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Between Scientific Publication and Public Perception: Some Economic Remarks on the Allocation of Time in Science

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Abstract

Like every other human being, scientists also have to allocate their scarce resources of time and production according to their personal preferences. Today's scientific system is dominated by different (external) incentives that influence a researcher's decisions. With respect to the individual research strategy, there seems to be a conflict between scientific rigor and practical relevance. In addition, only certain scientific results actually find their way into the general public.We assume therefore that the use of virological and economic expertise are two different forms of reception of science by another social sphere. If our assumption is correct, the question arises as to how such rules of reception are formed and stabilized. This question will be investigated in the present paper. With regard to his or her publication strategy, the scientist therefore has to decide interdependently. Based on the economic approach in general, and Gary S. Becker's theory of time allocation specifically, we develop a simple model to explain scientific decision-making behavior. We derive several implications with regard to a strategy on time allocation in research processes, and thus contribute to a better understanding of scientific decision-making processes. In our paper, we concentrate on the general conditions in (business) economics, but the findings can also be applied to other (human) sciences.In order to be as up-to-date as possible, we take an additionallook at the role of science in the current COVID-19 crisis as well.

Keywords: Economics of science • Time allocation • Publication strategy • Scientific system • COVID-19

Introduction

Periodically, the "Sachverständigenrat zur Begutachtung der gesamt-wirtschaftlichen Entwicklung" (German Council of Economic Experts), colloquially referred to as "Wirtschaftsweisen" ("Wise Men of the Economy"), presents an annual economic report and comments on several current economic aspects. The reception of the recommendations of the collective, as well as those of other advisory bodies (e.g., ifo, ZEW, DIW, etc.) operating in the (macro-) economic context, appears to be rather low [1]. In addition, "the relationship between top-level research and policy advice among German economists seems to be more substitutive than complementary" [2]. This makes it all the more astonishing that political decision-makers in the so-called "COVID-19 crisis" are dealing with scientific expertise from the point of view of economists. Beyond the question of whether or not the recommendations for action that were made by the virologists advising politicians were appropriate to manage the pandemic, all political decision-makers relied on the scientific expertise,especially fromthe medical sciences, in their daily political activities. The reference to the exceptional situation as the cause falls short of the mark, because the economic consequences of political action are to be mitigated by programs which economists were essentially only able to comment on after their adoption. Although the climate issue is hardly noticed in these times, at least in the media, similar things could also be observed in this context. While politicians, under increasing pressure from NGOs and activists, have been referring to a "consensus" among climate researchers in their measures for a few years, the economic side of the coin, which has already been worked on for decades in the context of environmental economics in general (starting with [3-8]) and the pricing of externalities and climate change in particular [9,10], has been largely ignored. The topic was not only recognized in economics, but its implementation in the practical business sphere was also put on the agenda early on by business economics (e.g., [11]). No discipline can claim to have the only valid recipe for solving modern problems. The human being and the interaction with his or her environment are too complex for that. In the context of the current pandemic, the virologist Alexander Kekulé and the economist Jens Südekum (2020) [12] show that different perspectives from different disciplines are required for the political treatment of complex phenomena: while virological expertise is directly translated into political action, economic decisions are preferably developed directly from the political arena in its interaction between executive and administrative bodies [13,14]. The current COVID-19 pandemic and the different perception of scientist let us assume that public and political perception could have a significant influence on a scientist's strategic decisions. Like every individual a scientist decides under uncertainty and is limited by scarce resources and time budget. To contribute to the topic of the economics of science we would like to develop a simple allocation model that emphasizes a relation between different decision parameters influencing the research strategy of a stereotypical utility-maximizing scientist. In addition to the public and political perception already mentioned, it is in particular the decision between rigor and relevance which is relevant for decision-making. The scientist is thus faced with the decision to allocate his scarce resources to the various determinants according to his individual preferences in such a way that his utility is maximized.If our assumption, that the use of virological and economic expertise are two different forms of reception of science by another social sphere, is correct, the question arises as to how such collective rules of reception are formed and stabilized. This question will be investigated in the present paper. Our goal is to propose an explanatory model which can be empirically tested in future research. Our model is based on the fundamental economic assumptions of methodological individualism and utility maximization (section 2), differentiates between the expected utility from rigor versus relevance against the background of the anticipated and experienced selection criteria of media, public and politics over time (section 3) and implies the retroactive effect of the degree of attention gained on the decisions considered

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in the model (section 4). The paper concludes with an outlook on further research (section 5).

