How Do Microscopic Models of Financial Markets Explain?

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Abstract

Financial theory is in trouble. Market crashes and high volatility are only too familiar to everyone, although the standard theories predict that they hardly ever occur. According to the well-known and (partly due to its simplicity) still widely used random-walk model, the probabilities for price changes of, say, stocks should result in a Gaussian distribution. However, experience tells us that large changes occur far more often than 'allowed' by a Gaussian distribution. New models are needed which lead to realistic probability distributions. 'Econophysicists' are particularly active in this field by constructing microscopic models of financial markets on the basis of various ideas and tools from physics. But in which sense do these models contribute scientific explanations? In this paper I will investigate what and how one exemplary econophysics model explains.

Keywords: Scientific explanation; complex systems; econophysics; mechanisms; models

1 Introduction

Econophysics is a comparatively new interdisciplinary sub discipline between physics and economics that tries to analyse, and in a certain sense explain, economical phenomena by using physics. The core of econophysics consists in the transfer of methods, models and theories from physics into the domain of economy. One of the most advanced areas of econophysics is concerned with the analysis of financial markets, in particular stock markets. An outstanding example for the success of econophysics is the description of financial market crashes by using the advanced physical theory of phase transitions where the common characteristic is a sudden occurrence of a comprehensive change of the state of affairs. Econophysics seems to offer reductive explanations since particular observed phenomena are reduced to underlying micromechanisms, which account for a number of diverse phenomena. Unfortunately, the situation is not as straightforward as it might first appear. In order to make the discussion more concrete I analyse one particular representative model and test how well it fits into different theories of explanation. Summing up, my result is that econophysics does explain, but none of the theories of explanation can catch this fact with sufficient success. However, I demonstrate how theories of explanation could, in a revised and extended form, accommodate econophysics.

2 The Explanatory Target

The first major activity in econophysics is the statistical analysis of the observed price changes of financial assets such as stocks, bonds or currencies. The second extensive activity in econophysics is the construction of models that reproduce certain characteristics of these statistics. As far as the question of scientific explanation is concerned the statistical analyses are the field to look for explananda (what is to be explained) whereas the branch of model construction is concerned with the explanans (what does the explaining).

In economics one considers various alternatives how to capture price changes, for instance absolute changes, relative changes and logarithmic changes.[1] The so-called *return function* catches how price changes evolve over time. The most commonly used return function

$$\mathrm{ret}(t) = \ln p(t) - \ln p(t-1)$$

employs the logarithmic changes of the market price p(t) for a given asset. The advantage of considering logarithmic (or short: log) changes instead of absolute changes, p(t)-p(t-1), is the scale invariance of log changes with respect to the price scale.[2] Scale invariance ensures that the frequencies of price changes can be compared in a meaningful way, which is independent from the (arbitrary) absolute value of the underlying asset. Another important advantage of logarithmic plotting is the fact that functions of quantities that vary exponentially become straight lines, which is easily visible even in empirical curves (and is therefore a good starting point for their analysis).[3]

The most important object of study in econophysics is the statistics of price changes, which is given by plotting the probability distribution of (log) returns, i. e. price changes. The statistical analysis of observed probability distributions of price changes in financial markets yields remarkable results, which call for explanation. Summing up one can say that the outstanding statistical characteristic of financial markets is an unusually high probability for large changes. By saying ‘unusually’ I mean that the probability distribution functions deviate significantly from the normal (or Gaussian) distribution, which holds for so many randomly distributed quantities (e. g. the distribution of the IQ or of coin tosses) that it is sometimes even postulated for exam results. In comparison to the Gaussian distribution, the probability distribution functions for price changes of financial assets have a sharper peak around zero change (see figure 1) and, which is the most important feature, so called ‘fat tails’. This means that the curve remains well above the horizontal axis even for large changes, whereas the Gaussian distribution has almost reached zero (see inlay in figure 1). This dry sounding statistical fact is the analytical counterpart of the nerve-racking fact that financial market crashes occur far more often than old-fashioned and still widely used risk control theories predict. Another characteristic features of financial market that contributes to fat tails in the distribution function is the occurrence of so-called clustered volatility, i. e. periods of high volatility, which often follow a crash.

