and J.L.R. Proops in cooperation with Reiner Manstetten (1998) Evolution, Time, Production and the Environment (3rd edition) Springer Verlag, Heidelberg.  
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Klauer, Bernd, Reiner Manstetten, Thomas Petersen and Johannes Schiller (2017) Sustainability and the Art of Long-Term Thinking, Routledge, Abington, Oxon and New York, NY. *All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical or photocopying, recording or otherwise without the prior permission of the publisher. The material is reproduced in MINE with permission of the Licensor through PLSclear (Ref. No: 8527, licenced 14.12.2018). We want to express our gratitude to Bernd Klauer, Reiner Manstetten, Thomas Petersen and Johannes Schiller for supporting the MINE Project and granting the permission to use parts of the content of their book.*

### 4.1 Recommended literature Recommendations

#### Key literature

Klauer, Bernd, Manstetten, Reiner, Petersen, Thomas, Schiller, Johannes (2017) Sustainability and the Art of Long-Term Thinking, Routledge, London and New York. [The content of the concept BASICS OF TIME is mainly taken from this pioneering book.]

#### Recommended for further reading

Hawking, Stephen. (2011) A brief History of Time. From the Big Bang to Black Holes, Transworld Publications, UK.

## 4.2 References

### Philosophy

Aristotle (1993) Physics. Books III and IV. Clarendon Aristotle Series, Clarendon Press, Oxford. [Fundamental text on time from Greek philosophy.]

Aristotle (2014) Nichomachean Ethics. Hackett Publishing, Indianapolis. [Fundamental text on ethics from Greek philosophy.]

Augustine (1988) St. Augustine's Confessions. Vol. II. Harvard University Press, Cambridge, Massachusetts; William Heinemann, London. [Fundamental text on time from the late antiquity.]

Heidegger, Martin (1996) Being and Time. A Translation of Sein und Zeit. State University of New York Press, Albany. [Fundamental text on time from the 20<sup>th</sup> century.]

Kant, Immanuel (1855) Critique of pure reason. Henry G. Bohn, London. [Fundamental text on time from the age of enlightenment.]

Kant, Immanuel (1991) On the Common Saying: 'This may be true in theory, but it does not apply in practice'. In: Political Writings. Ed. by Hans S. Reiss. Cambridge University Press, Cambridge et al., 61–92.

Kant, Immanuel (2001) Critique of the Power of Judgement. Ed. by Paul Guyer. The Cambridge Edition of the Works of Immanuel Kant, Cambridge University Press, Cambridge et al. [Main text of the concept of power of judgement.]

Popper, Karl R. (2005) the Logic of Scientific Discovery. Taylor & Francis e-Library, Routledge, London, New York.

Spaemann, Robert, Löw, Reinhard (1985) *Die Frage Wozu? Geschichte und Wiederentdeckung des teleologischen Denkens*. Piper, München. [Account of the historical development of teleological thinking from a philosophical perspective.]

Suchanek, Andreas (2001) *Ökonomische Ethik*. Mohr Siebeck, Tübingen. [Attempt to develop an economic ethics.]

Wieland, Wolfgang (2001) *Urteil und Gefühl. Kants Theorie der Urteilskraft*. Vandenhoeck & Ruprecht, Göttingen. [Perhaps the most advanced interpretation of Kant's Critique of the Power of Judgement.]

### Theory of stocks

Faber, Malte, Frank, Karin, Klauer, Bernd, Manstetten, Reiner, Schiller, Johannes, Wissel, Christian (2005a) *Grundlagen einer allgemeinen Theorie der Bestände*. In: Beckenbach, Frank, Hampicke, Ulrich, Leipert, Christian, Meran, Georg, Minsch, Jürg, Nutzinger, Hans G., Pfriem, Reinhard, Weimann, Joachim, Wirl, Franz, Witt, Ulrich (eds.) *Innovationen und Nachhaltigkeit. Jahrbuch Ökologische Ökonomik 4*. Metropolis, Marburg, 251–294.