Basic Assumptions

Methodological individualism and utility maximization

In the following we will present two crucial assumptions of our analysis. This seems to be important in two respects: First, they are the basis of our model and are important for its interpretation. Secondly, it is necessary for the interested public to recognize that scientists are individuals who – like other people as well – pursue their own interests. The principle of methodological individualism founded by Joseph Schumpeter [15] applies both to human action in general, and to the process of scientific knowledge in particular. According to this conception, individuals always act individually, whereas collectives do not act autonomously. This idea applies to states and organizations, and also to the scientific community. Thus, research is only carried out by individuals, not by an institution as a whole. However, it can be argued that scientists at public institutions tend to be oriented towards the common good, should such a thing exist despite Arrow's [16] impossibility theorem, but it is more likely to assume that scientists, just like other people (and this also applies to judges; [17]), are (also) interested in their own well-being, and are thus influenced by incentives in their decisions (e.g. [18,19]). This is without prejudice to the fact that altruistic action can also serve one's own benefit (on volunteer labor supply see e.g. [20]). The idea of looking at science and at scientists from an economic perspective is not new, although the economic analysis of science is still relatively young [21]. The transfer of economic methodology once again demonstrates the flexibility of the economic approach (for more information on the economic approach, see [22]) to the "economics of science" (as overviewed in [23,24]). Science can be understood as competition between individuals: "Scientific competition means competition within academic or open science and its institutions: learned societies, scientific journals, the peer review system, Nobel prizes, and modern research-oriented universities" [25]. The economics of science are conceived as explanatory or "positive" science in order to give a better understanding of processes and behaviors within academia [23]. Accordingly, a scientist bases his or her decisions on the expected benefits and then compares it with the costs incurred (e.g. [19,26]). Of course, this does not rule out the possibility that, due to the uncertainty inherent in every decision (fundamentally [27]), the consequences may be misjudged [28,29]). This is especially true in academic careers, in which a lot depends on random constellations [30]. Nevertheless, a scientist will acknowledge this uncertainty in order to try to improve his or her position and thus increase his or her benefit (e.g., [28,29]). The individual benefit of a researcher may be expressed by rigor in terms ofreputation, what is reflected by publications in renowned top scientific journals, citations in scientific journals (on the value of a citation Diamond [31]), invitations as speaker at conferences, and/or by relevance by mentions in newspapers or appearances on television, or even political influence [18][1].