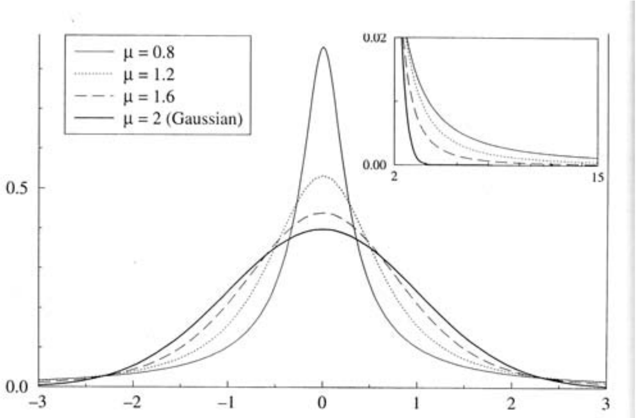

Figure 1: Gaussian versus other probability distribution functions (From Bouchaud and Potters 2000)

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[1] See 5.1 in Mantegna and Stanley (2000) for pros and cons of various alternative definitions of return functions.

[2] Another possibility for the return function is the direct percentage [p(t)-p(t-1)]/p(t-1).

[3] This so-called ‘scaling’ of empirical or simulated data sets is important for my case study below.

3 Microscopic Models of Financial Markets

The aim of the construction of microscopic models of financial markets is to reproduce the observed statistical features of market movements (e. g. fat tailed return distributions, clustered volatility, crashes) by employing or inventing highly simplified models with large numbers of agents (market participants).[4] The relevant parts of physics that are used to build microscopic models of financial markets are usually models and methods from condensed matter physics and statistical physics. Microscopic models of financial markets are highly idealized as compared to what they are meant to model. Often all agents have identical properties or there are very few subgroups. Another option is to have a set of agents with random variations. The interaction between agents is usually modelled to be extremely simple, like 'do what your nearest neighbour does.'

In a very successful collaboration the economist T. Lux and the physicist M. Marchesi developed a model that can be regarded as a paradigm case of a microscopic model of financial markets. It is simple enough to be comprehensible but it is comparatively realistic in its setting, unlike many other models.[5] The conceptual aim of Lux and Marchesi is to achieve a reconciliation of two prima facie conflicting hypotheses both of which one is not easily willing to give up. On the one hand one has the *efficient market hypothesis*, which states that changes of financial market prices reflect incoming news. This hypothesis implies that price changes are produced by exogenous factors. On the other hand we have the *interacting agents hypothesis* which at first sight says the very opposite, namely that price changes arise endogenously from the mutual interaction of the market participants. The justification of the interacting agents hypothesis lies in the empirical fact that the universal characteristics of price change statistics (fat tails, clustered volatility) are structurally similar to scaling laws in physics. In physics, scaling laws arise from the interaction of a large number of interacting units, e. g. particles, where most microscopic details are irrelevant. Due to this structural similarity between these observed phenomena in physics and finance it suggests itself to assume an equally similar explanation, hence to assume the validity of the interacting agents hypothesis.

In the following I will sketch some details of the stochastic multi-agent model which Lux and Marchesi use in order to reconcile the efficient market hypothesis and the interacting agents hypothesis. There are two types of traders, 'fundamentalists' and 'noise traders' (or 'chartists').[6] Fundamentalists are rational traders in the sense that their action is based on the comparison of the fundamental value p_f of the traded asset (e. g. stocks, bonds or currencies) and the actual market price p. Fundamentalists buy if $p<p_f$ and sell if $p>p_f$. In the case of noise traders the behaviour only depends on the current price trend and the opinion of the other traders. Furthermore Lux and Marchesi assume that noise traders can be either optimistic or pessimistic. While optimists buy when the share prices rise, pessimists sell. A crucial feature of the setting used by Lux and Marchesi refers to the dynamics for the fundamental value p_f, more precisely it refers to the relative changes of p_f between two time steps, which are computed via the logarithm of p_f. These so-called 'log changes' of p_f are assumed to be Gaussian random variables, i. e. it is assumed that

$$\ln p_f(t) - \ln p_f(t-1) = \varepsilon(t)$$

where $\epsilon(t)$ is the Gaussian distribution. This assumption is decisive for the Lux/Marchesi approach because it means that changes of p_f cannot be the reason for the typical statistical features of financial assets like fat tails and clustered volatility. Another essential aspect of

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[4] See Voit 2001 and Johnson et al. 2003 as well as Casti 1997 for the wider background.

