Supervenient Causes in Economics

J. Harbecke and R. Knudsen[1]

Abstract

This paper investigates whether the philosophical supervenience problem has any bearing on the economic sciences. It first reconstructs some examples of economics normal science that aim at a correct description and explanation of causes of observable phenomena in an economic reference system. Subsequently, the supervenience problem is presented as it is known from the philosophy of biology and the philosophy of mind. A formulation of the problem for economic causes is then developed in an analogous way, even though the ontological commitments of economics are less obvious. The main hypotheses defended in this paper are the following ones: (i) Economic models are amenable to causal interpretations and (ii) the efficacy of economic causes characterized by such models is fundamentally problematic from a metaphysical point of view, analogously to that of biological and mental causes. Moreover, it is shown that (iii) the problem of causal exclusion is even more drastic for economic causes than for biological or mental causes due to a non-localizability and an overlap of economic events.

1 Introduction

Descriptive economics, just as most other "special sciences" (Fodor 1974), generally deals with the correct description and explanation of observable phenomena in a previously specified reference system.[2] The title of the groundbreaking work "An Inquiry into the Nature and Causes of the Wealth of Nations" (1776) by Adam Smith already hints at this fact at the dawn of economics as a science. Considering the strong theoretical focus of, for instance, modern neoclassical microeconomics, it might seem as though economics has left this methodological

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[1] Author affiliations:
Jens Harbecke, Witten/Herdecke University, Germany. Email: jens.harbecke@uni-wh.de
Richard Knudsen, Witten/Herdecke University, Germany. Email: richard.knudsen@uni-wh.de

[2] Economics has also always been concerned with normative questions such as those analyzed by welfare economics. Moreover, the study of organizational systems and forms in institutional economics, the structural strategic study of cooperation and conflict are not purely descriptive. In this paper, however, we focus on the descriptive branches of economic enquiry.

path mapped out by Smith.[3] Today's introductory textbooks of neoclassical economics are more cautious in the application of causal language and often refer only indirectly to causal processes and causal interactions.[4] Notwithstanding, the analysis of competitive, monopolistic or oligopolistic markets, for instance, is ultimately a modeling of causal dependencies. The analyzed effect is the emergence of a particular equilibrium as, for instance, a market-clearing or a non-market-clearing price. As causes of such an effect, certain characteristics of groups of suppliers or groups of demanders are postulated, which ground supply- and demand functions. Although the models do not explicitly use causal language, it is usually unambiguously clear to the interpreter of these standard models, which factors are to be considered causes and which factors are to be considered effects.

Economics is usually defined as the branch of science concerned with the production, consumption, and transfer of (scarce) goods and services. Its scientific domain comprises individuals, businesses, governments, and nations. Its main aim is to clarify the accumulated structure of choices on allocating resources that are made based on wants and needs, and to determine the conditions under which economic efforts maximize certain outputs. Today, economics as an empirical and theoretical science branches out into many different schools with different methodologies and different conceptions of causation. Much of economic "normal science" (Kuhn 1962), such as neoclassical microeconomics and new-keynesian macroeconomics, seeks empirical bindings of its models, follows a descriptive approach and is interpreted causally. One prominent notion of causation in economics is the concept of Granger Causality (Granger 1969) used in econometric time series regression. As a paradigmatic example, Fehr and Schmidt (1999) identify an inequity aversion among a fraction of a human society as a cause of social stability and cooperation. Another example is a paper by Brunnermeier and Pedersen (2009) who model a causal relationship between "Market Liquidity and Funding Liquidity" as a cause for certain observed phenomena (for a more detailed

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[3] In particular, the differences between classical and neoclassical approaches e.g. regarding the notion of economic value are especially salient.

[4] For example, Pindyck & Rubinfeld (2005) and Krugman & Wells (2005) almost completely avoid causal language (the latter less than the former). The introductory textbook by Gans et al. (2011, 47-49) is almost an exception as it highlights the connection of causation and modeling in economics in a separate passage.

reconstruction of these example, cf. section 3 below).

If economic events are causes at all, they are macroscopic causes in the sense that they cannot be re-described in microphysical terms in any straightforward way. Macroscopic phenomena with allegedly causal forces are known in most of the special sciences as, for instance, in biology and psychology. In the philosophy of mind and the philosophy of biology, however, the existence and efficacy of macroscopic causes has been critically debated over the last decades. The debate about the "supervenience problem of causal exclusion" deals with the apparent redundancy of non-microphysical causes due to the empirically well-documented completeness of the physical. The physical is regarded as complete because every physical event has a physical cause and all non-physical events "supervene" on physical events, meaning that they cannot occur without an underlying physical event (cf. Kim 2003, 155).[5] If every physical event already has a physical cause and all non-physical events supervene on physical events, it seems that mental and biological events cannot bring about any causal differences in the world. Or in other words, the omnipresence of physical causes excludes the existence of genuine mental and biological causes. This argument has been brought to mainstream metaphysical research of the 20th and 21st century most notably by the works of Jeagwon Kim (1979, 1985, 1998, 2003, 2005).