Decision Parameters

Rigor versus relevance

Following Ludwig von Mises [32], "human action is [always] purposeful behavior."This also applies when information deficits and bounded rationality are taken into account (fundamentally [33,34]). This axiom can also be applied to a scientist, who has to divide a scarce time budget according to research content and methods.[2] In the scientific community, the distinction between the two antagonists, rigor and relevance, has been previously established, especially for the applied sciences. While rigor in this caserefers to scientific rigor, relevance regularly refers to the importance of the research for a particular addressee, so that a distinction can be made between scientific and practical relevance [35]. For the purpose of simplification, we would like to focus in the following on rigor and practical relevance in this paper. According to Dilger [35] we understand rigor as "the very systematic and methodical approach, the following of scientific rules and standards." There seems to be a trade-off between rigor and (practical) relevance [36], so that in a society based on the division of labor, it is not surprising that specialization occurs within the scientific community [35]. But a danger can be seen when rigor dominates one discipline [35]. This is a problem in many disciplines, e.g. in economics as well as in business economics. In particular, after the recent international financial crisis, movements have formed worldwide that oppose research which is based on unrealistic assumptions and is exclusively quantitative-empirical oriented, and which is focused on only a small number of top journals (to this problems ee e.g., [2,37,38]). Within the scientific community of business economics, especially in management science, the discussion about rigor and relevance had already reached a peak in the early 2000s (e.g., Rynes, Bartunek and Daft 2001) [36,39] and is still ongoing (e.g. [40]). In 2009 a dispute arosein the German economics community about the (methodological) orientation of the discipline (Wilgeroth 2009, [41]), with one side oriented towards economic policy in the sense of relevance and one, primarily internationally oriented side in the sense of rigor, which can be seen as "Neuer Methodenstreit" (e.g. [42,43]). The fact that the topic is also important for the broader economically interested public is shown by an article by Matthias Binswanger [44] (2012, with 40,088 reads as of 3/31/20) on the German-speaking blog "Ökonomenstimme", in which he critically discusses the article by Edlund and Korn [45] entitled "A Theory of Prostitution," which was published in the Journal of Political Economy. In his critique, Binswanger follows Mankiw [46]:

"[M]ore young economists today are doing Levitt-style economics and fewer are studying the classic questions of economic policy. That is disconcerting, to a degree. It could be especially problematic twenty years from now, when President Chelsea Clinton looks for an economist to appoint to head the Federal Reserve, and the only thing she can find in the American Economic Association are experts on game shows and sumo wrestling."

Concerning the discussion about rigor and relevance, however, it must be countered by the fact that practical relevance cannot be obtained solely by advising political decision-makers. Relevance is primarily a subjective category, so that the demand of a broad public also leads to relevance ("public relevance"), which may lead to political relevance. The opposite case, in which political relevance encourages public relevance, is also conceivable. Although Steven Levitt does not research in areas that are (explicitly) relevant to economic policy, the worldwide success of his book *Freakonomics*, written together with Stephen Dubner [47], shows that he is able to convey the economic approach to a broad public, which can by no means be dismissed as irrelevant. Therefore, relevance seems to exist both in the expression "political" and in the expression "public," whereby it can be assumed that both expressions influence each other.

Selection mechanisms of public, politics and science

Scientific findings presented by economists are always related to a specific historical point in time that is more or less connectable to the criteria of rigor and public or political relevance. While the criteria for rigor are generally an outcome of a negotiation of processes within the scientific community, concrete public interests form the demand from politics and the specific public for the respective results.Rigor can be understood as a concrete form within the framework of a particular style of thinking [48], a paradigm [49], or a research program [50], which has been formed by the cooperation of scientists who feel committed to it. Rigor determines which characteristics are used to assess knowledge gains. The disregard of rigor or the deliberate deviation from it is connected with a high risk of rejection or disregard of the presented knowledge in the scientific community. At the same time, for example, the acceptance of a journal article that does not comply with rigor by a reviewer is also associated with kind of risks for the reviewer,[3] but at least with increased

1 Depending on whether a scientist is more extrinsically or intrinsically motivated, he or she also benefits from his or her work: "Research is in many ways a kind of game, a puzzle-solving operation in which the solution of the puzzle is its own reward" [81].

2 To reduce the complexity of our analysis and to concentrate on research we abstract here from administrative tasks and lectures.

3 One of the risks is, that the article does not represent the reviewer's scientific position. To maximize his own utility, he has strong incentives to support his own point of view and to reject others. Towards the characteristics and problems of the scientific (peer) review system, particularly concerning status differences between reviewer and other and the influence on the results of the review process see Zuckermann and Merton [82] who differentiate between *"status-solidarity", "status-competition", "status-deference", "status-envy", "status-patronage"* and *"status-subordination"*.

effort for the reviewer [2]. Over time, this development converges to a high degree of standardization and typification, with a decrease in originality and research diversity (e.g. [51]). Frey and Osterloh [52] call the problem within a peer-review as

"conservative bias, that is the bias against unconventional ideas. Referees subjectively have more information on research projects that are close to existing knowledge.Moreover, information on those contributions is more consistent. Withunorthodox contributions referees have less – and usually inconsistent – information."