[5] See Lux and Marchesi 1999.

[6] The coinage of and the distinction between 'fundamentalists' and 'noise traders' is not due to Lux and Marchesi, but is established in economics.

the setting used by Lux and Marchesi is that the partition into the three groups of traders is not static but traders can switch from one group to another. For the transition between the three groups of traders Lux and Marchesi assume certain probabilities. While the probability for a transition between optimistic and pessimistic traders depends on the majority opinion and the current price trend, the transition probability between fundamentalists and noise traders depends on a comparison of profits for fundamentalist and chartist strategies.

As it is usual in EP, and in studies of complex systems in general, the results do not come from analytical calculations but from computer simulations. This is also the case in the work by Lux and Marchesi. Figure 2 shows the result of one ‘simulation run’.

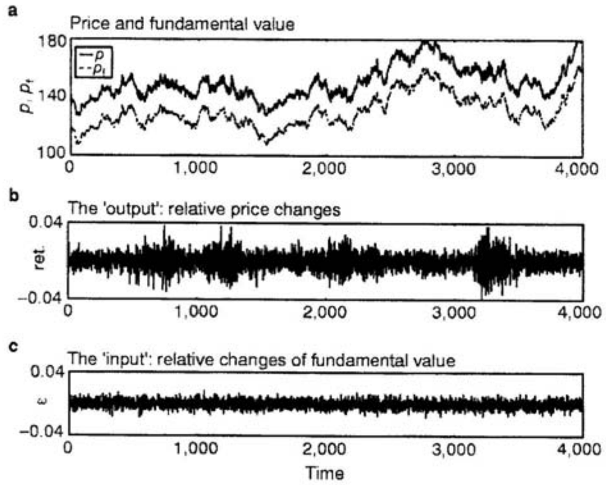

Figure 2: Result of simulation run (From Lux and Marchesi 1999)

The intuitively most compelling impression of the result can be gained by comparing the time developments of the market price p (upper curve) and the fundamental value p_f (lower curve), first, with each other, and, second, with respect to their statistical properties. The most interesting statistical property is the frequency of price changes from one time step to another. The crucial point of the result is that the time developments of the market price and the fundamental value are very similar while, at first sight surprisingly, their statistical properties differ remarkable. The two lower diagrams show the relative price changes which are extracted from the time developments shown in the first diagram. Only after this extraction the difference between the distribution of changes of the market price and the fundamental value become visible. Although the market price tracks the fundamental value in average it deviates significantly on a short time scale, allowing for the typical ‘extreme events’ and the clusters of high volatility which are observed in real markets. Lux and Marchesi conclude that the market is efficient in the sense that the market price follows the fundamental value. This does not apply for the short term, however, where the relative changes of the market price deviate from the normal distribution, which was assumed for the relative changes of the fundamental value. Since clustered volatility and large changes thus arise purely endogenously through the interaction of market agents, which results in the market price, the efficient market hypothesis and interacting agents hypothesis are reconciled.

In their analysis Lux and Marchesi use methods from statistical physics (keyword: critical phenomena), which are applicable for models with a large number of subunits that are in simple interaction with each other. The analysis of the scaling properties (in particular the extraction of critical exponents) shows that the exponents for the exogenous input series (i. e. the random change of the fundamental price p_f) do not allow for fluctuations of the order observed for actual price changes. Lux and Marchesi show that the emergence of a power-law distribution of price changes is produced by changes from quiet to volatile periods, which are due to transitions of agents from one group to another, more precisely from fundamentalists to noise traders. This behaviour, which some econophysicists call ‘switching’, will play an important role in my own analysis of how Lux and Marchesi contribute to the scientific explanation of financial market behaviour. Moreover, Lux and Marchesi found that a system looses its stability when the number of noise traders exceeds a certain critical value, and they observed so-called ‘on-off intermittency’, i. e. the fact that instabilities are recurrent but only temporary. Eventually, it should be stressed that the qualitative results of Lux and Marchesi are very robust since temporary instability (high volatility) is possible for a wide range of parameter values. In the following, I will carry out a case study in which I will survey, taking the work by Lux and Marchesi as an exemplary approach in econophysics, how well different theories of scientific explanation are suited to describe what econophysics can contribute to the understanding of economical phenomena.