At the same time, the supervenience problem has been given little attention in the philosophy of economics. A possible reason is that to many researchers it may seem that the results from the debates of philosophy of mind and philosophy of biology can directly be transferred to analogous questions regarding theory construction in the economic sciences. Hence, a separate debate in the philosophy of economics might not seem necessary. However, as we will show, it is important to discuss the supervenience problem for economic causes separately, because it is especially dramatic for the latter kind of causes. Even if the philosophy of mind and the philosophy of biology can eventually offer a satisfying solution to the problem, the causal

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[5] To be precise, supervenience describes an asymmetric dependence of classes of properties (cf. Kim 1982, 1984). The most popular „strong" formulation of the notion of supervenience is the following: „A set of properties A supervenes on a set of properties B if, and only if, for all properties ϕ in A, any instance x of ϕ is necessarily also an instance of a property ψ in B, and, necessarily, for all instances y if y is an instance of this ψ , then it is also an instance of the ϕ." Reformulated for events, this typically means that, for instance, every mental event necessarily occurs together with a physical event, and this physical event is sufficient for the occurrence of the mental event.

efficacy of economic events will still remain questionable due to the limited specifiability of the spatiotemporal localization of economic events.

Our aim in this paper is to examine which specifics the supervenience problem bears for causal modeling in the economic sciences. First, we will show that genuine economic causes are affected by the supervenience problem in a similar way as mental and biological causes. Secondly, we will explain why economic causes are even more called into question from a metaphysical perspective. Economic causes can typically not be localized in any straightforward way, which widens the gap between physical and economic causes. This radicalizes the supervenience problem. Methodologically, we will examine the paradigmatic examples of causal economic models mentioned above to develop an analogous supervenience problem for causal propositions in economic sciences and to discuss the mentioned specificities.

The investigation will be structured in the following way. Section 2 will at first introduce the supervenience problem. Section 3 will reconstruct the mentioned examples of causal modeling in economics and then develop an analogous formulation of the supervenience problem for economic causes. Section 4 will explicate the specifics of the problem for economic causes in contrast to mental and biological causes. Part 5 will summarize the findings and provide an outlook for possible further research on the topic.

2 The Supervenience Problem

Economic causes are mainly macroscopic causes in the sense that they cannot be easily re-constructed microphysically. The efficacy and, more fundamentally, the mere existence of macroscopic causes have been debated controversially in the philosophy of mind and the philosophy of biology. The main question discussed in this debate is how mental or biological events can have causal effects, given that all concrete events already have sufficient physical causes. Analogously, it can be asked whether economic causes are similarly threatened by an argument of exclusion, or whether there is a fundamental difference to biological and mental causes.

To answer to this question, this section first reconstructs the problem of mental causation, also

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named the "supervenience problem", in order to subsequently develop an analogous formulation for economic causes. The argument is mainly discussed in two different versions, in the mental-physical version, also called the "original exclusion argument" (cf. appendix) and the mental-mental version. The latter is usually called the "supervenience problem".

The supervenience problem consists of several assumptions, each of which can be considered plausible in isolation, but which in conjunction provably imply a contradiction. The assumptions or premises of the problem can be described as follows. The first premise states that our self-model and the model we generally possess about other peoples' inner life essentially involves the assumption that at least some mental events can cause other mental events. For instance, thoughts and memories of a beloved person can cause the longing to see that person again as soon as possible. Furthermore, the two thoughts "If TSG 1899 Hoffenheim loses today, they will be relegated to the second division." and "TSG 1899 Hoffenheim loses today" can cause the additional thought "TSG 1899 Hoffenheim will be relegated to the second division." Thoughts, memories and states of longing are considered prototypical mental events. The fact that we can often make remarkably reliable predictions about ourselves and others with these kinds of assumptions and these theories of causality suggests that at least some mental events cause further mental events (assumption (P1)). The following formalization specifies the logical structure of such a proposition (assumption $(P1)^F$ is intended as a summary of (P1); $(P1)'^F$ expresses an interpretation of $(P1)^F$ in formal language; $(P1)'^{F*}$ explicates the formalization $(P1)'^F$ in natural language):[6]

$(P1)^F$ 'Some mental events cause further mental events.'

$(P1)'^F$ $\exists x \exists y \exists \phi \exists \psi (\mathcal{M}\phi \land \phi x \land \mathcal{M}\psi \land \psi y \land Cxy)$

$(P1)'^{F*}$ Some mental events instantiate a property belonging to the class of mental properties, and cause events that as well instantiate a property belonging to the

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[6] In the formalization, the "fine-grained" model of events of Jaegwon Kim (1993) is presupposed, according to which an event consists in the instantiation of a property through an object at a point in time. Atomic sentences of predicate logic can therefore be considered as descriptions of events in Kim's sense.

class of mental properties.