Faber, Malte, Frank, Karin, Klauer, Bernd, Manstetten, Reiner, Schiller, Johannes, Wissel, Christian (2005b) *On the foundation of a general theory of stocks*. *Ecological Economics*, 55, 155–172.

Faber, Malte, Proops, John L.R. (1998) *Evolution, Time, Production and the Environment*. 3. ed., Springer, Berlin, Heidelberg, New York. [Standard text on evolution, time and the environment. It has been extensively used for the concept EVOLUTION.]

Georgescu-Roegen, Nicholas (1971) *The Entropy Process and the Economic Process*. Harvard University Press, Cambridge, Mass. [See in particular chapter 9.]

Klauer, Bernd, Manstetten, Reiner, Petersen, Thomas, Schiller, Johannes (2013) *The art of long-term thinking: A bridge between sustainability science and politics*. *Ecological Economics*, 93, 79–84. [Summary of the theory of stocks, which is employed in this concept.]

Klauer, Bernd, Manstetten, Reiner, Petersen, Thomas, Schiller, Johannes (2017) *Sustainability and the Art of Long-Term Thinking*, Routledge, London and New York. [The content of the concept BASICS OF TIME is mainly taken from this pioneering book.]

Schiller, Johannes (2002) *Umweltprobleme und Zeit. Bestände als konzeptionelle Grundlage ökologischer Ökonomik*. Metropolis, Marburg. [Encompassing analysis of time and environmental problems, employing the concept of stock.]

Winkler, Ralph (2003) *Zeitverzögerte Dynamik von Kapital- und Schadstoffbeständen. Eine österreichische Perspektive*. Metropolis, Marburg. [Analysis of the interaction between stocks of capital and stocks of environmental pollutants.]

Wodopia, Franz-Josef (1986) *Time and Production. Period versus continuous analysis*. In: Faber, Malte (ed.) *Studies in Austrian Capital Theory, Investment in Time*. Springer, Berlin, Heidelberg et al. [The paper deals with the implications of Georgescu-Goegen' stock-flow approach, in particular with the question, "How can timing and temporal structures be described completely in an economic model?" (page 186).]

### Theory of capital

The present concept deals with basics of time, hence the focus is not on how time is treated in Economics or Ecological Economics. For this reason we give here at least some short remarks and additional annotated literature.

The classical field of temporary economic development is the theory of capital. Introductions are given by Bliss (1975), Burmeister (1980), Hartcourt (1972), Hennings, (1997), Stephan (1995) and Weizsäcker (1971).

As in philosophy, capital theory is characterized by many controversies due to the different approaches. Overviews are given by Bernholz (1993) Burmeister (1974), Faber (1980; 1986: Chapters 1 and 2), and Kurz (1990).

Bernholz, Peter (1993) "The Importance of Böhm-Bawerk's Theory of Capital and Interest. Böhm-Bawerk is the founder of the Austrian theory of capital which has experienced a renaissance (Bernholz 1994, Faber (1979), Hennings 1997), Stephan (1996) and Weizsäcker (1971) because of the dissatisfaction with neoclassical capital theory (Bliss 1974) beginning in the 1970s).

Bliss, Christopher (1975) *Capital theory and Distribution of Income*. Amsterdam, North Holland. A classic book on neoclassical capital theory.

Burmeister, Edwin (1974) "Synthesizing the Neo-Austrian and Alternative Approaches to Capital Theory: A Survey." *Journal of Economic Literature*.

Burmeister, Edwin (1980) *Capital theory and Dynamics*. Cambridge University Press. Cambridge, England etc. A standard textbook on neoclassical capital theory.

Faber, Malte (1979) *Introduction to Austrian Capital Theory*. Springer, Berlin, Heidelberg, New York.

Faber, Malte (1980) Relationships between Modern Austrian Capital Theory and Sraffa's Capital Theory, *Zeitschrift für die gesamte Staatswissenschaft* 136: 617-629.

Faber, Malte (Ed.) (1986) *Studies in Austrian Capital Theory, Investment and Time*. Springer, Berlin, Heidelberg, New York.