4 Econophysics in the Light of Theories of Scientific Explanation

In the analytical tradition of philosophy various models of explanation have been brought forward some of which are competing until the present day. The first and at its time unrivalled one was the covering law model of explanation which is the basis for all later proposals.

4.1 Econophysics and the Covering Law Model of Explanation

The main ideas of the covering law model in the tradition of Logical Positivism go back to a joint work by Carl G. Hempel and Paul Oppenheim from 1948. This first version was restricted to deductive-nomological explanations (D-N explanations); Hempel achieved an extension to inductive statistical explanations in 1962. In the 1960s the covering law model was confronted by various serious objections, which led to its abandonment. New models of explanation were established which maintained some main traits of the covering law model while escaping some objections. The basic idea of the covering law model is that explanations are essentially arguments the main constituents of which are explanans and explanandum. The explanandum is the phenomenon (or empirical regularity) for which an explanation is sought and the explanans provides a set of premises that entail the explanandum. The model is called ‘*covering law*’ model because the phenomenon to be explained, i. e. the explanandum, is meant to be subsumed under a general law, which covers this phenomenon as a special case. The covering law model is an account of scientific *explanation* because the background idea is that phenomena are explained when it can be shown that they should be expected as logical consequences of universal laws of nature. In the case of *deductive-nomological* explanations the explanandum follows deductively from the explanans and the law that appears in the explanans is a universal law. Later, the covering law model was extended to *deductive-statistical* and *inductive-statistical* explanations where, again, the first part of the expression specifies the kind of logical relation between explanans and explanandum and the second part refers to kind of law that is used for the explanation. In both cases, i. e. deductive-*statistical* as well as inductive-*statistical* explanations, at least one of the general laws that are used in the explanans is a probabilistic law. Moreover, for *inductive*-statistical explanations the inference in the argument is no longer deductively valid but only inductively strong, i. e. the explanans does not follow with certainty but can only be inferred with a certain strength which is close to but smaller than 1. After an initial period of widespread acceptance the covering law model was criticized on various grounds. The first obstinate problem is that the notion of a law of nature is unclear, since there seems to be no criterion for the distinction between universal laws and accidental generalizations. A second problem for the covering law model is that it cannot account for the asymmetry of explanations (The length of a building explains the length of shadow but not vice versa). Although the covering law model ('CLM' in the following) of explanation was abandoned due to these and other problems, it is nevertheless the starting point of my case study because all other theories of explanation rest on the CLM and modify it in some respect(s).

In order to see whether the CLM of explanation catches the work by Lux and Marchesi it is necessary to identify an explanandum and an explanans as well as a certain logical relation between them, be it a deductive or an inductive one. The explanandum can be either a particular event or a special law and the explanans must contain a more general law. With respect to the exemplary case of the work by Lux and Marchesi it is not immediately obvious how their explanatory target fits into the explanans/explanandum scheme of the covering law model. The explanandum in the Lux/Marchesi case is neither a particular event nor a special law since Lux and Marchesi aim at reconciling two prima facie conflicting hypotheses (the efficient market hypothesis and the interacting agents hypothesis). The difficulty for a philosophical classification of the explanandum of Lux and Marchesi is that their aim is qualitative although their analysis is quantitative. One might think that this is an idiosyncrasy of the work by Lux and Marchesi but the opposite is true. Quantitative studies with qualitative explanatory aims are typical for econophysics. I can see a number of reasons for this peculiar feature. One reason is that econophysics is still comparatively young as a scientific discipline and its models are not yet sufficiently developed to reproduce realistic data. Another reason lies in the subject matter, i. e. economics, where reliable predictions are notoriously hard to make. Eventually, one might speculate that a third reason is the very nature of econo-*physics* which, as one may conjecture, will never be in a position to achieve more than analyses of very general features of complex systems.