The formal analysis is based upon the following language:[7]

logical constants	:	'¬', '∧', '∨', '→', '↔', '=', '∀', '∃'
individual variables	:	'x', 'y', 'z', 'x_1', 'x_2'...
types / predicates	:	'C', 'S'
type variables / predicate variables	:	'ϕ', 'ψ', 'γ', 'δ', 'ϕ_1', 'ϕ_2' ...
types of types / second order predicates	:	'$\mathcal{P}$', '$\mathcal{M}$', '$\mathcal{E}$'

Furthermore, the following interpretations are presupposed:

$$\mathfrak{I}(C) \quad = \quad \{(x, y) : x \text{ causes } y\}$$

$$\mathfrak{I}(\mathcal{M}) \quad = \quad \{\phi : \phi \text{ is a mental property}\}$$

Our basic understanding of the mental suggests that a mental event cannot occur at any place at any time, unless a physical event simultaneously occurs at the same place. We do not encounter mental events free-floating in a vacuum. They are bound to complex systems like brains or possibly certain future super-computers. Present-day research in brain physiology and neurosciences has developed this understanding further, and it has revealed that mental events are very closely linked to physical events. Physical events often serve as sufficient conditions for the occurrence of mental events. This relational dependence of mental events on physical events and the sufficiency of physical events for mental events have been characterized as a relation of "supervenience" (cf. Kim, 2003, 155, Kim 1982, 1984, and fn. 3 above). Hence, a further plausible assumption is that every mental event can be assigned a physical event, such

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[7] In order to develop the respective deductions from the mentioned premises, the language would additionally have to contain individual constants and further one-place predicates of first order logic, which temporarily act as extensions of the variables. For the sake of simplicity we have not listed these in the table.

that the mental event supervenes on the physical one (cf. Harbecke, 2013, 223-224) (assumption (P2)). This assumption can be formalized as follows:

(P2)^F 'Every mental event supervenes on at least one physical event.'

(P2)$'^F$ $\forall x \forall \psi (\psi x \wedge \mathcal{M}\psi \rightarrow \exists y \exists \gamma (\gamma y \wedge \mathcal{P}\gamma \wedge Syx))$

(P2)$'^{F*}$ For every event instantiating a property belonging to the class of mental properties, there is an event instantiating a property belonging to the class of physical properties which is supervenience-sufficient for the mental event.

Type '$\mathcal{P}$' subsumes all physical properties; 'S' expresses a relation of sufficiency in the sense of supervenience:

$$\mathfrak{I}(\mathcal{P}) \quad = \quad \{\phi : \phi \text{ is a physical property}\}$$

$$\mathfrak{I}(S) \quad = \quad \{(x,y) : x \text{ is supervenience-sufficient for } y\}$$

At the same time, it seems that mental events are not identical to physical events. In the philosophical literature, different arguments have been developed to support this hypothesis. One of these arguments points out that mental events, in contrast to physical events, seem to have a semantic dimension. They possess semantic content and thereby point to the outside world. Therefore, they are of a "non-local" or "extrinsic" kind. Physical events do not share this property. Hence, mental and physical events cannot be identical.

Moreover, it has been argued even for purely local mental events that they cannot be identical to physical events either, since the mental properties they instantiate are not coextensive with any physical property. No human brain is identical to another, and a mental property M, such that $\mathfrak{I}(M) = \{x : x \text{ is a thought of spaghetti}\}$ is most likely physically realized in different ways in different brains (cf. Putnam, 1967). Since coextensiveness is a necessary condition for the identity of properties and the identity of properties is a necessary condition for the identity of events, the non-identity of mental and physical events follows (Assumption (P3)).

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(P3)^F 'Mental events are not identical to physical events'

(P3)'^{F} $\forall x \forall y \forall \phi \forall \psi (\phi x \wedge \mathcal{M}\phi \wedge \psi y \wedge \mathcal{P}\psi \rightarrow x \neq y)$

(P3)'^{F*} Every event instantiating a property from the class of mental properties is not identical to any event instantiating a property from the class of physical properties.