Faber, Malte, Proops, John L.R., Speck, Stefan, with Jöst, Frank (1999) *Capital and Time in Ecological Economics. Neo-Austrian Modelling*. Edward Elgar, Cheltenham, UK, Northampton, MA, USA. This book gives an overview of how Neo-Austrian capital theory can be applied in Ecological Economics.

Harcourt, Geoffrey C. (1972) *Some Cambridge Controversies on the Theory of Capital*, Cambridge, England, Cambridge University Press. Sraffa's book (1960) led to the Neo-Ricardian theory of capital, which led to a heated controversy among neoclassical economists. Harcourt's book gives a detailed account of it.

Hennings, Klaus H. (1997) *The Austrian theory of Capital and Value*. Edward Elgar, Cheltenham, UK, Brookfield, US. This is a detailed and excellent account of Böhm-Bawerk's theory of capital by a pupil of John Hicks.

Hicks, John (1973) *Capital and Time. A Neo-Austrian Approach*. Clarendon Press, Oxford, 1939. This is a major contribution to Neo-Austrian capital theory.

Kurz, Heinz Dieter (1990) "Debates in Capital Theory". In: Eatwell, J, M. Milgate and P. Newman (eds.) *Capital Theory*. Macmillan, London

Marx, Karl (1867-1894) *Capital*. Progress Publishers (1965-1967), Moscow.

Newman, Peter (1962) "Production and Commodities by means of Commodities". *Schweizerische Zeitschrift für Volkswirtschaftslehre und Statistik*, 98: 58-75. [Excellent review of Sraffa's seminal monograph by (1960) which is not readily accessible].

Petersen, Thomas and Malte Faber (2018), *Karl Marx und die Philosophie der Wirtschaft. Unbehagen am Kapitalismus und die Macht der Politik*, fourth edition as extended new version, Alber, Freiburg.

Reiß, Winfried (1981) *Umwegproduktion und Positivität des Zinses. Eine neo-österreichische Analyse*. Duncker & Humblot, Berlin.

Sraffa, Piero (1960) *Production of Commodities by Means of Commodities*, Cambridge, Cambridge University Press. [Sraffa is, like the Neo-Austrians, an outsider in economics. Sraffa employs a classical approach which has Ricardian traits and also some traits in common with the Marxian approach. An example is that the demand side is missing. His book gave rise to the Neo-Ricardian School (see Faber 1980 and Newman 1962).]

Stephan, Gunter, (1995) *Introduction to Capital theory. A Neo-Austrian Perspective*. Springer, Heidelberg etc.

Weizsäcker, Carl Christian von (1971) *Steady State Capital Theory*. Springer, Berlin, Heidelberg, New York.

#### Case study on water

Brown, Gardner M., Johnson, Ralph W. (1984) Pollution Control by Effluent Charges: It Works in the Federal Republic of Germany, Why Not in the U.S.? *Natural Resources Journal*, 22, 929–966.

EC – European Communities (2000) Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for the Community action in the field of water policy. <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32000L0060>, 16.03.2015.

EEA – European Environment Agency (2006a) Land accounts for Europe 1990–2000. Towards integrated land and ecosystem accounting. Luxembourg.

EEA – European Environment Agency (2006b) Urban Sprawl in Europe. The ignored challenge. Luxembourg.

Eisenbarth, Siegfried (1995) Altlastensanierung und Altlastenfinanzierung: Freistellung und Sanierung in den neuen Ländern unter Beteiligung des Bundes. *Economica*, Bonn.

Ekardt, Felix (2011) *Theorie der Nachhaltigkeit. Rechtliche, ethische und politische Zugänge – am Beispiel von Klimawandel, Ressourcenknappheit und Welthandel*. Nomos, Baden-Baden.

Faber, Malte, Stephan, Gunter, Michaelis, Peter (1989) *Umdenken in der Abfallwirtschaft. Vermeiden, Verwerten, Beseitigen*. 2. ed., Springer, Berlin, New York, London, Paris, Tokyo, Hong Kong.