What econophysics tries to explain is so-called '*stylised facts*', to use the econophysics' jargon. Examples are herd behaviour, crashes, clustered volatility, i. e. periods of high volatility, etc. For this reason it is already the typical kind of explanandum in EP which does not fit into the standard scheme of the CLM. Stylised facts are neither particular events since by definition they do not occur in reality, nor are they special laws since they are too qualitative to be called laws at all. One could think that EP deals with statistical laws but even that is not true because the dynamical patterns that are reproduced are usually not realistic in a quantitative sense. Assuming for now that the CLM can be extended to include stylised facts as explananda the next question concerns the general laws that, according to the CLM, appear in the explanans. The deductive-nomological (D-N) version of the covering law model of explanation requires that the explanandum phenomenon is subsumed under a general law from which, together with suitable initial and boundary conditions, it follows deductively. In the case of Lux and Marchesi as well as for EP in general it seems that the law(s) which is/are used in the explanans can only be structural laws, since no reference is made to physical constituents for which fundamental laws of physics hold. Therefore, the covering law model of explanation can only be an appropriate description of what Lux and Marchesi achieved if it also works for structural laws in the explanans.[7] However, assuming that the law(s) which is/are used in the explanans are structural laws one gets the following problem.

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[7] The distinction between structural and material laws is introduced and illustrated in Stöckler 2000.

Arguments which have the form required by the CLM are potential explanations. If the premises of such a potential explanation are all true then it is accepted as a true explanation. A crucial aspect of the significance of natural laws for explanations consists in the fact that the used laws are assumed to be true. However, structural laws (e. g. harmonic oscillator or wave equations) cannot be true or false. Rather, they can or cannot be successfully applied in certain cases. The reason for the occurrence of structural laws in explanations for the behaviour of complex systems could be that the complicated interaction of a huge number of constituents prevents an explanation in terms of fundamental laws of nature (Stöckler 2000: 297). In this sense there would be only pragmatic reasons for the use of structural laws.

I think the covering law model of explanation can be excluded as a candidate for an appropriate description of the work by Lux and Marchesi as well as for most other analyses in econophysics. Here structural laws play a central role and an inclusion of structural laws into the covering law model seems to be against the spirit of this model. However, if it should turn out that there are also strong arguments against all other models of explanation an alternative to the plain dismissal of the covering law model could be an extension of the covering law model from *deductive-nomological*, *deductive-statistical* and *inductive-statistical* explanations to *deductive-structural* or *inductive-structural* explanations. Since such an extension would not be a simple matter this outlook may finish the discussion of this option for now.

4.2 Unification versus Consistency in Lux and Marchesi

The main proponents of a unificationist account of explanation are Michael Friedman (1974) and Philip Kitcher (1981). The basic idea is that the essential function of explanations is unification. More precisely, explanations lead to a simplification and systematisation of our scientific picture of the world by classifying observed phenomena into a comprehensive unified structure. In the case of a successful explanation the number of logically independent law-like sentences is reduced, which means that, in the unificationist account, explanation is a global matter. Friedman's famous and notorious example for such a reduction is that the "laws of mechanics" (Newton's axioms and the law of gravitation) explain the set comprising the laws of the kinetic gas theory together with Kepler's laws. Like the CLM of explanation the unificationist account is plagued by that fact that the notion of a law of nature unclear. Moreover, the unificationist account is restricted to the explanation of special laws while particular events are not considered as possible explananda. Eventually, the technical formulation of the idea that unification (and thus explanation) is achieved via reduction of independent laws is a surprisingly difficult business, which can be seen by realizing, for instance, that special law's like Kepler's laws follow only approximatively since further assumptions are needed for their derivation.