The importance of scientific findings for political and administrative decision-makers lies on the one hand in the acquisition of control knowledge, and on the other hand in the production of legitimacy for decisions. Both can occur either coupled or decoupled with each other. Thus, it is conceivable that control knowledge is adapted from scientific knowledge without referring to the production of legitimacy by explicitly referring to the origin of the knowledge from the scientific system. As Max Weber [53] has already pointed out, the separation of specialized expertise and political decision-making power is by no means unproblematic. This appears to have been the case, for example, in the context of nudging ([54,55]) and the establishment of corresponding experts in governmental centers in the UK, the US and Germany ([56,57]). Several countries have written guidelines for scientific policy advice [58]. The market for political consulting is being worked on intensively. On the supply side, there are ministerial advisers, (private) consulting firms, NGOs, think tanks, and lobbyists on the one hand (e.g. [59]), and scientific policy advisors on the other, who may be privately or publicly funded (e.g. [58]). Such approaches to the incorporation of experts on new scientific findings that are relevant to control ultimately accumulate over time in a so-called departmental research ("Ressortforschung"). This refers to subordinate authorities whose task it is to work on politically relevant issues using established scientific theories and methods. From time to time, the scope of action of such authorities is extended by a budget for contract research, which enables the tendering of specific research projects. Such calls signal political relevance for the topic in question to scientists who are free to decide on funding. A general problem of scientific policy advice is the conflict between facts and power ("Sachbezug" and "Machtbezug", [58]). The link between the acquisition of control knowledge and the pursuit of legitimacy is established when political decision-makers refer to scientific evidence when announcing or explaining their decisions. In most cases, this legitimacy production takes place in a personalized form, i.e., a specific scientist or small group is used as evidence for the assumptions of impact associated with the political decision. The suitability as a "supplier of legitimacy" depends, among other things, on the perceived independence of the scientist from the interests of third parties, and ultimately on his or her commitment to the ethos of science and the associated CUDOS norms [60]). The instrumentalization of scientific findings in the course of the production of political legitimacy can also lead, due to the polarization between the governing parties and the opposition parties, to the legitimization of other control proposals with other experts, and thus to the start of a politicization spiral of the scientists who generate legitimacy.This mutually relationship between science and politics is currently evident due to the COVID-19 crisis. There seems to be a broad scientific, political and generally accepted consensus reached on the assumptions that some intervention must be taken, to slow down the spreading of infections. But each country takes different actions, because this pandemic is completely new and there is little empirical evidence. As a result of this uncertainty the assessments concerning the most effective actions differ, because even in natural sciences, the interpretation of empirical findings depends on (subjective) preferences and assumptions. Spoken with Ludwik Fleck [48], scientific findings follow a social conditionality. In Sweden, for example, esp. Anders Tegnell advises the government as anepidemiologist and this appeals to a common sense to issue recommendations instead of strict prohibitions. In the UK and the Netherlands, so-called "herd immunity" was initially pursued, but its supporters have been heavily criticized, so that they adjusted their strategies, but not quite strictly. Deviating from these rather *laissez-fair* measures, there are countries like Spain and Italythatearly adopted very strict restrictions on the advice of their leading scientists (example). In Germany, Christian Drosten, Alexander Kekulé, and Hendrik Streeck seems to be the scientists that get the most public attention. In a situation characterized by uncertainty such as the current one, political actors seek the advice from scientific experts. Two aspects should be pointed out in this context. On the one hand, it should be emphasized that, in Max Weber's sense, scientists do not set normative goals themselves and thus leave all political decisions to the elected representatives. On the other hand, it should also be pointed out that there is a possible danger that leading scientists could be politically instrumentalized to underline political wishful thinking with scientific reputation.Obviously, in the current pandemic there is a trade-off between the goal "Protection against infection" and those effects that results by actions to realize that goal, e.g., negative economic, social or mental (what of course is a medical aspect as well) effects. From a theoretical perspective, an optimum can be found where the marginal utility of the actions to contain infections correspond the marginal costs. The individual weighting within the target function is a normative decision and is not answerable by science. In particular, a constructive debate about the pros and cons is required to balance these conflicting goals. Whatwe can also learn from the current situation is, thatan actual optimum can only be found if an interdisciplinary approach is followed [17]. Consequently, the scientists consulted for policy advice must focus different aspects: In addition to virologists who primarily pursue health protection, economists, psychologists and lawyers, for example, must also be involved in the discussion. At this point, we can remark that scholars can achieve public attention or even relevance through their role as producers of legitimacy for political decisions. It should be noted that the individual legitimacy resources do not seem to be infinite, and must be replenished by a return to scientific rigor and originality, although this can also be done by colleagues within the same institution. This would also explain the divergence between international top-level research and policy advisory within economics [2].However, scientists can also gain public attention by translating complex problems into a broadly understandable form (e.g. the works of Stephen Hawking) or by applying scientific models to interesting everyday phenomena (e.g. [61-63]) in an entertaining way.