Figure 1 illustrates a causal model representing assumptions (P1) − (P3) as a typical case of mental causation. The constants *a*, *b*, *c* and *d* represent objects, *M* und *M** represent mental properties, *P* and *P** represent physical properties. Corresponding to the "fine-grained" theory of events (cf. Kim, 1993), *Ma*, *M*b*, *Pc* and *P*d* characterize events, where the causal relation *Ma → M*b* follows as a typical case from assumption (P1), and *Pc → Ma* and *P*d → M*b* (with dotted arrows) are regarded as cases of the supervenience assumption (P2). They state, that, for instance, *Pc* is the supervenience base for *Ma*. The non-identity assumption is implicitly depicted, for instance, by the fact that *Pc* and *Ma* appear in different bubbles. The causal relation *Pc → P*d* is usually added by Kim and others as "in a certain way following from the assumptions" without being supported by any further arguments.
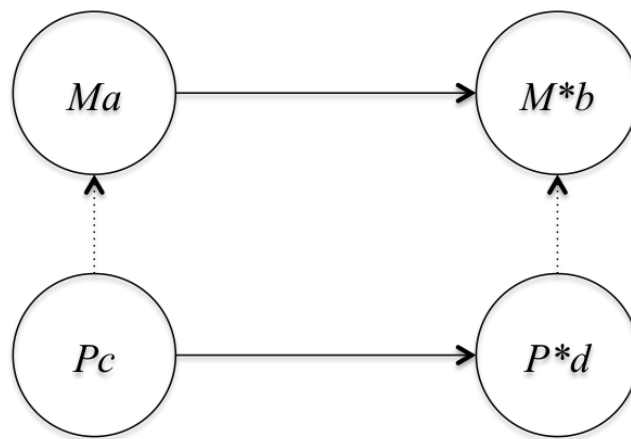

Figure 1: The supervenience problem of causal exclusion.

It has been argued by various authors, but most prominently by Jaegwon Kim (2003) that assumptions (P1)-(P3) are inconsistent, at least if a further plausible assumption is added. The argument can be found in the following passage:

As earlier noted, [the assumptions "*Ma* causes *M*b*"] and ["*P*d* causes *M*b*"] together give rise to a tension when we consider the question "Why is [*M*b*] instantiated on this occasion? What is responsible for, and explains, the fact that [*M*b*] occurs on this occasion?" For there are two seemingly exclusionary answers: (a) Because [*Ma*] caused [*M*b*] to instantiate on this occasion, and (b) because [*P*d*], a supervenience base of [*M*b*], is instantiated on this occasion". (…) Given that [*P*d*], is present on this occasion, [*M*b*] would be there no matter what happened before; as [*M*b*]'s supervenience base, the instantiation of [*P*d*], at t in and of itself necessitates [*M*b*]'s occurrence at t. This would be true even if [*M*b*]'s putative cause, [*Ma*], had not occurred—unless, that is, the occurrence of [*Ma*] had something to do with the occurrence of [*P*d*] on this occasion. (Kim, 2003, 155/156)

By characterizing the relation between the two assumptions as a "tension", Kim obviously refers to an inconsistency of both propositions. As the supervenience of mental events on physical events is beyond doubt in his view, it is clear that either the proposition about the causal relation between mental events (P1) is false, or it has to be modified in a way that describes the mental event *Ma* as the cause of event *P*d,* and hence only as an indirect cause of *M*b.* As a direct cause of *M*b,* however, *Ma* is excluded by *P*d.*

As Harbecke (2013) has shown in detail, the characterization of the relation as a "tension" by Kim must be added as a "background" premise to his argument. Otherwise, the argument is not valid. The logical form of this premise named (P4) is not trivial. Its most probable formulation is: Caused events never have a supervenience base that is not identical to them. Or expressed in formal terms:

(P4)^F 'Events are not causally-supervenience overdetermined.'

(P4)'^{F} $\forall x \forall y (Cxy \rightarrow \neg \exists z (Szy \wedge z \neq y))$

(P4)'^{F*} For all events having a cause, there is no event that is supervenience-sufficient for, and simultaneously non-identical to, them.

It can be shown by rigorous proof that formulae $(P1)'^F$-$(P4)'^F$ are inconsistent with one another.[8] Informally, the problem consisting of premises (P1)-(P4) can be explicated in the following way. If mental events cause further mental events and both have physical bases of supervenience, then according to premise (P4) the mental event caused must be identical to its physical base of supervenience. This exactly, however, is negated by premise (P3). From this contradiction it follows that (at least) one of the premises must be false. In Kim's view, it is premise (P1).

Kim develops this argument further in order to show in a last step that mental events are identical to physical events. His strategy is to show that mental properties can be reduced to physical properties after all. For the following sections, the argument explicated so far is sufficient, however.

3 Economic Causes and Exclusion

This section investigates the relevance of the supervenience problem for economic causes. As section 1 pointed out, the hypotheses of the mentioned research examples make statements about causal relations between economic events. Let us call this proposition (P1#). The two research examples are reconstructed in the following paragraphs to illustrate why economic models are amenable to causal interpretations.