Looking at the work by Lux and Marchesi it seems that one sense in which they explain is by unifying the unconnected efficient market hypothesis on the one side and the interacting agents hypothesis on the other side. However, this would be a premature conclusion. I think it is more appropriate to say that Lux and Marchesi try to fulfil the general requirement of consistency, which is threatened by two conflicting theories about the same field of phenomena. As far as unification is concerned theories of complex systems rather seem to unify science as a whole by reducing very diverse phenomena to some universal dynamic patterns, whose manifestations one can observe in such different contexts as financial markets, ferro-magnets and avalanches. But even this evaluation is problematic since it is not clear whether the universal patterns that seem to 'govern' dynamics of complex systems can be classified as (fundamental) laws of nature.

4.3 Causation, Mechanisms and Structures

The main proponents of the causal (mechanical) models of explanation are David Lewis and Wesley Salmon. The basic idea of this type of approach is that causation should be seen as the primary notion, whereas explanation is derived from it. An event is explained by stating its causal history, i. e. a chain of causes that leads to the event. A causal model of explanation can solve some problems of the covering law model. For instance it gives a convincing account for the asymmetry of explanations (The building *causes* the shadow and not vice versa). However, causal (mechanical) models of explanation also have problems. Foremost of these is that the used notions of causation are confronted with objections (e. g. Lewis' theory of causation in terms of counterfactuals on the basis of his modal realism).

Salmon developed different models of explanation in which causation always plays a central role. His first model of explanation is an attempt to account for causal aspects that were ignored by the covering law model of explanation and led to such counterintuitive results that the length of a shadow explains the height of a building. Salmon argues that the covering law model of explanation is ill founded in its assumption that explanations are arguments. Rather, he thinks that explanations need to cite causal relations and these, this was Salmon's initial idea, can best be captured in terms of statistical relevance relations. Among other things, Salmon's statistical relevance model of explanation (Salmon 1971), has the advantage over the covering law model of explanation (in its inductive statistical version) that it also catches those cases where a statistical explanation is obviously successful although the explanandum event does not follow with high probability (e. g. a quick recovery after a special medication that works only in less than 50% of all cases). However, in the following discussion of Salmon's statistical relevance model of explanation it turned out that causal relationships are underdetermined by statistical relevance relationships. Listing statistical relevance relationships, as it is required for statistical relevance explanations, is not sufficient to fix the relevant causal relationships, as Salmon had intended. In the face of serious counter-arguments against his statistical relevance model of explanation Salmon abandoned this approach in favour of what he called the causal mechanical model of explanation (Salmon 1984).

Coming back to my case study, the applicability of causal models of explanation is particularly hard to evaluate. Major parts of econophysics are concerned with the statistical analysis of financial data. It is difficult in general to identify causes in statistical theories since nothing is said about particular causes. Rather it is said which kinds of configurations of constituents lead to which statistical properties on the macro level. This problem for causal models of explanation applies generally to analyses of higher-level or complex systems and so it is relevant for the Lux/Marchesi approach as well.[8] One characteristic feature of complex systems consists in the fact that various materially different microstates can lead to the same macrostate. Since in most contexts only the dynamics of the macrostate is of interest knowledge of micro details does not contribute anything to what we want to understand. This fact is a serious problem for the causal models of explanation since here the core of explanations is seen in the specification of causes that lead to a particular event. Since it seems that only material constituents or fields can be causally efficacious but not general pattern it is hard to see how the causal models of explanation could shed light on the explanatory force of analyses of complex systems.

One possible objection to Woodward's argument depends on the conception of the causal (mechanical) model of explanation one has. One can stress the causal aspect in

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[8] See section 4.3 in (Woodward 2003: 27ff) for a very illuminative discussion.

terms of the continuous spatio-temporal *processes* (with transfer of energy and momentum) on the level of individual constituents of a complex system. Alternatively, one can stress the mechanical aspect in terms of *mechanisms* that cause a certain higher-level feature. While the extensive statistical analysis of financial data is indispensable for all other enquiries in econophysics and also sufficient for some practical purposes I think it is justified to say that no pretence to explanation is made. It is described and mathematically analysed what one observes but no story is told about how these observed facts are produced. Of all accounts of explanation the causal (mechanical) model emphasizes most that a story has to be told about what it is in the world that physically brings about the explanandum event. This is exactly the aim of the other main part of econophysics where, in an unusually clear-cut division of labour, stories are supplied that (may) explain the observed statistical features on the basis of microscopic models of financial markets. Coming back to my paradigm case again, Lux and Marchesi seem to specify a causal mechanism on the level of traders, which leads to the statistical effects for which an explanation is sought. For instance, one of the most interesting (and practically relevant) results of Lux and Marchesi is that it is the switching between groups of traders that causes instabilities and periods of high volatility (clustered volatility).