Faber, Malte, Stephan, Gunter, Michaelis, Niemes, Horst (1983) *Umweltschutz and Input-Output- Analyse. Mit zwei Fallstudien der Wassergütewirtschaft*. J.C.B. Mohr (Paul Siebeck), Tübingen

Fischer, Beate, Jöst, Frank, Manstetten, Reiner (2010) Die Persistenz von Institutionen – Hindernisse auf dem Weg zu einer nachhaltigen Flächennutzungspolitik in Deutschland. *Zeitschrift für Umweltpolitik & Umweltrecht*, 33(4), 391–416.

Fischer, Beate, Klauer, Bernd, Schiller, Johannes (2013) Prospects for sustainable land-use policy in Germany: Experimenting with a sustainability heuristic. *Ecological Economics*, 95, 213–220.

Gawel, Erik, Köck, Wolfgang, Kern, Katharina, Möckel, Stefan, Holländer, Robert, Fälsch, Marcel, Völkner, Thomas (2011) Weiterentwicklung von Abwasserabgabe und Wasserentnahmeentgelten zu einer umfassenden Wassernutzungsabgabe. UBA-Texte 67/2011, Umweltbundesamt, Dessau.

Möckel, Stefan (2009) Bewirtschaftung von Bundeswasserstraßen entsprechend der Wasserrahmenrichtlinie. Legal opinion written for BUND, unpublished.

Petersen, Thomas, Faber, Malte (2000) Bedingungen erfolgreicher Umweltpolitik im deutschen Föderalismus. Der Ministerialbeamte als Homo politicus. *Zeitschrift für Politikwissenschaft*, 1/00, 5–41.

Petersen, Thomas, Klauer, Bernd (2012) Staatliche Verantwortung für Umweltqualitätsstandards. Governance im Kontext der EG-Wasserrahmenrichtlinie. *GAI/A*, 21(1), 48–54.

Petersen, Thomas, Schiller, Johannes (2011) Politische Verantwortung für Nachhaltigkeit und Konsumentensouveränität. *GAI/A*, 20(3), 157–161.

Petry, Daniel, Klauer, Bernd (2005) Umweltbewertung und politische Praxis in der Bundesverkehrswegeplanung – Eine Methodenkritik illustriert am Beispiel des geplanten Ausbaus der Saale. Metropolis, Marburg.

Petschow, Ulrich, Wlodarski, Wojciech (2009) Stand und Potenziale der Elbe-Binnenschifffahrt und deren wirtschaftliche Wirkungen auf die Elbe-Region. Schriftenreihe des IÖW 194/09, Inst. für ökolog. Wirtschaftsforschung, Berlin.

Pahl-Wostl, Claudia (2010) Conceptualising uncertainty in environmental decision-making: the example of the EU Water Framework Directive. *Ecological Economics*, 69, 502–510.

van der Brugge, Rutger, Rotmans, Jan, Loorbach, Derk (2005) The transition in Dutch water management. *Regional Environmental Change*, 5(4), 164–176.

### Miscellaneous

Faber, Malte, Manstetten, Reiner, Petersen, Thomas (1997) Homo Oeconomicus and Homo Politicus. Political Economy, Constitutional Interest and Ecological Interest. *Kyklos*, 50(4), 457–483.

Radnitzky, Gerard, Bernholz, Peter (1987) Economic Imperialism. The Economic Method Applied Outside the Field of Economics. Paragon House Publishers, New York.

Simon, Herbert A. (1959) Theory of decision making in economics and behavioural science. *American Economic Review*, 49(3), 253–283.

Suchanek, Andreas (1993) Der homo oeconomicus als Heuristik. Diskussionsbeiträge der wirtschaftswissenschaftlichen Fakultät Ingolstadt und der Katholischen Universität Eichstätt, Nr. 38. KUE, WFI, Ingolstadt.

Tolstoy, Leo (1952) *War and Peace*. William Benton, Encyclopaedia Britannica, Chicago, London, Toronto.

Williamson, Oliver E. (2000) The New Institutional Economics: Taking Stock, Looking Ahead. *Journal of Economic Literature*, XXXVIII, 595–613.

#### Online-References

Harpers Magazine Online: <https://harpers.org/blog/2009/03/augustine-on-the-illusion-and-reality-of-time>, accessed on 23.10.2018