In their study "A Theory of Fairness, Competition and Cooperation", Fehr & Schmidt (1999) develop a model to explain why people behave purely selfishly in some situations, but not in others. While the standard self-interest model predicts the selfish behavior, it does not predict that people empirically behave non-selfishly in specific situations. The authors therefore, based on findings in sociology and social psychology, develop a model with an inequity aversion among the subjects. These subjects "do not care per se about inequity that exists among other people but are only interested in the fairness of their own material payoff relative to the payoff of others." (p. 819). Again drawing upon previous findings, inequality to the subject's disadvantage reduces its utility more than inequality to the subject's advantage within the model. The authors then extensively apply their model to different strategic games and develop

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[8] Due to limits of space, we leave this exercise to the reader.

predictions. When compared with the various empirical experimental results on these games, they find overall consistency of the model's predictions with empirical evidence.

In their study, the authors hardly use causal language. They mostly link the model and its components using the word "prediction" to the empirical results. Two aspects, however, clearly hint at a causal interpretation of their result: (1) Despite avoiding explicit causal language, the authors use the word "explain" on several central occasions ("This paper asks whether there is a simple common principle that can explain this puzzling evidence." (817); "In this paper we ask whether this conflicting evidence can be *explained* by a single simple model." (818); "We show that in the presence of some inequity-averse people ''fair'' and ''cooperative'' as well as ''competitive'' and ''noncooperative'' behavioral patterns can be *explained* in a coherent framework." (819); "Hence, any alternative to the standard self-interest model faces the challenge to *explain* both "fair" outcomes in the ultimatum game and "competitive" and rather "unfair" outcomes in market games" (825)). The authors clearly interpret their model's predictive power as explanatory and, therefore, ultimately as causal. Furthermore (2), when introducing the central assumption of inequity aversion, the authors thoroughly explain why this assumption is plausible (cf. 821- 823). If the realism of the assumptions was not important, this would be redundant. Therefore, the abstract's last two sentences "We show that if some people care about equity the puzzles can be resolved. It turns out that the economic environment determines whether the fair types or the selfish types dominate equilibrium behavior." (817) can be reformulated to "Some events in the economic environment and events of inequity aversion among some subjects causes events of fair behavior in some situations, and of selfish behavior in others."

Brunnermeier & Pedersen (2009) develop a model explaining several empirical phenomena of liquidity. Their four-period-model of a security market with customers, speculators and financiers "links an asset's market liquidity (i.e., the ease with which it is traded) and traders' funding liquidity (i.e., the ease with which they can obtain funding)" (2201). From the consistency of their model's predictions with empirical evidence obtained, the authors infer a

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bidirectional causality of certain events of market liquidity and certain events of funding liquidity as a cause for certain empirical phenomena. Illustrative examples are the following:

(1) "Liquidity suddenly dries up; we argue that fragility in liquidity is in part due to destabilizing margins, which arise when financiers are imperfectly informed and the fundamental volatility varies.

(2) Market liquidity and fragility co-moves across assets since changes in funding conditions affects speculators' market liquidity provision of all assets.

(3) Market liquidity is correlated with volatility, since trading more volatile assets requires higher margin payments and speculators provide market liquidity across assets such that illiquidity per capital use, i.e., illiquidity per dollar margin, is constant.

(4) Flight to quality phenomena arise in our framework since when funding becomes scarce speculators cut back on the market liquidity provision especially for capital intensive, i.e., high margin, assets.

(5) Market liquidity moves with the market since funding conditions do." (2228)

It seems obvious that the authors intend terms such as "arise", "affects", "moves with… since funding conditions do" in a causal sense. We consider these two examples as paradigmatic for contemporary economic theorizing. Hence, we argue that the notion of causation among economic events, in contrast to mere prediction or correlation, plays a central role for descriptive economics.
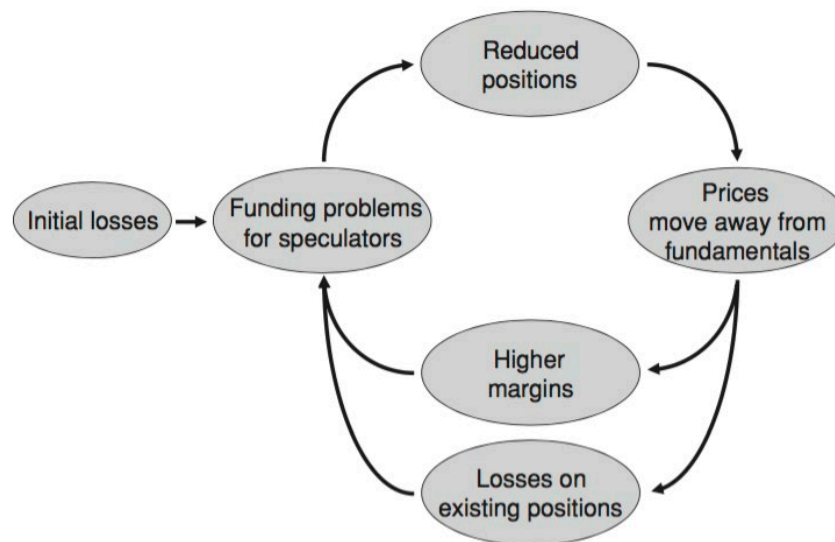
Figure 2: Causal modeling (Brunnermeier & Pedersen 2009, 2204)