In the Lux/Marchesi approach the question would then be whether it is appropriate to identify many agent models as causally efficacious mechanisms. One problem for such an identification is clearly that agent-based models are highly idealized in a way that it is not even claimed that they are spatio-temporally real. I want to claim, however, that the aim of econophysics is not to construct models of financial markets that are as realistic as possible in as many aspects as possible. In particular, the modelled interacting parts of the financial market mechanism (i. e. the market participants) as well as the interaction itself are not supplied with detailed realistic properties. Rather, the aim is to isolate those structural features of financial markets that are responsible or at least sufficient to explain certain observed statistical features. Realism is thus aimed at only with respect to certain isomorphic structures of the model market on the one side and the real market on the other side. I want to exemplify this claim by highlighting the switching mechanism. It is largely irrelevant when, how often or according to which rules traders switch their strategies. What matters is, first, the very possibility of switching and, second, that the probability for a switch to occur is not purely stochastic but depends on the behaviour of the other traders, either collectively via the market price or individually via observation of what neighbouring traders do.

I want to sustain my claim about the intended limits of realistic modelling by contrasting good unrealistic explanations with inferior unrealistic explanations. Explanations using the random walk model are inferior to the one using the more recent microscopic models of financial markets. However, the main reason for this inferiority is not that the whole setting of the random walk model is less realistic than for microscopic models of financial markets. Rather, the crucial point is that the individual steps (or acts of coin tossing) are independent from each other. There is no interaction in the random walk model. Since this assumption leads to the well-known normal (or Gaussian) distribution it does not account for the significant observed deviations from the normal distribution in the tails of the distribution function. What econophysics tries to isolate are those features in the underlying mechanism that lead to the observed fat tails of the probability distribution function of price changes. It is not essential that the mechanism be realistic. It only matters that certain structural features are modelled, such as interaction between the parts of the multi-agent mechanism or the possibility of strategy change. Once these features are incorporated the employed microscopic models of financial markets may be surprisingly unrealistic in various other features. Moreover, playing around with numerous different more or less unrealistic models has the advantage that it is possible to single out exactly which structural features are responsible for the statistical effects one wants to explain. In contrast, an approach with a detailed realistic model might not reveal what it is that is actually crucial for the explanation. My point is that econophysics explains by concentrating on significant structural features while there is hardly any pretence to realism in many other respects.

4.4 The Pragmatic Account of Explanation

The main proponent of the pragmatic account of explanation is Bas van Fraassen. The basic idea of this view is that the quality of explanations is subjective. Explanations are relative to our interests, which may change, so that explanations have nothing to do with truth but only with utility.

Like the other accounts of scientific explanation the pragmatic account also has something to offer in order to understand in which sense Lux and Marchesi explain financial matters. *We* are interested in the dynamics of the macrostate so that the concentration on the macrostate and the neglect of micro-details seems to be driven by our interests. And these are particularly important in this context because applications are the main goal of econophysics. The pragmatic account of explanation appears to be a appealing account for complex systems in general because pragmatic considerations are particularly important due to the fact that complex systems are hard to handle analytically. However, against this evaluation it seems justified to object that applications are most successful if the explanation is true.

5 Conclusion

The covering law model of explanation, the unificationist account, the causal (mechanical) model and the pragmatic account all have something to offer in describing how microscopic models of financial markets explain. However, they also all have their shortcomings. Three reactions recommend themselves. The first is to deny that there is a single theory of scientific explanation that covers most or even all cases of explanations that are generally seen as successful. The second possibility is to construct an eclectic combination. The third option, which I would favour, is to revise or extend the most promising candidate. I think this candidate is the causal mechanical model of explanation, which needs to be extended to allow for mechanisms that are realistic only in certain structural features.

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