Modelling Scientific Decision-Making

In economics, life cycles are often assumed, for example for products or business enterprises (e.g. [64-66]). On this research we build a career cycle for the professional life of a scientist. To reduce the complexity of our analysis, we assume three stereotypical phases:

(I) **Core research**: This first phase is characterized through the subject area in which the researcher engages in scientific discourse through his own publications.Here he or she produces knowledge and can achieve rigor and/or relevance within a limited scientific community.

(II) **Discipline**: After building a certain reputation within his core research the contributions to subject areas that follow his or her field of research, but which he or she has not worked on. He or she extends the area but still remains within the overall discipline. Here the scientist can achieve relevance, but does not produce knowledge and cannot achieve rigor in his core research.

(III) **Non-specialist**: The consumption in III requires prior investments in I and II. In particular, a minimum level of activity in the scientists'core research area is necessary. In this phase, the subjectdoesnot have any relation to the scientist's discipline.[4] When the scientist comments on those topics, he or she produces neither knowledge nor rigor nor relevance as a scientist.Nevertheless, he or she (as an individual) can attain political or public relevance, e.g., on social media channels. We can assume that this should be easier for a well-established scientist, because the legitimacy produced by the CUDOS norms as a member of the scientific community is transferred to the other (external) subject area. However, if an abuse of the role as a scientist for this (III) subject area is recognized by the public, this reduces c.p. the effect of CUDOS legitimacy as a scientist in the successor period. By obtaining academic degrees and titles, the position can be strategically expanded so that public credibility increases. Whether the individual exploits the possibilities gained in phase III depends on his or her personal preference, e.g. whether he or she attaches importance to being in the public.

4 We understand this in terms of the content and not from the methodical perspective.

In phase I, relevance is limited to a small scientific community. However, if political or public relevance is sought and it is expected by the scientist that this cannot be achieved with the core research, he or she decides to make contributions on areas that lie outside the core research field (phase II) as well. For the scientist, it may be necessary to invest again in rigor and scientific relevance in this new field of research. This new field is not aligned atgain in knowledge or rigor, but at achieving political or public relevance, which is needed for phase III. With Bourdieu one could argue that knowledge, rigor and academic relevance as places of capital can only be exchanged for public or political relevance as another place of capital once a certain minimum level of resources has been reached. Consequently, phase II could be interpreted as the phase in which the connectivity to political and/or public relevance is established. Scientists without a preference for political or public relevance have chosen their topics according to other preferences. But, scientists with preferences for public/political relevance will choose their topics in the way they think they will become "relevant". To illustrate our ideal-typical phase-model graphically, we built on the common approach of a product life cycle, see Figure 1. In the actual core research area, additional gain in knowledge and reputation can only be gained if the resource consumption is high (decreasing marginal utility). The scientist recycles his or her own ideas, which have reached the maximum of the life cycle. If necessary, the scientist even fears a decline in reputation. In order to develop further, the scientist moves on to phase II and expandshis or herresearch area. Once the optimum is reached in phase II, the scientist begins to invest resources in phase III.