Of course, the linguistic form of the economic "event" is rather unfamiliar in economics, as the economic sciences mainly analyze relations of economic properties, objects, or factors. More concretely, economics is primarily concerned with factors in choices and tendencies in aggregate events and statistics. As a consequence, whenever the notion of causation has played a role at all for economics, it has classically favored an understanding of causality which relies on type-level statistical comparisons on the one hand, on hypothesized causal connections in simplified models on the other hand. However, it is important to see that general, or type-level, causal claims can be true only if there is a (sufficiently large) set of individual events that fall under the relevant types and that are in fact connected by actual causal relations. A type-level factor in choice such as inequity aversion studied by Fehr & Schmidt (1999) can be characterized as causal only if there are sufficiently many economic subjects that within concrete individual settings decide partially as a result of their individual aversion to inequity. It is in this sense that events are the actual *relata* of causality. An economic event can therefore be as diverse as a financial loss of a speculator, an inequity aversion within a person, an aggregate productivity rise in an industry due to technological progress or an increase in money supply.

Besides their causal efficacy, it seems obvious that economic events always have a systematic

connection to the underlying physical world. This might be less transparent for complex factors such as money aggregates than for many mental events. Whereas cash money obviously possesses a physical basis, this is not directly obvious for deposit money. But even this form of money needs a complex physical base in a broader sense, which manifests itself in booking media and the physicality of economic agents. In short, it is impossible for any kind of money to exist in a void. Therefore, the proposition that every economic event supervenes on at least one physical event seems to be beyond doubt (P2#).

The straightforward identity of economic and physical causes is less intuitive, however. A prominent argument against identity, for instance, of money aggregate events, has been formulated by Jerry Fodor:

> Suppose, for example, that Gresham's 'law' ['Bad money drives out good money'] really is true. (...) Gresham's law says something about what will happen in monetary exchanges under certain conditions. I am willing to believe that physics is general in the sense that it implies that any event which consists of a monetary exchange (…) has a true description on the vocabulary of physics (…). But banal considerations suggest that a description which covers all such events must be wildly disjunctive. Some monetary exchanges involve strings of wampum. Some involve dollar bills. And some involve signing one's name to a check. What are the chances that a disjunction of physical predicates which covers all these events (i. e., a disjunctive predicate which can form the right hand side of a bridge law of the form 'x is a monetary exchange of ⇆…') expresses a physical natural kind? In particular, what are the chances that such a predicate forms the antecedent or consequent of some proper law of physics? (Fodor 1974, 103.)

Fodor here restates the argument of multiple realization that was already mentioned in the explanation of assumption (P3) (cf. again Putnam, 1967). In regard of economic causes the argument of multiple realization analogously implies that economic events are not identical to physical events (P3#). Together with premise (P4), it can then be proven that premises (P1#)-(P3#) are inconsistent.

(P1#)^F 'Some economic events cause further economic events.'

(P1#)'^{F} $\exists x \exists y \exists \phi \exists \psi (\mathcal{E}\phi \wedge \phi x \wedge \mathcal{E}\psi \wedge \psi y \wedge Cxy)$

(P2#)^F 'Every economic event supervenes on at least one physical event.'

(P2#)'^{F} $\forall x \forall \psi (\psi x \wedge \mathcal{E}\psi \rightarrow \exists y \exists \gamma (\gamma y \wedge \mathcal{P}\gamma \wedge Syx))$

(P3#)^F 'Economic events are not identical to physical events.'

(P3#)'^{F} $\forall x \forall y \forall \phi \forall \psi (\phi x \wedge \mathcal{E}\phi \wedge \psi y \wedge \mathcal{P}\psi \rightarrow x \neq y)$

With the following interpretation:

$$\mathfrak{I}(\mathcal{E}) \quad = \quad \{\phi : \phi \text{ is an economic property}\}$$

It follows that the supervenience problem of causal exclusion can also be formulated for economic causes. One possible formulation is based on premises (P1#)-(P3#), all of which are convincing in isolation, but which are inconsistent in conjunction. In the debate within the philosophy of mind different authors have come to the conclusion that mental events do not possess any causal efficacy in our physical world, in contrast to our everyday life "folk psychological" assessment of mental causes. They are "epiphenomena" and their causal effect is illusionary, given that mental events exist at all. An analogous conclusion seems to emerge for economic events from the comparable considerations explicated above. Economic events are not causally efficacious, pace the common practice of causal explaining and modeling in economics. They are epiphenomena supervening on purely physical processes without being identical to them.