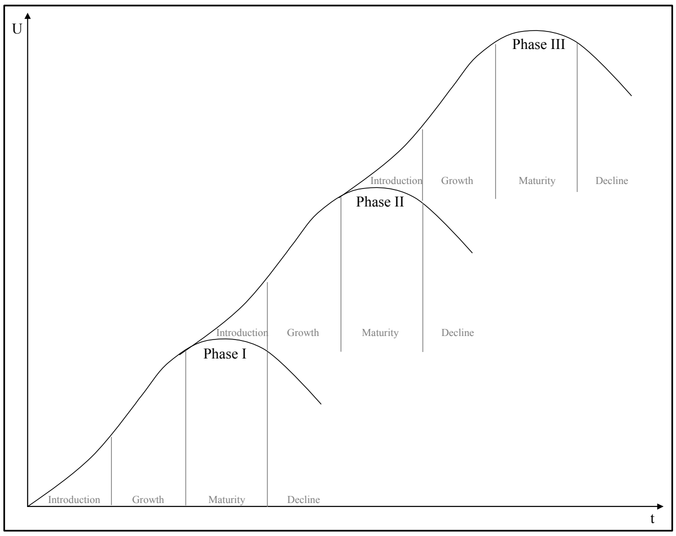

Figure 1. Scientific career life cycle (t = time; U = Utility).

Since scientists are also subject to the law of scarcity, they must choose between various alternatives. Our model to explain the decision-making behavior of a stereotypical scientist assumes an individual who maximizes his or her expected utility in accordance with his or her intertemporally stable utility function, or strives to do so under incomplete information and uncertainty. For the scientist, it is therefore a matter of maximizing the allocation of his or her time budget for different scientific activities in accordance with his or her utility function, which can provide him or her with different anticipated consumption benefits[5]. Emrich and Pitsch [18] apply the religious-economic household models of Becker [64-67] and Azzi and Ehrenberg [68] to sports science, distinguishing the consumption of a scientist into internal (C_i) and external (C_e) recognition [18], presenting a model that we now use as a proxy for rigor and relevance[6]. The scientist thus maximizes his intertemporal utility U of the following function (for the basic model, see [68]):

$$U = U(C_i + C_e) \tag{1}$$

Of course, it is important to optimize its benefits over time. For this purpose, the costs (CO) of the investment are compared with the present values of the earnings (U):

$$\max \left(\sum_{t=0}^{n} \frac{U_t}{(1+\delta)^t} - \sum_{t=0}^{n} \frac{CO_t}{(1+\delta)^t}\right); \text{ with } \delta \text{ as discount rate} > 0 \tag{2}$$

Since a researcher's academic reputation ([18]; in the context of entrepreneurship theory, e.g. [69] is the decisive factor for career opportunities,and represents *the* crucial currency, it directly determines the decision-making calculation (e.g. [19]). The reputation of a researcher is not a static quantity, but rather a dynamic one, which depends in particular on past reputation, academic background in the sense of social networks, and publication activity (for a satirical formalization in the context of the "PARK model," see [70]). The determinants "past reputation" and "academic background" favor a "Matthew effect", so that once a certain success has been achieved, the current success can be attributed more to previous success [71]. In addition to these non-financial flows of benefits, financial benefits can also of course play a role, although this benefit component is likely to tend to be less important, especially for state universities in German-speaking countries and the fixed part of the remuneration. However, since financial incentives and other influencing factors cannot be completely neglected, they should be expressed using a confoundere. Variable earnings can be understood as a function of reputation, so that they often increase in the course of a career.[7] Total consumption C is dependent on the total time T available for consumption purposes (for the theory of the allocation of time, fundamentally, see [67]), which results from individual weighting, based on the subjective preferences. We assume a stereotypical scientist who has to allocate his scarce time budget on activities that produce C_i and/or C_e.