It is important to notice that the conclusion reached here cannot be considered a result of empirical or theoretical economic research. It rather results from certain basic metaphysical assumptions that are prior to any scientific research. They reflect basic conceptions many scientists are willing to accept before they actually engage in research. Simultaneously, however, the conclusion of an epiphenomenalism of economic causes has consequences for the interpretation of pertinent research results. Ultimately, this conclusion demonstrates that

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propositions about economic causes and effects may be pragmatically informative and helpful, but are factually false. Therefore, if Fehr & Schmidt (1999) claim that a causal relation holds between an inequity aversion among a fraction of the population and several observed phenomena, they make a possibly pragmatically helpful, but ultimately false statement. The same applies to to Brunnermeier & Pedersen (2009) and their claim of a bidirectional causality between "Market Liquidity and Funding Liquidity". These conclusions are curious as they will likely clash with the intuitions of the scientists about their own work.

In order to dissolve the conflict between the metaphysical assumptions and the common interpretations of the research findings, different strategies can be pursued. A classical argumentation consists of an instrumentalist interpretation of theory construction in economics. The most prominent representative of this school of thought in economics is Milton Friedman (1953). In Friedman's view, the question about the truth of causal statements is rather insignificant. Rather, the task of economics is "to provide a system of generalizations that can be used to make correct predictions about the consequences of any change in circumstances." (1953, 146). Or in more detail:

> The ultimate goal of a positive science is the development of "theory" or "hypothesis" that yields valid and meaningful (i.e., not truistic) predictions about phenomena not yet observed. Such a theory is, in general, a complex intermixture of two elements. In part, it is a "language" designed to promote "systematic and organized methods of reasoning In part, it is a body of substantive hypotheses designed to abstract essential features of complex reality. (1953, 148)

In other words, theories of economics are not primarily concerned with the truth values of descriptions of initial conditions and economic laws. They are almost solely measured relative to their predictive power, and not relative to the adequacy of their assumptions. A different way to put this point is to say that the economic sciences are not interested in whether the described economic events are in fact causally related. Instead, their primary aim is to make correct predictions. In this sense, there seems to be no deeper problem for Fehr & Schmidt (1999) and

Brunnermeier & Pedersen (2009). The authors, according to this understanding, are almost exclusively concerned with predictions and not with truth.

The instrumentalist interpretation has been criticized from various directions. One such counterargument points out that, at an early stage, a science may well focus primarily on the functional description of phenomena. At later stages, however, it is usually expected that the scientific theories describe the world meticulously. Only through a truly adequate description of the analyzed systems an explanation of their actual structure and behavior can be attained. Furthermore, correct predictions typically demand an explanation of why they actually turned out to be correct. An answer to this question can hardly avoid saying something about the interactions of factors and actual causes.

Another strategy to avoid the given problem is to reject either assumption (P2#) or assumption (P3#). If (P3#) is rejected, this implies that causally efficacious economic events are always identical to physical events. Anyone holding this opinion would have to defuse Fodor's argument of multiple realization (cf. section 3). In recent years, this strategy has been repeatedly developed in the philosophy of mind and the philosophy of biology. As an example, Esfeld and Sachse (2007) argue that macroscopic predicates can be analyzed through sets of subtypes and can be reduced to complex physical predicates. Rejecting the hypothesis of supervenience (P2#) would be even more radical and must be regarded as questionable. Economic causes without any physical basis are hardly conceivable.

Finally, assumption (P4) can be rejected in principle. This premise also played a major role in the formulation of the supervenience problem of economic causes. This strategy has been extensively developed by Harbecke (2013). Although in the illustrated causal model in illustration 1, for instance, the conflict between the mental cause Ma of $M*b$ seems intuitive and obvious, this conflict becomes highly doubtful upon closer examination. At least under the assumption of a regularity theory of causality (Baumgartner 2008, Graßhoff and May 2001) or an interventionist theory of causation (cf. Woodward 2003), assumption (P4) becomes less convincing. Only under the presupposition of a process theory of causality (cf. Dowe 1992, Salmon 1984), assumption (P4) seems legitimate. An analogous strategy would, therefore, be

left open for defenders of economic causation. However, it remains to be seen, whether this strategy proves itself to be convincing.

4 Causality and Localization

Even if the arguments against assumption (P4) are eventually evaluated as convincing, economic causation still faces the following serious additional problem, which is much less relevant for mental and biological causes. Physical events like pulling the trigger of a Glock 19 and the arrival of a bullet on the target are definable and distinguishable in their spatiotemporal expansion. This applies to mental events and their effects in a similar way. As far as we know today, mental events do not occur anywhere in the universe, but only within brains and possibly within future supercomputers. Moreover, biological causes are usually delineable as molecular events or events involving biological organisms. Economic events, in contrast, are much harder to localize in spatiotemporal terms. It is virtually impossible to say "where" the rise of money supply occurs, "where" the emergence of a market-clearing price arises and "where" an expansion of social infrastructure exists. The non-localizability problem creates an additional gap between physical, biological and even mental causes on the one, and economic causes on the other side. In particular, the non-localizability implies that the truth conditions of assumptions (P1#) to (P3#) are specifiable to a smaller degree than, for instance, those of assumptions (P1) to (P3). As a consequence, the truth of (P1#) in particular is still heavily in question, even when the inconsistency between assumptions (P1#) to (P4#) is resolved.