The individual weighting of C_i and C_e depends on the respective target function of the scientist.

The researcher's time budget can be defined as:

$$t_r = 24h - t_1 \tag{3}$$

with t_1 = leisure time; t_r = research time

$$t_{Ci}(w) = w \cdot t_r \tag{4}$$

with t_{Ci} = time budget for C_i

$$t_{Ce}(w) = (1 - w) \cdot t_r \tag{5}$$

with t_{Ce} = time budget for C_e

$$C(w) = w \cdot c_i + (1 - w) \cdot c_e + e \tag{6}$$

with e = other influencing factors

To receive the total consumption, the scientist has to carry out an intrinsic weighting of C_i and C_e. The variables rigor (RI) and relevance (RE) – outlined above – as well as the preferred level of gain in knowledge (K), so that the weighting can be written as a function of those variables.

$$w = w(RI, RE, K) \tag{7}$$

Therefore, the height of w follows from the individual preference for RE, RI and K. This connection can be described as follows:

The more important RI, the higher w.

The more important RE, the lower w.

The more important K, the higher w.

The individual preference for RE, RI and K is, of course, a dynamic variable, which the researcher particularly makes depending on the respective phase (I, II, III). For example, if the researcher primarily aims for external reputation in phase III, he will consider RI and K as unimportant and RE as very important. As a result, he will choose w as low as possible and consequently maximize C_e. The researcher must allocate the time budget on his or her internal and external consumption. He or she divides the time on the basis of a personal

5 Another assumption is that the scientist considered here is already established within the scientific community, so that his initial investment can be neglected. Ideally, the model is considered for a full-professor.

6 It should be noted that the scientist can of course also be interested only in gaining knowledge ("motive of salvation," [68,18], but he must also live "from science" [18] ("motive of consumption," [68,18]), so that the motive of consumption regularly precedes the motive of salvation.

7 With regard to the earning potential in the context of lectures.

weighting, which will mostly shift significantly during his or her career cycle. While the weighting of internal consumption will inevitably predominate at the beginning of the career, the importance shifts more and more to external consumption with increasing reputation and thus additional work by the own team and other scientists. The so-called "Heinsberg-study" for example [72], which determines the COVID-19 infection fatality rate, was published by 22 authors, while Hendrik Streeck is the scientist that is well-known from talk-shows and newspapers.We have to acknowledge that investments to gain knowledge, rigor, and relevance are not disjunctive. For example, a unit of time invested to gain knowledge may also partially benefit rigor, relevance, or both. If one illustrates this in a VENN diagram, it becomes clear that by considering the size of the overlapping areas α, β, γ, and δ as prototypes for the decision situations of scientists in the choice of their research object, the optimization function according to the individual preferences of the choosing scientists can be derived (Figure 2).

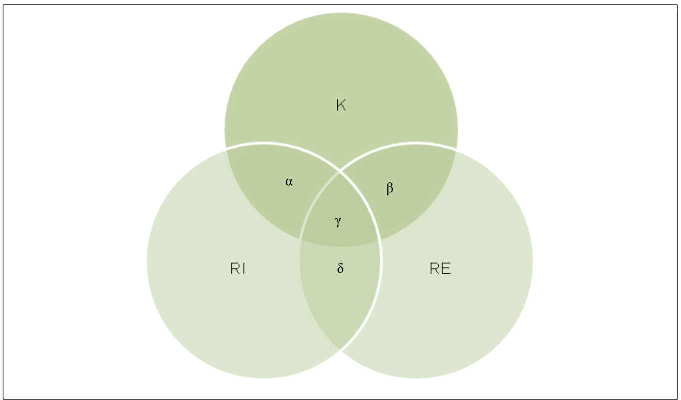

Figure 2. Investments in RI, RE, K.