As a second additional problem, some economics causes are hardly distinguishable from their effects in spatiotemporal terms. For instance, a rise in money supply and a rise in income are events that cannot be easily separated in the sense of their spatiotemporal extension. However, existing contemporary theories of causation require that cause and effect do not overlap. Without this condition, for instance, the regularity theory of causation would judge Donald Trump taking a walk in the White House's garden to be a cause for the walk of a person in the White House's garden as well as of the movement of Donald Trump's left earlobe within the White House's garden etc. Because these are conceptual or constitutive relations between events, it would be misleading to characterize their relation as causal. Hence, due to the overlap

of cause and effect, the truth and causal interpretability of assumption (P1#) is more questionable than the analogous ones from the philosophy of mind and biology.

The truth value of causal economic propositions is therefore questionable for two reasons: on one side due to the relation of economic events to physical events as expressed by the supervenience argument. Secondly, the ontological shape of economic events casts doubt on their causal efficacy to a more dramatic degree than mental or biological events.

5 Conclusion

In this paper, in a first step the supervenience problem for the exclusion of macro-causes as it is known from the philosophy of mind was presented. Subsequently, the works of Fehr & Schmidt (1999) and Brunnermeier & Pedersen (2009) were discussed as examples of causal modeling in economics and an analogous formulation of the supervenience problem was developed for economic causes. The problem is based on four assumptions all of which can be considered convincing in isolation, but which jointly imply a contradiction. These assumptions were formulated as follows:

$(P1\#)^F$ 'Some economic events cause further economic events.'

$(P2\#)^F$ 'Every economic event supervenes on at least one physical event.'

$(P3\#)^F$ 'Economic events are not identical to physical events.'

$(P4)^F$ 'Events are not causally-supervenience overdetermined.'

It was pointed out that the premises implying the contradiction cannot be regarded as results of empirical or theoretic research in the economic sciences. Rather, they are premises preceding research. The main hypothesis of this paper says that, analogously to biological and mental causes, the causal efficacy of economic events and, hence, the truth of causal propositions such as those mentioned above is questionable. In the final section, the specifics of the problem for economic causes in contrast to biological and mental causes were discussed.

Due to limits of space, it was not possible to investigate in more detail whether economic events must be regarded as extrinsically individuated. Extrinsic properties and events bear particularly problems for causal relations (cf. Yablo 1997). Furthermore, it could not be elaborated which theory of causality is most suitable for the reconstruction of causal explanations in economics. These questions are to be answered by future research.

Appendix

The supervenience problem for mental causes is often presented in the following version, which has also been called the "problem of causal exclusion". In this formulation, it is not assumed that mental events cause further mental events, but that mental events cause physical events. The following assumptions reflect this construction:

(P1)   'Some mental events cause further mental events.'

(P1)' $\exists x \exists y \exists \phi \exists \psi (\mathcal{M}\phi \wedge \phi x \wedge \mathcal{M}\psi \wedge \psi y \wedge Cxy)$

(P1)'*   Some events instantiate a property belonging to the class of mental properties
         and cause events instantiating a property belonging to the class of physical
         events.

(P2)   'Every physical event has a physical cause. '

(P2)' $\forall x \forall \psi (\psi x \wedge \mathcal{P}\psi \rightarrow \exists y \exists \gamma (\gamma y \wedge \mathcal{P}\gamma \wedge Cyx))$

(P2)'*   For all events, if they instantiate a physical property, they are caused by an event
         also instantiating a physical property.

(P3)   'Mental events are not identical to physical events'

(P3)' $\forall x \forall y \forall \phi \forall \psi (\phi x \wedge \mathcal{M}\phi \wedge \psi y \wedge \mathcal{P}\psi \rightarrow x \neq y)$

(P3)'*   For all events instantiating a property from the class of mental properties, they
         are not identical to any event instantiating a property from the class of physical

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properties.

(P4) 'Physical events are not causally overdetermined.'

(P4)' $\forall x \forall y (\exists \phi (\phi x \land \mathcal{P}\phi) \land Cyx \rightarrow \neg\exists z(Czx \land z \neq y))$

(P4)'* For all events having a cause and instantiating a property from the class of physical properties, there is no event that causes them without being identical to the cause just mentioned.

The impossibility of mental causation can also be inferred from these premises. Our reason for not choosing this formulation of the problem is that economic events are rarely described as causes of thoroughly physical effects. This marks a difference to mental events. It is an important part of "folk psychology" that mental events such as wishes or thoughts often have physical effects. For this reason, the mentioned formulation of the causal exclusion problem has not been examined in more detailed in this paper.

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