With respect to the individual nature of human beings, scientists also have different preferences. A scientist with a strong preference for relevance will therefore choose research topics that maximize the sum of β, γ, and δ. A preference for rigor will maximize the sum of α, γ, and δ. In both cases, δ decreases, which is in line with the findings of Haucap and Mödl [2]. A scientist who is only oriented on gaining knowledge will sometimes achieve more rigor, sometimes more relevance, and sometimes neither of the two with his research results. His internal (C_i) and external (C_e) recognition (Emrich and Pitsch [18]) are likely to be systematically lower than that of scientists with a higher preference for rigor or relevance, due to the randomness of meeting rigor or relevance with the knowledge gained. Sincethe academic market is a form of "winner-take-all" competition (Stephan [24]), following Feld, Necker, and Frey [73], fundamentally Frank and Cook [74]), the group of scientists appointed to relevant chairs should be more likely to include researchers with a clear preference for rigor or relevance. However, since the assignment of rigor and relevance are also winner-take-all markets, these produce a relatively high proportion of less successful researchers with a preference for relevance or rigor. For them, the opportunity costs of spending time outside of science would decrease, leading to less time spent inside science, and also to a reduction in the number of research objects processed. This should primarily affect research objects for which a high degree of connectivity to rigor or relevance was originally anticipated. At the collective level, this weakens the orientation towards rigor and relevance as criteria for the selection of research objects, which leads to an approximation to the ethos of science, and stabilizes it.

If one follows our model and accepts that

- neither rigor nor relevance as a scientist can be achieved without substantial gain in knowledge, and
- public or political relevance can be promoted through rigor,

thenit would be advisable for young scientists to allocate their time on rigor, regardless of their individual preferences. If the young researcher has established himself or herself, for example, by being appointed to a (full) professorship, he or she can shift the focus of his or her research topics according to his or her concrete preferences toward relevance or pure knowledge gain, or maintain the focus on rigor. If it becomes clear that the selected research topics do not fulfil the expected benefits over the course of time, which were considered in the decision-making process, this leads to a reduction in the amount of time invested in research, as well as the relative strengthening of research for the purpose of a pure gain in knowledge.

Concluding Remarks and Outlook

Science plays an extremely important role in modern society, and is also one of the primary drivers of growth. Because of their scarce time budget of 24/7, scientists have to choose between different alternatives in how to spend their time. By valuing their preferences, they have to consider several interdependencies between their orientation concerning content and methods, which we summarize as a decision between rigor and relevance and the perception in media, politics, and the scientific community. We explain the decision of a stereotypical individual researcher by developing a simple model that builds on the rational choice approach, in particular on Schumpeter's methodological individualism and Becker's utility maximizing man that has been adopted to the economics of science. For further research, we see four especially important pathways:

1. The model that we suggest could be tested empirically by future research in order to gain more knowledge on the individual behaviors of modern scientists. In particular, these findings could be compared to the traditional understanding of scientists that is proposed by Merton [60]. In this context, Sztompka [75] notes that the scientific ideal type is threatened by an increasing instrumentalization of scientific knowledge, financial pressures, and dependencies.

2. In our analysis, we focus on the current conditions within a scientific system that is characterized by external incentives. One aspect that could be reflected in future research is the individual well-being of the scientists. Feld, Necker, and Frey [73] found that economists' life satisfaction is unrelated to publication success, which is measured by publishing a paper in one of the top journals. They show that spending more time on research is more important for the well-being of the economists, which is in line with the intrinsic motivation by "solving a puzzle" [73] or to "hunt myths" ([76]). Following the "crowding out"approach by Deci [77] or Frey [78], the pressure to publish in the top journals could have a contrary effect.

3. A gain in scientific knowledge is a public good – especially in times of internet and open access, SSRN, ResearchGate, etc. – which is primarily produced in institutions financed by taxes. To this extent, it has no market price, which results from supply and demand, and is a first indication of the value of market participants. However, research in the field of public goods has developed various methods that allow valuation, at least heuristically (e.g., [79]). With regard to the economics of well-being, the life satisfaction approach appears to be particularly promising (e.g., [80]), so that future re search could address the empirical value measurement of scientific findings.

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